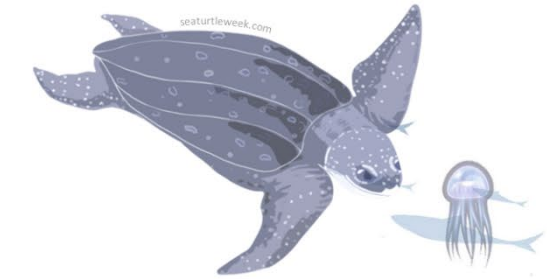
Abstract Book

2nd UN Ocean Decade Regional Conference &
11th WESTPAC International Marine Science Conference



22–25 April 2024

The Berkeley Hotel Pratunam, Bangkok, Thailand

Acknowledgements

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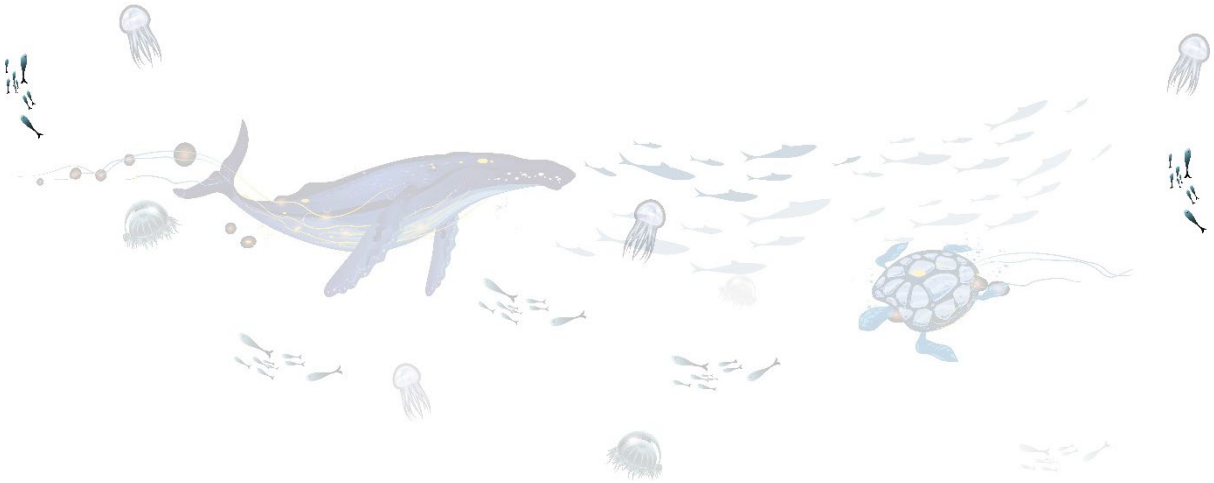
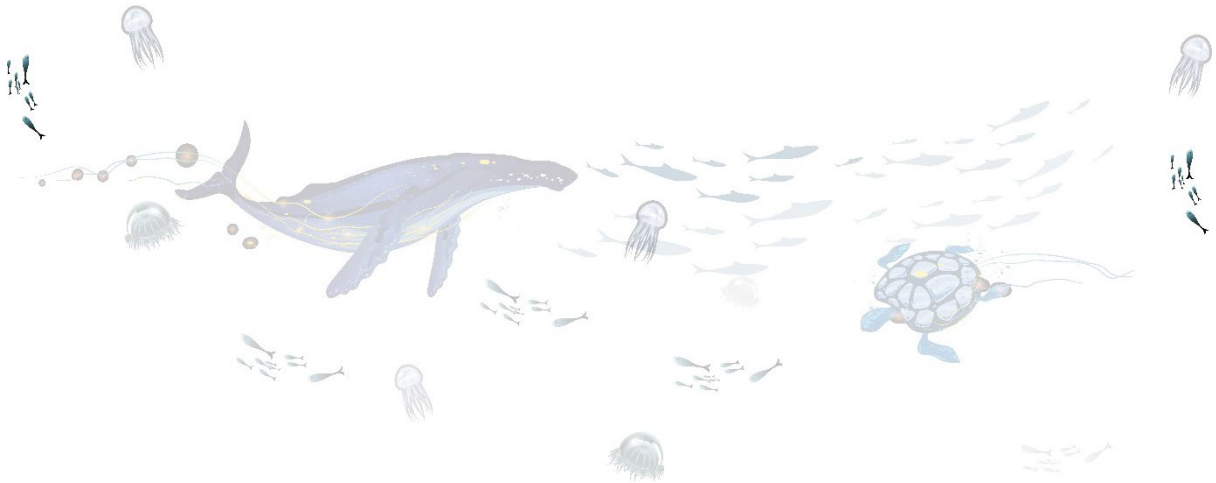


Sub-theme A:
Ocean Processes and Climate Change

Session A1:
Unveil the Kuroshio and its role in climate and ocean: Observational and modelling perspectives on multi-scale variability and multi-disciplinary aspects of the Kuroshio



Programme

Venue: Kensington A, 5th Floor
Date: 22 April 2024

Conveners:

Akira Nagano	JAMSTEC, Japan
Zhaohui Chen	Ocean University of China, China
Hanna Na	Seoul National University, Republic of Korea
Xiaopei Lin	Ocean University of China, China
Xin Liu	Xiamen University, China
Hiroaki Saito	Atmosphere and Ocean Research Institute, The University of Tokyo, Japan

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10:45–11:00	Predictability of oceanic variability off the eastern coast of Japan by eddy-resolving forecasting System	Masami Nonaka, *JAMSTEC, Japan*
11:00–11:15	Diurnal variation of mixed layer depth at ocean climate station KEO in the northwestern Pacific	Na Feng, *Ocean University of China, China*
11:15–11:30	Daily monitoring of the Kuroshio over the Izu Ridge using GNSS on a ferryboat	Kaoru Ichikawa, *Kyushu University, Japan*
11:30–11:45	Seamount wake and turbulent mixing induced by the Kuroshio and tides in Tokara Strait	Eisuke Tsutsumi, *Kagoshima University, Japan*
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On regime shift of the Kuroshio Extension system after 2018

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Abstract

The Kuroshio Extension (KE) system constitutes the western boundary current outflow after the Kuroshio separates from the coast of Japan. In the past 40 years following the 1976/77 climate regime shift in the North Pacific climate system, the KE system has been observed to oscillate between a stable and an unstable dynamic state with a preferred period of ~10 years. This decadal modulation has been argued to result from a delayed negative feedback process involving the KE variability, its impact upon the overlying storm tracks, the basin-scale wind-forced main thermocline adjustment, and the response of the KE system to the westward-propagating thermocline anomalies. In August 2017, the Kuroshio south of Japan developed a large meander (LM) path which has persisted over the past 6 years. By analyzing eddy-resolving sea surface height data and by adopting a wind-forced linear vorticity model, we demonstrate that the on-going persistent LM is maintained by an exceptionally stable dynamic state of the KE that is both forced by wind stresses across the Pacific basin and by the occurrence of the Kuroshio LM. Through the nonlinear mutual enhancement between the KE and its upstream LM, the KE system has entered a new regime with a super dynamic stability.

Keywords: Kuroshio, Kuroshio Extension, regime shift, super stability, delayed negative feedback

Predictability of oceanic variability off the eastern coast of Japan by eddy-resolving forecasting system

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[2] *The University of Tokyo, Japan*

Abstract

Warm sea surface temperature anomalies have been frequently observed off the east coast of Japan since the 2010s, and suggested to affect regional marine ecosystems and climate. For the anomalies, previous studies have suggested the influence of increased anticyclonic mesoscale eddies. In the present study, we investigate the predictability of interannual temperature variability in the region with seasonal to interannual lead time using a prediction system based on an eddy-resolving ocean general circulation model (Kido *et al*. 2023, Geophys. Res. Lett.). From the 36-month prediction experiments initialized on January 1st of each year from 1994 to 2020, we found moderate forecast skill in predicting surface and subsurface temperature at 1-year lead time over the region south of Hokkaido, the northernmost main islands of Japan. Further analysis suggests that a source of the predictability is an anticyclonic eddy shed from the Kuroshio Extension and its northward propagation to the high-skill region, which is found in both the observation and the prediction.

Keywords: prediction, Kuroshio Extension, warm temperature, anticyclonic eddy

Diurnal variation of mixed layer depth at ocean climate station KEO in the northwestern Pacific

Na Feng[1, 2], Jingjie Yu[1], Zhaohui Chen[1, 3], Yongzheng Liu[4, 5], Bolan Gan[1], and Haiyuan Yang[1]

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Abstract

The mixed layer depth (MLD) is important for both physical and biological oceanography. Nevertheless, the variation and mechanism of diurnal MLD remain uncertain. The diurnal variation of MLD (h') within the Kuroshio Extension region is investigated utilizing observations from Kuroshio Extension Observatory (KEO) buoys. The prominent diurnal cyclic pattern is found in MLD with its maximum depth occurring prior to sunrise and shallowest arriving before sunset. Furthermore, the most pronounced h' occurs in April, whereas the weakest fluctuation is observed during the summer, exhibiting seasonal variations. A one-dimensional mixed-layer model is employed to assess the relative contribution of atmospheric forcing and oceanic stratification to h'. It is found that h' is primarily governed by high-frequency solar radiation, demonstrating contribution of 41% at least, and intensifies with strengthening diurnal fluctuations in shortwave radiation. In contrast, the low-frequency variations in wind stress exert a greater influence on h' than its high-frequency variations, accounting for no more than 20%. The oceanic stratification, including the initial upper ocean MLD and thermocline slope, contributes 22% and 7% to h', respectively. It is found that the diurnal fluctuations in MLD weaken with enhanced oceanic stratification.

Keywords: mixed layer depth, diurnal variation, Kuroshio Extension

Daily monitoring of the Kuroshio over the Izu Ridge using GNSS on a ferryboat

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Abstract

The Kuroshio, the western boundary current of the North Pacific, has stably taken a large meandering path south of Japan since August 2017. Variations of the wind Sverdrup transport and mesoscale eddy activities are considered major causes of the large meander, but the significant bottom topography of the Izu-Ogasawara Ridge should be one of the key factors controlling formation and deformation of the large meander of the Kuroshio. However, because of the absence of dense satellite altimeter tracks over the Izu Ridge, sea surface height (SSH) and geostrophic velocity observations over the Izu Ridge are not frequent, which would prevent accurate prediction of non-linear rapid Kuroshio path changes. Therefore, since 2022 June, we have deployed the Global Navigation Satellite System (GNSS) receivers on the ferryboat “Tachibana Maru” (Tokai Kisen, 5681t) cruising between Takeshiba Port, Tokyo to Hachijo-jima Island, which crosses the Kuroshio over the Izu Ridge twice a day. Using precise point positing (PPP) and post processed kinematic (PPK) positioning referring to fixed land GNSS stations operated by the Geospatial Information Authority of Japan, SSH variations along ship tracks are determined. After removing the EGM08 geoid height, along-route sea surface dynamic height (SSDH) variations are obtained of several tends of centimeters. The measured SSDH describes variations of the Kuroshio axis position due to its meanders, together with presence of branch currents. However, better geoid model is required, especially around islands, to increase the accuracy of absolute geostrophic velocity.

Keywords: the Izu-Ogasawara Ridge, Kuroshio large meanders, GNSS, ferryboat observations

Seamount wake and turbulent mixing induced by the Kuroshio and tides in Tokara Strait

Eisuke Tsutsumi[1, 2], Ryuichiro Inoue[3], Takeyoshi Nagai[4], Hirohiko Nakamura[1], Ayako Nishina[1], Takahiro Endoh[5], Anne Takahashi[2,6], Ren-Chieh Lien[6], Eric Kunze[7], Sachihiko Itoh[2], and Daisuke Hasegawa[8]

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Abstract

Current, stratification and turbulence were measured with an ADCP/CTD mooring and shipboard microstructure profiler to investigate mixing due to interaction between seamount topography, the Kuroshio and tides. Measurements were conducted in the downstream wake of Hirase Seamount in Tokara Strait, a 550-meter-tall seamount rising from the 600-m deep seafloor, during November 2019, November 2020 and November 2021. The flow is characterized by topographic Rossby Number $Ro \geq 1$ and topographic Froude number $Fr_t = U/Nh < 1$. An intense turbulence layer at 150–200 m depth has average TKE dissipation rate $\epsilon = O(10^{-6})$ W kg^{-1} and vertical eddy diffusivity $K_\rho = O(10^{-3})$ m^2 s^{-1}. Turbulence is also enhanced at greater depths, $\epsilon = O(10^{-7})$ W kg^{-1} and $K_\rho = O(10^{-4}–10^{-3})$ m^2 s^{-1}. Turbulence is enhanced at ebb tide and low water when surface tidal flows are with the Kuroshio along banded vertical shear layers in the seamount wake where Kelvin-Helmholtz billows were observed, suggesting shear instability. The banded shear structure likely forms due to the tidally-accelerated surface Kuroshio jet and tilted tide-induced wake vortices. Although our sampling is unlikely to capture all phases of the turbulence evolution with the shear instability, estimates of mixing efficiency Γ based on the microstructure shear and temperature suggest that the turbulence in the seamount wake may cause more efficient mixing (Γ~0.5) at ebb tide and low water than at high water (Γ~0.2). Our study highlights the importance of tidally-generated wake vortices for dissipation and mixing in the Kuroshio.

Keywords: Turbulent mixing, Seamount wake, Kuroshio, tides, Tokara Strait

Dynamical and ecological interaction between the Kuroshio and coastal circulation

Kiyoshi Tanaka[1], Toru Miyama[2], Takahiro Toyoda[3], Kunio Kutsuwada[4], Masato Niki[4], Daisuke Takahashi[4], Kazuyuki Uehara[4], Yukio Unno[5], Kenichi Kobayashi[5]

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Abstract

Coastal circulation off the south coast of Japan interacts strongly with the Kuroshio current. The interaction process plays an important role in ecosystems along the Kuroshio Current and adjacent coastal seas, because large amounts of water including heat and nutrients are exchanged between them through the interaction. Therefore, we are currently conducting a research project designed to investigate this interaction. The area around Suruga Bay is one of the study areas where strong dynamical and ecological interaction occurs between the coastal circulation and the Kuroshio Current, and ecology of Sakura-shrimp is targeted as a representation of coastal ecosystem study in the area. It should be noted that catches of the Sakura-shrimp have rapidly decreased to almost zero recently, and one of the most plausible causes of the rapid decrease is marine environmental change due to drastic change of the Kuroshio Current from the straight path to the large-meander one. In this context, our study has three objectives: development of advanced numerical simulation, establishment of sustainable in situ observation, and collaboration with stakeholders. With regard to the numerical simulation, high-resolution ocean circulation models with data assimilation (JCOPE and MRI.COM models) have started simulating the processes directly. Moreover, recent downsized instruments (ADCPs, CTD-profilers, loggers for temperature, salinity, and flow velocity) enable the observation to be conducted easily and sustainably utilizing ordinary fishing boats, aquaculture facilities, and commercial ships. These observations are vital for validation of the numerical simulation. Moreover, establishment of synergistic collaboration with stakeholders, such as local fishers and a shipping agency, is essential to the project. Frequent scientific observations with high spatial and temporal resolution cannot be made without stakeholder's support. At the same time, many social problems, such as the poor catch of the Sakura-shrimp in recent years, cannot be solved without advanced scientific knowledge. Therefore, sustainable observation system is being developed with the stakeholders. The final goal of our project is to present a clear vision for future ocean science, meeting the expected outcome of the UN Decade of Ocean Science.

Keywords: Future ocean science, Advanced numerical simulation, Sustainable observation, Collaboration with stakeholders

Amami-Kuroshio project: baseline assessment of subtropical environment of the Amami Islands and the influence of the Kuroshio on the biosphere and humanosphere

Yusuke Yokoyama and Hiroaki Saito

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Abstract

The Amami Islands (N27° 02'–N29° 22') locate between Kyushu and Okinawa consisting of 56 small islands including 8 inhabited islands. The Kuroshio flows west of the islands in the East China Sea and outflows to the North Pacific Ocean through the Tokara Strait north of Amami Island (the largest island). Marine and terrestrial ecosystems are greatly influenced by the Kuroshio and its variability. It also has major impact on fishery and tourism, which are the most important industry in the islands, and also nurturing their unique culture.

The effects of global warming on the marine environment of the Amami Islands and also mainland Japan, such as coral bleaching, loss of seagrass, northward migration of subtropical fish, etc., are evident. Understanding the influence of the Kuroshio, which transports warm and nutrient-depleted water and subtropical organisms northward, is a pressing issue for the sustainable use of marine ecosystem services. Considering the long-term and recent rapid changes in the environment around the Kuroshio, understanding the past, present and future of the Amami Islands is useful for developing countermeasures to global warming in the Amami Islands and also for the mainland Japan in which "subtropicalization" is underway.

In 2022, we launched the Amami-Kuroshio Project for the baseline assessment of the subtropical environment of the Amami Islands and the influence of the Kuroshio on the biosphere and humanosphere. The project is led by AORI, University of Tokyo, in collaboration with scientific institutions in Japan and WESTPAC member countries and local communities of the islands. We investigate the status and change of the Kuroshio and its influence on the structure and dynamics of the marine ecosystem as well as marine ecosystem services using physical, chemical, and biological oceanographic approaches. We also investigate the past Kuroshio by means of geochemical and paleoceanographic approaches. We work closely with the local community, including high schools, to disseminate scientific knowledge and support citizen science to know the environment of each island and/or embayment, to identify the unique ecosystems and ecosystem services, and to establish local identity. In the presentation, we will show how to examine the present and past environment of the islands and how to contribute to the society through the preparation of best scientific knowledge and education/outreach activities.

Keywords: Amami Islands, Kuroshio, subtropical, ecosystem, humanosphere

The stronger Kuroshio intrusion leads to higher chlorophyll a concentration in the northern South China Sea

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Abstract

The Kuroshio intrusion from the Luzon Strait is considered to significantly influence the ecosystems in the South China Sea (SCS). However, when the Kuroshio intrusion is strongest during the Northeast Monsoon, field observation data are limited, and the vertical mixing caused by the strong wind may also mask the effect of Kuroshio intrusion. Here, we reanalyzed the published data of 20 cruises (5,338 samples) in the SCS from 2004 to 2015, and specifically conducted two field cruises during the Northeast and the Southwest Monsoon in 2018, respectively. Field observations of both cruises indicated a unimodal pattern of the upper 50 m total chlorophyll a (Chla) concentrations with Kuroshio intrusion index, and the stronger Kuroshio intrusion in the Northeast Monsoon more significantly enhances the Chla concentration. This higher enhancement during Northeast Monsoon was attributed to the contributions of *Synechococcus* and nanophytoplankton, which was *Prochlorococcus* in the other monsoon. Furthermore, the long-term remote sensing data confirmed a consistent result that Kuroshio intrusion leads to an increase in Chla concentration especially in the Northeast Monsoon, and a significant positive correlation between the intensity of Kuroshio intrusion and Chla increase was found. Along with the significant weakening trend on the intensity of Kuroshio intrusion, we suggested that the biogeochemical effect on the South China Sea ecosystem may be weaken in the future.

Keywords: Monsoon, Biogeochemical, Ecosystem, Phytoplankton, South China Sea

ENSO-related water mass modification in the Kuroshio origin region, east of the Philippines

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Abstract

Sea surface temperature variation in the western tropical and subtropical North Pacific is related to atmosphere and ocean variations on various timescales from days to decades. In addition to variations of sea surface forcing, the entrainment of deep water from the subsurface layers is responsible for the sea surface temperature variation. Deploying a mooring buoy at 13˚N, 137˚E, named the Philippine Sea mooring observation (PHSMO) site, we initiated the observation in December 2016. As of now, we obtained temperature, salinity, dissolved oxygen concentration, and current velocity data down to a depth of 300 m for longer than 5 years at PHSMO site, and observed their interannual variations at the site. We examined the time series data at the site, focusing on El Niño-Southern Oscillation timescale variation. After the precedent La Niña, the main thermocline and saline tropical water layer was displaced upward from mid-2018 to early 2019. Associated with this, the apparent oxygen utilization (AOU) at 150 m depth increased, so that deep old water was uplifted. Despite that afterward, the main thermocline was displaced downward, the AOU was persistently high until early 2020. This implies that the old deep water was upwelled and advected from the east in addition to the local uplift. As the negative phase of the Pacific decadal oscillation (PDO) are accompanied by frequent occurrences of La Niña events, our finding supports the suggestion by Nagano et al. (2022) that the strong (weak) upwelling of deep water cools the upper ocean in the western tropical Pacific and affects the phase reversal of the PDO. Our observation contributes to monitor the upper-ocean conditions in the western North Pacific tropical and subtropical region and leads to the improvements of predictions of the regional and global climate changes and marine ecosystems, the main goals of the 2nd Cooperative Study of the Kuroshio and the Adjacent Regions (CSK-2) programme registered to the UN Decade of Ocean Science for Sustainable Development.

Keywords: Philippine Sea, Kuroshio, air-sea interaction, ENSO, PDO

Observations of upstream-downstream connectivity of the Kuroshio current variability in the East China Sea

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Abstract

The Kuroshio Current in the East China Sea (ECS) was observed from June 2020 to June 2022 using four moorings of the Acoustic Doppler Current Profile (ADCP). The moorings were located in the Okinawa Trough, across and along the path of the Kuroshio: southwest (upstream and onshore), southeast (upstream and offshore), northwest (downstream and onshore), and northeast (downstream and offshore), respectively. The mean currents in the upper 500 m are northeastward following the steep continental slope of the Okinawa Trough, and the current speeds decrease with depth, presenting near bottom countercurrent at the onshore stations. The observed current velocities show significant variance in the 8–32 day band, and the amplitude of the band-pass-filtered cross-path velocity is comparable to that of the along-path component in the upper 100 m, implying a strong meandering of the Kuroshio in this frequency band. However, the along-path velocities at the southwestern and northwestern sites present a positive relationship with a time lag of about 11 days (southern site leads). It suggests that the meandering of the Kuroshio propagates in the downstream direction, possibly with some frontal feature, which provides observational evidence for the connectivity of the Kuroshio variability between upstream and downstream regions in the ECS. The details of the horizontal and vertical structures of the Kuroshio frontal meander will be discussed using high-resolution numerical model output.

Keywords: Kuroshio, East China Sea, ADCP, meander, upstream-downstream connectivity

Weakening of the Kuroshio by cyclonic cold eddies enhanced by the tropical cyclones

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Abstract

An array of five pressure-recording inverted echo sounder (PIES) moorings spanning a distance of 420 km around the subtropical countercurrent and North Equatorial Current regions of the western Pacific detected extraordinary sea level drops from November to December 2013. In October 2013, three typhoons, namely, Danas, Wipha, and Francisco, consecutively passed east of the PIES sites, which significantly strengthened pre-existing cyclonic cold eddies to create the observed sea level drops. The typhoon-strengthened cold eddies propagated westward over approximately 1000 km for approximately 4 months and eventually met the Kuroshio offshore Taiwan. The approaching eddies interacted with the Kuroshio upstream for ~3 months and reduced the Kuroshio intensity by up to 24% in February–May 2014, the lowest record for the last 26 years of satellite measurements. Our results can provide a new mechanism linking typhoon-to-eddy-to-Kuroshio variability through oceanic processes.

Keywords: Typhoon, oceanic cold eddies, Kuroshio, Typhoon-to-eddy-to-Kuroshio link, Pacific Ocean

Long-term variation of the eddy kinetic energy in the northeastern South China Sea modulated by the enhanced Kuroshio looping pathway

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Abstract

The seasonal to interannual variability of eddy kinetic energy (EKE) in the Northeastern South China Sea (NE-SCS) has been widely studied and it is recognized that they are strongly related to the state of the Kuroshio pathway in the Luzon Strait. While, due to the lack of long-term observations and high-resolution simulations, the decadal change of EKE in NE-SCS remains unexplored. In this study, we show the EKE trend in the past 30 years in the NE-SCS by using satellite observation and high-resolution simulation (daily Hybrid Coordinate Ocean Model Global Analysis). It is found that due to the weakening of the Kuroshio in the Luzon Strait since 1990s, the Kuroshio shows an enhanced looping path in the NE-SCS, inducing stronger EKE in this region. Further analysis confirms that the energy transfer by baroclinic instability is dominant for the increasing of EKE, when the Kuroshio intrudes into the NE-SCS and brings more potential energy inside the circulation. The Kuroshio state along the Luzon Strait is the key for modulating the EKE in the NE-SCS. Furthermore, the long-term weakening of Kuroshio current along the Luzon strait in the past 30 years is determined by the decreasing of subtropical mode water, corresponding to the positive phase of the Atlantic Multidecadal Oscillation. This study provides insight into the interaction between marginal sea (i.e., the SCS) and open ocean (i.e., the western Pacific Ocean), finally linking to the global climate change.

Keywords: Long-term Variation, South China Sea, Kuroshio Looping Pathway, Eddy Kinetic Energy, Mode Water

Dynamics of the vertical phytoplankton distribution in the Philippine Sea

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Abstract

Satellite derived productivity gives us a quick glance of biological activity from the ocean surface. The occurrence of the subsurface chlorophyll maximum (SCM) is overlooked in such satellite information as it occurs at depths greater than optical capability. We attempted to explain how the plankton in Philippine Sea are distributed vertically within the water column by determining mechanisms that regulate their distribution. As climate change is affecting the hydrodynamics of the world's oceans, studying how these changes will influence the productivity, distribution and abundance of phytoplankton communities is an urgent research question. We found that the vertical phytoplankton profiles and community structure distinctly responded to variations in the oceanographic features and conditions, wherein a more southern location of the NEC bifurcation corresponded to a decrease in chlorophyll-a levels as the water masses changed from predominantly North Pacific subtropical water to NEC tropical water. Also, we were also able to provide two predictive relationships that may be useful in determining phytoplankton productivity in the offshore areas of eastern Philippines: the first equation presents an alternative equation to calculate the integrated chlorophyll-a biomass from remotely-sensed wind stress and wind speed estimates while the second provides an estimation of the depth of the SCM based on surface chlorophyll-a, wind stress and wind speed. The equations may provide a more accurate estimation for primary production in the Philippine Sea and may eventually be scaled up to estimate potential fishery productivity at depth. Overall, we conclude that changing environmental conditions would most likely influence the phytoplankton community at the SCM: higher temperatures may favor the proliferation of dinoflagellates that may thrive in more stratified water while frequent mixing due to passage of storms would momentarily enhance phytoplankton productivity in the area. These findings imply that in the highly variable Philippine Sea, alternate periods of calm and intense mixing periods would most likely allow trophic cascade leading to succession of plankton groups that could ultimately cascade the food web. This could give light to the potential productive fishing zones in the country that may contribute to food security.

Keywords: subsurface chlorophyll maximum (SCM), Philippine Sea, phytoplankton productivity

Onshore intensification of subtropical western boundary currents in a warming climate

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Abstract

Subtropical western boundary currents (WBCs) refer to swift narrow oceanic currents that flow along the western edges of global subtropical ocean basins. An anomalous onshore intensification is found to induce anomalous warming that exacerbates coastal marine heatwaves, reduces ability of the oceans to absorb anthropogenic carbon dioxide, and destabilizes methane hydrate stored below the sea floor in shelf regions. Owning to limited observations and coarse resolution of climate models, how greenhouse warming may affect the zonal structure of global WBCs remains unknown. Using seven high-resolution climate models, we find an onshore acceleration of the WBCs in a warming climate. The multi-model ensemble means onshore acceleration ranges from 0.10±0.08 to 0.51±0.24 cm s^{-1} per decade over 1950–2050. Enhanced oceanic stratification associated with surface warming induces an uplift of the WBCs and leads to the projected changes. Our finding highlights the urgent needs for a comprehensive assessment of the associated impacts.

Keywords: WBCs, onshore intensification, global warming

Surface wave height regulated by ocean currents

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Abstract

Ocean currents exert notable influences on surface wave height through wave-current coupling. In this paper, we provide solid evidences that ocean currents can regulate the significant wave height (SWH) by comparing measurements of a fleet of surface drifting wave buoys (DrWBs) with GFS-WW3 model product. In the Kuroshio Extension (KE) of Northwestern Pacific, the SWH observed by DrWBs are shown to be generally lower (higher) than that simulated by GFS-WW3 when waves propagate towards (against) the direction of surface currents. It is indicated that the GFS-WW3 product could be underestimated/overestimated by up to 5% compared with observed SWH if the forcing from current field is not involved. Adopting altimeter derived data, further analysis shows consistent relationship between observed and modelled SWH in the global ocean, except for regions where ocean swells dominate. The findings may help improve wave model simulations without increasing computational burdens if this relationship is considered.

Keywords: significant wave height, current effects on waves, drifting wave buoy, Kuroshio extension

Hydrographic measurement during BUDEE cruise 2022 in Maluku Sea

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Abstract

A multi-disciplinary study on physical processes and dynamics of upwelling and Maluku Indonesia Throughflow, paleoclimate/paleo-upwelling, biogeochemistry, ichthyoplankton and fisheries acoustics has been conducted successfully in September 2022 onboard R.V. Baruna Jaya VIII in Banggai Maluku Sea. This study aims to investigate stratification and structure of Indonesian Throughflow water, ocean circulation and upwelling structure. About 40 casts of SBE CTD 19 plus and along-track RDI shipboard ADCP 75 kHz datasets have been acquired during the cruise. Relatively weak upwelling intensity is found in the southwesternmost Maluku Sea – Banggai waters, indicated by outcropped of isotherms and isohalines from 40 m depth to the sea surface, as well as a high chlorophyll-a concentration from sea surface down to depth. Weak upwelling intensity during BUDEE cruise 2022 is modulated by interannual climate variability of El Nino. Upper 300 m circulation indicates anti-clockwise circulation in the Maluku Sea, associated with zonal variation of ITF water. Observed strong northeastward flows are found in Lifamatola Strait, as well as strong northward flow in the narrow Bote Strait (~300 m depth) that disrupts Banggai upwelling with fresher and warmer water from northern Banda Sea.

Keywords: BUDEE cruise, Indonesian Throughflow water, upwelling, Banggai Maluku Sea, CTD and SDCP datasets

Vertical structure and interannual variability of upwelling in Banggai waters, Maluku Sea: a model study

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Abstract

The Indonesian Throughflow (ITF) entering via its eastern path may recirculate within the Maluku Sea and modulate upwelling intensity there. However, it is still less understood on ocean circulation changes related to ENSO events may lead to disrupt vertical structure of upwelling. This study aims to investigate anomalies of ocean circulation and the vertical structure of upwelling during five different ENSO events between 2008–2023 (15 years). The daily averaged ocean circulation model outputs from Marine Copernicus are analyzed in this study. It is shown that there is an increased meridional component, leading to larger northward meridional currents during the El Niño event in 2015 (strong), 2019 (weak), and 2023 (strong), as revealed by its stronger positive anomaly compared to the negative anomaly during the strong La Niña in 2010 and weak La Niña in 2022. Negative ocean temperature anomalies occurred during the El Niño events. The lowest seawater temperature minimum occurred during super El Niño events in 2015, while the highest seawater temperature maximum occurred during strong La Niña events in 2010. In contrast to temperature, the highest surface salinity occurred during a weak El Niño in 2019 in August. In El Niño events, minimum temperatures with an isotherm of 260°C appear below the surface layer in 2015, 2019, and 2023, but 2023 still tends to be warmer. While in the La Niña event, the 260°C temperature is more than 50 m deep, or around 60–70 meters. The vertical structure of the meridional current component shows an upwelling jet in El Niño years (2015 and 2019) and La Niña years (2010) from a depth of 100 towards the nearshore surface. In the year of El Niño 2023, weak upwelling was formed and only northward flow occurred in the upper 50 m depth.

Keywords: Banggai-Maluku Sea, interannual variability, ENSO, seasonal upwelling, Maluku throughflow, reanalysis datasets

Anomaly of Maluku Indonesian throughflow circulation during different ENSO year in the last 15 years (2008–2023)

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Abstract

Connecting between the Indo-Pacific Oceans, the Indonesian Throughflow (ITF) in the Maluku Sea (MS) plays an important role in transferring heat and freshwater via its secondary eastern path which impacts ocean-atmosphere dynamics and climate variability. However, there is still a lack of in situ observation there. This study aims to investigate Maluku ITF circulation and its response to the ENSO events during the last 15 years, using global ocean reanalysis datasets between 2008–2022 from Copernicus. An anomaly of strong southward transport volume in the upper 550 m depth appeared during a strong La Niña 2010, in contrast to that during super El Niño 2015. In the northern entrance of MS, the southward Maluku throughflow intensifies in the western side, and then recirculates back northward in the eastern side. However, during super strong El Niño, a weakened southward flow is found in the western side in the upper layer and between 200–500 m depth, and southward flow in the upper 150 m depth in the eastern side. This ocean circulation anomaly impacts heat and freshwater budget, in turn to ocean-atmosphere in the basin-scale of Maluku Sea.

Keywords: Maluku Sea, Indonesian Throughflow, ENSO, transport volume, reanalysis datasets

Stratification of Indonesia Throughflow water and its circulation along 125E in the Banggai-Maluku Sea

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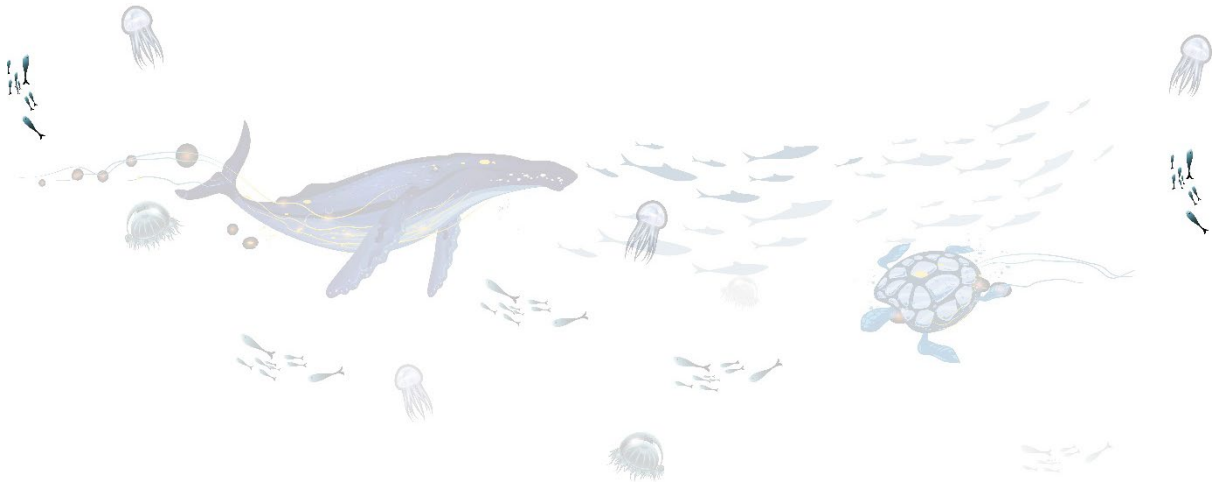
Abstract

The secondary pathway of Indonesian Throughflow (ITF) that enters from its inflow portal of the northern Maluku Sea is assumed to recirculate in the Banggai-Maluku Sea, where its upper-layer circulation returns into the Pacific and deeper flows continue southward into Seram/Banda Sea via Lifamatola Strait. This study aims to identify the type of water mass, stratification, and currents in the Banggai-Malucca Sea using direct CTD casts and shipboard ADCP measurement datasets from the BUDEE cruise in September 2023. The result shows the water mass stratification of the mixed layer having a depth of 0–75 m with a temperature range of 26–29°C, while the thermocline layer has a depth of 28–407 m with a temperature range of 23–26°C, and the deep layer has a depth of 407–1000 m with a temperature value of 4–12°C. The current pattern of the Banggai Sea Maluku Sea at a depth of 52–400 m is more dominantly influenced by non-tidal currents, the influence of tidal currents only covers a depth of 148m less than non-tidal currents. Instantaneous current transport at each depth is more dominant currents moving out of the Maluku Sea with a total of 4.1Sv.

Keywords: water mass characteristics, current direction, instantaneous current transport

Sub-theme A:
Ocean Processes and Climate Change

Session A2:
Western Pacific Marginal Seas: Physics, biogeochemistry and ecosystem



Programme

Venue: Mayfair C/Mayfair B, 11th Floor
Dates: 22–23 April 2024

Conveners:

Jing Zhang	University of Toyama, Japan
SungHyun Nam	Seoul National University, Republic of Korea
Vyacheslav Lobanov	V.I.Il'ichev Pacific Oceanological Institute, Russia
Eko Siswanto	JAMSTEC, Japan
Liu Qian	Ocean University of China, China

Time	Presentation Titles	Speakers
22 April 2024	Mayfair C	
Section 1		
10:30–10:55	Water and nutrient transport between land and ocean: toward the healthy, productive, and sustainable Asian marginal seas	Jing Zhang, *University of Toyama, Japan*
10:55–11:10	FATIMA Yellow Sea 2023 experiment: a sea fog study	Jae Hak Lee, *GeoSystem Research Corporation, Republic of Korea*
11:10–11:25	Ocean currents in the Philippine internal seas as simulated by 1/36° SURF-NEMO model	Aiko Love Del Rosario, *University of the Philippines Diliman, The Philippines*
11:25–11:40	Seasonal variability of Primorye current system	Lobanov Vyacheslav, *V.I.Il'ichev Pacific Oceanological Institute, Russia*
11:40–11:55	Mesoscale eddies in the Kuril basin of the Okhotsk Sea	Sergey Prants, *V.I. Il'ichev Pacific Oceanological Institute, Russia*
11:55–12:10	Research on the East sea current field and the intersection of vortex belts affecting upwelling water in the south central region of Vietnam	Nguyen Do Vinh, *Institute of Oceanography, VAST, Vietnam*
12:10–12:25	Formation and fate of internal waves on the northern shelf of the South China Sea	Xiaolin Bai, *Xiamen University, China*
Section 2		
13:30–13:50	Variable ecosystem responses in western North Pacific LMEs to the warming after 2014	Sinjae Yoo, *Jeju National University, Republic of Korea*
13:50–14:05	Seasonal hydrographic patterns of the Gulf of Thailand and interactions with the South China Sea: insights from a numerical Model utilizing the novel dataset	Tanuspong Pokavanich, *Kasetsart University, Thailand*
14:05–14:20	18 Years of the upper Gulf of Thailand observations: physical and chemical properties	Arachaporn Anutaliya, *Burapha University, Thailand*

Time	Presentation Titles	Speakers
14:20–14:35	Scenarios for water transport from the Tyumen river to marine economic and protected areas based on field measurements, satellite data, ROMS modeling and Lagrangian analysis.	Lipinskaya Nadezhda, *V.I.Il'ichev Pacific Oceanological Institute, Russia*
14:35–14:50	Observation of upwelling and chlorophyll-a spatio-temporal distribution in relation to physicochemical parameters in the Flores Sea and Pantar Strait, Indonesia	Iis Triyulianti, *BRIN, Indonesia*
14:50–15:05	The decline of the nutrient concentrations in the marginal seas around the Korean peninsula over the past 30 years	Sojin Park, *Seoul National University, Republic of Korea*
Section 3		
15:30–15:45	Isotopic composition of nitrate in the western Pacific Ocean: biogeochemical signals and their transport	Wentao Wang, *Chinese Academy of Sciences, China*
15:45–16:00	Lateral transport of dissolved inorganic carbon in a mangrove-creek-estuary system: implications for ocean acidification	Qian Liu, *Ocean University of China, China*
16:00–16:15	Detecting terrestrial organic carbon contribution to the shelf sea dissolved organic matter using deuterium stable isotope signatures	A'an Johan Wahyudi, *Nanyang Technological University, Singapore*
16:15–16:30	Determination of copper (II)-binding ligands in tropical coastal area	Ng Li Qing, *Universiti Putra Malaysia, Malaysia*
16:30–16:45	Harnessing earth observations for assessing optical water quality in Asian coastal oceans	Eko Siswanto, *JAMSTEC, Japan*
16:45–17:00	Projecting physical-biogeochemistry changes (1990–2060) in the South China Sea under RCP8.5 climate change scenario	Nur Hidayah Roseli, *Universiti Malaysia Terengganu, Malaysia*
23 April 2024	Mayfair B	
Section 4		
10:00–10:15	Control factors of nutrient concentration and material cycle in the eastern part of Seto Inland Sea Japan	Akihiko Morimoto, *Ehime University, Japan*
10:15–10:30	Impacts of tropical cyclone Seroja on the phytoplankton chlorophyll-a and sea surface temperature in the Savu Sea, Indonesia	Riza Yuliratno Setiawan, *Universitas Gadjah Mada, Indonesia*
10:30–10:45	*Noctiluca* red tide and hypoxia in the upper Gulf of Thailand in 2023	Anukul Buranapratheprat, *Burapha University, Thailand*

Time	Presentation Titles	Speakers
10:45–11:00	Temporal variability of phytoplankton community structure in relation to marine environmental dynamics in temperate coastal waters	Koichi Yano, *Soka University, Japan*
11:00–11:15	Spatial heterogeneity of seasonal phytoplankton blooms in the Yellow Sea: physical drivers and biological responses	Hongjun Song, *First Institute of Oceanography, China*
11:15–11:30	Increasing dolphins appearances during extreme upwelling events: a potential marine wildlife tourism in Alor Kecil, Alor Island, Indonesia	Anindya Wirasatriya, *Diponegoro University, Indonesia*
11:30–11:45	A review of impacts of reclamation activities on water quality - towards environmental impact assessment strategy for Manila Bay	John Darryl Lagdameo, *University of the Philippines Diliman, The Philippines*
11:45–12:00	Reproductive strategies among the Paracalanidae copepods in Sagami Bay, Japan and Sepanggar Bay, Malaysia	Aruku Kawano, *Yokohama National University, Japan*

Water and nutrient transport between land and ocean: toward the healthy, productive, and sustainable Asian marginal seas

Jing Zhang

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Abstract

Given the unrelenting advance of climate change, significant changes in the hydrological and biogeochemical cycles, together with increasing human economic activities, are affecting the ocean structure and ecosystem in the Asia Marginal seas. In addition, oceanographic physical conditions, such as stratification, vertical mixing and horizontal transport, are important in controlling the behavior of nutrients. Here, current studies focusing on the material transfer between land and ocean and the influence of global warming will be introduced. As one of the western boundary currents, the Kuroshio with its nutrient-rich subsurface water plays a crucial role in carbon circulation, shaped by topography and ocean mixing processes. Chemical tracers as developed by the GEOTRACES program, and its related studies are excellent tools to identify and quantify water masses mixing and material sources at different spatial and temporal scales. Our results indicate that the dominant sources and supply of nutrients are from cross-shelf Kuroshio; and the well mixed nutrient-rich water on continental shelf continues downstream, boosting primary production, thriving fishing grounds east of Japan. It needs to be emphasized that all data have gone through the calibration and comparison between different labs/cruises, ensuring its accuracy and reliability. An ongoing ten-year WESTPAC program, "Healthy, Productive and Sustainable Asian Marginal Seas: Understanding changes in the marine environment in response to global climate change", will also be briefly introduced in this talk. The global warming effects have also begun to appear in the weather and the water cycle of some coastal cities. In Japan, the temperature is rising 1.7 times faster than the world's average, and this has turned snowfall into rainfall, and as a result, the amount of snowfall in these areas has decreased by up to 50% over the past 40 years. The reduction in the snowfall caused a deterioration in the function of water storage and groundwater recharge. These shifts are expected to increase river water and shallow groundwater volume and a shortened residence time before flowing to the coastal ocean, eventually decreasing nutrient concentrations in the terrestrial water. In this area, it is vital to understand the status of the water and nutrient dynamics and then adopt appropriate measures based on scientific evidence in cooperation with the government. A three-year ongoing project (Environment Research and Technology Development Fund) will also be introduced, with the goal to conserve sustainable water and implement appropriate nutrient management.

Keywords: nutrient transport, water cycle, climate change, productive and sustainable, Asian Marginal Seas,

FATIMA Yellow Sea 2023 experiment: a sea fog study

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Abstract

The FATIMA (Fog and Turbulence Interactions in the Marine Atmosphere) project is underway to understand and quantify the complex interactions between processes that underlie the life cycle of sea fog in shallow seas. As a field experiment of the project, FATIMA-Yellow Sea (YS) field campaign was conducted in the eastern YS and northern East China Sea (ECS) during June 20 to July 09, 2023 using R/V Onnuri of the Korea Institute of Ocean Science and Technology. In this presentation, the highlights of the YS campaign are summarized from four perspectives. First, a vast number of platforms and methods of observation were used. The R/V Onnuri played a key role in observation as a moving air-sea research laboratory, and time series data of ocean-atmospheric variables were collected on three Korea Ocean Research Platforms in the YS and ECS. Various unmanned observation methods, i.e., satellite (Geostationary Ocean Color Imager-II), wave glider and ocean current moorings were mobilized to obtain data such as sea fog, cloud and sea-level temperature images, ocean currents, and ocean-atmosphere fluxes. In addition, with the cooperation and participation of the National Institute of Meteorological Sciences (NIMS) of Korea, observations using the aircraft Nara and NIMS' R/V Gisang-1 were taken. Second, a vast suite of observational equipment was deployed covering from turbulence to synoptic survey both in ocean and atmosphere: it included CTD/LADCP, VMP 250, ROSR, etc. for oceanographic observation and doppler lidar, W-band radar, micro rain radar, visibility sensor, disdrometer, etc. for meteorological observation. Third, to make the best of shipboard observations, online meetings focused on the exchange of weather condition and forecast information including sea fog from different numerical model products, which were held daily during the period of experiment. It was a tripartite operational meeting involving local laboratories in Korea, the United States, and Canada with the research team on R/V Onnuri. As a result of these meetings, eight intensive operational periods (IOPs) were identified, which exceeded initial expectations based on climatology. Third, based on observed field information and results from an atmosphere-ocean coupled model, COAMPS, some ocean-atmospheric phenomena that control sea fog generation in the YS were identified. The behavior of Jangma front, strong tidal mixing in the coastal area, especially off the southwestern tip of the Korean Peninsula, and distribution of low salinity water which appeared in the southwestern YS were suggested as top contenders for the background of ocean-atmospheric condition for sea fog formation, maturation and extinction.

Ocean currents in the Philippine internal seas as simulated by 1/36° SURF-NEMO model

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Abstract

Current global ocean models are limited to spatial resolution of 1/8° to 1/12° which is around 8–14 km in grid size. Due to the presence of islands, shallow depths and narrow straits surrounding the Philippines archipelago, global models cannot resolve and explain the internal sea surface currents. Several high-resolution models are available for describing the internal seas, however, setting up boundary conditions for these models is a challenge. A Relocatable Ocean Model such as SURF (Structured and Unstructured grid Relocatable ocean platform for Forecasting) allows for easier setting up high resolution models because it automatically uses coarser regional ocean models as boundary conditions for a high resolution, re-gridded nested model. This study investigates the movement of ocean currents and tides within the internal seas of the Philippines using SURF-NEMO (Nucleus for European Modelling of the Ocean). An internal seas model with horizontal grid resolution of 1/36° and 100 vertical levels is nested within the large-scale Global Ocean Physics Analysis and Forecast system at 1/12° resolution. The model presents the reasons for the productivity in the region through exploration of possible tidal resonance, and shallow sea dynamics within the internal seas.

Keywords: Internal Seas, Ocean Modelling, SURF-NEMO

Seasonal variability of Primorye current system

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Abstract

Primorye (Liman) current is a boundary flow along the northwestern coast of the Japan Sea which transports colder and less saline water from Tatar Strait area to the south-west down to the Peter the Great Bay area. Its continuation to the south-west along the northern coast of Korea is the North Korea Cold Current. We study structure and seasonal variability of Primorye Current based on ship CTD observations, satellite data, surface drifters and moorings. Variability of Primorye Current is especially prominent in the fall season (September-December) when the monsoon winds over the region change from summer to winter phase. A reversal current flowing in opposite direction (to north-east) is observed in September-October along the southern Primorye coast. Then in November-December it changes to normal mode of the south-westward flow. However, it also transports warm and high salinity water of North-western Branch of Tsushima Current directed from the area off Hokkaido toward the Russian coast. This flow is important for water mass formation in the northwestern part of the Japan Sea as it brings relatively warm water to the Russian coast controlling local climate of the coastal area and it brings high salinity water into the area of strong cooling off Peter the Great Bay in winter which provides preconditions to deep convection.

Keywords: Primorye Current, seasonal variability, ship and satellite observations, moorings, Mesoscale Eddies in the Kuril Basin of the Okhotsk Sea

Mesoscale eddies in the Kuril basin of the Okhotsk Sea

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Abstract

We conducted the first altimetry-based systematic census of mesoscale eddies in the Kuril Basin in the Okhotsk Sea in 1993–2021 using the automatic eddy tracking algorithm AMEDA. The dominance of cyclonic eddies over anticyclonic eddies was observed, which contradicts to the common opinion that anticyclonic eddies prevail over cyclonic ones in the Kuril Basin. We focused mainly on long-lived eddies with lateral size in the range from several tens of kms to some hundreds of kms and with a lifespan longer than 30 days. It was found that such eddies were inhomogeneously distributed over the study area with increased occurrence frequency in some domains. It is explained by peculiarities of the circulation and topographic features in the Basin where a transformed subtropical water of the Soya Warm Current, specific Okhotsk Sea water transported by the offshore branch of the East Sakhalin Current and subarctic Pacific water circulate and mix. The content of these water masses and its seasonal and interannual variations inside the surface cores were estimated using a novel particle-tracking technique. The kinematic characteristics of these eddies have been computed for the long observation period of time. The vast majority of the anticyclonic and cyclonic eddies have the nonlinearity parameter exceeding one implying that they are coherent features transporting water with its properties. Peculiarities in distribution of formation, occurrence and decay locations have been analyzed. The comparison of our results with observation and numerical simulation of eddies in the Kuril Basin have been discussed. The work was supported by the Russian Science Foundation (project no. 23-17-00068).

Keywords: Okhotsk Sea, Kuril Basin eddies, detection and characteristics, core water origin

Research on the East sea current field and the intersection of vortex belts affecting upwelling water in the south central region of Vietnam

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Abstract

Many research works have mentioned the upwelling phenomenon; researchers have studied it in many different directions and concentrated their research mainly on the South Central Sea. The research results indicate several causes and mechanisms of upwelling, and the results have explained most of the consequences of the phenomenon. However, there are some consequences of the phenomenon, which the explanation still needs to be convincing, such as why the phenomenon of upwelling often occurs in Khanh Hoa - Binh Thuan. Those consequences of upwelling in that region are: The sea has a high source of nutrients favorable for developing biological life. Approaching the direction of studying the phenomenon of upwelling in the South Central Sea is due to the convergence of mesoscale eddy belts in the area, which forms the phenomenon of upwelling. Based on the assessment of the size, bottom topography, and meteorological regime in the South China Sea, there is a basis to confirm that the South China Sea has large-sized vortices. Through calculation and simulation of the dynamics of the South China Sea by ROMS (open-source software) for a long time every year. The results show that the current field evolution has many different forms, especially the disturbance pattern in forming large vortices, often repeating mesoscale eddy belts in the South Central Sea - Vietnam. When no mesoscale eddy belts converge in this area, the vertical flow rate at the mid-section has a dominant negative value. When mesoscale eddy belts link here, the vertical flow velocity at the mid-section section has a positive value.

Keywords: Mesoscale eddy, South Central Vietnam, Upwelling phenomenon

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Formation and fate of internal waves on the northern shelf of the South China Sea

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Abstract

Internal waves have a wide range of scales but are typically unresolved in climate or global models. With an unprecedented capability of observing and simulating these processes, they are becoming increasingly important to quantify the upscale effect of these processes. As the largest marginal sea in the western Pacific, the South China Sea has the most energetic and frequent internal waves around the world. These waves are also affected by multiscale processes, climate changes and anthropogenic impacts. There have been considerable advances in exploring generation and propagation of internal waves in recent years. However, the understanding on the process and implication of shoaling internal waves on the continental shelf is still very limited.

This presentation will summarize and share the authors' research progress in internal waves and their impacts in ocean mixing and shelf ecosystem in recent years, as well as future research direction in the study region. This talk focuses on the processes and implications of shoaling internal waves over the shelf of the northern South China Sea. By combining the field measurements, satellite observations, theoretical analysis, and nonhydrostatic numerical simulations, we present the features of these internal waves, their shoaling process, and the environmental impacts on the shoaling waves. The talk will include four parts: 1) review of recent results on investigating shoaling ISWs process, 2) fission process and its implication on wave breaking and energy cascade, 3) the local generation and dissipation of the nonlinear internal waves on the continental shelf, and 4) the implications of shoaling internal waves on marine ecosystems. The related contents for each part can be referred to the speaker's publications (https://mel2.xmu.edu.cn/staff.asp?tid=1468).

I have focused on researching nonlinear internal waves for a decade to improve our understanding on the formation and fate of internal waves on the continental shelf. My contribution is not only on the fundamental and theoretical studies, but also on improving and developing new observations.

Keywords: internal waves, multiscale interactions, physical-biological coupling, continental shelf, South China Sea

Variable ecosystem responses in western North Pacific LMEs to the warming after 2014

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Abstract

An extraordinary warming event, dubbed as “The Blob”, occurred in 2014–2016 in the eastern North Pacific. During this period, the eastern North Pacific has experienced wide-ranging ecosystem impacts from the marine heat wave. On the other hand, not much is known about the response on the other side of the North Pacific. Here, the long-term trends of chlorophyll-a, primary productivity and environmental variables in four LMEs in the western North Pacific are analyzed using satellite and in-situ data. SST has invariably increased after 2014 in the Yellow Sea, East Sea, East China Sea and Kuroshio LMEs. However, chlorophyll a and primary productivity showed different responses among the four LMEs. While these decreased in the Yellow Sea, East China Sea, and Kuroshio LMEs, they increased in the East Sea LME. Such trends cannot be explained by the euphotic depth, PAR, or SST. Possible causes of the change are discussed here.

Keywords: ecosystem response, chlorophyll a, primary productivity, warming

Seasonal hydrographic patterns of the Gulf of Thailand and interactions with the South China Sea: insights from a numerical Model utilizing the novel dataset

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Abstract

Based on recent three-dimensional hydrodynamic modeling with higher grid resolution, more realistic spatial meteorological forcing, river and offshore boundaries with model validating by long-term in-situ measurements, this study presents seasonal hydrographic features of the Gulf of Thailand (GOT) with additional details. The model applied the ECMWF-ERA5 data, modified GloFAS river discharge data, HYCOM water temperature and salinity, TPXO tidal data and best available bathymetric data combined from over 77 local nautical charts. The model was calibrated and validated against measured several water levels at measurement stations around the GOT, 3 water temperature stations, 2 salinity stations and 2 flow velocity stations. Moreover the model was validated with near-surface current measurement with in-house developed more than 10 satellite drifters released at different times around GOT. Seasonal three-dimensional features of the GOT was extracted from the modelling results after 3 years spin up period and present according to different monsoonal phases, i.e., the Northeast monsoon (November–February), 1st monsoon transition (April–May), the Southwest monsoon (June–September) and 2nd monsoon transition (October). Results indicate seasonal stratification within the GOT, governed by halocline during the southwest monsoon and the 2nd monsoon transition, and by thermocline during the 1st monsoon transition. The model captures intricate circulation patterns, revealing multiple clockwise gyres and counterclockwise gyres during monsoon seasons. Noteworthy alongshore currents, such as the southward strong current along Prachuap Khiri Khan province, referred to as the 'Prachuap Coastal Jet,' are observed during the 2nd monsoon transition. Furthermore, the model highlights significant seasonal variations in the interactions between the GOT and the South China Sea (SCS). During the southwest monsoon, low-density water flows out of the gulf at the upper layer, while higher density water enters through the mouth at deeper layers. Conversely, during the northeast monsoon and the 1st monsoon transition, water from the SCS enters the GOT at the eastern side of the mouth, coinciding with the exit of water from the GOT at the western side. The SCS influx area is broader during the 1st monsoon transition compared to the northeast monsoon. The model also indicates that the interactions GOT and SCS vary significantly seasonally. At the southwest monsoon, low density

water flows out of the gulf at the upper layer while higher density water enters through the mouth at the deeper layer. However, water from the SCS enters to the GOT at eastern side of the mouth at the same time water exits from the GOT at western side during the northeast monsoon and the 1st monsoon transition. The SCS influx area is broader during the 1st monsoon transition contrasted with the northeast monsoon. The outcomes underscore that despite its shallow nature and strong tidal mixing, the GOT exhibits robust three-dimensional and seasonal features influenced by salinity and water temperature.

Keywords: Gulf of Thailand, South China Sea, seasonal variation, three-dimensional model, Prachuap Coastal Jet

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18 years of the upper Gulf of Thailand observations: physical and chemical properties

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Abstract

The upper Gulf of Thailand (uGoT), an extension of the South China Sea serving as a marginal sea of the equatorial Pacific Ocean, experiences significant seasonal and interannual forcings, e.g. monsoon winds and the El Niño-Southern Oscillation (ENSO). Moreover, the seawater quality is increasingly affected by eutrophication and dense aquaculture in the area. Despite these dynamics, variabilities of seawater physicochemical properties, particularly on an interannual timescale, have not been previously studied.

The study utilizes data collected from stations along the Chonburi coast, which serves as the eastern boundary of the uGoT, from 2005 to 2022. Among the measured parameters, sea surface temperature (SST), salinity, suspended solids and silicate exhibit pronounced seasonal variations. At interannual timescale, SST, salinity, and suspended solids tend to be low, while pH tends to be high during La Niña events. These deviations generally reverse during El Niño events. Interestingly, SST measurements along the Chonburi coast can explain 42% of Niño3.4 SST, an ENSO indicator, when the Chonburi coast SST leads by one year.

The measurements along Chonburi coast also reveal spatial variation, although the stations only span 26 km. In the northernmost stations, influenced by freshwater runoff and dense aquaculture farming, low dissolved oxygen and pH, along with high nutrient concentrations are present. During the travel restrictions in the 2020–2021 period due to the coronavirus 2019 pandemic, concentrations of total ammonia, nitrite, nitrate, and phosphate are anomalously low, reflecting the impact of eutrophication from the travel and tourism industry on seawater quality.

Over the 2005–2022 period, long-term trends of SST and seawater pH are assessed. The measured SST increases at a rate of 0.06°C per decade, which is lower than the global SST increase of 0.13–0.17°C, although the dataset used here is much shorter than those used for global estimates. Additionally, a period of rapid SST increase of 1.9°C from 2005 to 2012 is observed. Over the 18-year period, seawater pH decreases by 0.12, comparable to the global change in surface pH over the past 70 years; however, the trend could be masked by the presence of low pH at the end of the observations. To obtain a more robust estimate of the long-term SST and pH trends in the uGoT, longer observations are necessary. Nonetheless, the observations reflect seawater warming and acidification in the region that have a negative impact on the local ecosystem; hence, policy plans and actions are necessary.

Keywords: Gulf of Thailand, seawater quality, physicochemical variabilities, acidification, El Niño-Southern Oscillation

Scenarios for water transport from the Tyumen river to marine economic and protected areas based on field measurements, satellite data, ROMS modeling and Lagrangian analysis

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Abstract

The work focuses on identifying and studying the scenarios of water transport of the Tyumen River in the northeastern direction towards the Far Eastern Marine Reserve and areas of mariculture development. This is done through satellite and in-situ measurements, as well as oceanographic modeling using the ROMS model and Lagrangian analysis. The main direction of the Tyumen River flow is to the south. However, analysis of multi-year archival measurements from GOCI-COMS-1 and MODIS-Aqua/Terra satellite radiometers has revealed cases where the flow direction changes towards the north. Additionally, anomalous patches with a diameter of about 10 km and increased concentration of chlorophyll a have been observed in the study area. Analysis of in-situ and model data has demonstrated that these patches are submesoscale eddies with increased levels of colored dissolved organic matter and chlorophyll a, indicating the presence of river water in these eddies. The identified eddies play an important role in transporting water from the Tyumen River in the northeast direction. Furthermore, Lagrangian analysis has been employed to study the trajectories of the main water flow in this direction. It was determined that the main seasons of water transfer of the Tumannaya River in the northeastern direction are spring and fall. At the same time, such cases were practically not observed in the middle of summer. The transport can be carried out both by river plume propagation and by submesoscale eddies.

Keywords: satellite data, water transfer, river plumes, sub-mesoscale eddies, Lagrangian analysis

Observation of upwelling and chlorophyll-a spatio-temporal distribution in relation to physicochemical parameters in the Flores Sea and Pantar Strait, Indonesia

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Abstract

The Flores Sea and Pantar Strait waters are Indonesian deep waters that are passed by the Indonesian Throughflow (ITF), which originates in the Pacific Oceans and flows to the Indian Ocean through Lombok Strait. These water masses have distinct properties thought to impact the mechanisms and processes of marine physics and biogeochemistry in Flores Sea and Pantar Strait waters. This study provides a preliminary result of the Jala Citra 3 Expeditions 2023 in the Flores Sea and Pantar strait for the observation of upwelling and the measurement of chlorophyll-a and physic-chemical parameters as part of their program in Indonesian waters ecology and oceanography. The purpose of this study is to investigate satellite and in situ data observation for chlorophyll-a and physics-chemical parameters in the Flores Sea and Pantar Strait waters. The expeditions were conducted using KRI SPICA 934 in April 2023. The processing of temperature satellite imagery data revealed that upwelling events in April 2023 appear to be weak. Upwelling affects the region's hydrology by lowering temperature and dissolved oxygen while increasing salinity, density, and nitrate-nitrogen concentrations. Temperature, salinity, Total Suspended Solid (TSS), chlorophyll-a, and dissolved oxygen (DO) value distributions all showed spatial heterogeneity. All physico-chemical datasets that underwent cluster analysis produced two unique clusters, demonstrating the existence of two distinct regions that are highly impacted by physico-chemical parameters.

Keywords: Upwelling, Chlorophyll-a, Physic-Chemical Parameters, Flores Sea, Pantar Strait

The decline of the nutrient concentrations in the marginal seas around the Korean peninsula over the past 30 years

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Abstract

We examined the changes in the concentrations of dissolved inorganic nitrogen (DIN) and phosphorous (DIP) in the surface seawater (0–3 m) of the Yellow Sea (YS), the southern sea (SS) of Korea, and the East/Japan Sea (ES) from 1995 to 2021. Each study region was divided into the coastal and remote areas based on the distance (10 km) from the coastline. In general, the DIN concentrations in the marginal seas were an order of magnitude higher than those in the Kuroshio Current (KC), indicating large terrestrial source inputs. The coastal areas adjacent to the Korean Peninsula in the three marginal seas showed a rapid decline in nutrients by up to 50% during 1997–2021, mainly due to decreased terrestrial input from the Korean Peninsula. In the remote YS, DIN concentrations have doubled due to an increased DIN supply from the Changjiang River, while DIP concentrations showed no significant change due to its scavenging near the Changjiang River estuary. In the remote SS, the DIN concentrations increased notably around 2005 and declined afterward, while the DIP concentrations gradually decreased by about 10%. The nutrient trends in the SS seem to be associated with freshwater dynamics and water-column stratification. In the remote ES, the DIN and DIP concentrations decreased by 50%, perhaps due to enhanced stratification. In addition, we further observed a reduction in nutrients in the subsurface (200–500 m) ES by 20%, comparable to those in the subsurface Kuroshio Water. This nutrient decline in the subsurface may be associated with a regional climate regime shift. The large changes in nutrient concentrations in the study region may alter biological production as well as coastal farming activities around the Korean Peninsula.

Keywords: Oligotrophication, Nitrogen, Phosphorus, East China Sea, East/Japan Sea

Isotopic composition of nitrate in the western Pacific Ocean: biogeochemical signals and their transport

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Abstract

The Western Pacific Ocean, which has a complicated circulation system, plays a significant role in regulating the global marine nitrogen cycles and budgets. By using nitrate isotope ($\delta^{15}N\text{-}NO_3^-$ and $\delta^{18}O\text{-}NO_3^-$) techniques, powerful insights can be provided. In this study, nitrate concentrations and $\delta^{15}N\text{-}NO_3^-$ and $\delta^{18}O\text{-}NO_3^-$ values were obtained along meridional (130°E) and zonal (20°N) transects in the Western Pacific Ocean. The $\delta^{15}N\text{-}NO_3^-$ and $\delta^{18}O\text{-}NO_3^-$ values ranged from 2.92 to 10.88‰ and from 1.96 to 5.67‰, respectively. For the water mass originating in the Northern Hemisphere, the relatively low $\delta^{15}N\text{-}NO_3^-$ and high N* in the intermediate water indicated the remineralization of sinking organic matter produced by N_2 fixation at shallow depths, while the simultaneously elevated $\delta^{15}N\text{-}NO_3^-$ and $\delta^{18}O\text{-}NO_3^-$ in thermocline suggested significant assimilation. For the water mass originating in the Southern Hemisphere, remineralization of high-$\delta^{15}N$ particles was observed in both the thermocline and intermediate water, and the thermocline was also potentially influenced by lateral advection. Based on end-member mixing calculations, at least 62% of the nitrate in the water of the North Subsurface Countercurrent was contributed from the Southern Hemisphere, while North Pacific Tropical Water, South Pacific Tropical Water and nutrient-rich upwelling probably accounted for 21.7%, 30.5% and 47.8%, respectively, of the nitrate in the water of the North Equatorial Countercurrent. Furthermore, intensive N_2 fixation introduced lower $\delta^{15}N$ into the thermocline from the North Equatorial Current to the Kuroshio Current, while this biogeochemical process was not obvious in the intermediate water. These results filled in gaps in the nitrate transport and biogeochemical process in the Western Pacific Ocean, providing important details for establishing the global nitrogen cycle model.

Keywords: Western Pacific Ocean, nitrate isotopes, nitrogen fixation, remineralization, nitrate sources quantification

Lateral transport of dissolved inorganic carbon in a mangrove-creek-estuary system: implications for ocean acidification

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Abstract

Mangroves are highly efficient carbon sinks that play a critical role in global carbon cycling, but the lateral transport of carbon from mangroves to the coastal ocean through surface water and groundwater is not well understood. This study aimed to investigate the variations and fluxes of dissolved inorganic carbon (DIC) across a mangrove-creek-estuary continuum in southeast China (Zhangjiang) through four seasonal cruises. Our findings revealed a strong positive correlation between DIC and radium, a natural tracer of submarine groundwater discharge (SGD), which followed tidal variations. Groundwater export of DIC from the mangrove to the creek was found to be a major contributor (56–89%) to the total DIC input, with tidal amplitude being the dominant factor in seasonal variations of DIC flux. Lateral transport of DIC from the creek to the estuary was significant, accounting for half of the Zhangjiang mangrove net ecosystem exchange of carbon dioxide, equivalent to the global mangrove missing carbon sink. Both water flux and DIC concentrations modulated the lateral transport of DIC from the creek to the coastal ocean. Contrary to previous studies, SGD in the Zhangjiang mangrove estuary was found to reduce pH values, potentially worsening coastal ocean acidification. These findings suggest that mangrove-derived DIC outwelling represents an important additional carbon sink beyond carbon burial and could play a significant role in the carbon budget of coastal areas.

Keywords: mangroves, dissolved inorganic carbon, submarine groundwater discharge, lateral transport, ocean acidification

Detecting terrestrial organic carbon contribution to the shelf sea dissolved organic matter using deuterium stable isotope signatures

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Abstract

Examining the context of coastal biogeochemical cycles, this study explores the applicability of deuterium stable isotope (δ^2H_n) as an alternative to carbon stable isotope ($\delta^{13}C_{DOC}$) in quantifying terrigenous dissolved organic carbon (tDOC). Conducted in Southeast Asia's Sunda Shelf Sea, the study establishes a robust correlation (r2 = 0.42) between δ^2H_n and $\delta^{13}C_{DOC}$, revealing the terrigenous fraction of DOC over a year-long monthly time series. Notably, δ^2H_n demonstrates stronger associations with salinity and chromophoric dissolved organic matter (CDOM) optical properties than $\delta^{13}C_{DOC}$. Considering the key role of Dissolved Organic Carbon (DOC) in coastal biogeochemical cycles, the research suggests that δ^2H_n offers an effective solution to the limitations of $\delta^{13}C_{DOC}$, providing enhanced sensitivity in quantifying tDOC across coastal gradients. This work emphasizes the potential of δ^2H_n as a valuable tool for comprehending the dynamics of terrigenous organic carbon in complex coastal marine ecosystems.

Keywords: terrigenous dissolved organic carbon, Sunda Shelf Sea, deuterium, marine biogeochemistry, carbon cycle

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Determination of copper (II)-binding ligands in tropical coastal area

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Abstract

Seawater samples were collected during pre and post Northeast monsoon season along the East coast of Peninsular Malaysia in this study. The concentration of copper (II)-binding organic ligands (CuL) and conditional stability constants (log K) were determined by using competitive ligand exchange-adsorptive cathodic stripping voltammetry. This method involves titrating the natural organic ligands in the sample with added Cu (II) standard and added ligands, salicylaldoxime (SA) to compete with the natural organic ligands (L´). The concentration and classes of the organic ligand that can form complexes with Cu (II) were identified by using the log K through Van den Berg linearization. It is found that the strong complexing ligands in the sample with log K>12. This study provides an insight of the condition of the bioavailability of dissolved copper in the coastal area. This study could highlight the role of the organic ligands in the coastal water which could contribute to the bioavailable and toxicity to the organism.

Keywords: Copper speciation, organic ligands complex, dissolved copper, competitive ligand exchange-adsorptive cathodic stripping voltammetry

Harnessing earth observations for assessing optical water quality in Asian coastal oceans

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Abstract

Due to the high population density and human activities in the coastal zones, coupled with vulnerability to climate change, Asian coastal oceans face significant environmental pressure. Eutrophication and red tide are among the challenges causing harm to marine ecosystems and fisheries resources, consequently leading to socioeconomic impacts. To support mitigation and adaptation efforts, a satellite-based Earth observation providing information relevant to water quality over a large spatial scale in near-real-time is highly demanded. Optically, coastal oceans can be categorized into three main water types dominated by suspended sediment, colored dissolved organic matter, and phytoplankton biomass, as they are in-water substances, due to their absorption and backscattering properties, determining the color of coastal waters. Waters dominated by phytoplankton may experience normal seasonal blooms or abnormal red tide outbreaks, causing water column hypoxia and other detrimental effects to life below the waters. Eutrophication and red tide commonly occur in coastal regions and small embayments. Therefore, satellite observation with finer spatial resolution is essential for their observation and monitoring. This study utilized ocean color observation data from the Japanese GCOM-C/SGLI, providing data with a 250-m resolution suitable for coastal water observation and monitoring. The SGLI-retrieved remote sensing reflectance spectral shapes and a Quasi-Analytical Algorithm (QAA)-based inherent optical properties were inspected to classify coastal waters based on the mentioned optical water quality. The potential use of Earth observation for red tide detection will also be demonstrated.

Keywords: ocean color, remote sensing, optical properties, phytoplankton, water quality

Projecting physical-biogeochemistry changes (1990–2060) in the South China Sea under RCP8.5 climate change scenario

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Abstract

South China Sea (SCS) is a semi-enclosed water body located in the Southeast Asia regions. SCS was susceptible to climate change with previous studies had shown increasing trends of SST in the region. In this study, our aim was to explore the changes of temperature, salinity and biogeochemistry components induced by climate change. Forecast model, NEMO-ERSEM, simulated under RCP8.5 scenario is used to study the changes of physical-biogeochemistry in the SCS from year 1990 to 2060. Data were extracted and analyzed for winter monsoon (DJF) and summer monsoon (JJA) seasons at three upwelling areas; western SCS (near Vietnam), eastern SCS (near Borneo) and southern SCS (near Peninsular Malaysia). The anomalies showed that the sea surface temperature (SST) had an increasing decadal trend (6.9% during summer monsoon and 7.1% during winter monsoon). Meanwhile, sea surface salinity (SSS) anomalies showed declining trends (-0.8% during both seasons). During summer monsoon, surface oxygen concentration decreased (-2.6%). Similar trends were observed in the diatom nitrogen (-8.6%), microphytoplankton concentration (-8.6%) and microzooplankton concentration (-8.4%). Nitrate (11%) and ammonium (7.6) concentration are predicted to be increased by the end of 2060. The trends are varied during winter monsoon where surface oxygen is expected to be decreased (-2.3%). Diatom nitrogen, nitrate, ammonium and microphytoplankton concentration are predicted to increase by 5.1%, 29%, 6.4% and 4.5% respectively. Microzooplankton showed negative percentage anomalies (-11.3%) by the end of 2060 during winter monsoon. On the discussion for upwelling regions, eastern SCS had different anomalies distribution than the western and southern SCS because upwelling in eastern SCS occurred during winter monsoon and upwelling in western and southern SCS occurred during summer monsoon. Despite variability in the seasons, the decadal trends showed most of the changes in the physical and biogeochemistry components will have significant changes by 2060 and mostly occurred after the 2020–2029 periods.

Keywords: Biogeochemistry; South China Sea; NEMO-ERSEM; Climate Change; RCP8.5 scenario

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Control factors of nutrient concentration and material cycle in the eastern part of Seto Inland Sea Japan

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Abstract

Seto Inland Sea (SIS) is a semi-enclosed coastal sea in Japan connected to the Pacific Ocean. SIS was in a severe eutrophic condition in 1960's and 1970's and is in an oligotrophic condition at the moment due to reduction of nutrient load from land. In order to attain a suitable nutrient condition, we have to understand nutrient and material cycles in the SIS. Especially, nutrient condition in the eastern part of the SIS (ESIS) might be controlled by nutrient load from land because large cities like Osaka and Kobe are facing the SIS and several rivers supply nutrients into the SIS. We developed a physical-ecosystem coupled model to understand material cycle related to lower trophic ecosystem in the ESIS and then calculated contributions to dissolved inorganic nitrogen (DIN) in the ESIS from major nutrient source, namely, land (rivers), bottom sediment, and the Pacific Ocean using a tracking technique for ecosystem variables. In addition, we revealed the contribution ratio of nutrient load from each river to DIN in the ESIS. The numerical model well reproduced temporal and spatial variations in observed DIN and chlorophyll-a concentrations. Dominant nutrient source was land (rivers) in Osaka Bay but bottom sediment in Harima-Nada. In Harima-Nada, although several rivers supply nutrients there, the highest contribution to DIN concentration was Yodo River which does not directly supply freshwater and nutrients there. We carried out sensitive analysis to know ecosystem response related to nutrient concentration change. When nutrient load from all rivers in the model domain are increased, response of phytoplankton both Osaka Bay and Harima-Nada was different; phytoplankton increased with nutrient load increase in Osaka Bay and no response of phytoplankton in Harima-Nada. In Harima-Nada, we found that total chlorophyll-a concentration was not so much changed with increase of nutrient load from rivers but composition of phytoplankton was changed; large size of phytoplankton increased and middle and small size phytoplankton decreased.

Keywords: Nutrient cycle, Seto Inland Sea, Ecosystem model

Impacts of tropical cyclone Seroja on the phytoplankton chlorophyll-a and sea surface temperature in the Savu Sea, Indonesia

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Abstract

Tropical cyclone (TC) Seroja was a rare climatic event in the Indonesian Seas, particularly in the Savu Sea. This unprecedented event, which occurred on April 4, 2021, caused fatalities and severe damage to the region's infrastructure and economy. High spatio-temporal resolution satellite measurements of surface winds (Cross-Calibrated Multi-Platform), surface chlorophyll-a (Himawari-8), and sea surface temperature (SST; RSS OISST) are used to disentangle the impact of extreme wind speed (>10 $m \cdot s^{-1}$) on chlorophyll-a and SST. High wind speed associated with TC Seroja induced strong upwelling and vertical mixing in the Savu Sea, which led to phytoplankton blooms and SST depression. An abrupt change of daily variability and positive anomaly in phytoplankton chlorophyll-a concentrations reaches 13 $mg \cdot m^{-3}$ and 0.3 $mg \cdot m^{-3}$, respectively. At the same time, the SST shows significant cooling up to 3 °C. Our results provide novel insights on the exceptional occurrence of a TC within the Indonesian Seas and highlight its impact on chlorophyll-a and SST.

Keywords: Tropical cyclone Seroja, Ekman pumping velocity, chlorophyll-a, sea surface temperature, Savu Sea

Noctiluca red tide and hypoxia in the upper Gulf of Thailand in 2023

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Abstract

Noctiluca red tide in the northeast of the upper Gulf of Thailand during the southwest monsoon in 2023 was very severe compared to previous records. This dark-green algal bloom lasted for a long period for several months and extended over a very wide area that has never been seen before. The mass die-off of coastal marine life was a critical effect that occurred when dissolved oxygen was consumed by the decomposition of dead plankton cells. This impact included the loss of cultured shellfish in the blooming area. Satellite data show the evidence of strong phytoplankton bloom that is connected to river discharge, monsoonal wind and current. The blooming areas were initiated offshore by surface current convergence off the river mouths and then transported to the east coast of the upper gulf where strong blooms were observed. Landward winds result in intense and long-lasting blooms. Field observations in the upper gulf reveal the development of hypoxia in near-bottom water in a very wide area in early October 2023, the transition period from the southwest to the northeast monsoon. This evidence may be related to the strong green Noctiluca bloom that happened earlier during the southwest monsoon, a few months earlier. It is also related to strong water column stratification from freshwater discharge from large rivers in the same period. We observed millions of *Noctiluca* cells during the cruise in August 2023, but hypoxia did not develop because of water column well-mixing. The mechanism of interannual variations is still unknown, and the impact of climate change is unclear. This requires a long-time monitoring system and an ecosystem prediction model that can be used not only for the investigation of this eutrophic mechanism but also for red tide and hypoxia warning to minimize the resulting severe impact at the same time.

Keywords: red tide, hypoxia, *Noctiluca*, seasonal variations, Gulf of Thailand

Temporal variability of phytoplankton community structure in relation to marine environmental dynamics in temperate coastal waters

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Abstract

Phytoplankton form the foundation of the aquatic food web and are the primary driver of biogeochemical processes including the export of carbon to the deep ocean. During the last decades, sea surface temperature (SST) has been experiencing warming under climate change scenarios, and phytoplankton communities are predicted to change accordingly. Therefore, in the context of global climate change, knowledge of the distributions, compositions, and biomass of phytoplankton communities are crucial to understand biogeochemical cycles. Previous studies have emphasized the importance of focusing on regional-scale studies due to the contrasting warming rates between global and regional levels. Sagami Bay is a temperate coastal area located on the southern coast of central Japan, and faces the northwestern Pacific Ocean. The open bay has been well studied from oceanographical viewpoints, and can be regarded as the most stable ground for fishery production in Japan. Thus, in order to maintain the fishery ground, it is important to understand the contribution of different phytoplankton groups to primary consumers and biogeochemical cycles. The purpose of this study is to clarify temporal variability of the phytoplankton community structure in relation to marine environmental dynamics (temperature, salinity, nutrients, etc.) in the temperate coastal waters. The specific objectives are (1) to characterize the regional phytoplankton biomass and communities which co-vary with environmental factors (*in situ*), (2) to evaluate the spatial and temporal variability of regional water masses (remote sensing), and (3) to assess the impact of climatological indices (Kuroshio intrusion, El Niño Southern Oscillation, Pacific Decadal Oscillation, etc.) on regional phytoplankton communities and environmental factors. The *in situ* observations were carried out at Station M (35° 09’ 45” N, 139° 10’ 00” E) in Sagami Bay from 1995 to 2023, and remote sensing data from 2002 to 2023 were also evaluated by MODIS-Aqua. Preliminary results show a significant warming trend ($P < 0.001$) of SST, increasing 1.32℃ during 20 years. Further, the median value of the haptophyte’s signature pigment (19’-hexanoyloxyfucoxanthin) increased from 2017 to

2020. The results suggest that temporal SST variability affects phytoplankton community biomass. Our investigation will reveal that other environmental factors, such as euphotic depth, salinity and nutrients, also vary temporally with climatological indices under global climate change, which drive phytoplankton community succession.

Keywords: climate change, temporal trend, *in situ* observations, remote sensing, Sagami Bay

Spatial heterogeneity of seasonal phytoplankton blooms in the Yellow Sea: physical drivers and biological responses

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Abstract

Seasonal phytoplankton blooms and associated biological-physical drivers have been studied in various marine systems throughout the world. In the present study, satellite and in situ observations are used to examine spatial heterogeneity in the timing and magnitude of phytoplankton blooms in relation to local and remote physical processes in the Yellow Sea (YS), a marginal sea in the northwestern Pacific Ocean. Satellite ocean color data reveal that annual chlorophyll maximums vary significantly in both timing and magnitude over different subregions of the YS. Strong summer blooms were found off estuary regions, and widespread spring blooms were found in the central trough. Localized autumn and winter peaks were found in small patches around Jeju Island and in nearshore regions. A statistical analysis of *in situ* measurements of the western YS suggests that variability in hydrographic properties could explain most of the spatial heterogeneity observed in both bloom timing and magnitude. The spatial heterogeneity of hydrographic properties, such as thermal or haline stratification and nutrient availability, are controlled by a suite of physical forcings, including the extent of the YS Cold Water Mass, river discharge, warm slope water intrusion, and seasonal warming/cooling. Our results imply that the spatial heterogeneity of marginal seas must be carefully considered when assessing phytoplankton responses in the context of climate change, due to the uncertainty and complexity of underlying mechanisms.

Keywords: phytoplankton blooms, spatial heterogeneity, physical processes, Yellow Sea

Increasing dolphins appearances during extreme upwelling events: a potential marine wildlife tourism in Alor Kecil, Alor Island, Indonesia

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Abstract

The seas of Alor Kecil Village, Alor Island, Indonesia is as an area with the occurrence of Extreme Upwelling Event (EUE) as denoted by the extreme and sudden drop of sea surface temperature (SST) to less than 15°C. The EUE occurs in August to November, twice a day and lasts for 1 to 4 days with the duration only about an hour. This unique oceanographic phenomenon becomes the only one in the world since cannot be found in other tropical seas. The dramatic temperature drop during EUE makes the small fishes unconscious and then attracts dolphins to come and feed. This is the first study that quantifies the dolphin appearance during EUE using daytime CCTV observation. Full month observation was conducted in May and September 2022 which represent the month with and without EUE. In May 2022, the minimum SST is only 21.47°C on 19 May 2022. The total appearance of dolphin in May 2022 is 54 appearances. In September 2022, the minimum SST of 17.34°C occurs on 13 September 2022. The total dolphin appearance increases into 82 appearances. Furthermore, we focus the observation on the EUE period on 2–4 September 2023 and 30 September–2 October 2023 which has much lower SST than September 2022. The SST drops in September and October 2023 reach ~12°C. The dolphin appearance on 2–4 September 2023 and 30 September–2 October 2023 are 105 and 90 appearances, respectively, which occurs mostly within one hour during the peak of EUE. The frequent dolphin appearances during EUE is potential to be developed as a marine wildlife tourism, since people can watch dolphin attraction only from the seashore along the Alor Kecil Village.

Keywords: extreme temperature drop, dolphin appearance, Alor Island, CCTV

A review of impacts of reclamation activities on water quality - towards environmental impact assessment strategy for Manila Bay

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Abstract

As the global population is expected to rise in the coming years, the demand for housing and land needs will continue to increase, and reclamation activities in coastal wetlands to meet this demand are becoming more common. In highly developed countries, land reclamation is being recognized as one of the popular urban planning strategies for boosting their economy and expanding their tourism industries. It helps address growing population problems by creating more urban spaces and providing better job opportunities. Reclamation creates new land mass and alters the topography of coastal areas. During reclamation, sediments are transported to new locations through dredging activities which may induce turbidity, increase in total suspended solids (TSS), increase in nutrient concentration, and decrease photosynthetically active radiation (PAR). Through time, reclamation activities may heavily influence the geological state, ocean dynamics, nutrient distribution, and biogeochemical patterns that naturally exist near the reclaimed sites. This study will present a comparison of reported reclamation activities done in different regions of the world, their extent of coverage, typical sediment material used, and reported direct implications on water quality and indirect implications on biological organisms, among others. Environmental conditions such as dissolved oxygen content and pH of seawater and other factors will be taken into consideration when assessing the impacts of reclamation activities on the water quality of Manila Bay, a tropical estuarine embayment that serves as a drainage area of surrounding sub-watersheds. Based on the synthesis of available information, a framework will be created as a strategy to best approach the assessment of water quality impacts of reclamation in Manila Bay. This could serve as inputs for models that can address the long-term effects of reclamation in the area.

Keywords: Reclamation, environmental impact assessment, water quality

Reproductive strategies among the Paracalanidae copepods in Sagami Bay, Japan and Sepanggar Bay, Malaysia

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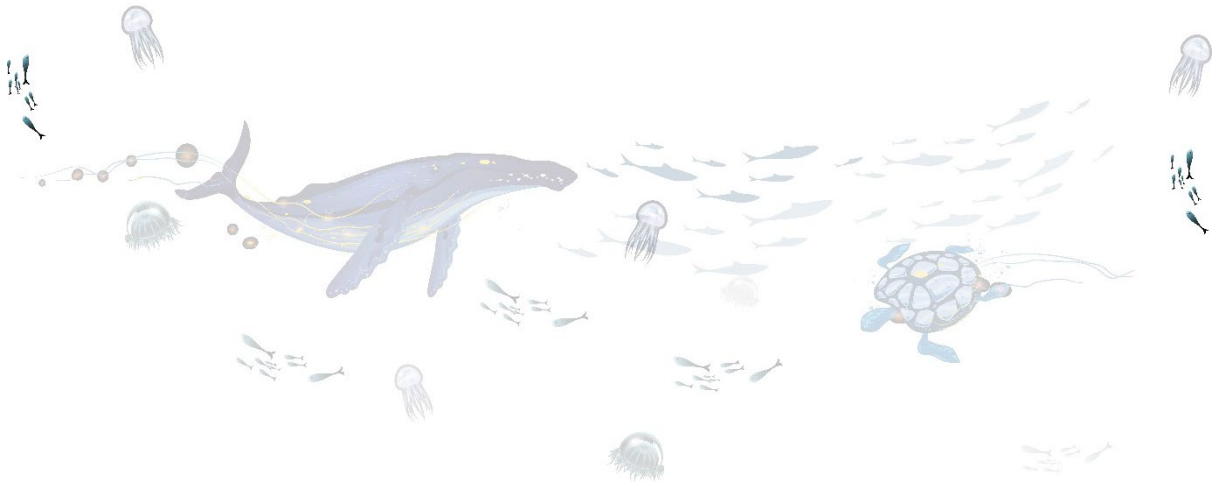
Abstract

The egg production rate (EPR) and reproductive strategies of the marine planktonic copepods are essential to understanding their population dynamics. The Paracalanidae copepods are one of the essential food items for many fishes, including commercially important species, because they are a dominant group in the zooplankton community of coastal waters worldwide. In the temperate coastal water of Sagami Bay, Japan, although several sub- and tropical paracalanids appear seasonally, *Paracalanus orientalis* exhibits high population density regardless of seasons. The objective of this study is to reveal differences in reproductive strategies of the Paracalanidae species collected between temperate and tropical coastal waters. We collected plankton samples at St. M in Sagami Bay, Japan, and St. 5 in Sepanggar Bay, Malaysia. The depths of St. M and St. 5 are 120 m and ca. 30m, respectively. The two genera, *Paracalanus* and *Acrocalanus*, were collected using a plankton net with a diameter of 30 cm and a mesh size of 30 μm, towed vertically from a depth of 30 m to the sea surface. Vertical profiles of water temperature, salinity, and Chl *a* were recorded using sensors. Each adult female was incubated for 24 hours under a light cycle (12L:12D) with in situ water temperatures. Eggs were checked and counted at 18:00, 6:00 (local time), and at the end of the experiments to measure clutch sizes and numbers of clutches. Additionally, the prosome length (PL) of adult females and egg diameter (ED) were measured to convert their carbon contents. In Sagami Bay, the species with high EPR spawned regardless of the day-night cycle. Among the higher EPR species, the *Acrocalanus* spp. and *P. orientalis* had shorter clutch intervals. On the other hand, lower EPR species in Sagami Bay and the species collected in Sepanggar Bay mainly released their eggs during the night with relatively longer clutch intervals. Among these species, *P. aculeatus major* showed the largest clutch size, while its clutch intervals were longer. Considering the higher carbon investment per egg in *P. gracilis*, this species was considered a K-strategists.

Keywords: Egg production, clutch size, clutch interval, daily cycle, r/K reproductive strategies

Sub-theme A:
Ocean Processes and Climate Change

Session A3:
Advance the understanding
of marine heatwaves and their impacts



Programme

Venue: Chelsea B, 5th Floor
Date: 22 April 2024

Conveners:

Liying Wan	National Marine Environmental Forecasting Center, China
Toru Miyama	Application Laboratory, JAMSTEC, Japan
Fei Zheng	Institute of Atmospheric Physics, Chinese Academy of Sciences, China

Time	Presentation Titles	Speakers
Section 1		
13:30–13:45	Significant impact of ocean current variability on marine heatwaves around Japan	Toru Miyama, *JAMSTEC, Japan*
13:45–14:00	Progress on the evolutionary characteristics and climatic causes of warming and marine heatwaves in the coastal China Seas	Rongshuo Cai, *Third Institute of Oceanography, China*
14:00–14:15	On the calculation of solar radiation at the bottom of mixed layer in the global ocean based on ocean color satellites	Zhongping Lee, *Xiamen University, China*
14:15–14:30	Evaluation of marine heatwaves in the North Pacific Ocean simulated by CMIP6 models: a clustering-based approach	Wonkeun Choi, *Korea Institute of Ocean Science and Technology, Republic of Korea*
14:30–14:45	Marine heatwave during the El Niño Southern Oscillation based on satellite derived in the Banda Sea	Choerunnisa Febriani, *Universitas Padjadjaran, Indonesia*
14:45–15:00	**Discussion**	
Section 2		
15:15–15:30	Upper ocean stratification preconditions Marine Heat Wave (MHW) events in marginal seas	Dong Eun Lee, *Chungnam National University, Republic of Korea*
15:30–15:45	Prolonged marine heatwaves in the East Korea Bay in the East Sea: characteristics and mechanisms	Chan Joo Jang, *Korea Institute of Ocean Science and Technology, Republic of Korea*
15:45–16:00	Understanding marine heatwaves in the Bay of Bengal: progresses and future endeavors	Yun Qiu, *Third Institute of Oceanography, China*
16:00–16:15	Comparative analysis of Marine Heatwave (MHW) and Degree Heating Week (DHW) and its applicability to Philippine Seas	Rachel Francisco, *University of the Philippines, The Philippines*
16:15–16:30	Seasonal trends in marine heatwaves and its impacts on coral reef connectivity	Yi Guan, *Guangdong Ocean University, China*

Time	Presentation Titles	Speakers
16:30–16:45	Analysis of marine heatwaves in China's coastal seas and adjacent offshore waters	Liying Wan, *National Marine Environmental Forecasting Center, China*
16:45–17:00	**Discussion**	

Significant impact of ocean current variability on marine heatwaves around Japan

Toru Miyama, Yasumasa Miyazawa, and Hakase Hayashida

Japan Agency for Marine-Earth Science and Technology, Japan

Abstract

Marine heatwaves have been progressively intensifying and escalating around Japan in recent years, in a manner analogous to other regions of the world. A noteworthy characteristic of this region is the significant influence of the western boundary current system of the North Pacific, including the Kuroshio, Oyashio, and Tsushima Warm Currents, which play a crucial role in the occurrence of marine heatwaves. To gain a comprehensive understanding of the ocean heatwaves in this region, we have developed the dataset of marine heatwaves and cold spells around Japan using the JCOPE2M ocean reanalysis system, created by the Application Laboratory of the Japan Agency for Marine-Earth Science and Technology. In recent years, there has been a considerable increase in the frequency and intensity of marine heatwaves in this dataset, both at the surface and in the subsurface layer, particularly since around 2015. Marine heatwaves increased, particularly at the thermocline depth, which was affected by ocean currents. It is worth noting that marine heatwaves at the surface have been considerably influenced by El Niño and tend to intensify towards the end of an El Niño event. In the Oyashio region, marine heatwaves have been on the rise since 2010, attributed to the warm-water eddy emanating from the Kuroshio Extension. Along the southern coast of Japan, marine heatwaves have seen a surge due to the Kuroshio large meander that began in 2017. Offshore, the Kuroshio meander has been causing intense marine cold spells. The Sea of Japan has been experiencing a warming trend in recent years, and the augmentation of the Tsushima Warm Current has contributed significantly to this warming.

Keywords: marine heatwaves, Kuroshio large meander, Oyashio, Japan Sea, Tsushima Warm Current

Progress on the evolutionary characteristics and climatic causes of warming and marine heatwaves in the coastal China Seas

Rongshuo Cai and Hongjian Tan

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Abstract

Robust warming and frequent extremely high sea temperature events (marine heatwaves, MHWs) have been observed in the coastal China seas (CCS) over the past decades, causing a series of ecological disasters, including mass mortality of marine organisms and outbreaks of harmful algal blooms. This study presents a comprehensive review of the research progress involving the warming and MHWs in the CCS, including the characteristics and causes of long-term warming trend and MHWs. Under the combined influences of the East Asian monsoon and Kuroshio, the sea surface temperature (SST) in the CCS, especially in the East China Sea (Bohai, Yellow and East China Seas, hereafter ECS), has shown an enhanced response to global warming, with annual mean increases of 1.02±0.19°C and 1.45±0.32°C during the period of 1960–2022, respectively, with significant inter-decadal and inter-annual variability. In addition to the influence of large-scale air sea interaction such as ENSO and PDO, SST changes are also directly affected and jointly affected by the East Asian Monsoon changes and the Kuroshio meridional transport. Since 1982, the MHWs in the CCS has obviously increased in frequency, intensity, and duration, and are projected to be likely further increase in the future. Among them, the frequency of MHWs in the ECS and SCS is 20 times and 4 times higher than that in the 1980s, respectively, and there are high correlations between them and the negative Indian Ocean Dipole and the El Niño. Frequent extreme MHWs have caused devastating disasters to some marine ecosystems such as coral reefs and aquaculture. There is an urgent need for in-depth research on the physical processes and predictability of marine heatwaves, as well as the forecasting and early warning systems.

Keywords: the coastal China seas, warming, marine heatwaves, IOD

On the calculation of solar radiation at the bottom of mixed layer in the global ocean based on ocean color satellites

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Abstract

Solar radiation is the fundamental energy source of the earth systems, especially the visible part of solar radiation (Evis) that can reach as deep as ~300 m into the ocean to heat up waters beneath the mixed layer, subsequently affecting ocean circulations as well as the atmosphere. To adequately quantify the penetration, or vertical distribution, of Evis in the global ocean, it is required to use products obtained from satellite ocean-color remote sensing, and traditionally this is based on the empirically estimated chlorophyll concentration (Chl). Because of the inherent biological nature of Chl, it is associated with large uncertainties when Chl is converted to the attenuation coefficient of Evis, consequently the estimated Evis at the bottom of the mixed layer is of large errors. A more robust approach is to quantify the vertical distribution of Evis based on waters' inherent optical properties, along with a model following radiative transfer. In this report, a comparison of the two approaches in obtaining Evis at the bottom of the mixed layer over the global ocean is presented, where large differences in Evis at the bottom of the mixed layer are evident. We strongly advocate the utilization of physics-based models/systems for the calculation of Evis in the upper water column.

Keywords: Solar radiation, upper water column, chlorophyll concentration, inherent optical properties

Session A3: Advance the understanding of marine heatwaves and their impacts

Evaluation of marine heatwaves in the North Pacific Ocean simulated by CMIP6 models: a clustering-based approach

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Abstract

Climate models are the primary tool for projecting marine heatwaves (MHWs). Before projecting future changes in MHW, the simulation performance of the climate model should be evaluated to understand the impact of model bias on the interpretation of future changes. Previous studies have mainly focused on evaluating the common bias simulated by multi-model ensembles of climate models. However, when evaluating individual models, there are some groups with similar bias patterns, and clustering them can provide more diverse representative biases than the common bias. In this study, we aimed to evaluate the MHW characteristics (total days, frequency, and mean intensity) in historical simulations from 30 Coupled Model Project Intercomparison Phase 6 (CMIP6) models in the North Pacific Ocean (NPO) compared to OISST reanalysis data for 33 years (1982–2014), and to cluster CMIP6 models with similar bias patterns in order to understand the representative bias. The 30 CMIP6 models were clustered into five groups using hierarchical clustering based on similar MHW bias patterns. For total MHW days, each group showed a spatial distribution of overestimation similar to the Pacific decadal oscillation pattern, and a spatial distribution of overestimation, concentrated in the Kuroshio Extension, the southwestern North Pacific and the Bering Sea, respectively. In the mean MHW intensity bias, over 80% of the CMIP6 model showed a dipole pattern in the Kuroshio extension. This dipole pattern is likely caused by the simulation of the Kuroshio Current flowing further north in the CMIP6. To identify whether the climate model simulated the Kuroshio Current to flow further north than observed, the performance of the ocean current simulation was evaluated using the same model for each of the clusters. The same clusters that showed a dipole pattern in the mean MHW intensity also showed a more northerly simulation of the Kuroshio Current compared to observations. This study suggests that clustering is necessary to identify the representative bias of climate models and to understand the characteristics of the climate models used before projecting future marine heatwaves.

Keywords: hierarchical clustering, extreme climate, ocean dynamics, atmospheric forcing, Kuroshio overshooting.

Session A3: Advance the understanding of marine heatwaves and their impacts

Variations of surface marine heatwaves in the Northwest Pacific

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Abstract

Parameters of surface marine heatwaves (MHWs) in the Northwest Pacific (NWP) during 1993–2019 are derived from sea surface temperature (SST) based on satellite remote sensing and a data-assimilative global ocean reanalysis product (i.e., OISST V2.1 and GLORYS12V1). Analysis of the two SST datasets obtains similar spatial distributions of the mean annual MHW total days, frequency, duration, mean intensity and cumulative intensity, and interannual variations of these parameters. The MHW total days and duration from GLORYS are usually higher than that from OISST. According to GLORYS, the larger than 7 MHW total days are found over the largest area of both the shelf and deep waters in summer, while over the smallest area in spring. In selected representative regions, interannual variations of the MHW total days are positively correlated with the SST anomalies. In summer, the MHW total days have positive correlations with the Western Pacific Subtropical High (WPSH) intensity, and negative correlations with the East Asia Monsoon (EAM) intensity, over nearly the whole South China Sea (SCS) and in low-latitude NWP. In winter, positive correlations with both the WPSH and EAM intensities present over the western part of SCS.

Keywords: surface marine heatwaves, seasonal-mean statistics, inter-annual variation, correlation with atmosphere-ocean indices

Marine heatwave during the El Niño Southern Oscillation based on satellite derived in the Banda Sea

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Abstract

The Banda Sea holds significant potential in the field of fisheries and is one of the largest fishing grounds in Indonesia, with a total catch potential of 4,669,030 tons per year. However, the escalating anthropogenic global warming over the past few decades has led to the occurrence of Marine Heatwaves (MHWs), posing a threat to the ecosystem. This research aims to analyze the categories, characteristics, and trends of MHWs in the Banda Sea during the El Niño Southern Oscillation (ENSO) phases. The study utilizes descriptive statistical methods, including the calculation of averages, percentiles to determine MHWs characteristics, and linear regression methods to identify trends. The average characteristics of MHWs in the Banda Sea waters are found to be a frequency of 2.3 events per year, a maximum intensity of 1.4°C per year, and a duration of 9.3 days. The average frequency of MHWs shows a positive linear trend ranging from 0.03 to 0.2 events per year, the range of linear trends for maximum intensity varies between -0.03 to 0.03°C per year, and the duration of MHWs indicates a predominantly positive linear trend ranging from -0.3 to 0.7 days per year. Almost all of them show an increase or a positive trend. In the years 1997 and 2015, during El Niño events, the average frequency was 0.5 events per year, maximum intensity was 1.3°C, and average duration was 7 days. In La Niña events, specifically 1998 and 2015, the average values were high, with a frequency of 8 events per year, maximum intensity of 1.5°C, and duration of 15 days. This is attributed to the influence of ENSO, where temperatures decrease during the positive phase (El Niño) and increase during the negative phase (La Niña).

Keywords: Nino Index, global warming, Indonesian seas, sea surface temperature anomalies, Indonesian throughflow

Upper ocean stratification preconditions Marine Heat Wave (MHW) events in marginal seas

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[2] Korea Institute of Ocean Science and Technology, Busan, Republic of Korea

Abstract

The major events since 1982 in the marginal sea area west and south of the Korean Peninsula have been led by abnormally strong stratification in the vicinity, which was detected at least two months in advance. This robust coincidence provides substantial control over mid-summer events through local stratification in early summer. Such heatwave-leading stratification can be attributed to various oceanic factors during early summers, including anomalous sea surface temperature, freshwater flux, and wind mixing. Knockout-style experiments using a 1-dimensional ocean model revealed that the upper ocean stratification in the preceding months, mostly through wind mixing, is capable of regulating MHWs. Meanwhile, in the longer historical records, gradual decreases in the intensity and frequency of the daily wind gusts were found, possibly as a mixed result of anthropogenically induced climate change and strong natural variability of the midlatitudes. This might have dominated in enhancing the occurrence of MHWs, combined with the rising background surface temperature.

Keywords: Marine Heatwave, Vertical Stratification

Causes of 2022 summer marine heatwave in the East China Seas

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Abstract

Recent occurrences of marine heatwaves (MHWs) in coastal China seas have caused serious impacts on marine ecosystem services and socio-economics. Nevertheless, the underlying physical process, including local drivers and remote associations, remains poorly understood, thereby hindering accurate predictability. In this study, we reported an extreme MHW event in the East China Seas (ECSs, including the Bohai, Yellow, and East China Sea), lasting for 75 d with a maximum intensity of 1.96°C above climatology (1982–2011) during the summer 2022. This ECSs MHW event was triggered by a combination of anomalous atmospheric and oceanic conditions, including enhanced insolation, weakened surface wind speed, suppressed latent heat loss from ocean, a shallower mixed layer, and upper ocean current anomaly. Mixed-layer temperature budget diagnosis suggested that changes in the ECSs temperature were dominated by the surface net heat flux, largely due to strong shortwave radiation flux, during the development and decay of the MHW event. Oceanic advection also created favorable conditions for the maintenance of the MHW. These physical drivers were further regulated by the westward expanded and intensified western Pacific subtropical high (WPSH), potentially linked to the negative phase of Indian Ocean Dipole (IOD). Despite the three years (2020–2022) consecutive La Niña events, the ECSs summer MHWs appeared to be more closely linked to negative IOD events, with a lagging period of 1–3 months. The seasonal precursor signals of the negative IOD have the potential to affect local physical drivers of ECSs MHWs through regulating the strength and position of WPSH, thus serving as a promising predictor for the ECSs MHWs. The future likelihood and intensity of the ECSs MHWs are projected to increase substantially in the coming decades, largely due to broad-scale warming attributed to anthropogenic climate change. Consequently, there is an urgent need to develop MHW forecasting and early warning systems, and robust approaches to mitigation and adaptation.

Keywords: Marine heatwaves, East China Seas, Indian Ocean Dipole, Western Pacific subtropical high

Prolonged marine heatwaves in the East Korea Bay in the East Sea: characteristics and mechanisms

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Abstract

Marine heatwaves (MHWs)—prolonged extremely high ocean temperature events—have become more intense, frequent, and longer in recent years, destructively impacting marine ecosystems and subsequent socio-economic consequences. The East Korea Bay (EKB) in the northwestern East/Japan Sea (EJS) has experienced 32% longer MHWs (16.8±24.0 days/event) compared to those of the whole EJS (12.6±11.5 days/event), especially with two extremely long-lasting MHWs of more than three months (161 and 126 days). In this study, we investigate the distinct characteristics of the long-lasting MHWs in the EKB for 37 years (1982–2018) and their possible physical mechanism using satellite and reanalysis products. During the long-lasting MHWs (top 20% duration, >18 days) in the EKB, an enhanced ocean surface cooling dominated by latent heat flux anomaly (-51W/m^2) and the weak positive solar radiation anomaly (3.6 W/m^2) suggest a predominant role of oceanic processes. The spatiotemporal distribution of sea level anomalies shows that the long and strong anticyclonic eddies with higher amplitude seem to be associated with extremely long-lasting MHWs. There is a significant positive correlation between the MHWs duration and the eddy intensity in the EKB (r= 0.32; p<0.05), especially during the long-lasting or consecutive MHWs in the EKB. A heat budget analysis further supports the dominant role of advection by the anticyclonic eddies for maintaining long-lasting MHWs. Our findings suggest that the ocean processes including eddies can contribute to driving extremely long-lasting MHWs in the EKB in the EJS.

Keywords: long-lasting marine heatwaves, anticyclonic eddies, East Korea Bay, mixed layer heat budget

Understanding marine heatwaves in the Bay of Bengal: progresses and future endeavors

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Abstract

Marine heatwaves (MHWs), characterized by extremely warm water events, are increasingly prevalent globally, posing significant threats to marine ecosystems. The Bay of Bengal (BOB), witnessing one of the fastest warming rates among tropical oceans since 2005, coupled with shallow mixed layer induced by low-salinity water, favors the occurrence of strong MHWs. Consequently, coral reefs in the BOB are facing escalating bleaching threats due to the dramatic increase of these extreme events under such a warming climate. Supported by the Asian Cooperation Fund Project, we have conducted a very successful joint survey in winter 2019, to investigate MHWs and its potential influence on coral reefs along Myanmar coasts, in cooperation with Pathein University. The related work has also been conducted in the BOB in the recent years, to explore on some vital issues, including regionality and seasonality of MHWs, relationship between interannual variability of MHWs and El Niño-Southern Oscillation (ENSO) & Indian Ocean Dipole (IOD), and their influence on ecosystems. The main achievements on these issues are introduced in this talk. Moreover, comprehensive future research plans and international cooperation are suggested to enhance the monitoring, understanding and prediction of MHWs in the BOB.

Keywords: Marine heatwaves, ENSO, IOD, coral reefs

Comparative analysis of Marine Heatwave (MHW) and Degree Heating Week (DHW) and its applicability to Philippine Seas

Rachel Francisco, Charina Lyn Repollo, and Cesar Villanoy

University of the Philippines, Marine Science Institute, The Philippines

Abstract

Increasing sea surface temperature has been shown to expose both tropical and high latitude organisms beyond their thermal limits causing stress and even mortality. In order to assist the survival of marine organisms against thermal stress, we need to be able to quantify how heating progresses in the Philippine seas and determine the organism-specific threshold against thermal stress. Marine heatwave (MHW) is a new measure of heat stress that is able to capture extreme and short-lived temperature anomalies which were documented to have had a large impact on marine organisms globally. On the other hand, Degree Heating Week (DHW) is the widely-accepted measure of heat stress able to detect the long-term gradual accumulation of heat that eventually leads to bleaching. This study aims to provide an analytical comparison of marine heatwaves and degree heating week in terms of their climatology, intensity, frequency, and spatial distribution within the Philippine seas. Archived DHW data from NOAA Coral Reef Watch, as well as detected marine heatwaves from 1982–2021 using Operational Sea Surface Temperature and Ice Analysis (OSTIA) will be used as a dataset. Results of this study can be a reference for marine biologists on developing strategies to help various marine organisms cope with increasing sea surface temperature for a specific region in the Philippines.

Keywords: marine heatwaves, degree heating week, sea surface temperature, thermal stress

Seasonal trends in marine heatwaves and its impacts on coral reef connectivity

Yi Guan and Tianyu Zhang

Guangdong Ocean University, China

Abstract

Marine heatwaves (MHWs) are extreme climatic events that can have devastating impacts on ecosystems, often causing abrupt ecological changes and socioeconomic consequences. It has been estimated that MHWs has increased in intensity, frequency, and duration globally. However, the predominant focus of current research has been on summertime occurrences within specific regions or global oceans, with limited attention to the seasonal trends of MHWs and their potential impacts for coral reefs. To address this research gap, our study examines seasonal trends in MHWs within major coral reefs, regions characterized by high biodiversity. We use Daily Optimum Interpolation Sea Surface Temperature data (OISST) to identify the number of MHW events and MHW days, and mean, maximum, as well as intensity of MHWs for major coral reef regions in each season between 1982 and 2021. Additionally, we employ a Lagrangian trajectory model to simulate the potential changes in coral reef connectivity if marine heatwaves occur in coral spawning season. Our analyses aim to inform management practices that may enhance the resilience of coral reefs.

Keywords: marine heatwave, seasonal trend, coral reef connectivity

Analysis of marine heatwaves in China's coastal seas and adjacent offshore waters

Zhijie Li[1, 2] and Liying Wan[1, 2]

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Abstract

Marine heatwaves (MHWs) are changing global ecosystems and bearing profound socio-economic impacts, yet our understanding of the spatial features, temporal evolution characteristics, and regional differences in China's marginal seas remains insufficient. In this study, the spatio-temporal variation characteristics of the frequency, mean intensity, maximum intensity, cumulative intensity, duration and total days of MHWs are systematically analyzed based on daily sea surface temperature data from Operational Sea Surface Temperature and Ice Analysis (OSTIA) for the period of 1983–2020. The results show the following: The annual mean frequency of MHWs in China's coastal seas is 1.4–4.6 counts per year, and increases gradually from north to south. The annual mean of mean intensity, maximum intensity and cumulative intensity are respectively in the ranges of 0.3–2.9°C, 0.4–3.7°C and 3.9–41.7°C days, all of which show a significant decreasing trend from north to south. The annual mean of duration and total days of MHWs are in the respective ranges 8.7–19.7 and 18.9–69.1 days. The annual mean of frequency, cumulative intensity, duration and total days all show a clear increasing trend, with respective linear increases of 1.03 counts, 3.57℃ days, and 1.98 and 17.58 days per decade. The annual mean of the mean intensity and maximum intensity have no obvious upward trend with the exceptions of the Bohai and Yellow Seas. Finally, MHWs were divided into the four categories of moderate, strong, severe and extreme, with the results showing that moderate ones account for more than 70% of all heat wave events, while strong, severe and extreme ones respectively account for about 25, 2, and 0.02%.

Keywords: marine heatwaves, frequency, mean intensity, maximum intensity, duration

Sub-theme A:
Ocean Processes and Climate Change

Session A4:
Ocean environmental and climate changes in the past:
High and low latitude connections in the Asian Continental Margins

Programme

Venue: Chelsea B, 5th Floor
Date: 23 April 2024

Conveners:

Xuefa Shi	First Institute of Oceanography, China
Gerrit Lohmann	Alfred Wegener Institute, Germany
Takuya Itaki	Institute of Geology and Geoinformation, Japan
J. Paul Liu	North Carolina State University, USA
Shuqing Qiao	First Institute of Oceanography, China

Time	Presentation Titles	Speakers
Section 1		
10:00–10:15	Quaternary organic biomarkers western Indo-Pacific warm pool paleoceanography: new progress	Min-Te Chen, *Institute of Earth Sciences, NTOU*
10:15–10:30	Depth of thermocline changes at the Makassar Strait based on planktonic foraminiferal abundance during the last glacial maximum	Oktavira Dwi Demia Larasati, *Institut Teknologi Bandung, Indonesia*
10:30–10:45	Dynamics of dissolved methane and organic matter in water in the Chukchi Sea summertime in 2015 and 2016	Oanh Thi Ngoc Bui, *Vietnam National University Ho Chi Minh City, Vietnam*
10:45–11:00	A Storm surge hazard indicator and hazard evaluation in China	Xiang Fu, *National Marine Environmental Forecasting Center, China*
11:00–11:15	Comparison of sediment source to sink process in high and low latitude areas of Asian continental margin	Xuefa Shi, *First Institute of Oceanography, China*
11:15–11:30	A review of in situ marine environment research and efforts in Southeast Asia	Wai Leong, *National University of Singapore, Singapore*
11:45–12:00	**Discussion**	

Quaternary organic biomarkers western Indo-Pacific warm pool paleoceanography: new progress

Min-Te Chen

Institute of Earth Sciences, NTOU

Abstract

The tropical Indo-Pacific warm pool (IPWP) is key to global climate change. The Banda Sea, which is located at the central IPWP, would be essentially important in advancing our understanding of controlling mechanisms in determining the timing and amplitude of the prevailing Asian-Australian monsoon (AAM) and the interactions with changes in seasonal and latitudinal incoming solar insolation, Northern Hemisphere (NH) ice volume, cross-equatorial flows from the Southern Hemisphere, and any ENSO-like processes in the IPWP. The sediment cores from the Banda Sea provide excellent climate archives for documenting climate responses relevant to IPWP to any processes mentioned above. This talk will present initial results from analyzing an IMAGES core MD012380 collected from the central Banda Sea. This analysis aims to find data evidence of surface and sub-surface hydrographic responses, mainly at orbital time scales in the central IPWP during the late Quaternary. By precisely tuning the MD012380 benthic $\delta^{18}O$ to the LR04 stack, we have successfully established an astronomically tuned age model of the past 800ka. We evaluated the uncertainty of phase estimation of mainly precession frequency band in the time interval of 0–400k with the age model where most Asian speleothems monsoon records exist for comparison. The results of our studies suggest that, despite the ~3kyr uncertainty associated with oxygen isotope stack tuning, there is a ~7–8kyr lag of AAM maxima relative to the NH summer insolation maxima at the precession frequency band. Our studies suggest that it remains difficult to reconcile the phase differences between marine and speleothem monsoon records. We will also present the results of our GDGTs (TEX86) temperature estimates from the core as well as ground-truth experiments of the organic biomarker proxies based on suspension particulate matter and box samples that indicate the temperature proxies are faithful indicators for annual mean averaged climate. We conclude that using GDGTs organic biomarkers opens a new reliable window for IPWP paleoceanographic studies.

Keywords: Indo-Pacific warm pool, hydrography, GDGTs, TEX86, SST, monsoon

Session A4: Ocean environmental and climate changes in the past: High and low latitude connections in the Asian Continental Margins

Depth of thermocline changes at the Makassar Strait based on planktonic foraminiferal abundance during the last glacial maximum

Oktavira Dwi Demia Larasati[1], Marfasran Hendrizan[2,] and Rima Rachmayani[3]

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[3] Oceanography Research Group, Faculty of Earth Science and Technology, Institut Teknologi Bandung, Bandung, Indonesia

Abstract

The Indo-Pacific Warm Pool (IPWP) exerts a strong influence on the global climate system as it partially controls the heat and moisture exchange (pressure gradient) between the atmosphere and ocean, and thus, the intensity of the Indonesian Throughflow (ITF). ITF is a vital route for the transfer of heat and water from the equatorial western Pacific Ocean to the eastern Indian Ocean and thus to maintain the IPWP extent and intensity in the western Pacific and the eastern Indian Ocean. The circulation of the ITF is complex and depends on the thermocline structure. Changes in thermocline depth (DOT) off the Makassar Strait are poorly known than in other part of ITF pathways, such as in the Timor Sea, which is the outflow pathways of the ITF. Here, we present a high-resolution planktonic foraminifera-based proxy study at the main entrance of the Indonesian Throughflow in the Makassar Strait to reconstruct the ITF variability and to understand the ITF changes during the last glacial maximum (LGM). Planktonic foraminiferal assemblages in cores collected from the Delta Mahakam offshore coded TR 1926 (0°13.664' N/ 117°47.436' E, 616 m depth) from the TRIUMPH 2019 cruise were used to reconstruct the DOT changes at the Makassar Strait. The DOT change is obtained by the ratio of thermocline dweller species compared to mixed layer dweller species. We suggest that during the LGM (23–18 ka) the DOT was shoaling than during the Holocene. This shoaling indicates that there was a decrease in the intensity of the ITF during the LGM, which we hypothesize that is influenced by the glacio-eustatic sea-level changes that have modified the geometry of the pathways within the Indonesian Seas, as well as by the monsoon activity which was modulated by the changes in the insolation with a precessional cyclicity.

Keywords: ITF, planktonic foraminifera, LGM, DOT

Session A4: Ocean environmental and climate changes in the past: High and low latitude connections in the Asian Continental Margins

Dynamics of dissolved methane and organic matter in water in the Chukchi Sea summertime in 2015 and 2016

Oanh Thi Ngoc Bui[1], Sohiko Kameyama[2], Urumu Tsunogai[3], Shigeto Nishino[4], JinYoung Jung[5], Eun-Jin Yang[5], and Sung-Ho Kang[5]

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[4] *Japan Agency for Marine-Earth Science Technology, Japan*
[5] *Korea Polar Research Institute, Republic of Korea*

Abstract

In the Arctic Ocean, massive CH_4 hydrates from marine sediments released, and methanogenic CH_4 produced in an anaerobic environment with high organic matter on the seafloor and then diffusion into the water column were examined. High methane emissions in the Chukchi Sea are from the surface seawater and bottom areas observed during the Arctic Ocean expedition belonging to R/V *Mirai* and IBRV *Araon* cruises. High methane concentrations were observed in the continental shelf in the summertime of 2015 and 2016. Higher dissolved methane concentration was found here, resulting from high *in situ* methanogenesis of organic matter. Relations between CH_4 and nutrients, as well as its precursors, are considered. Both physical factors, such as water masses, cold-core eddies and biogeochemical factors, are deemed to control methane distribution in the region.

Keywords: methane emission, Chukchi Sea, Arctic Ocean

Variations in the Kuroshio current and the North Pacific Intermediate Water during the late quaternary

Jianjun Zou and Xuefa Shi

First Institute of Oceanography, Ministry of Natural Resources, China

Abstract

The Kuroshio Current and North Pacific Intermediate Water have significant impacts on the marine environment, ecosystem, and climate in the North Pacific. By examining sedimentary cores from the western subtropical North Pacific, it has been observed that the dynamics of the Kuroshio Current weaken during glacial periods and strengthen during interglacial periods. The changes in the Kuroshio are influenced by both low latitude and extratropical climate processes. Additionally, research on the ventilation changes in the subtropical intermediate water mass reveals that its strength varies on millennium timescales, being stronger during colder periods and weaker during warmer periods. These fluctuations are mainly controlled by the teleconnection processes between the ocean and the atmosphere, which is driven by the meridional overturning circulation in the North Atlantic. During the late Quaternary, the North Pacific Intermediate Water and Kuroshio Current have alternately influenced environmental changes in the western subtropical waters over glacial and interglacial cycles. The interaction between these water masses and their effects on the environment and climate warrant further investigation.

Keywords: Kuroshio Current, North Pacific Intermediate Water, late Quaternary

A Storm surge hazard indicator and hazard evaluation in China

Xiang Fu, Jingming Hou, Qiuuxing Liu, Mingjie Li, and Sendong Liang

National Marine Environmental Forecasting Center, Beijing, 10081, China

Abstract

Risk is a complex outcome that is depicted as a function of the combined effects of hazards, the assets or people exposed to hazard and the vulnerability of those exposed elements. Hazard, as “an event or occurrence that has the potential to cause harm to people and/or property” (Shepard, et al., 2011), is a determining factor when assessing disaster risk. Since storm surge disasters are mainly caused by high tide inundation or destruction, either directly physical causing factors: storm surge and high-water level, should be considered in surge hazard evaluation. A storm surge hazard indicator was developed based on the analytic hierarchy process (AHP) with both the storm surge index and high-water index. Using this indicator, the storm surge hazard along the Chinese mainland coast was evaluated. Storm surges were simulated by the GPU-based high-resolution 2-D hydrodynamic operational storm surge model, driven by ERA5 reanalysis data. High waters were calculated from coastal warning water, a threshold at which storm surge hazards probably occur. The results show that the annual maximum storm surges increasing along almost the entire east coast and along Guangdong coast. Meanwhile, the range of where annual maximum storm surges exceed 2 meters expands in the last 40 years. The storm surge hazard for more than 80% of the mainland coast are moderate and low. The coasts with high-level storm surge hazard represent less than 20% of the whole coastline of mainland China and included the three bays of Bohai, the head area of Hangzhou Bay, in the Pearl River Estuary, the areas along the eastern coast of the Leizhou Peninsula and the coastal area of Guangxi Province.

Key words: storm surge, hazard index, evaluation, Chinese mainland

Session A4: Ocean environmental and climate changes in the past: High and low latitude connections in the Asian Continental Margins

Comparison of sediment source to sink process in high and low latitude areas of Asian continental margin

Xuefa Shi[1, 2], Shuqing Qiao[1, 2], Shengfa Liu[1, 2], Jianjun Zou[1, 2], Yanguang Liu[1, 2], Zhengquan Yao[1,2], Kunshan Wang[1, 2], Limin Hu[2, 3], Jingrui Li[2], and Gang Yang[1]

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Abstract

As the largest continental margin in the world, the Asian continental margin (AM) is under the influence of the strongest land-sea interaction and the most frequent exchanges of material and energy. The rivers in the AM contribute about two-thirds of the global fluvial sediments to the ocean, which has a great impact on the sedimentation, biogeochemical processes and marine ecology of the marginal seas and the global oceans. Through international cooperation during the past 20 years, we have systematically carried out sedimentological investigation from the East Siberian shelf in the north to the Bay of Bengal in the south of the AM. Based on these data, we compiled a 1:3000000 sediment type map of the AM and several 1:1000000 sediment type maps of the key areas, and elaborated the distribution pattern of sediments; We established a set of effective provenance proxies to elucidate the properties of fluvial sediments, identified the sediments provenance in the Gulf of Thailand, Andaman Sea, Bay of Bengal, South China Sea, Sea of Japan, Sea of Okhotsk and East Siberian Sea, described the processes of transportation and deposition of fluvial sediments in the ocean; We clarified the sediment source to sink processes and controlling factors in the marginal seas within different latitudes and established the sedimentation model; The source, input and burial of organic carbon on the shelf at different latitudes and their response to natural processes and human activities have been quantitatively evaluated; The mechanisms controlling the sediment source to sink process, driven by the Asian monsoon, sea-level change, uplift of Tibetan Plateau, ocean current and sea ice, were revealed.

Keywords: East Siberian Sea, Bay of Bengal, Sediment, Asian Continental Margin, Source to Sink

Session A4: Ocean environmental and climate changes in the past: High and low latitude connections in the Asian Continental Margins

A review of *in situ* marine environment research and efforts in Southeast Asia

Wai Leong[1], Joleen Chan[1], Shaun Gabriel Jiaxiu Wee[1], Chen Mengli[1], Shermaine Than[1], Tries Razak[2], Rindah Talitha Vida[2], Cut Aja Gita Alisa[2], Tran T M Hang[3], Justine Perry Domingo[4], Lalita Putchim[5], Chalermrat Sangmanee[6], Anukul Buranaprathepprat[7], Lee Jennie[8], Aazani Mujahid[9], Cherry Aung[10], Matthew Glue[11], and Jani Tanzil[1]

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[11] *Fauna & Flora International, Cambodia*

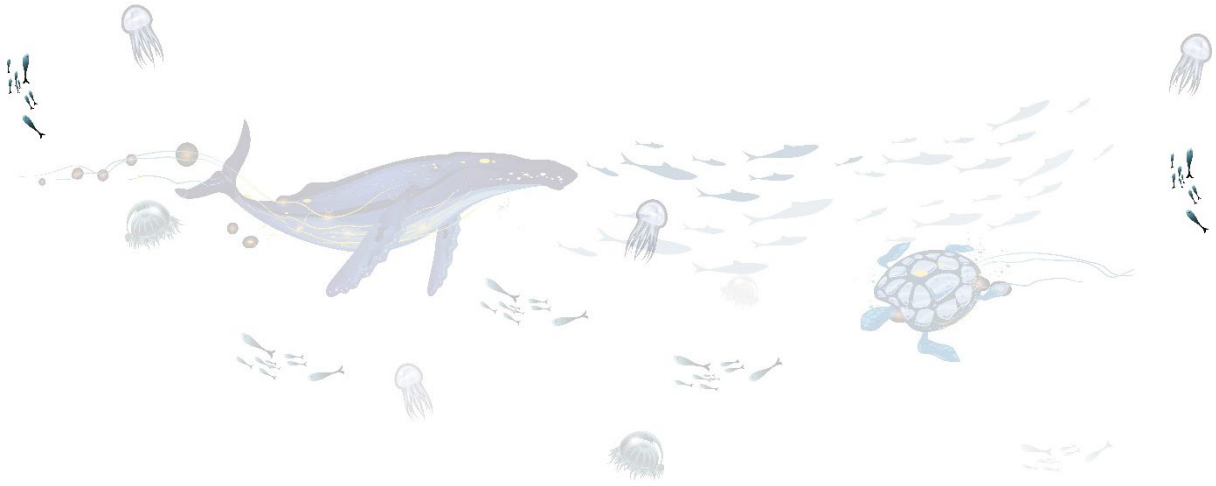
Abstract

Southeast Asia (SEA) consists of many nations with extensive coastlines and marine territories, as well as the Coral Triangle – the global marine biodiversity hotspot. With climate change and increasing coastal urbanization, changes in the marine environment are expected to significantly impact this region's biodiversity and the many coastal communities dependent on healthy seas. To date, long-term marine water quality records for SEA are considered sparse, with few contributions to global ocean databases. There are, however, active and long-standing research conducted in this region that incorporate observing and/or characterizing the marine environment as part of their efforts. Here, we review published academic literature for SEA, focusing on ASEAN countries, to provide an overview of marine environment research and monitoring, and data availability in this region. A total of 521 scientific articles (1970–2021) were filtered from Web of Science and Scopus. 1,421 additional papers were contributed by invited country experts via recommendation or from additional Google Scholar searches. Studies were distributed around the seas in the region, with largest numbers from the Java Sea (23.5%) and South China Sea (14.7%), followed by the Gulf of Thailand (9.4%), Indian Ocean (6.2%), Malacca Strait (6.2%), Makassar Strait (5.7%), Bali Sea (5.2%), Banda Sea (4.1%), Andaman Sea (3.9%), Johor Strait (3.3%). Most of the studies arose from research that focused on pollution (40.4%) and ecological monitoring (43.3%), and a majority were short-term in nature (60.7% as one-off observations). Results of this study will provide valuable insights on the extent of marine environment research in SEA, and identify gaps needed to strengthen collective efforts to better assess the health of our shared seas.

Keywords: Southeast Asia, *in situ*, marine, data, review

Sub-theme A:
Ocean Processes and Climate Change

Session A5:
Sediment source-to-sink processes responding to rapid climate change



Programme

Venue: Somerset B, 5th Floor
Date: 22 April 2024

Conveners:

Zhifei Liu	Tongji University, China
Penjai Sompongchaiyakul	Chulalongkorn University, Thailand
Fernando P. Siringan	University of the Philippines, The Philippines
Edlic Sathiamurthy	Universiti Malaysia Terengganu, Malaysia

Time	Presentation Titles	Speakers
Section 1		
10:30–10:45	Source-to-sink transport processes of fluvial sediments on the Gulf of Thailand	Zhifei Liu, *Tongji University, China*
10:45–11:00	Geochemical characterization of marine sediment cores from the Gulf of Thailand: constraints on provenance and weathering	H. M. Zakir Hossain, *Jashore University of Science and Technology, Bangladesh*
11:00–11:15	Suspended sediment transport along tropical river catchment-estuary-coastal shelf continuum system: a case study from the Selangor River, Malaysia	Aijun Wang, *Third Institute of Oceanography, China*
11:15–11:30	Sediment accumulation rates in the eastern upper Gulf of Thailand using ^{210}Pb dating method	Ratsirin Supcharoen, *Chulalongkorn University, Thailand*
11:30–11:45	Anthropogenic lead (Pb) sources in the atmosphere and deposition trends in the Indian Ocean	Reshmi Das, *Jadavpur University, India*
11:45–12:00	Distribution and elemental composition of atmospheric aerosols over the Gulf of Thailand during the southwest monsoon	Jariya Kayee, *Nanyang Technological University, Singapore*
12:00–12:15	Compositions and sources of sedimentary organic carbon on the Gulf of Thailand	Baozhi Lin, *Tongji University, China*
Section 2		
13:30–13:45	Coastal erosion along the northwest coast of Luzon: trends and causes	Fernando P. Siringan, *University of the Philippines Diliman, The Philippines*
13:45–14:00	Disturbance of marine sediments by tsunami and its effect on water quality	Mitsuru Hayashi, *Kobe University, Japan*
14:00–14:15	Typhoon Chan-Hom (2015) induced sediment cross-shore transport in the mud depo-center of the East China Sea inner shelf	Yunhai Li, *Third Institute of Oceanography, China*

Time	Presentation Titles	Speakers
14:15–14:30	Integrated assessment of total mercury distribution in water, sediment, and biota of Thai river estuaries	Prabakaran Krishnamurthy, *Chulalongkorn University, Thailand*
14:30–14:45	Environmental disturbances could affect sediment trapping in tropical coastal seagrass beds	Ow Yan Xiang, *National University of Singapore, Singapore*
14:45–15:00	Chemical weathering in the Mekong river basin: clay mineralogy and element geochemistry of lower-reach river sediments	Pham Nhu Sang, *Tongji University, China*
Section 3		
15:30–15:45	Plio-pleistocene structures and deposition in the southern Java Sea	Susilohadi Susilohadi, *BRIN, Indonesia*
15:45–16:00	Sea level and East Asian monsoon influenced chemical weathering records in the southern South China Sea over the past 21 ka	Hongchao Zhao, *Tongji University, China*
16:00–16:15	Optical properties of dissolved organic matter from Bangpakong River to Sichang Island, Thailand	Warasyn Boontanapibul, *Chulalongkorn University, Thailand*
16:15–16:30	Multi-annual change of Jakarta Bay's carbonate system	Camellia Kusuma Tito, *IPB University, Indonesia*
16:30–16:45	Chromophoric dissolved organic matter in Bangpakong estuary, Thailand	Chirawat Duangthong, *Chulalongkorn University, Thailand*
16:45–17:00	Investigating the geochemical characteristics and associated toxicity of bioavailable metals around Singapore intertidal zones by diffusive gradients in thin films (DGT)	Iravati Ray, *Jadavpur University, India*

Source-to-sink transport processes of fluvial sediments on the Gulf of Thailand

Zhifei Liu[1], Penjai Sompongchaiyakul[2], Baozhi Lin[1], Christophe Colin[3], Shuo Feng[1], Yulong Zhao[1], Rithy Meas[4], Khanh Phon Le[5], Edlic Sathiamurthy[6]

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Abstract

Terrigenous detrital fractions of marine sediments usually carry important environmental information about conditions on adjacent continents and transport dynamic mechanisms from land to sea. Sediments on the continental shelf particularly in semi-closed gulf or bay with relatively stable hydrodynamic environments may play a significant role on source and transport study through their source-to-sink processes. We here provide an excellent example of the Gulf of Thailand in the southwestern South China Sea to address transport processes and potential differential settlement once fluvial sediments enter the gulf. More than 200 surface samples collected from the seafloor throughout the gulf and surrounding major river mouths were analyzed for clay mineralogy, major element geochemistry, and neodymium and strontium isotopes. The results show that major rivers surrounding the Gulf of Thailand provide different clay mineral assemblages and major and isotope geochemical compositions that present several characteristic end-members. The clay mineral assemblages vary strongly from the river mouths to the shallow shelf, indicating potential differential settlement of individual clay mineral, mainly as preferred settlement of kaolinite and illite and long-distance transport of smectite. Major and isotope geochemical compositions also show a land to sea gradient but are largely unified in the center of the gulf. Tides and seasonal surface currents play major rules on fluvial sediment transport and unified components in the gulf. The study draws attention on provenance analysis and environment application of marine detrital sediments, because the preferred settlement of clay minerals may strongly change the fine-grained components of marine deposits from fluvial sediments of their source areas.

Keywords: surface sediments, clay mineralogy, Nd-Sr isotopes, source-to-sink processes, Gulf of Thailand

Geochemical characterization of marine sediment cores from the Gulf of Thailand: constraints on provenance and weathering

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Abstract

The geochemical compositions of marine sediment cores collected from the Gulf of Thailand (GOT) were studied to determine the change in elemental distribution, provenance, and intensity of chemical weathering. The major, trace, and rare earth element (REE) contents show high enriched in Pb, Th, Ce, Sr, Zr, Sc, and Y and systematically depleted in K_2O, Na_2O, MgO, Fe_2O_3T, Sr, and Ba relative to average upper continental crust (UCC). Marked depletion of these elements relative to UCC signifies the destruction of plagioclase and K-feldspars in the weathering profiles of the source region. Similarly, high contents of Zr, Th, Ce, and Y relative to UCC, imply their mobility and availability likely controlled by the resistant heavy minerals. Abundances of SiO_2 and Al_2O_3 in the sediment samples differ from 51.94 to 56.31 wt.% (average 54.12 wt.%) and 10.64 to 13.14 wt.% (average 12.11 wt.%), respectively. SiO_2 shows a marked negative correlation with Al_2O_3 (r = -0.95) and a strong linear trend which is consistent with the high quartz content. Among the other major oxides, a positive correlation exists between Al_2O_3 and TiO_2, Fe_2O_3T, MgO, and K_2O suggesting phyllosilicates as well as heavy minerals may influence their abundances. The chondrite-normalized REE patterns for GOT sediments reveal LREE enrichment (La_N/Yb_N, 7.86-9.13), nearly flat HREE (Gd_N/Yb_N, 1.42-1.71), and significant Eu anomalies (Eu/Eu*, 0.53-0.69), indicating felsic provenance. Geochemically, the GOT sediments have low compositional maturity and are classified as greywacke. The provenance discriminating diagrams, immobile trace element ratios (Th/Sc, La/Sc, Zr/Sc, Cr/Th, and Th/Co), and REE (ΣLREE/HREE, Eu/Eu*, and Gd_N/Yb_N) parameters represent that the GOT sediments were primarily originated from felsic source rocks, with the composition close to average granodiorite, rhyolite, I-type and S-type granites. The ICV, CIA, and PIA proxies, and Rb/Sr and K_2O/Rb ratio values of the marine sediments reveal a low to moderate intensity of chemical weathering in their source area. The overall weathering pattern in the sediments could be influenced by the strength of East Asian monsoon circulation over the upland areas.

Keywords: Geochemistry, provenance, weathering, marine sediments, Gulf of Thailand

Suspended sediment transport along tropical river catchment-estuary-coastal shelf continuum system: a case study from the Selangor River, Malaysia

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Abstract

With the increase of intense human activities, the degradation of ecosystems in tropical regions is significant. Due to the high rainfall in tropical watersheds, terrestrial substances such as freshwater, sediment, and pollutants are rapidly released into the sea, which has a significant impact on the evolution of typical ecosystems in estuaries and adjacent coastal zones. This study takes the Selangor River Catchment-Estuary-Coastal Sea System in Malaysia as the study area and discusses the transport processes and fate of terrestrial substances after entering the sea through field observations and indoor experiments. The research results indicate that terrestrial material delivered by Selangor River are mainly trapped in the estuary area, and the fine sediment transport seaward by the river plume and transport landward again by tidal current, resulting in the development of extensive tidal flats on both sides of the river mouth.

Keywords: river catchment-estuary-coastal shelf continuum system, sediment transport, pollutants, river plume, Selangor River

Sediment accumulation rates in the eastern upper Gulf of Thailand using ^{210}Pb dating method

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Abstract

Sediment accumulation rates were determined for sediment cores from the eastern upper Gulf of Thailand by using ^{210}Pb dating method. Four cores (64-74 cm long) were collected in November 2020 from the area from the river mouth of Bangpakong River to the east of Sichang Island. Additionally, one sediment core (58 cm long) was collected near the coast of Siracha in March 2020. All five sediment cores were sub-sectioned into 2-cm depth intervals. Eight sediment layers in each core were selected and analysed for ^{210}Pb activities via the measurement of ^{210}Po and the internal tracer ^{209}Po by alpha spectrometry. Sediment accumulation rates were estimated from excess ^{210}Pb profiles by applying constant flux and constant sedimentation (CFCS) model. Sediment accumulation rate at the station closest to the Bangpakong River mouth (~10 km from the mouth) cannot be estimated because the ^{210}Pb values were nearly constant for more than half of the core potentially resulted from the sediment disturbance. Based on the CFCS model, sediment accumulation rate at the station ~20 km from the river mouth is 0.40 cm/yr, which is comparable to the sediment accumulation rate of 0.43 cm/yr at the station ~4 km north of Sichang Island. At the station ~2 km east of Sichang Island, sediment accumulation rate slightly increased to 0.48 cm/yr. Across from the east of Sichang Island station, distinctively high sediment accumulation rate of 1.68 cm/yr is found at the station ~3.5 km from Siracha coast. Sediment accumulation rates in this study are within the previous rates reported in the Gulf of Thailand, except one core with maximum rate near Siracha coast. The surprisingly high sedimentation rate near Siracha coast could be explained by numerous processes/activities nearby including coastal erosion, aquaculture, and ship transport near the pier at Siracha coast. Sedimentation rates determined in this study can be used to study carbon burial rates in order to provide better understanding of biogeochemical degradation of organic matter in marine sediment in the eastern upper Gulf of Thailand.

Keywords: radiometric dating, alpha spectrometry, Bangpakong River, Sichang Island, Siracha

Anthropogenic lead (Pb) sources in the atmosphere and deposition trends in the Indian Ocean

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Abstract

Aerosols play a crucial role in regulating biogeochemical cycles of metals. Once these aerosols are deposited into the ocean, they can influence marine ecosystems in various ways. For instance, certain metals can serve as nutrients for marine organisms, while others may be toxic in higher concentrations. Understanding the sources and dynamics of atmospheric aerosols is essential for assessing their impact on ocean ecosystems and overall environmental health. South and South East Asian countries have recently come under scrutiny of Pb pollution due to several reasons. In India, Thailand and Vietnam, more than 250 million children have blood lead level >5 microgram/decilitre (ug/dL). Additionally, present day Pb emissions have surpassed past century emission from leaded gasoline used in these countries. Lastly, several countries including Indonesia and Myanmar in the region were using leaded gasoline until this century. Pb isotopic compositions of aerosols (n=341) were compiled along with well documented (coal, ore, unleaded and leaded fuel, solid waste and biomass burning, upper continental crust) and previously excluded (tertiary coal & wood charcoal, ship emission, sea spray) sources for Singapore, Thailand and Vietnam (SEA) & India. The compiled data was subjected to Bayesian 3D isotope ($^{206}Pb/^{207}Pb$ -$^{208}Pb/^{207}Pb$ -$^{208}Pb/^{206}Pb$) mixing model (MixSIAR) simulation that takes into account the standard deviations in the multiple end member isotopic data. MixSIAR estimates reveal consistent contribution from natural background (52% for SEA and 35% for India). Leaded gasoline is the largest contributor in SEA (median contribution up to 39%). Tertiary coal/fuelwood combustion and ore processing dominate in India. Vehicular combustion contributes up to 6% in SEA and India. Ship emission, an underdetermined source in India contributes up to 15%. Corals faithfully record changes in both the concentration of Pb and its isotopic compositions in seawater across different temporal and spatial scales. In light of the atmospheric Pb emissions, Pb/Ca and Pb isotopic ratios of corals from Phuket (1945–2010), Sumatra (1951–2004), Jung Island (1962–2009), Chagos (1989–2010), Salomon (1989–2010), Diego Garcia (1999–2010) and Lakshadweep (1989–2013) from literature will be discussed. This provides an insight into the dynamic evolution of Pb sources, transport, and depositions within the Indian Ocean.

Keywords: Atmospheric particulate matter, anthropogenic lead (Pb), Pb/Ca ratios and Pb isotopes, coral records, Indian Ocean

Distribution and elemental composition of atmospheric aerosols over the Gulf of Thailand during the southwest monsoon

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Abstract

Elemental in aerosol can be natural (crustal dust, sea spray, volcanoes, forest fire) and anthropogenic (industrial emission, high temperature combustion, vehicle emission) sources. After being spewed up into the atmosphere, they often travel long distances to remote ocean regions via precipitation or dry deposition. Marine aerosols were collected over the Gulf of Thailand (GOT) during the 2018 Southwest monsoon on board of M.V. SEAFDEC2 while cruising. During the southwest monsoon, the wind mainly blows over the Indian Ocean to the GOT. Elemental concentrations (i.e., Al, As, Ba, Ca, Cd, Cu, Cr, Fe, Mg, Mn, Na, Ni, Pb, Sr, V, and Zn) were determined to investigate for their distribution. The elements were determined by inductively coupled plasma-mass spectrometry (ICP-MS) after acid digestion and preconcentration. The results reveal that Al, Ca, Fe, Mg and Na were presented in high concentration (average >290 ng/m^3), while As, Ba, Cr, Cu, Mn, Ni, Pb, Sr, V and Zn were presented in low concentrations (average <40 ng/m^3). Enrichment factor (EF) values indicate that elements are originated from oceanic, crustal, and anthropogenic sources. The oceanic source (Sr, Ca, Mg and Na) explains 95% (range 81–99%) of total elements in the aerosols. Elements such as Al, Fe, Mn and Ba explain 4.6% of the total elements. These elements associate with the crustal source. Only a minimal amount (0.63%, range 0.02–4.5%) of the total elements is originated from anthropogenic activities over or nearby the GOT that shown by loading of As, Cd, Cu, Cr, Ni, Pb, V and Zn.

Keywords: PMcoarse, $PM_{2.5}$, trace element, the Gulf of Thailand

Compositions and sources of sedimentary organic carbon on the Gulf of Thailand

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Abstract

The deposition of fluvially derived terrestrial organic carbon (OC) together with marine OC in marine sediments has important implications for the global carbon cycle. However, dispersal extent and fates of terrestrial soil and petrogenic OC on the continental shelf have remained unclear and debated. Here, we present OC compositions and mineral properties of marine sediments from the Gulf of Thailand and the adjacent Mekong shelf, as well as river sediments from continents surrounding them in order to determine the provenance of sedimentary OC in this tropical epicontinental sea. We find that stable carbon isotope composition ($\delta^{13}C$) and radiocarbon activity ($\Delta^{14}C$) of sedimentary OC fall between those of marine OC and of river sediments, mainly composed of C3 plant-dominated pre-aged soil and petrogenic OC. Mixing model reveals that the OC in river sediments is predominantly sourced from pre-aged deep soils, accounting for 73±5%, with the remaining consisting of modern surface soil (25±6%) and bedrock (2±1%). The sedimentary OC on the shelf is primarily derived from marine OC, accounting for 65±15%, with terrestrial soil OC and petrogenic OC contributing 24±14% and 10±5%, respectively. The sources, degradation, and aging of OC and mineral surface area determine the spatial pattern of sedimentary OC compositions in the Gulf of Thailand and the Mekong shelf. The contents of marine, soil, and petrogenic OC decrease with increasing distance

offshore, consistent with changes in spatial patterns of sedimentation rate of terrestrial materials and of marine primary production in the overlying water column. Extensive degradation of terrestrial OC and extremely low OC burial rate in this tropical epicontinental sea suggest a minor role on OC sequestration in marine sediments, but an important CO_2 source to the atmosphere in the context of the global carbon cycle.

Keywords: Radiocarbon, Organic carbon, River sediment, Marine sediment, Tropical epicontinental sea

Coastal erosion along the northwest coast of Luzon: trends and causes

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Abstract

Coastal erosion is a prevalent problem along an almost 600 km long coastline of northwest Luzon. In this study, satellite images and maps complemented by field surveys were used to establish trends of shoreline change. The possible causes of erosion are identified using ancillary oceanographic and meteorological data, and anecdotal accounts. The largest and fastest shifts in shoreline position, which can be within a kilometer of either erosion or accretion, are in delta shorelines. A shift in river mouth position, mostly natural, is the main driver of these changes. However, co-seismic subsidence caused by an 8.1 magnitude earthquake in 1990 combined with eustatic rise of sea level andt natural compaction, is likely a major contributor to continuing extensive erosion in the delta plain shorelines in the southern part of the study area. Shorelines fringed by extant or relict coral reefs, although dominated by erosion, have mostly only undergone several meters of shoreline shift. This low magnitude of erosion is attributed to the attenuation of waves by extant or relict reef platforms. Storms led to large changes as well, mostly erosion, but the shorelines tend to recover after a while. However, more frequent passage of storms tends to result in more widespread erosion. Seawalls and groins, meant to mitigate erosion, and solid-based piers contribute to erosion. Other contributors to erosion include beach mining and quarrying, degradation of coral reefs, and removal of beach vegetation. Coastal erosion is expected to worsen with the acceleration of eustatic sea level rise and increase in frequency and intensity of typhoons.

Keywords: coastal erosion, relative sea level rise, river mouth shifts, storms, hard structures

Disturbance of marine sediments by tsunami and its effect on water quality

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Abstract

Tsunami may disturb marine sediments and various materials in the water column. The environment of sediments after redeposition will be different from that before the tsunami. Considering the case of a tsunami caused by the Nankai Trough earthquake hitting Osaka Bay, tsunami, suspension of sediments, changes in heavy metal and nutrient concentrations in seawater, redeposition sites and dissolved materials flow out of Osaka Bay were predicted using numerical models. In addition, an incubation experiment was conducted to simulate post-redeposition. It was suggested that sediments will be suspended in the inner part of Osaka Bay by the tsunami, and that heavy metal and nutrient concentrations in seawater will be much higher than environmental standards after the tsunami. It was predicted that suspended sediments would be redeposited along the shore line and near the ocean front due to tidal residual currents within a month. About 80% of fine particulates and dissolved materials would be discharged to the open ocean in about two months. The release rate of redeposited sediments after exposure to the aerobic environment caused by a tsunami may decrease to approximately 70% of the current level for NH_4-N and 60% for PO_4-P. If the nitrogen and phosphorus accumulated in the sediments of Osaka Bay are released to the water column all at once by the tsunami, Osaka Bay may become oligotrophic like other bays of the Seto Inland Sea.

Keywords: Osaka Bay, Nankai Trough Earthquake, nutrient, redeposition, release

Typhoon Chan-Hom (2015) induced sediment cross-shore transport in the mud depo-center of the East China Sea inner shelf

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Abstract

The erosion, transport, and deposition processes of sediments that are influenced by typhoons are significant constituents of the sedimentary source-sink processes in marginal seas. Nevertheless, the genesis of storm deposit layers in the continental shelf and their subsequent development and preservation after typhoons have not been comprehensively investigated. In this study, we have conducted a systematic investigation of the processes related to sediment transport and deposition, which were primarily induced by Typhoon Chan-Hom, and analyzed the evolution and preservation of storm deposits utilizing grain-size analysis, radionuclides (^{137}Cs, $^{210}Pb_{ex}$ and ^{7}Be), and organic geochemistry (TOC, TN and $\delta^{13}C$). The ^{137}Cs, $^{210}Pb_{ex}$, and ^{7}Be inventories of surface sediment and total ^{210}Pb inventory of short sediment cores measured three days after the typhoon suggest that the sediments in the water depth <30 m were eroded, resuspended, and then transported offshore to deposit in the deeper areas (water depth >50 m) of the Mud Depo-center of Zhejiang-Fujian Coast (MDC-ZFC), resulting in the formation of significant storm deposits with high $^{210}Pb_{ex}$ and ^{7}Be. In addition to sediment transport, the offshore area also received organic matter generated by typhoon-induced phytoplankton blooms. Hence, in the present study area, the features of marine organic matter that possess high total organic carbon (TOC) content (>0.4%), low carbon to nitrogen (C/N) ratio (<7.5), and high $\delta^{13}C$ value (>-22‰) are crucial for identifying the storm deposit formed by cross-shore sediment transportation. Furthermore, the radionuclides and organic geochemical signals of the sediments revealed that no significant disturbance or transport of the storm sediments occurred three weeks after the passage of Typhoon Chan-Hom due to the high water depth, indicating that these storm deposits could be effectively preserved in this area. This study provides a valuable basis and reference for accurately identifying and interpreting typhoon sedimentary records in the MDC-ZFC.

Keywords: radionuclides, cross-shore transport, storm deposit, Typhoon Chan-Hom

Integrated assessment of total mercury distribution in water, sediment, and biota of Thai river estuaries

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Abstract

The study investigated the Total Mercury (T-Hg) content in water, sediment, and biota samples collected from the estuaries of Bangpakong, Rayong, and Prasae rivers in Thailand. Water samples from these locations displayed T-Hg concentrations within the ranges of 36.500 to 81.200 ng/L in Bangpakong, 3.058 to 32.520 ng/L in Rayong, and 6.668 to 29.075 ng/L in Prasae River. These concentrations were found to be below the NEB seawater quality standards, specifically Class I (Natural Resource Preservation) and Class V (Industry or Ports), with a limit of ≤100 ng/L. Sediment samples revealed T-Hg content ranging from 0.016 to 0.109 mg/kg in Bangpakong, 0.002 to 0.095 mg/kg in Rayong, and 0.004 to 0.207 mg/kg in Prasae river. Importantly, these values remained below the PCD sediment quality guidelines of 0.4 mg/kg. Additionally, fish and crustacean samples from a fish landing center near Bang Pakong were analyzed for T-Hg levels in muscle, gill/carapace, and gut tissues. Fish muscle tissues exhibited T-Hg concentrations ranging from 4.426 to 187.13 µg/kg, gill tissues from 1.515 to 141.134 µg/kg, and gut tissues from 5.205 to 42.937 µg/kg. Crustaceans showed T-Hg concentrations in muscle tissues ranging from 9.414 to 40.741 µg/kg and gill/carapace tissues from 0.0657 to 3.021 µg/kg. Notably, these recorded mercury concentrations in the biota tissues did not exceed stipulated guidelines. Human health risk assessment was performed using the Target Hazard Quotient (THQ), and the THQ values were found below 1 (THQ <1), indicating no significant human health risk through the consumption of these fishes. This comprehensive assessment provides valuable insights into mercury distribution in the studied estuaries, reassuring that the examined water and sediment samples meet regulatory standards while highlighting the necessity for continued monitoring to ensure environmental sustainability.

Keywords: Mercury contamination, Thai estuaries, environmental monitoring, water and sediment quality, bioaccumulation, human health risk assessment

Environmental disturbances could affect sediment trapping in tropical coastal seagrass beds

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Abstract

Coastal seagrass meadows can function as sediment sinks by trapping and storing sediments underneath the vegetation. This function plays an important role in limiting the movement of sediments and nutrients from land to coastal ecosystems that are further offshore, such as coral reefs. In this study, we aim to understand features of the seagrass canopy that contribute to sediment trapping. In various seagrass beds around Singapore, we quantified the amount of sediments deposited within and around seagrass beds. Sediment deposition varied across sites and was strongly influenced by local hydrodynamics. Within sheltered environments, a low seagrass canopy (~17mm height, 0.29 Leaf area index (LAI)) trapped more sediments than bare substrate. However, in areas with strong tidal flushing or water flow, there were no significant differences in sediment deposition between a tall and dense seagrass canopy (~58mm height, 1.6 LAI) and adjacent bare substrate. Seagrasses are vulnerable to climate change, notably the exposure to acute temperature rises, as well as to human activity-induced changes to water quality that results in light attenuation and nutrient inputs. Our mesocosm experiments demonstrated a strong impact of these environmental changes to seagrass canopy structure. In heated treatments (31°C), tropical seagrass (*Cymodocea serrulata*) reduced shoot size (cm^2) by 12% and shoot density (m^{-2}) by 9% compared to ambient treatment (28.5°C) after 12 weeks. This translated to ~19% reduction in LAI (total green leaf area per unit of ground surface area). In a separate experiment, tropical seagrass *Thalassia hemprichii* displayed significant reductions in shoot density (16%), shoot size (8%) and LAI (19%) when subjected to ~50% light reduction. The enrichment of background nutrients increased the LAI of *T. hemprichii* by 21%, affecting higher shoot density (4%) and shoot sizes (20%). To investigate how such changes to the seagrass canopy could affect sediment trapping, we replicated the canopy structure measured under different temperature and light-nutrient treatments using plastic mimics, and quantified sediment deposition within and in the wake of the canopy in controlled flume studies. Overall, our findings illustrated that not all seagrass beds are effective 'sediment traps' along the land-sea interface; the ones that tend to be, were of higher plant cover and shoot density in sheltered environs. This suggests that the decline in seagrass cover due to both global (climate change) and local (local water quality change) stressors, could adversely impact sediment retention by seagrass beds.

Keywords: seagrass, sediments, deposition, flume experiment, climate change.

Chemical weathering in the Mekong river basin: clay mineralogy and element geochemistry of lower-reach river sediments

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Abstract

Chemical weathering of parent rocks in river basins plays a significant role in controlling the global geochemical cycle and climate change, especially in the world's largest river basins such as the Mekong River basin in the tropical region. However, the chemical weathering process of the Mekong River basin is still not well understood. In this study, clay mineralogy and major/trace-element geochemistry of fluvial sediments (clay, silt, and sand fractions) collected from the lower Mekong River basin (Cambodia and Vietnam) were utilized to investigate the sediment provenance and chemical weathering process. Major-element compositions of clay, silt, and sand fraction sediments from both the mainstream and tributaries consist of dominant SiO_2, Al_2O_3, and Fe_2O_3, (84%, 89%, and 95%, respectively) and minor K_2O, Na_2O, MgO, CaO, TiO_2, P_2O_5, and MnO. The clay mineral assemblages in mainstream sediments are high in illite (36%), moderate in kaolinite (28%) and chlorite (26%), and low in smectite (10%), whereas those in tributary sediments are high in smectite (37%), moderate in kaolinite (26%) and chlorite (22%), and low in illite (15%). Based on clay mineralogy and elemental geochemistry, river sediments of the mainstream in the lower reach may be derived mainly from the lower part of the middle reach of this basin, with secondary contributions from the upper and lower reaches as well as the upper part of the middle reach. The clay mineral proxies (smectite/(illite + chlorite) and kaolinite/(illite + chlorite)) combined with elemental geochemistry (CIA, $\alpha^{Al}E$ values, and weathering trends) of clay fraction sediments indicate intensive chemical weathering in the lower and middle reaches. High-relief topography and cold and dry climatic conditions in the upper reach result in high illite and chlorite of the soil and moderate chemical weathering. Relatively, the chemical weathering intensity increases from the upper reach to the middle reach and further to the lower reach. Tectonics in the middle and upper reaches of the Mekong River basin play the most important role in controlling weathering and erosion processes, while the East Asian-Indian monsoon climate condition with warm temperatures and predominant rainfall throughout the year and the lithology are the main forcing factors for the intensity of chemical weathering in the lower reach.

Keywords: clay minerals, major elements, trace elements, chemical weathering, Mekong River.

Plio-pleistocene structures and deposition in the southern Java Sea

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Abstract

The south Java Sea forms a submerged part of the Sunda Shelf and lies on a relatively stable continental shelf, which reached its final form during the Quaternary. Marine geological investigations in this area have mostly been carried out as part of regional studies on the Sunda Shelf. Detailed studies, particularly for Plio-Pleistocene geological structures and sedimentary sequences, are lacking, and, as a result, the response of the shelf area to the present geological development and extreme sea level fluctuations during Plio-Quaternary times is poorly known. The Marine Geological Institute of Indonesia (MGI) has run single-channel seismic surveys in the Sunda Shelf as a part of the routine mapping program within the Indonesian region. Some of the data, particularly on the southern part of the Sunda Shelf, have been interpreted in order to delineate shallow geological structures and define sedimentary sequences developed within the shelf. The data shows that until the Middle Pleistocene, geological structures in the southern Java Sea inherited previous structural grains: northeast (NE) trending structures are related to the regional suture belts running from central Java to south Kalimantan, and east (E) trending structures developed since the Mio-Pliocene along the northern Java, Madura, and Kangean Islands. The NE-trending structures formed half-graben basins and controlled sedimentary deposition in the north of east Java and Madura until the Middle Pleistocene. While E-trending synclinal basins formed along the northern coast of Java, Madura, and Kangean may still be active, as indicated by some local thickening of Pleistocene deposits. This structural orientation indicates the recent dominance of a northward tectonic compressional stress. Even though Quaternary sedimentation gradually changed the basin morphology into a relatively flat plain characterized by multiple erosional features resulting from extreme sea level fluctuations.

Keywords: Plio-Pleistocene, Java Sea, shallow geological structures, sea level fluctuation, seismic stratigraphy.

Sea level and East Asian monsoon influenced chemical weathering records in the southern South China Sea over the past 21 ka

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Abstract

High-resolution major element geochemistry of Core MD05-2892 from the lower Sunda Slope was analyzed to investigate the variation of chemical weathering records and its controlling factors in the southern South China Sea since the last glaciation. Chemical index of alteration (CIA) and SiO_2/Na_2O ratio were selected as chemical weathering proxies. The values of the proxies are higher during the last glaciation than during the Holocene. We attribute this to the provenance shift caused by sea level change. Provenance analysis indicates that the Malay Peninsula and Sumatra were the major sediment sources for the study region during the last glaciation, while the Indochina Peninsula has been the major source since the early Holocene. Accordingly, the weathering evolution analysis reveals increased physical erosion in the Malay Peninsula and Sumatra during enhanced East Asian summer monsoon rainfall, while increased chemical weathering in the Indochina Peninsula during the intensified monsoon rainfall. Therefore, the chemical weathering records of the deep-sea sediments in the southern South China Sea were regulated by monsoon rainfall-driven physical erosion in the Malay Peninsula and Sumatra during the last glaciation, while the records have been influenced by monsoon rainfall-induced chemical weathering in the Indochina Peninsula since the early Holocene. This study emphasizes that higher weathering values of the deep-sea sediments during the last glaciation could be related to the provenance variation driven by sea level change, rather than to enhanced chemical weathering in the same provenance.

Keywords: major elements, sea level, East Asian monsoon; chemical weathering, southern South China Sea

Optical properties of dissolved organic matter from Bangpakong River to Sichang Island, Thailand

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Abstract

Dissolved organic matter (DOM) plays an important role in oceanic and global carbon cycling. DOM input into the ocean can be land-derived (i.e., allochthonous DOM) or produced in-situ (i.e., autochthonous DOM). Here we investigated the eastern section in the upper Gulf of Thailand that often faces eutrophication and hypoxia/anoxia. The area under investigation covers Bangpakong River to the north all the way south to Sichang Island. Surface water samples were collected during wet season (November 2022) and dry season (March 2023) and they were analyzed using fluorescence excitation-emission matrix (EEM) spectroscopy combined with a parallel factor analysis (PARAFAC) model. We applied different indices including fluorescence index (FI), humification index (HIX), and biological index (BIX) along with the quantified dissolved organic carbon (DOC) concentration to explore the temporal and spatial variation in DOC in the study area. The results showed that values of FI, HIX, BIX, and DOC concentration in the wet season are 1.71±0.21, 0.66±0.24, 1.41±0.70, and 6.56±2.59 mg/L, respectively. Furthermore, values during the dry season are 1.61±0.11, 0.77±0.14, 1.00±0.23, and 6.08±2.59 mg/L, respectively. The values of BIX in wet season were higher than dry season at high salinity samples due to the presence of OM fleshly released into the water. The source of this OM pool was likely microbial-derived organic matter. In contrast, HIX values were high in low salinity samples substantiating the rise in terrestrial humic substance flushed into the river system along with the runoff. DOC concentration in the wet season is slightly higher than that in the dry season and we could observe the peak of DOC concentration which corresponds to the blooms of phytoplankton. This study demonstrates that the combination of these biogeochemical techniques can serve as an effective means to trace the origins and attributes of DOM in coastal environments.

Keywords: FDOM, EEM, fluorescence index, biological index, humification index

Multi-annual change of Jakarta Bay's carbonate system

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Abstract

Coastal regions are highly susceptible to acidification, which is primarily caused by organic matter input from rivers. The process of remineralizing this organic matter has significant implications for the carbonate system within coastal ecosystems. Jakarta Bay, located in Indonesia, is an estuary that receives an exceptional amount of organic materials from 13 river estuaries in the metropolitan area. While much is known about the environmental dynamics and ecological conditions, the variability of the carbonate system in this tropical coastal region remains relatively unknown. This study aimed to analyze the multi-annual changes in the carbonate systems in Jakarta Bay by examining model product datasets of pH and the partial pressure of carbon dioxide (pCO_2) and data fields of total alkalinity (Talk) and dissolved inorganic carbon (DIC). Our discussion begins with the evaluation of the Copernicus Marine Environment Monitoring Service (CMEMS) model product datasets using in situ observation data from multiple periods. We then conducted spatial distributions, seasonal patterns, and interannual variability analyses. Finally, we discussed the response of the carbonate systems to extreme climatic phenomena to gain a better understanding of the variability of carbonate systems in the nearby estuarine system.

Keywords: pH, total alkalinity, dissolved inorganic carbon, partial pressure of carbon dioxide, Jakarta Bay

Chromophoric dissolved organic matter in Bangpakong estuary, Thailand

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Abstract

Bangpakong River is one of the four major rivers draining into the Gulf of Thailand. It transports sediments and other materials both in dissolved and particulate forms through the estuary before reaching the eastern side of the upper Gulf of Thailand. Chromophoric dissolved organic matter (CDOM), a significant fraction of dissolved organic matter (DOM), plays an important role in mediating biogeochemical processes in natural waters. Here, we investigated the seasonal and spatial distribution of light absorption coefficients of CDOM by sampling surface water samples in November 2022 (wet season) and March 2023 (dry season). In the wet season, the absorption coefficient of CDOM at a wavelength of 355 nm, $a_{CDOM}(355)$, ranged from 2.54 m^{-1} to 7.96 m^{-1} and the slope ratio (S_R), a proxy for DOM molecular weight, ranged from 0.891 to 1.685. In the dry season, $a_{CDOM}(355)$ ranged from 2.64 m^{-1} to 6.52 m^{-1} and S_R ranged from 0.919 to 1.161. The relationship between $a_{CDOM}(355)$ and salinity indicated that CDOM was behaving mostly in a conservative manner with $a_{CDOM}(355)$ being higher in river water than in seawater. We also observed a spike in $a_{CDOM}(355)$ and marked changes in other absorption parameters associated with phytoplankton bloom during the wet season.

Key words: CDOM, Seasonal variation, Salinity gradient, Slope ratio, Absorption coefficient

Investigating the geochemical characteristics and associated toxicity of bioavailable metals around Singapore intertidal zones by diffusive gradients in thin films (DGT)

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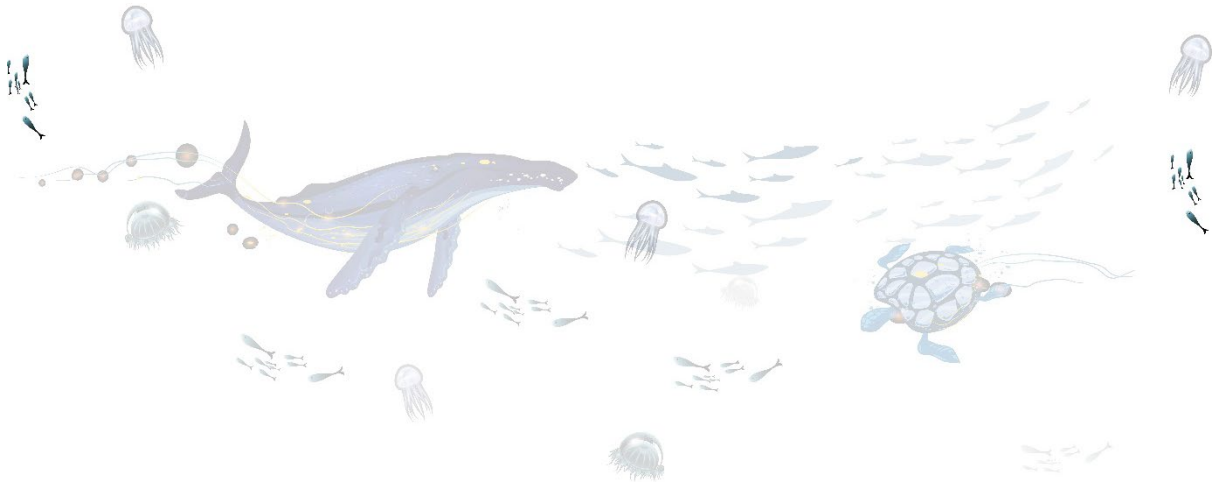
Abstract

Intertidal zones (ITZ) harbour rich biodiversity and are also extremely dynamic environments due to rigorous interactions among air, water and sediment. Additionally, ITZs near coastal cities may receive metal pollutants from anthropogenic sources due to its vicinity to coastal cities like Singapore. The metals in the ITZ are expected to undergo rigorous changes among sediment and water. To understand the dynamics of metals in the ITZ, assessing the sources, and the associated toxicity of the bioavailable metals, the diffusive gradient in thin films (DGT) are deployed in sediments. DGTs are capable of measuring labile metals from different depths of the sediments and porewaters. DGT probes with chelex100 resin gels were deployed at the ITZs of 5 sites, including Bendera Bay (sandy sediment), West Coast (sandy-muddy sediment), Check Jawa (sandy-muddy sediment) and Mandai Mudflats for 48 hours to a depth of about 12–15 cm. The gels from the harvested DGT probes were sectioned at intervals of 0.5 cm to analyse bioavailable concentrations and fluxes of Al, Cr, Mn, Fe, Co, Ni, Cu, Zn, As and Pb. The general order followed by the fluxes is Fe>Mn>(Al, Zn)>Cu>Ni>As>Pb>Cr>Co. The region of reductive dissolution inferred from peak fluxes of Fe and Mn are generally shallow (<4cm). This subsurface Fe maxima drives subsurface peaks in a series of other elements like As. At all the sites, bioavailable [Co] and [Pb] exceeded [Co] and [Pb] in seawater, suggesting the sediment might be a large reservoir for these metals, where possible disturbances (like dredging) may trigger release of metals. Pb and Al were highly correlated at all the locations (r=0.63-0.80), suggesting coherent processes governing the bioavailable Pb in the intertidal zones around Singapore coast. Pb also demonstrated high correlations with Co (r=~0.85), at West coast and Check Jawa. The cumulative flux of Cu, Ni, Pb and Zn normalised to water quality guideline (WQG) thresholds (DGT_{WQG}) for survival of 95 % of benthic organisms is a parameter for determining toxicity. DGT_{WQG} >36 DGT Toxic Units (DGT_{TU}) is deemed hazardous. However, the DGT_{WQG} around Singapore coasts ranged from 124–867 DGT_{TU}. The order of contribution percent towards the DGT_{WQG} follows Cu>Zn>Pb>Ni.

Keywords: intertidal zone, diffusive gradient in thin films, metal fluxes, bioavailable fraction

Sub-theme A:
Ocean Processes and Climate Change

Session A6:
Climate variability in the Indo-Pacific Maritime Continent (IPMC): Understanding impacts on atmosphere-ocean dynamics



Programme

Venue: Jubilee B, 11th Floor
Date: 23 April 2024

Conveners:

Dava Amrina	BMKG, Indonesia
Nelly Florida Riama	BMKG, Indonesia
Chidong Zhang	NOAA, USA

Time	Presentation Titles	Speakers
Section 1		
10:00–10:15	Comparison of FNL and ERA5 as WRF model input with incorporation of Reynolds OI SST in the simulation of atmospheric conditions during rain-induced flood events in Tangerang	Dendi Rona Purnama, *BMKG, Indonesia*
10:15–10:30	Reef temperature dynamics in the West Pacific from coral carbonate elemental ratio geochemistry	Timothy Glenn Iringan, *University of the Philippines, The Philippines*
10:30–10:45	Andaman local responses to 2016 super El Niño	Nuttida Chanthasiri, *Ocean University of China, China*
10:45–11:00	Exploring the spatiotemporal variations in soil moisture-precipitation relationship in the Maritime Continent	Pallav Ray, *Florida Institute of Technology, USA*
11:00–11:15	Identification of ENSO and IOD Impact on average monthly rainfall in Indonesia Maritime Continent by machine learning	Richard Mahendra Putra, *BMKG, Indonesia*
11:15–11:30	Characteristics of Jakarta rain rate associated with the Madden-Julian Oscillation and topography	Sopia Lestari, *BRIN, Indonesia*
11:30–11:45	Relationship between the Hadley circulation and tropical SST meridional structures under different thermal conditions in the Indo-Pacific warm pool	Xuanliang Ji, *Beijing Normal University, China*
11:45–12:00	Investigating inter-annual precipitation variability using moisture budget analysis in northern Sumatra Island during boreal summer and winter	Yahya Darmawan, *STMKG, Indonesia*
Section 2		
13:00–13:15	The effect of climate variability to the air-sea carbon flux in Indonesia Waters	Avrionesti, *Indonesia State College of Meteorology Climatology and Geophysics (STMKG), Indonesia*
13:15–13:30	The study of ocean wave climate variabilities around Indonesia Seas	Muhammad Arief Rahman, *BMKG, Indonesia*

Time	Presentation Titles	Speakers
13:30–13:45	Predictability of the ocean-atmosphere coupled system of the Indo-Pacific Maritime Continent	Chidong Zhang, *NOAA, USA*
13:45–14:00	Response of sea surface temperature on west coast of Sumatra Island during El Niño event in 2023	Nelly Florida Riama, *BMKG, Indonesia*
14:00–14:15	Detection of MJO characteristics in the Indonesian Maritime Continent	Ivonne M. Radjawane, *Bandung Institute of Technology, Indonesia*
14:15–14:30	The Influence of MJO and tropical waves during mesoscale convective complex (MCC) as an indicator of tropical cyclone development (case study: Tropical Cyclone Seroja)	Rion Suaib Salman, *BMKG, Indonesia*
14:30–14:45	Discovering ENSO modulation in the Indo-Pacific Maritime Continent (IPMC) through sparse identification of nonlinear dynamics (SINDy) Model using MJO Data	Widya Ayuningtiyas, *BMKG, Indonesia*
14:45–15:00	Effects of Indian Ocean Dipole initialization on the forecasting of La Niña one year in advance	Shouwen Zhang, *Southern Marine Science and Engineering Guangdong Laboratory (Zhuhai), China*
Section 3		
15:30–15:45	The freshwater distribution on the southern part of the Indonesian Throughflow during the Indo-Pacific climate anomaly using OFES data	Amirotul Bahiyah, *Sriwijaya University, Indonesia*
15:45–16:00	The new operational of Indonesian Ocean Forecast System based on high resolution couple atmosphere-wave-ocean model (InaCAWO)	Furqon Alfahmi, *BMKG, Indonesia*
16:00–16:15	Study on ocean heat content during the n-IOD 2010 and p-IOD 2012 events along the western Sumatra until southern Java Islands waters	Ivonne M. Radjawane, *Bandung Institute of Technology, Indonesia*
16:15–16:30	Impact of Indonesia Throughflow on tropical cyclone genesis in the Banda Sea	Khafid Rizki Pratama, *BMKG, Indonesia*
16:30–16:45	Seasonal and interannual variability of fronts and their impact on chlorophyll-a in the Indonesian seas	Yuntao Wang, *Second Institute of Oceanography, China*
16:45–17:00	**Discussion**	

Comparison of FNL and ERA5 as WRF model input with incorporation of Reynolds OI SST in the simulation of atmospheric conditions during rain-induced flood events in Tangerang

Dendi Rona Purnama, Yosafat Donni Haryanto, Nelly Florida Riama, Praditya Tito Yosandi, and Bagas Briliano

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Abstract

On 13th November 2022, the Tangerang area suffered from flooding due to very heavy rain. To reduce the impact caused by hydrometeorological disasters, improving the quality of weather prediction is one of the essential factors that can be used as a reference for early action in disaster emergency response. Various numerical weather modeling platforms have been widely studied and used operationally, including the WRF model. This study used the WRF model to analyze the atmospheric conditions on 13th November 2022 in Tangerang. The experiment conducted in this study was to provide different model input data into the WRF model. The model input data used include FNL and ERA5, with an SST update option using Reynolds Optimum Interpolation. The results showed that the WRF model with ERA5 provided a lower RMSE value and higher correlation than FNL. Experiment with ERA5 is able to show at which hours the highest rain intensity has occurred. The results of the WRF model analysis using ERA5 data show that there are convergence and shear lines, and this has resulted in strong convective activity, especially around the Tangerang area.

Keywords: heavy rain, WRF, FNL, ERA5, Reynolds OI SST

Session A6: Climate variability in the Indo-Pacific Maritime Continent (IPMC): Understanding impacts on atmosphere-ocean dynamics

Reef temperature dynamics in the West Pacific from coral carbonate elemental ratio geochemistry

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[2] *University of Southampton, United Kingdom*

Abstract

Carbonate biomineralization contains geochemical information of past seawater conditions from whence it was formed. Numerous studies have investigated elemental ratios such as sea surface temperature (SST) proxies used in the context of climate fluctuations, ocean warming, and in the calibration of other parameters such as δ^{11}B-derived pH. Analysis of these indicators is especially useful for periods before instrumentation and in areas without continuous monitoring, as is the case for most regions in the West Pacific. In this study, a suite of temperature proxies (Sr/Ca, Mg/Ca, U/Ca, Li/Mg) were measured using laser ablation–inductively coupled plasma–mass spectrometry (LA–ICP–MS) on a *Porites* sp. core sampled in Surigao del Norte, eastern Philippines, which is influenced by large-scale processes such as the El Niño Southern Oscillation (ENSO) and Pacific Decadal Oscillation (PDO) along with local variations. A core with a temporal range of approximately 40 years is selected and is measured at a submonthly resolution. These proxies were calibrated against MUR-SST (Multi-scale Ultra-high Resolution Sea Surface Temperature Analyses) temperature data of daily resolution and were compared using Pearson's correlation to determine the best-fitting temperature indicator for the locality. Among the proxies, both Mg/Ca and Sr/Ca showed high correlation with satellite data while Li/Mg showed poor correlation. This discrepancy between Mg/Ca and Li/Mg, both utilizing magnesium, may be due to impingement of fluvial plumes to the reef, as suggested by Ba/Ca ratios, which subsequently altered chlorinity and thus Li concentrations. Both geochemical and remotely sensed data were subjected to low pass filtering to quantify variations due to ENSO and/or PDO, while power spectral density analysis was used to confirm these variations. Finally, interdecadal SST trends were analyzed and compared with contemporary data in the region.

Keywords: sea surface temperature, carbonate geochemistry, *Porites*, West Pacific

Session A6: Climate variability in the Indo-Pacific Maritime Continent (IPMC): Understanding impacts on atmosphere-ocean dynamics

Andaman local responses to 2016 super El Niño

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Abstract

Distinctive coral bleaching events in the Andaman Sea were noticed in spring 1998, 2010, and 2016, synchronously with El Niño decaying phase. However, the critical severity was announced in 2010, which was not a super El Niño year like the other two. Besides coral adaptation, the physical background that gives negative feedback in super El Niño year therefore needed to be understood. Evidence of lagging between Optimum Interpolation Sea Surface Temperature (OISST) based primarily on satellite data from the Advanced by High Resolution Radiometer (AVHRR) and sea temperature logger located 10-20 meter beneath the surface in the coral reef areas was intensely distinguished in 2016. Upwelling-like subsurface structure during 2016 El Niño decay were also captured from Thailand-China Joint cruise observations. Equatorial remote forcing and local dynamics are thereby hypothesized as subsurface colder attributions. Strong easterly wind anomalies are captured in the Equatorial Eastern Indian Ocean (EEIO) during El Niño peak (DJF) of 1998 and 2016. Besides strong positive SLA in the following El Niño decay phase, westerlies favorable Wyrtki Jet could be opposed by anomalous easterlies. WJ in 2016 therefore came late compared to strong WJ year in 2003, resulting in delay deepening thermocline in EEIO. Regarding SLA waveguide, cold subsurface water in Andaman Sea therefore remained longer before deepened thermocline arrived. SLA not only indicate equatorial Kelvin wave pathway, but also capture meso-scale eddies in then Andaman Sea. Daily-snapshots SLA show meso-scale eddies north and south of 8.5°N of Andaman Sea during spring 2016. Colder subsurface could be attributed to anomalous easterly wind stress occupied in Andaman Sea, promoting cyclonic eddies and lowering SLA between the gyres.

Keywords: Andaman Sea, coral bleaching, Wyrtki Jet, meso-scale eddies, upwelling-like

Session A6: Climate variability in the Indo-Pacific Maritime Continent (IPMC): Understanding impacts on atmosphere-ocean dynamics

Exploring the spatiotemporal variations in soil moisture-precipitation relationship in the Maritime Continent

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Abstract

The Maritime Continent (MC) plays a vital role in modulating global weather and climate through the release of latent heat of condensation. Precipitation is one of the primary parameters controlling soil moisture (SM), and, in turn, is affected by SM. Yet, the spatio-temporal variations of the SM-precipitation relationship in the MC have rarely been studied. We aim to understand the SM variabilities and their local and remote drivers over the MC using Soil Moisture Active-Passive (SMAP) satellite data from 2015 to 2022. The annual SM climatology resembles the annual rainfall pattern, with high SM (above 0.4 mm^3/mm^3) across the equatorial belt, particularly over the central part of Papua New Guinea. The seasonal evolution of SM follows the monsoonal migration of rainfall, with higher SM during boreal winter (DJF) and lower during April and August. However, the diurnal cycle of SM contrasts that of precipitation: the precipitation tends to peak in mid-afternoon, SM rises through late afternoon, peaks early the following morning, and then reaches a minimum around noon. The SM also shows significant intraseasonal variability with a 3-day lag with precipitation over the MC. Interestingly, SM also shows a 13-day negative correlation with precipitation in the intraseasonal timescale, where the SM leads precipitation. We also explore the role of major climate drivers that influence the SM in the MC using the Empirical Orthogonal Function (EOF) analysis. The first EOF mode is dominated by interannual variability connected with the El-Niño Southern Oscillation (ENSO) and Indian Ocean Dipole (IOD). There is a sharp decrease in SM due to decreased precipitation during the combined El-Nino-positive IOD years. The second EOF mode exhibits pronounced intraseasonal variability and is influenced by the Madden-Julian Oscillation (MJO). The results suggest that a decrease in MC soil moisture tends to precede MJO phases 1 and 2 when convection is generally enhanced over the Indian Ocean but suppressed over the eastern MC and western Pacific region by about two weeks. The implications of these results are discussed.

Keywords: maritime continent, soil moisture, MJO, diurnal cycle, ENSO

Identification of ENSO and IOD Impact on average monthly rainfall in Indonesia Maritime Continent by machine learning

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Abstract

For Indonesia Maritime Continent region, large-scale climate conditions are a highly significant factor influencing the rainfall intensity. Not only affected by conditions in the Pacific Equator (ENSO), the climate condition of Indonesia is also influenced by sea conditions in the Pacific known as the Indian Ocean Dipole (IOD). Recently, machine learning techniques have become a method used to detect and predict future climate conditions, as well as reproduce historical climate conditions. For these reasons, we conduct the study to identify the role of machine learning in analyzing historical conditions and the influence of ENSO and IOD on the monthly average rainfall in the Indonesian Maritime Contingent region. The dataset used in this research are monthly data from January 2001 to December 2020. The machine learning methods employed include Neural Network (NN), Linear Regression (LR), and Random Forest (RF). Monthly rainfall intensity is less simulated using NN and LR methods, with correlation values ranging from 0.058 to 0.382 for the Training Dataset and Testing Dataset with Cross Validation Fold-10. Meanwhile, the RF technique can simulate monthly rainfall intensity well over the 20-year historical climate data period with a correlation value of 0.9534.

Keywords: ENSO, IOD, machine learning

Session A6: Climate variability in the Indo-Pacific Maritime Continent (IPMC): Understanding impacts on atmosphere-ocean dynamics

Characteristics of Jakarta rain rate associated with the Madden-Julian Oscillation and topography

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Abstract

The Madden-Julian Oscillation (MJO) has been known to cause an increase of rainfall in Jakarta and surrounding regions. However, study on the interaction between MJO and rainfall in this region is limited. This research explores variations of local rainfall around Jakarta during MJO. We used C-band Doppler radar in October–April between 2009 and 2012 to characterize rain rate at much higher resolution than previous studies. Results show that MJO regulates rain rate over the region, but its influence varies in different topography. In phase 2 of strong MJO, the largest increase in mean and extreme rain rate is found. The MJO might generate lighter rain rate once it passes through Indonesia and higher rain rate when it comes nearer and departs Indonesia. The peak of hourly rain rate occurs at phase 2 over mountain and lowland areas in the southern radar domain, but later in phase 3 over the northern coast. In phase 5, over the northern coast and western part of radar domain, the strong MJO seems to initiate the maximum of hourly rain rate occurring in the early morning (02–03 LT) while over the eastern radar, MJO delays the peak by about 4 hours (18–21 LT) relative to the average. Our study has shown the advantages of using high-resolution radar for identifying local responses to the larger-scale forcing of the MJO in Indonesia.

Keywords: C-band Doppler radar, Jakarta, MJO, diurnal rainfall, topography

Session A6: Climate variability in the Indo-Pacific Maritime Continent (IPMC): Understanding impacts on atmosphere-ocean dynamics

Relationship between the Hadley circulation and tropical SST meridional structures under different thermal conditions in the Indo-Pacific warm pool

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[4] Laboratory for Ocean Dynamics and Climate, Pilot Qingdao National Laboratory for Marine Science and Technology, Qingdao, China

Abstract

The Hadley circulation (HC) induced by tropical underlying thermal conditions acts a significant role in the changes of global climate. The modulation of Indo-Pacific warm pool (IPWP) thermal conditions on the relationship between the HC and different tropical sea surface temperature (SST) meridional structures was investigated. Based on the two components of HC and SST, one equatorially asymmetric component (HEA for HC, SEA for SST) and one equatorially symmetric component (HES for HC, SES for SST), the connections of HC to different SST variations in the warm and cold IPWP are explored. The result demonstrates that the relationship of the HC to tropical SST is suppressed in the cold IPWP conditions, whereas it is equivalent to the climatology in the warm IPWP conditions. The plausible mechanism is that the cold (warm) IPWP events are in concordance with the La Niña (El Niño) decay phase. The La Niña decay phase are associated with significant equatorially asymmetric SST anomalies within the IPWP, generating an anomalous meridional circulation and favoring a strengthened equatorially asymmetric anomalous meridional circulation. By contrast, the SST anomalies associated with the El Niño decay phase are insignificant. The role of La Niña decay conditions in determining the suppressed connection between SST and HC is further verified by exploring the result after 1979. A similar suppressed response contrast has been detected. Therefore, the results demonstrate that warm and cold ENSO events have impacts on the interannual thermal conditions of IPWP, whereby it plays a considerable role in impacting the relationship between the HC and tropical SST. Particularly, with the rapid warming, the interconnection between ENSO events and thermal conditions of IPWP under different time-scales could be altered, the influence of which on the responses of the HC to tropical SST remains uncertain and is worthy further researching.

Keywords: Hadley circulation, sea surface temperature, Indo-Pacific Warm Pool, El Niño, La Niña

Session A6: Climate variability in the Indo-Pacific Maritime Continent (IPMC): Understanding impacts on atmosphere-ocean dynamics

Investigating inter-annual precipitation variability using moisture budget analysis in northern Sumatra Island during boreal summer and winter

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Abstract

This study aims to investigate the characteristics of precipitation anomalies in the northern parts of Sumatra Island during boreal summer and winter. Additionally, it examines the monsoon's varying impact on triggering precipitation variability in the study area. The analysis applies a moisture budget analysis to quantify the dominant component inducing precipitation variability during the JJA (June, July, and August) and DJF (December, January, and February) periods. Specifically, the moisture budget focuses solely on land precipitation, accounting for removing topographical effects in the budget model. Composite analysis and statistical approaches validate the moisture budget results. Utilizing the European Centre for Medium-Range Weather Forecasts (ECMWF) Re-Analysis Interim (ERA-Interim) data from 1981 to 2016, this study identifies nine dry and six wet years based on precipitation anomalies during JJA. For DJF it identifies eight dry and eight wet years based on precipitation anomalies. During both Boreal Summer and Winter, dry (wet) year anomalies over the study area predominantly correlate with downward (upward) vertical velocity anomalies rather than other variables like specific humidity, horizontal velocity, or evaporation. Furthermore, the moisture budget analysis shows the difference in magnitude of precipitation anomalies between boreal summer and winter, where the anomalies during summer are higher than in winter. The study demonstrates the significant role of monsoon Asian-Australian Monsoon (AAM) variability in influencing precipitation variability in the study area, especially during boreal summer. Moreover, it implies the precipitation variability over the northern part of Sumatra Island as a regional phenomenon. The study also highlights the possible relationship between large-scale tropical circulation and the Pacific Walker Circulation (PWC) modulation.

Keywords: Moisture Budget, Inter-Annual Precipitation, Monsoon, Sumatra Island, ERA-Interim

The effect of climate variability to the air-sea carbon flux in Indonesia Waters

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Abstract

The ocean as one of the global carbon reservoirs has the largest capacity among other carbon reservoirs, the biosphere and atmosphere. The ratio of reservoir capacity among the three is approximately 53:3:1, causing the ocean to play an important role in controlling the carbon globally, especially in the atmosphere. Here, we examine how carbon flux is influenced by climate variability in Indonesia, namely the ENSO and MJO phenomena. The carbon flux calculations are carried out using the open-source model, the FluxEngine. The carbon exchange process from the ocean to the atmosphere is determined by solubility, wind speed, and the partial pressure of carbon dioxide. In general, warmer ocean water during La Nina and active MJO conditions leads Indonesian waters to release more CO2 than during El Nino conditions due to reduced gas solubility in the water. An increased wind speed due to increased trade winds and convective activity when La Nina and MJO also strengthens the release of carbon from the ocean into the atmosphere.

Keywords: carbon flux, air-sea interaction, ENSO, MJO

The study of ocean wave climate variabilities around Indonesia Seas

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Agency for Meteorology Climatology and Geophysics (BMKG), Indonesia

Abstract

This study investigates the spatial-temporal variability of ocean wave climate in the Indonesian seas based on 20 years of wave data from a wave model hindcast called Ina-waves. The wave hindcast dataset is forced with the GFS and NCEP-NFL surface winds for the coarse domain and a 10 km resolution WRF model for the Indonesian high-resolution domain. The hindcast data provides information on significant wave height, wave period, and wave direction, allowing for a comprehensive analysis of wave climate dynamics over an extended period. The study focuses on the influence of regional climate factors on wave patterns, such as monsoonal winds, tropical cyclones, and large-scale climate oscillations such as the Madden-Julian Oscillation (MJO), El Nino-Southern Oscillation (ENSO), and Indian Ocean Dipole (IOD). In addition, wind speed analysis was carried out to improve the assessment of the impact of regional climatic drivers. The key findings indicate that the IOD, ENSO, and MJO all have a significant impact on wave conditions in Indonesian seas. Positive phases of the IOD and El Nino events are related to high wave activity in specific regions of the Indonesian seas as a result of changes in atmospheric circulation patterns, which impact trade wind patterns and result in higher wave heights in particular regions. On the other hand, negative phases of the IOD and La Nina occurrences may result in lower wave activity due to weaker trade winds. Because of its influence on atmospheric convection and wind patterns, the MJO can contribute to the variation of wave conditions in the region. It should be noted that the combined effect of these climate drivers on ocean wave height varies regionally and seasonally. Furthermore, understanding these complex relationships is essential for improving wave height forecasting and assessing the impact of climate change on coastal regions and maritime activities.

Keywords: ocean wave, spatial-temporal variations, Ina-waves, Indonesian seas

Predictability of the ocean-atmosphere coupled system of the Indo-Pacific Maritime Continent

Chidong Zhang

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Abstract

Because of its critical role in global weather and climate, the Indo-Pacific Maritime Continent (MC) is a primary target of global weather-climate prediction. Interactions between the ocean, atmosphere, and land in the MC, however, are not well understood. Particularly, the role of this interaction in the predictability of many important phenomena related to the MC, for example, the Madden-Julian Oscillation, is mostly unknown. This study discusses issues related to the study of predictability of the ocean and atmosphere of the MC and its possible connection to the predictability on broader basin and global scales.

Response of sea surface temperature on west coast of Sumatra Island during El Niño event in 2023

Ferdy Gustian Utama, Fara Diva Claudia, and Nelly Florida Riama

Meteorology, Climatology, and Geophysic Agency of Indonesia (BMKG), Indonesia

Abstract

The Nino 3.4 Index in 2023 shows a gradual increase from March until the end of the year. This condition illustrates the strengthening of the El Niño phenomenon in the Pacific region and reaches the Indonesian Maritime Continent. The response of sea surface temperature on the west coast of Sumatra Island due to the ongoing El Niño phenomenon was analyzed using descriptive methods based on *ODYSSEA Global Sea Surface Temperature Gridded Level 4 Daily Multi-Sensor Observations* data image. This research also uses the Fast Fourier Transform and power spectral density method as part of time series analysis. Time series analysis aimed to determine how strong the influence of the El Nino signal affects the variability of sea surface temperature on the west coast of Sumatra. The sea surface temperature image shows negative anomalies, especially at the southern equator area of the west coast of Sumatra Island. The temperature drop reaches approximately 3^{O}C which occurred in October - November, indicating the occurrence of coastal upwelling phenomena.

Keywords: Sea Surface Temperature, El Nino, West Coast Sumatra

Session A6: Climate variability in the Indo-Pacific Maritime Continent (IPMC): Understanding impacts on atmosphere-ocean dynamics

Detection of MJO characteristics in the Indonesian Maritime Continent

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Abstract

The Indonesian Maritime Continent (IMC) is a unique archipelagic country surrounded by several ocean-atmosphere interaction phenomena, including the intraseasonal Madden Julian Oscillation (MJO) events marked by strong convection propagates in equatorial area from Indian to Pacific Oceans. This study is focused on detecting the MJO characteristics which cross IMC in phases 3 to 5. The data used in this research includes Outgoing Longwave Radiation (OLR), SST, real-multivariate MJO (RMM) or RMM index, SST and wind of 850 hPa from the years 1988–2017. The research was conducted using several methods e.g. energy spectrum analyses, zero down crossing methods, and Hovmöller diagrams to review the characteristics of MJO. The results of analysis of OLR anomaly using the zero down crossing method show that there are 274 negative OLR anomaly events that propagate eastward but only 93 events (33.9%) are detected as MJO phenomenon. From the data analysis, there is 80.6% of MJO events can cross the IMC (Maritime Continent Crossing or MC-C) and 19.3% cannot cross the IMC (Maritime Continent Non-Crossing or MC-NC). This condition is also influenced by seasonal factors where during boreal winter more MC-C cases are found. The incidence of MC-C in boreal winter (53.3%) is higher than MC-NC (46.6%). There is suspected influence of IOD and ENSO phenomenon on the transmission of MJO that need to be studied further.

Keywords: Madden Julian Oscillation (MJO), Indonesian Maritime Continent (IMC), Outgoing Longwave Radiation (OLR)

The Influence of MJO and tropical waves during mesoscale convective complex (MCC) as an indicator of tropical cyclone development (case study: Tropical Cyclone Seroja)

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Abstract

As an early initiation of convective system in tropical region, Madden Julian Oscillation (MJO) and Tropical Waves, such as Kelvin and Rossby Wave play important role to produce an extraordinary formation of cloud, comprise the distinct life cycles of individual convective cells, bow echoes, and squall lines. Despite being separate entities, they come together to create a more extensive cloud system. Tropical Cyclone (TC) Seroja detected on 2nd April 2021 in East Nusa Tenggara province, Indonesia. It caused tremendous natural hazards, such as flooding, flash flooding, storm surge and landslides on some small islands. However, before the TC developed, Mesoscale Convective Complex (MCC) was spotted in Banda Sea on 30 March–1 April 2021. To analyze the MCC growth, MJO and tropical wave from North Carolina Institute for Climate Study (NCICS) data were used to determine the mesoscale dynamic. After that, by using weather satellite data (Himawari-8) from Japan Meteorological Agency (JMA) to observe the convective initiation of each cloud formation from 30 March to 1 April 2021. The result showed that the cloud formation developed by MCC in Banda Sea with intensive and massive four stages from initiation, development, mature stage, and dissipating. Another important point is that the main sources supporting the instability in the area is the active phase (4 and 5 phase) of MJO in the maritime continent. For the tropical waves, significant increase was observed for Kelvin and Rossby waves. This means MJO and tropical wave support the MCC to develop in Banda Sea and give chance to warm advection and low-level winds with strong vertical veer. Also, low-level convergence and upper-level divergence low-level warm temperature advection together with cyclonic vorticity advection increasing with height throughout the troposphere, causing maximum upward motion maximum at the mid-levels. In addition, from weather satellite data detected cloud formation and overshot in each development of Cumulonimbus (CB). Some areas of development showed minimum temperature of the top cloud and deep convection mixing with moisture of the environment. To conclude, MJO and tropical wave activities directly support MCC development and it becomes an important signal for tropical cyclone development.

Keywords: MJO, tropical waves, MCC, tropical cyclone

Discovering ENSO modulation in the Indo-Pacific Maritime Continent (IPMC) through sparse identification of nonlinear dynamics (SINDy) Model using MJO Data

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Centre for Marine Meteorology, Indonesia Agency of Meteorology, Climatology, and Geophysical (BMKG), Indonesia

Abstract

The Madden-Julian Oscillation (MJO) is an atmospheric planetary scale phenomenon that exists over the tropical region with global impacts. Investigating MJO behavior can be conducted through the inferred models, revealing its main kinematic characteristics, the relevance of non-linear dynamics, and MJO's dependency on ENSO. Understanding ENSO modulation in the Indo-Pacific Maritime Continent helps in predicting and recognizing temperature variations, rainfall patterns and extreme weather in the affected hemisphere. This research infers low-dimensional models of MJO data by applying the Sparse Identification of Nonlinear Dynamics (SINDy) algorithm. This research uses the daily-mean outgoing longwave radiation MJO index (OMI) from December to March within the period from 1980 to 2022 as input data for climatological models of the MJO and analyzes the inferred models during El Niño and La Niña years. This aims to analyze the MJO's behavior in OMI's phase space. The findings from this research reveal that the MJO is most commonly characterized by a harmonic oscillator, representing its eastward propagation and characteristic period. Additionally, SINDy can effectively model the MJO's evolution as a linear oscillator, contributing to the comprehension of MJO dynamics and its dependency on ENSO.

Keywords: ENSO Modulation, IPMC, MJO, SINDy

Session A6: Climate variability in the Indo-Pacific Maritime Continent (IPMC): Understanding impacts on atmosphere-ocean dynamics

Effects of Indian Ocean Dipole initialization on the forecasting of La Niña one year in advance

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Abstract

The climate systems over the Indian and Pacific oceans interact with each other at the interannual time scales. The Dipole Mode Index (DMI) is found to lead the Niño3 index by more than one year. Traditional understanding of this precursory relationship is thought through the atmospheric bridges, a.k.a. the Walker Cell variability. Latest studies suggest that the oceanic channel process, i.e. the Indonesian Throughflow (ITF) variability, plays a dominant role in the inter-basin interactions, which quickly emerges as a hot research topic. However, due to the concurrent ENSO and Indian Ocean Dipole (IOD) events in history, the effects of an IOD on the evolution of ENSO are contaminated by the repercussions of the ENSO. In 2019, a strong IOD took place in the Indian Ocean, with the tropical Pacific in a neutral state throughout that year, which provides an opportunity to test the effectiveness of the oceanic channel dynamics. A strong La Niña event indeed took place at the end of 2020, the dynamics of which are investigated using the China National Marine Environmental Forecasting Center (NMEFC) operational seasonal forecasting system. The strong subsurface cooling in the Indian Ocean is found to propagate to the eastern equatorial Pacific Ocean through the Indonesian seas and induce a strong La Niña event at the end of 2020, suggesting the dominance of the oceanic channel in the inter-basin forcing leading to the outburst of the 2020/2021 La Niña. In comparison, experiments initialized with only surface temperature anomalies over the tropical Indian Ocean show that the atmospheric bridge alone is unable to induce the onset of the 2020/2021 La Niña. Forecasting experiments of historical ENSO events with and without the IOD initializations suggest that both the delayed feedback of ENSO and the Indo-Pacific oceanic channel dynamics are important in forecasting the ENSO. Our study has underscored the effectiveness of Indian Ocean subsurface temperature initialization in ENSO prediction at the one-year lead time and suggested the importance of the Indo-Pacific oceanic channel dynamics in ENSO evolution.

Keywords: Indian Ocean Dipole, La Niña forecast, oceanic channel, atmospheric bridge

Session A6: Climate variability in the Indo-Pacific Maritime Continent (IPMC): Understanding impacts on atmosphere-ocean dynamics

The freshwater distribution on the southern part of the Indonesian Throughflow during the Indo-Pacific climate anomaly using OFES data

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Abstract

The freshwater plug in the main routes of Indonesian throughflow (ITF) is a powerful phenomenon that has significantly affected the water mass characteristics of the southern Indonesian Sea, notably from the Java Sea to the Banda Sea. The Indo-Pacific climatic anomalies also influence this ocean-atmospheric change. Using OFES data, this study explores freshwater flow at the surface and subsurface over the Java Sea to the Flores Sea. The salinity front and salinity budget formula were used in research studies to quantify the influence of surface flux, river discharge, and zonal advection in varying freshwater distribution over the study period. The Karimata Strait contributes to freshwater advection in the Makassar Strait and reaches the Indonesian Sea's deepest basin. Whereas, rainfall on Borneo Island has a substantial influence on the freshening sea through precipitation and river flow in the southern and eastern sections. Due to the lack of river discharge data, the contribution fluctuation of its parameter to sea freshening and the phenomena of freshwater plug under Indo-Pacific climatic events in Indonesian seas was previously unknown. The study area widely showed a salinity front with the value reaching more than 1 PSU. Shorter existence periods (Jan to May) were discovered in 2015 and 2016 as the result of extreme El Niño 2015–2016 and low positive IOD 2015 events, whereas the anomalies along Jan-May 2019 and 2020 were influenced by moderate El Niño 2018–2019 and extreme positive IOD 2019 events. This condition was followed by a lower total of front less than $1x10^2$ PSU. The longer periods occurred from January to June 2017 and 2018 attributed to moderate negative IOD 2016 and low La Niña 2018. However, wider frontal areas were illustrated in 2017 than in 2018 due to heavier rainfall anomalies on Borneo Island with a difference of total front value around $0.6x10^2$ PSU. Input sources

of river run-off are identified from Borneo Island, particularly from the eastern (southern) of Borneo where drainage actively supplied river runoff during Jan–Jun (Apr–May). It can be concluded that the low salinity water mass with its distribution is influenced a lot by river discharge from Borneo Island with its energy determined by Indo-Pacific climate anomalies.

Keywords: River discharge, Salinity Budget, Salinity Front, Salinity Flux, The main pathway of ITF

The new operational of Indonesian Ocean Forecast System based on high resolution couple atmosphere-wave-ocean model (InaCAWO)

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Indonesian Agency for Meteorology Climatology and Geophysics, Jakarta, Indonesia

Abstract

InaCAWO is a new part of the Indonesian Ocean Forecast System (BMKG-OFS) that was developed by the Indonesian Agency for Meteorology, Climatology, and Geophysics in collaboration with NC State University and Baron Weather in 2023. BMKG-OFS has been operated since 2004 to provide marine weather predictions and ocean modeling, especially for the Indonesian sea area continuously and in real-time conditions. In earlier stages, BMKG-OFS used wave modeling (Windwave-05, Wavewatch-III) with atmospheric modeling (WRF, GFS) as a forcing, separately. Couple modeling in these stages has the purpose of creating simulations with more accurate and more realistic conditions. The InaCAWO model is built upon the COAWST model. It includes the regional oceanic model (ROMS), the atmospheric model (WRF), and the Simulating Wave Nearshore (SWAN) model. The system is linked to the Model Coupling Toolkit (MCT), a compilation of information modeling procedures. The spatial and temporal resolution of the model InaCAWO is approximately 3 km, with an hourly timestep, a 2036 x 1116 grid, and 70 vertical layers. ECMWF is used for initial and boundary conditions in atmospheric modeling, while MERCATOR is used for ocean modeling. The atmospheric parameters of InaCAWO have been evaluated using mean sea level, surface wind speed, and daily precipitation based on synoptic observations over a period of one year despite the evaluation of ocean parameters based on satellite and drifter observations. The result indicates that the model's accuracy with contingency methods for all parameters is approximately 80%. InaCAWO is also capable of capturing a variety of unique Indonesian phenomena, such as the mixing process in Indonesian Throughflow with T-S Diagram, Eddy Circulations, flow Intensifications in narrow straits, and freshwater discharge.

Study on ocean heat content during the n-IOD 2010 and p-IOD 2O12 events along the western Sumatra until southern Java Islands waters

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[2] *Graduate Program in Earth Sciences, Bandung Institute of Technology, Bandung, Indonesia*

Abstract

Ocean heat content is one of indicators that can be used to predict the Indian Ocean Dipole phenomenon. This research aims to assess the changing of ocean heat contents and temperature profile during negative IOD 2010 and positive IOD 2012 along the western Sumatra until south Java Islands waters. The temperature data was obtained from HYbrid Coordinate Ocean Model (HYCOM) reanalysis model, while ocean heat content was calculated from temperature data. Based on the results, it has shown that the negative temperature anomaly at the n-IOD 2010, formed in the subsurface layer four months earlier of the n-IOD event and ended about six months after n-IOD event ended. For p-IOD 2012, the positive temperature anomaly in the surface layer has formed since the beginning of the year and coincides with the onset of p-IOD in the subsurface layer. Enhancement positive (negative) temperature anomaly in n-IOD (p-IOD) events was followed by increasing (decreasing) of the ocean heat content. The La-Niña phase coinciding with 2010 IOD caused the positive temperature anomaly to still occur even though the n-IOD event had ended. In contrast, the La-Niña phase that precedes the p-IOD event inhibits the formation of temperature anomalies, especially in the subsurface layer.

Keywords: Indian Ocean Dipole (IOD), ocean heat content, sea surface height, South Java Seas, West Sumatra Seas

Impact of Indonesia Throughflow on tropical cyclone genesis in the Banda Sea

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Abstract

This study aims to determine heat transport in the Indonesian Throughflow (ITF) passages that have an impact on changes in ocean heat content (OHC) and their relation to tropical cyclone genesis in the Banda Sea over the 2009–2019 period. During El Niño, meridional currents and ITF transport with an average depth of 0-300 meters experience a weakening, while during La Niña, they tend to strengthen. In terms of the vertical profile, heat transport in the Makassar Strait during La Niña was detected to be stronger in the Labani Channel and near the coast of Central Sulawesi, with values of 1.2 PW and 0.6 PW, respectively. The Lifamatola Strait was identified as strengthening in the Lifamatola Channel and the Halmahera Strait with a value of 0.5 PW and 0.3 PW, respectively. The results of the lag correlation between heat transport and the Oceanic Niño Index (ONI) show that the time lag during El Niño (La Niña) is around 7-8 (3–4) months. The correlation between the heat transport in the two straits and the ocean heat content in the Banda Sea results in a time lag of 3–4 months. OHC increased along with the strengthening of heat transport due to the strengthening of the ITF. During El Niño (La Niña) causing SSH elevation to decrease (increase), ITF and heat transport to weaken (strengthen), and OHC to decrease (increase). The intensity of tropical cyclone events shows that there are differences related to fluctuations in heat transport and ITF transport. The characteristics of a strong tropical cyclone in Category 1 with a short duration of movement are affected by an increase in OHC. In contrast, long-duration tropical depressions (TD) are affected by decreasing OHC. TD and tropical cyclone events in the Banda Sea have been identified to occur along 5°S to 6°S.

Keywords: heat transport, ocean heat content, Indonesia Throughflow, tropical cyclone

Seasonal and interannual variability of fronts and their impact on chlorophyll-a in the Indonesian seas

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[5] *School of Oceanography, Shanghai Jiao Tong University, Shanghai, China*

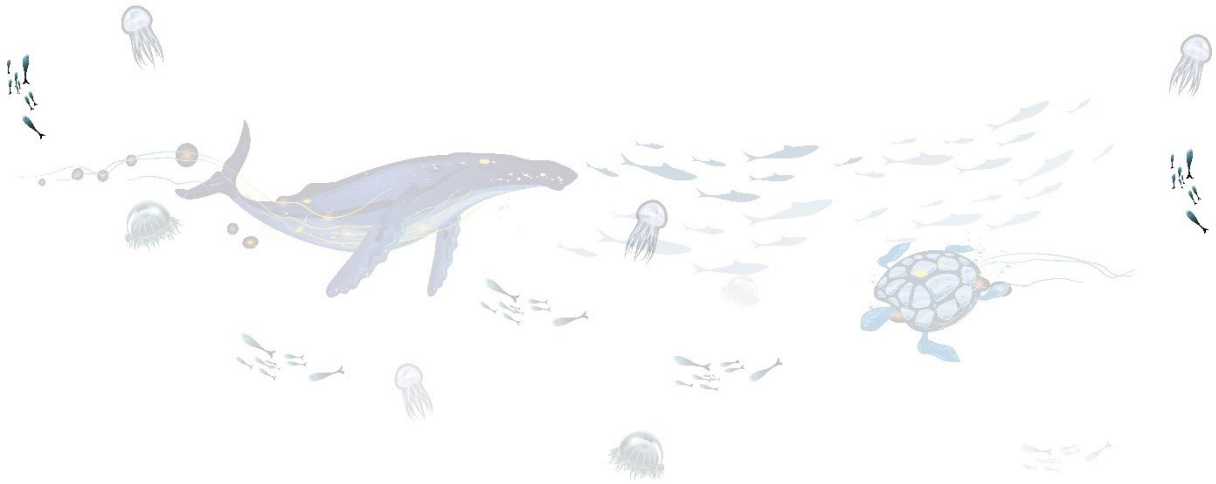
Abstract

The spatiotemporal variability of oceanic fronts in the Indonesian seas was investigated using high-resolution satellite observations. The study aimed to understand the underlying mechanism driving these fronts and their impact on chlorophyll-a variability. A high value of frontal probability was found near the coasts of major islands, exhibiting a distinct seasonal cycle with peaks occurrences during austral winter. The distribution variability of chlorophyll-a was generally consistent with the presence of active frontal zones, although a significantly positive relationship between fronts and chlorophyll-a was limited to only some specific areas, e.g., south Java Island and the Celebes Sea. Wind-driven upwelling played a major role in front generation in Java upwelling region and enhanced frontal activity can promote the growth of phytoplankton, leading to higher chlorophyll-a. Furthermore, the study demonstrated that wind patterns preceded variations in front probability and chlorophyll-a by approximately two months. This lag suggests that the spatiotemporal variability of fronts and chlorophyll-a in this region is primarily influenced by the monsoon system. In addition, the sea surface temperature (SST) simultaneously modulated the chlorophyll-a variability. Negative SST anomalies were typically associated with positive anomalies in front probability the chlorophyll-a in most areas. Notably, the interannual variability of fronts and chlorophyll-a are prominent in the Java upwelling region. During El Niño years, this region experienced an enhanced monsoon, resulting in a negative SST anomaly alongside positive anomalies in front probability and chlorophyll-a. A comprehensive description and underlying dynamics of frontal activity in the Indonesian seas are provided by this study. The findings are helpful to delineate the variability in chlorophyll-a, thereby facilitating the future understanding of local primary production and the carbon cycle.

Keywords: frontal probability, chlorophyll-a, wind stress, Indonesian seas, interannual variability

Sub-theme B: Marine Biodiversity, Seafood Safety and Security

Session B1: Biogeography and dispersal of marine life in the Western Pacific



Programme

Venue: Kensington B, 5th Floor
Date: 23 April 2024

Conveners:

Youn-Ho Lee	Korea Institute of Ocean Science and Technology, Republic of Korea
Ephrime B. Metillo	Mindanao State University-Iligan Institute of Technology, The Philippines
Zainal Arifin	BRIN, Indonesia

Time	Presentation Titles	Speakers
Section 1		
13:00–13:15	Diversity of reef-associated fishes of Saint Martin's Island in the Northern Bay of Bengal, Bangladesh through DNA barcoding	Kazi Ahsan Habib, *Sher-e-Bangla Agricultural University, Bangladesh*
13:15–13:30	Diversification and biogeography of *Kappaphycus* (Gigartinales, Rhodophyta)	John Michael L. Lastimoso, *University of the Philippines Diliman, The Philippines*
13:30–13:45	Evidence of fish following towed oil and gas platforms to a reefing site and rapid colonization	Se Songploy, *Chulalongkorn University, Thailand*
13:45–14:00	Variability of hard coral diversity and their endosymbiont algae (Symbiodiniaceae) in mesophotic reefs around Peninsular Malaysia	Nurzahirah Kamarudin, *Universiti Malaysia Terengganu, Malaysia*
14:00–14:15	Monsoonal dynamics and dietary influence on Omega-3 variability in Bali Sardines (*Sardinella lemuru*): implications for fisheries management and sustainable development goals	Aida Sartimbul, *Universitas Brawijaya, Indonesia*
14:15–14:30	A case study on the sea slugs (Order: Nudibranchia) with citizen science approached in marine biological data collections in Terengganu waters, Malaysia	Siti Nabila Ayu Jasni, *Universiti Malaysia Terengganu, Malaysia*
14:30–15:00	Discussion	
Section 2		
15:30–15:45	Species distribution modeling of octocorals within the Asia–Pacific region.	Christine Segumalian, *Independent researcher, The Philippines*
15:45–16:00	Comparison of diversity of marine fish in Bali Strait and Sempu Strait-East Java based on Environmental DNA: implication to sustainable fishery	Victor Adi Winata, *Universitas Brawijaya, Indonesia*

Time	Presentation Titles	Speakers
16:00–16:15	Geographic distribution pattern and genetic connectivity of Chinese Silver Pomfret (*Pampus chinensis*) populations across the northern Bay of Bengal and Indo-west Pacific region	Md. Nazmus Sakib, *Sher-e-Bangla Agricultural University, Bangladesh*
16:15–16:30	Catch efficiency of Squid jigging fisheries in the Oyashio Extension Regions	Zixuan Niu, *Ocean University of China, China*
16:30–16:45	The long-term monitoring of Ciguatera-causing dinoflagellates *Gambierdiscus* and *Ostreopsis* in Korean coastal waters	Eunyoung Yoon, *Advanced Institutes of Convergence Technologies, Republic of Korea*
16:45–17:00	**Discussion**	

Diversity of reef-associated fishes of Saint Martin's Island in the Northern Bay of Bengal, Bangladesh through DNA barcoding

Kazi Ahsan Habib[1, 2], Md. Jayedul Islam[1], Md. Nazmus Sakib[1, 2], and Amit Kumer Neogi[1]

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Abstract

The Saint Martin's Island is the only island in Bangladesh that supports coral communities with diversified reef-associated flora and fauna. It is an ecologically critical area (ECA) and a Marine Protected Area (MPA) in Bangladesh. This study employs the DNA barcoding approach to make a taxonomic catalogue of reef fishes of Saint Martin's Island (SMI) based on Morphology and DNA barcoding tools. Fish specimens were collected from the Saint Martin's Island between May 2017 and July 2019, and DNA barcoding, along with morphological analysis were performed with the support of NATP-2 project of Bangladesh Agricultural Research Council and DRMREEF project of WESTPAC. The study confirmed 99 reef-associated fish species in Saint Martin`s Island belonging to 17 orders, 42 families, and 74 genera. A total of 221 DNA sequences were obtained from these species out of which 179 sequences (96 species) were obtained from the COI gene and 42 sequences (26 species) were obtained from the 16S rRNA gene region. All of these sequences were submitted to the GenBank and Barcode of Life Data System (BOLD). Among these sequences, 70 sequences of the COI gene and 16 sequences of 16S rRNA gene region from 41 species were submitted for the first time into the GenBank from Bangladesh. The COI sequences contain 145 haplotypes with 337 polymorphic sites, and the mean genetic distances within species, genera, and families were calculated as 0.34%, 12.26% and 19.03%, respectively. On the other hand, 16S rRNA sequences comprised 31 haplotypes with 241 polymorphic sites, and the mean genetic divergences within species, genera and families were 0.94%, 4.72% and 12.43%, respectively. In this study, 37 species of reef fishes are recorded for the first time in Bangladesh and one is discovered as a species new to the science. This study is a significant contribution to the marine biodiversity of Bangladesh which would facilitate the assessment of species diversity for strategizing management action. It is also an important input to the DNA barcode library of reef fishes of the northern Bay of Bengal.

Keywords: reef associated fish, Saint Martin's Island, DNA barcoding, COI, 16S rRNA

Diversification and biogeography of *Kappaphycus* (Gigartinales, Rhodophyta)

John Michael L. Lastimoso and Wilfred John E. Santiañez

Gregorio T. Velasquez Phycological Herbarium (MSI) and The Marine Science Institute, College of Science, University of the Philippines Diliman, Quezon City 1101, The Philippines

Abstract

The Western Pacific Ocean has been a vital area in the development of techniques for tropical seaweed farming. Among the wildly cultivated crops in the region are *Kappaphycus* species, which are known for their prized gelling agent, *kappa* -carrageenan. This compound supported a burgeoning global industry in the early 1960s and has continued to significantly contribute to several maritime economies, notably those of the Philippines and Indonesia. However, years of extensive research on the farmed *Kappaphycus* have mainly focused on their physiology, farming optimization, genetic diversity, and species delineation. Studies on the historical environmental processes that shaped the emergence, diversification, and biogeographical distribution of this economically important group have not yet been fully explored using molecular techniques. Thus, we aim to fill that gap by first creating a multi-gene phylogeny of the red algal family Solieriaceae using publicly available datasets to infer phylogenetic relationships between *Kappaphycus* species and other euchuematoids. Subsequently, we calibrated the multi-gene tree of Solieriaceae using both primary (fossil) and secondary calibration points to evaluate the divergence times and historical events that may have influenced diversification among the *Kappaphycus* lineages. Finally, we used distributional data of wild *Kappaphycus* species, along with the multi-gene time-calibrated tree, to model the historical biogeographical patterns of these taxa. We examined both the temporal and geographic origins of *Kappaphycus* species and highlighted the evolutionary events that shaped their lineages. The biogeographical information resulting from our work also provided vital evolutionary information in understanding the past processes and historical events that may have impacted the distribution and speciation of this commercially important marine resource. Lastly, our work adds to the body of knowledge on *Kappaphycus* that may influence future seaweed farming practices in the Western Pacific Ocean.

Keywords: biogeography, *Kappaphycus*, Western Pacific, time-calibration, seaweed farming

Evidence of fish following towed oil and gas platforms to a reefing site and rapid colonization

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Abstract

We investigated the composition and abundance of fish assemblages associated with seven offshore oil and gas platform jackets in the Gulf of Thailand before (pre-lift and pre-tow), and immediately after relocation (post-tow and reefed). Jackets were cut, lifted until partly out of the water, and attached to the rear of a heavy lift vessel. They were towed at speeds of 2.7–3.3 knots for between 133.9 and 205.4 km before being placed on the seafloor at an artificial reef site. Sixteen species of fish were observed both before and after jacket towing. We believe these species have sought refuge in the complex structures out of the current and have remained with the jackets. Ten species of fish were observed before towing, but not after. A further seven species of fish were only observed after the jackets were relocated onto the seafloor and were assumed to be early colonizers to the structures. The paper provides empirical evidence of a much-discussed paradigm that fish can swim great distances following moved structures, and further evidence of the ability of fish to rapidly colonize reefed structures.

Keywords: oil and gas platform, artificial reef site, colonization, Gulf of Thailand

Variability of hard coral diversity and their endosymbiont algae (Symbiodiniaceae) in mesophotic reefs around Peninsular Malaysia

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Abstract

Mesophotic reefs are currently receiving an increase in attention as this deep water habitat potentially to serve as refugee for organisms from shallow areas especially under the unprecedented impacts of climate change. Mesophotic coral ecosystems (MCEs) are commonly found at depth of 30 to 50 m, and some MCEs can be found up to 170 m depth. Hard corals at MCEs are also light-dependent organisms. They harbour endosymbiotic algae (Symbiodiniaceae) which perform photosynthesis thus help hard corals to grow and survive. Studies on mesophotic reefs are limited and scarce, and there is no information about this ecosystem in Malaysia. This study aimed to identify mesophotic reef around Peninsular Malaysia, and to examine the species diversity of endosymbiont algae in hard corals at the mesophotic reefs. Since 2022, surveys were conducted by SCUBA at six selected islands around Peninsular Malaysia for both shallow and mesophotic reefs. Then, hard coral samples from the surveyed reefs were photographed and collected using hammer and chisel. All samples were preserved in 95% ethanol, further laboratory analysis prepared for CO1 coral barcoding and Symbiodiniaceae ITS2 amplicon sequencing. Off the six islands surveyed, four were found to have mesophotic reefs which are Pulau Tenggol, Pulau Yu and Pulau Tioman and Pulau Perak. Generally, mesophotic reefs around Peninsular Malaysia are at depth of 30 to 40 m depth. The hard corals at mesophotic reefs were lower in abundance and diversity compared to shallow reefs. Also, hard corals at deeper depth appeared in growth forms of plate, foliose, encrusting, massive and some solitary types. The corals have larger surface area in order to adapt in deeper reef with limited light source. Interestingly, there were same coral species found across shallow and mesophotic reefs, such as the *Hydnophora exesa*, *Turbinaria mesenterina*, *Favites pentagona*, *Duncanopsammia peltata*, and *Pachyseris speciosa*. As for species diversity of endosymbiont algae, most hard corals from both shallow and mesophotic reefs harboured genus *Cladocopium*, and some harboured genus *Durusdinium*. Moreover, hard corals that existed at shallow and mesophotic reefs, harbouring same genus of endosymbiont algae. In contrary, *Pachyseris* sp. coral founded to have genus *Durusdinium* at shallow reef, and genus *Cladocopium* at the mesophotic reef. The differences of endosymbiont algae may give further information regarding corals' adaptation in different environment. More studies would be needed to further elucidate the adaptability of hard corals from shallow to deep and to understand the role of MCEs in Malaysia water.

Keywords: mesophotic reef, coral reef, Symbiodiniaceae, hard coral, Malaysia

Monsoonal dynamics and dietary influence on Omega-3 variability in Bali Sardines (*Sardinella lemuru*): implications for fisheries management and sustainable development goals

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Abstract

Sardinella lemuru (1853), or Bali Sardines, are well-known as a high-nutritional-value source of omega-3 fatty acids. This omega-3 level has been linked to dietary sources, specifically plankton. Because the food of *S.lemuru* fluctuates according to the monsoon season, it is hypothesized that the omega-3 level varies as well. This is the first study to look at fluctuations in omega-3 concentration in *S.lemuru* based on full monsoon variations across a year. Here we used a combination of the plankton in stomach contents of *S.lemuru*, omega-3 content, and monsoonal oceanographic changes at Bali Strait to determine the dynamic of diet composition and omega-3 content of *S.lemuru* in four fishing seasons of 2012–2013. The findings reveal that the omega-3 content of *S.lemuru* is related to its food and follows the monsoon pattern. *S.lemuru* contains omega-3 of 11.8% and 25.35% of total fatty acids in the SE monsoon, Transition-2 season, and 14.9% of total fatty acids in the NW monsoon. Meanwhile, during the Transition-1 season, *S.lemuru* had the least quantity of omega-3, accounting for 0.23% of total fatty acids. The low omega-3 fatty acid concentration in Transition-1 season is thought to be related to zooplankton feeding in the previous season (NW monsoon) and the necessity for energy intake during the reproductive process. The role of monsoonal patterns on sardinella lemuru omega-3 content will be important in fisheries management, particularly to assist the Sustainable Development Goals program.

Keywords: Monsoon, *Sardinella lemuru*, Fatty acids, Bali Strait

A case study on the sea slugs (Order: Nudibranchia) with citizen science approached in marine biological data collections in Terengganu waters, Malaysia

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Abstract

This study sheds light on the often-overlooked nudibranchs, shell-less marine snails, utilizing an innovative citizen science approach to glean comprehensive insights. Nudibranchs are known for their aesthetic appeal, and understanding their biological and ecological aspects is crucial for determining their conservation status, especially since most of their presence in Malaysia is in lacks proper documentation. Owing to their delicate constitution and reliance on specific ecosystems, nudibranchs are highly susceptible to environmental shifts and the impacts of human activities. With the active participation of virtual citizens, we collected significant nudibranch data, including photographs and locality information, through platforms such as Google Forms and Instagram. A total of 77 species from 13 islands in Terengganu waters were identified and documented, with 21 species belonging to the Clad branchia suborder, 51 species to the Doridina suborder, and 5 species falling outside these suborders. Most species were deemed harmless to humans and were categorized as "Not Evaluated" on the IUCN Red List. The study was then shifted to further elucidate the biological and ecological data of nudibranch from Pulau Bidong and Pulau Kapas of Terengganu, where SCUBA diving and visual observations were utilized to verify the diversity, size range, and habitat preferences of aeolid and dorid nudibranchs. Pulau Bidong documented 25 species belonging to 11 genera and 7 families of nudibranchs, with the Phyllididae family emerging as the most dominant, and *Phyllidia elegans* being the most abundant species. Pulau Kapas recorded 13 species of nudibranchs, consisting of 6 genera and 5 different species identified from 9 sampling sites during the diving surveys and photo quadrate analysis. The Phyllididae family was predominant on Pulau Kapas, with *Phyllidiella pustulosa* as the most abundant species. The study revealed diverse size ranges, with the largest nudibranch measuring 60 mm, and an absence of specimens over 60 mm. Habitat preferences were established through ecological indices and software analysis, indicating a preference for algae, coral, and dead coral with algae. Nudibranch play a pivotal role in ecosystem equilibrium by consuming organisms like sponges and algae, thereby averting excessive proliferation. Throughout this study, the positive engagement of citizen scientists proved invaluable in building a robust scientific foundation, aiding in

nudibranch conservation efforts, and enhancing scientific knowledge about these captivating marine creatures. In essence, this research demonstrates the power of citizen science in expanding our understanding of marine biodiversity and contributing to its sustainable preservation.

Keywords: citizen science, nudibranchs, conservation status, diversity, tropical islands

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Species distribution modelling of octocorals within the Asia–Pacific region

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Abstract

Asia-Pacific hosts an extensive and diverse coral reef area across its tropical and warm-temperate regions. Scleractinians, and their octocorallian counterparts, not only dominate these reefs but are also the most diverse components of the benthos within the region. While hard coral distribution patterns are widely documented, information on suitable octocoral habitats within the Asia-Pacific is limited due to inadequate support, lack of interest, and insufficient documentation efforts. Moreover, with the ever-looming threat of marine biodiversity decline across the globe, identifying the possible conservation areas for these important marine resources is imperative. Thus, using maximum entropy modelling, we processed occurrence records and environmental spatial data to predict the potential patterns and environmental factors that may define shallow water octocoral distribution. Herein, we present the habitat suitability maps of octocorallian taxa. This work provides a baseline upon which more informed biodiversity surveys and marine spatial planning can be performed in the future.

Keywords: modelling, octocorals, MaxEnt, Asia-Pacific

Comparison of diversity of marine fish in Bali Strait and Sempu Strait-East Java based on environmental DNA: implication to sustainable fishery

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Abstract

Biodiversity has become a global issue that occurs locally, especially in East Java waters (Bali and Sempu Straits). The issue of biodiversity in East Java waters can be observed in the case study of *S. lemuru*, which experienced a shortage in the year La Nińa occurred. Subsequently, it could impact the diversity of the fish community, especially the trophic level above it, due to the scarcity of food sources in the food web. This study performs Environmental DNA (e-DNA) from three liters of seawater samples in the distribution area of S. lemuru and other fish in Bali Strait (Kedonganan (KD) in 2020 and Muncar (MCR) in 2020 and 2022) and Sempu Strait-East Java in 2020. The result of the Anacapa pipeline representing 213,876 sequence reads of MiFish 12S rRNA from 4 sites spanning two Southern East Java-Bali Strait regions revealed 99 fish amplified sequence variants (ASVs), 58.58% of which could be identified as species. Moreover, the MiFish pipeline represents 79 species, 63 genera, 39 families, and 23 orders. The result of eDNA based on the Mifish pipeline successfully identified 55 commercially important species in fisheries. The alpha diversity based on Shannon indices between sites was ranked as follows: KD (3.157) >MCR-2020 (2.238) >Sempu Strait (1.639) >MCR–2022 (1.373). Furthermore, samples plotted in the PCoA plot show that MCR–2022 and Sempu Strait are more similar in their taxonomic composition. Meanwhile, MCR-2020 and KD plotted distantly, indicating significantly different species lists. From the present study, we can calculate fish diversity by eDNA, and this finding will be helpful for baseline data for the future effective management of fisheries in these areas.

Keywords: ASVs, Dispersion, Diversity indices, eDNA, Marine fish

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Geographic distribution pattern and genetic connectivity of Chinese Silver Pomfret (*Pampus chinensis*) populations across the northern Bay of Bengal and Indo-west Pacific region

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Abstract

Chinese Silver Pomfret *Pampus chinensis* is a commercially important fishery species throughout its distribution area from Northern Indian Ocean to West Pacific region. In this study, we investigated the population genetic structure of *P. chinensis* using nucleotide sequence variation of the mtDNA D-loop region in the two different populations of the east and west coast of Bangladesh namely Cox's Bazar (CP) and Kuakata (KP), respectively in the northern Bay of Bengal (BoB). Then the sequence data were compared with another four regions of the Indo-west Pacific viz., Sonmiani and Omara of Pakistan coast in the Arabian Sea (AS), Beihai and Xiamen of China in the South China Sea (SCS). All of the 130 sequences defined 35 haplotypes where 10 haplotypes were found in the BoB populations. Among them nine haplotypes were unique for the BoB that are not present in other seas. The rest one haplotype of the BoB shared with AS populations. The nucleotide diversities (π) were very low in each population of BoB as 0.003 and 0.007 while the haplotype diversities (*h*) were relatively high, 0.632 and 0.855 for KP and CP populations, respectively. Population statistics (F_{ST}) value between KP and CC populations showed no significant deviation which implies no population genetic structure within the marine water of Bangladesh. However, estimates of F_{ST} between BoB populations (KP and CP) and each of the compared populations from other seas (AS, SCS) ranged from 0.132 to 0.269 with significant differences (P<0.01). This result indicates a unique population genetic structure was established in the BoB region compared to other seas of Indo-west Pacific. The Exact test of population differentiation showed that the fish populations are panmixic within the area of each sea (random mating) but they belong to separate breeding units in different seas. Tajima's *D* value and Fu's F_s values of the neutrality test exhibit positive value implies a demographic equilibrium for BoB populations. So, the emphasis should be given on maintaining the natural dynamics of the BoB as a single population and preventing human-induced disruptions that could compromise the genetic diversity and overall population health of *P. chinensis*.

Keywords: Chinese silver pomfret, Rupchanda, genetic stock, population structure, mitochondrial DNA

Catch efficiency of squid jigging fisheries in the Oyashio Extension Regions

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Abstract

The ratio of fishing effort to harvest is significantly influenced by the abundance of fishery resources. However, traditional statistics of fishery catches or commonly used Catch per Unit Effort (CPUE) metrics cannot accurately capture the complexity of resource abundance in the ocean. To address this issue, we propose here a novel approach that integrates the actual fishery catch and fishing duration and introduce Catch Efficiency (CE) as a metric for evaluating the efficiency of fishing operations, which can reflect the resource abundance in a more reasonable way. In this study, we focus on the CE of squid in the Oyashio Extension region in the Northwestern Pacific, and analyze the temporal and spatial variations of CE. Results show that CE of squid in this region is characterized by strong seasonal and interannual variability in terms of intensity and spatial distribution. Meanwhile, we find a close relationship between CE and background water mass distribution, chlorophyll-a concentration, and micronekton biomass, which implies the resource abundance of squid can be inferred from varying environmental factors in the fishing area.

Keywords: catch efficiency, CPUE, Oyashio Extension region, resource abundance, squid jigging

The long-term monitoring of Ciguatera-causing dinoflagellates *Gambierdiscus* and *Ostreopsis* in Korean coastal waters

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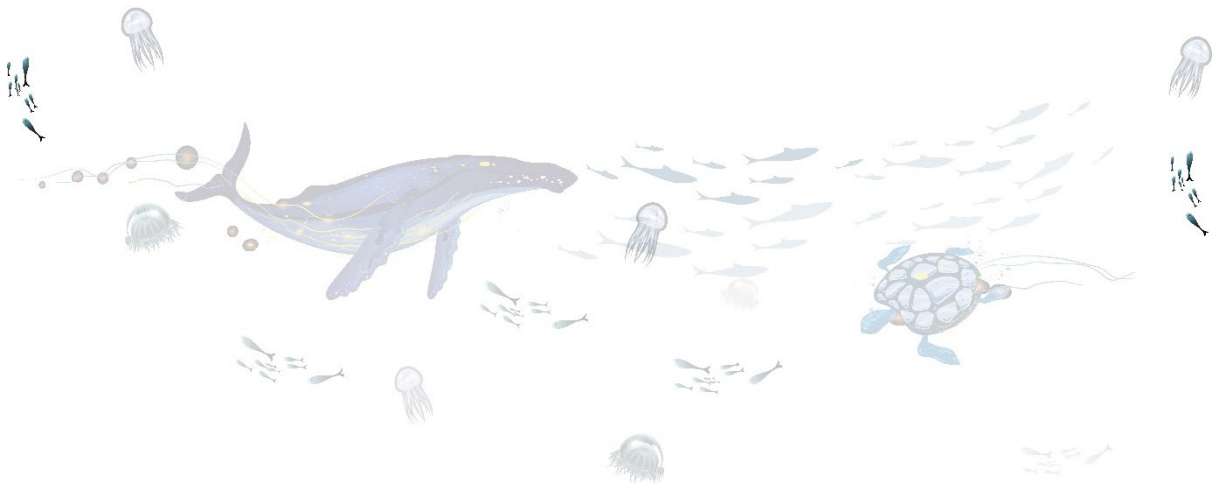
Abstract

Due to the combined effects of climate change and human activities, the marine environment and ecosystem of South Korea are undergoing rapid changes. The rate of water temperature increase in Korea exceeds the global average, leading to the influx and spread of Ciguatera-causing dinoflagellates. Subtropical toxic marine plankton, specifically *Gambierdiscus* spp. and *Ostreopsis* spp., known for causing ciguatera fish poisoning (CFP), were initially reported on Jeju Island in 2008. Since their first detection, they have been observed spreading to the northeastern part of Korean coastal waters with higher concentrations. As concerns grow regarding the expansion of their habitat due to climate change, understanding the potential risk of CFP in Korean waters becomes crucial. This study involved long-term monitoring of ciguatera-toxic dinoflagellates based on region, season, and water depth to confirm the distribution status and changes in South Korea. The results will provide essential data for predicting damage through early detection research and exploring future management measures.

Keywords: climate change, ciguatera-toxins, harmful algae, marine ecosystem, UN ocean decade

Sub-theme B: Marine Biodiversity, Seafood Safety and Security

Session B2: Systematics, taxonomy, and phylogenetics of marine life in the Western Pacific



Programme

Venue: Somerset A, 5th Floor
Date: 22 April 2024

Conveners:
Abe Woo Sau Pinn — CEMACS, Universiti Sains Malaysia, Malaysia
Naoto Jimi — Nagoya University, Japan

Time	Presentation Titles	Speakers
Section 1		
10:30–10:45	Garden of polychaetes: new ecosystem engineer in rocky ocean	Naoto Jimi, *Nagoya University, Japan*
10:45–11:00	Taxonomic problems of the acanthocephalan genus *Echinorhynchus* revealed by a molecular phylogenetic analysis of species from Japanese coastal waters	Yuki Kita, *Hokkaido University, Japan*
11:00–11:15	Molecular phylogeny of the Monostilifera with insights into the evolution of commensalism in Nemertea	Natsumi Hookabe, *JAMSTEC, Japan*
11:15–11:30	The necessity of DNA sequence data in the taxonomy and systematics of polymorphic marine worms: the case of nemerteans in the genus *Oerstedia* Quatrefages, 1864 (Nemertea, Hoplonemertea)	Jamael Abato, *Hokkaido University, Japan*
11:30–11:45	Recent progress in the taxonomy and phylogeny of Anthuroidea (Crustacea: Isopoda) in Japan	Shoki Shiraki, *Hokkaido University, Japan*
11:45–12:00	Unraveling the taxonomic identity and phylogenetic relationships of sea cucumber from the genus *Stichopus* (Holothuroidea: Stichopodidae)	Hong Leong Cheah, *Monash University Malaysia, Malaysia*
12:00–12:15	The cryptic diversity of the genus *Andrometra* (Echinodermata, Crinoidea, Antedonidae): taxonomic importance of cirri and arm ossicles	Gregorius Altius Pratama, *The University of Tokyo, Japan*
12:15–12:30	Diversity of octocoral species in submarine groundwater discharge (SGD) influenced sites in Mabini and Tingloy, Batangas, Philippines	Aubrey Jacklynn Abadiano, *University of the Philippines- Diliman, The Philippines*
Section 2		
13:30–13:45	Narrowing the gaps in the fish reference database for effective eDNA monitoring: preliminary surveys at the Malaysian mangrove ecosystems	Cecilia Chu, *University of the Ryukyus, Japan*

Time	Presentation Titles	Speakers
13:45–14:00	Species diversity of marine fishes in the Sulu Archipelago, Philippines: Building a DNA barcode reference library at the heart of Coral Triangle	Maybelle Fortaleza, *University of the Philippines Mindanao, The Philippines*
14:00–14:15	DNA barcoding elasmobranchs of Bangladesh: discovery of a new guitarfish species and potential uses in conservation	Md. Jayedul Islam, *Sher-e-Bangla Agricultural University, Bangladesh*
14:15–14:30	Phylogeny and biology of common coastal pricklebacks fish species (Perciformes: Zoarcoidei, Opisthocentridae) of the Northern Pacifica	Olesia Rutenko, *Far Eastern Federal University, Russia*
14:30–14:45	Discovering marine myxosporean (Cnidaria: Myxozoa) diversity in Malaysian waters: characterization, phylogeny, and host interactions in the northeast region of peninsular Malaysia	Muhammad Hafiz Borkhanuddin, *Universiti Malaysia Terengganu, Malaysia*
14:45–15:00	Coral community structure in Kota Kinabalu coastal waters, Sabah, Malaysia	Khodzori Fikri Akmal, *Universiti Malaysia Sabah, Malaysia*
Section 3		
15:30–15:45	Diversity of the picophytoplankton Mamiellophyceae in the West Philippines Sea with emphasis on *Ostreococcus*	Brian William Hingpit, *University of the Philippines- Diliman, The Philippines*
15:45–16:00	Genetic diversity, temporal variability, and host association of parasitic *Amoebophrya* spp. (Syndiniales Group II) in tropical marine waters	Maria Anna Michaela De La Cruz, *University of the Philippines Diliman, The Philippines*
16:00–16:15	New records of raphidophytes in the Philippines: morphology, phylogeny and their worldwide distribution	Samantha Patricia C. Esteban, *Central Luzon State University, The Philippines*
16:15–16:30	Genetic diversity of harmful Family Kareniaceae in the Philippines, including the detection of a potentially two undescribed species	Garry Benico, *Central Luzon State University, The Philippines*
16:30–17:00	**Discussion**	

Garden of polychaetes: new ecosystem engineer in rocky ocean

Naoto Jimi[1,2,*], Masashi Fukuoka[1], Hiroki Kise[3], Shozo Ogiso[4], Hisanori Kohtsuka[5], Natsumi Hookabe[5], Naohiro Hasegawa[6], Laetitia Gunton[7] and Pat Hutchings[7]

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Abstract

Based on the complex structure of coral, many small fish find refuge in it, and the ecosystems support a diverse range of life forms. With an increase in the diversity of habitats such as sandy areas, rocky outcrops, and coral reefs, there is an increase in the opportunity for species to specialize in different resources and coexist, leading to an increase in the diversity of animal populations, as predicted by Messmer et al. (2011). In areas where reef-building corals cannot survive, seaweed, brown algae, and red algae mainly play that role and contribute to the creation of biodiversity by providing a unique habitat through the formation of three-dimensional structures underwater, as observed by Chemello & Millazo (2002).

During a dive survey of a seaweed bed in Mie Prefecture, the presenter discovered that upright, tree-like nests were growing in clusters at depths deeper than 20 meters where the seaweed bed ended and the rocky outcrops emerged. Many small crustaceans, polychaetes, and other organisms were found to be attached to the parchment-like surface of the nests, which did not exist on the surrounding rock surfaces. The nests ranged widely in both the horizontal and vertical directions (between Sugashima and Ishikagami at depths of 15 to 40 meters) with 4 to 15 uprights per square meter, creating a situation that is appropriately called the "Forest of Polychaetes" This presentation will discuss the forest of polychaetes and the diversity of attached organisms that it supports.

Keywords: ecosystem engineer, biodiversity, invertebrates, annelida

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Taxonomic problems of the Acanthocephalan genus *Echinorhynchus* revealed by a molecular phylogenetic analysis of species from Japanese coastal waters

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Abstract

The genus *Echinorhynchus* is a group of fish-parasitic acanthocephalans known primarily from marine and fresh waters of the Northern Hemisphere. Currently, more than 50 species are known from around the world, most of which are parasites of demersal fish. In Japan, nine marine species and one freshwater species are known, and their distribution area is generally biased toward northern Japan. Of these, marine species are commonly found in cod, sculpin, and greenling. In this study, morphological information on two species of *Echinorhynchus*, obtained from north-western Pacific coastal area of Japan, were compared with existing data and specimens, and molecular phylogenetic analysis was conducted. As a result, the phylogenetic relationships between obtained specimens and closely related species were clarified, but some instances were observed where the phylogeny and morphology-based species identification were inconsistent. These results showed the difficulty of using the arrangement of the hooks on the proboscis, which has generally been regarded as an important morphological feature that distinguishes species, as a taxonomic key to the species of *Echinorhynchus*.

Keywords: Acanthocephala, fish parasite, Western Pacific, systematics

Molecular phylogeny of the Monostilifera with insights into the evolution of commensalism in Nemertea

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Abstract

Ribbon worms (Phylum Nemertea) are commonly known as predators or scavengers in a wide variety of marine, freshwater, and terrestrial ecosystems. Traditional classification of monostiliferous nemerteans solely based on morphological characteristics (especially internal morphology) has turned out to be not necessarily stable. Instead, a DNA-based approach is now commonplace to untie tangled knots of monostiliferan systematics. In the present study, we performed phylogenetic analyses based on 16S, COI, 18S, 28S, and H3 using monostiliferan specimens collected from 30 localities in Northwestern Pacific (including East China Sea, Pacific Ocean, the Sea of Japan, and the Sea of Okhotsk), aiming to clarify phylogenetic relationships between each monostiliferan family. In the resulting tree reconstructed with the multi-locus analyses, Malacobdellidae was nested in Prosorhochmidae. To further investigate the relationship, a preliminary analysis was performed based on an increased 12,841 bp of nucleotide sequences obtained from the mitochondrial genome (mitogenome, mtDNA); it has not been widely applied to molecular systematics in Nemertea. Based on the tree topology newly obtained, the present study explores morphological similarities between Malacobdellidae and Prosorhochmidae by observing not only the adult but also the larval morphology with a discussion on the evolution of endocommensal lifestyle in Nemertea.

Keywords: commensal, Japan, phylogeny, ribbon worm, systematics

Session B2: Systematics, taxonomy, and phylogenetics of marine life in the Western Pacific

The necessity of DNA sequence data in the taxonomy and systematics of polymorphic marine worms: the case of nemerteans in the genus *Oerstedia* Quatrefages, 1864 (Nemertea, Hoplonemertea)

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Abstract

The monostiliferous hoplonemertean genus *Oerstedia* Quatrefages, 1864 is currently composed of 30 valid ribbon worm species, of which, four valid species are currently recognized from Japanese waters—*O. dorsalis* sensu Iwata; *O. fuscosparsa* Abato, Kajihara and Yoshida, 2022; *O. polyorbis* Iwata, 1945; and *O. venusta* Iwata, 1954. Members of the genus *Oerstedia* are highly polymorphic, making the taxonomy and systematics of the species challenging and problematic. Thollesson and Norenburg (2003) applied two different names to the *Oerstedia* specimens collected from Akkeshi Bay, Hokkaido—*O. zebra* (now *O. oculata*) and *O. venusta*, the former was dorsally banded while the latter was not. However, the specimen they identified as *O. venusta* lacked the notable anterior cephalic furrows as in *O. venusta* s.str. Seven *Oerstedia* specimens which are morphologically similar with a Russian species *O. oculata* (Kulikova, 1987) and with the two *Oerstedia* from Akkeshi Bay were collected from Oshoro Bay, Hokkaido and Aniwa Bay, Sakhalin Island. The COI sequences generated from these species and the subsequent haplotype network analysis revealed that the *Oerstedia* from Akkeshi Bay, Oshoro Bay, and Aniwa Bay are conspecific (COI p-distance = 0–0.8%) and are different from *O. oculata* (COI p-distance = 4-7–4.8%). The phylogenetic tree based on the 16S, 18S, 28S rRNA, COI, and H3 genes revealed that the *Oerstedia* from Hokkaido and Sakhalin Islands are sister with the *O. oculata* and are nested in the clade *Paroerstediella* of the genus. We therefore establish the "*O. oculata*-like" *Oerstedia* reported in this paper as a new species—*Oerstedia pseudoculata* sp. nov. *O. pseudooculata* sp. nov. and *O. oculata* are very similar in their external features—both have the zebra and non-banded forms. Limited morphological differences between the two species can be observed. In this study, we emphasized the importance of molecular sequences in the taxonomy and systematics of the polymorphic marine worm species. Employing only the so-called traditional taxonomy for *Oerstedia* species is undoubtedly inadequate and can possibly result in some taxonomic problems and inconsistencies. The role of DNA sequence data in the taxonomy and systematics of the genus *Oerstedia* is always indispensable.

Recent progress in the taxonomy and phylogeny of Anthuroidea (Crustacea: Isopoda) in Japan

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Abstract

The superfamily Anthuroidea Leach, 1814 is a group of small (usually <10 mm), benthic isopod crustaceans, characterized by having an elongate body and widely expanded tailfan. It currently comprises six families, 63 genera, and over 600 described species worldwide. Anthuroids are mostly marine and have been reported from the intertidal zone to depths of about 6500 m. They occupy various substrates, including marine algae, sand, rocks, and coral rubble. As of 2020, 39 species had been reported from Japanese waters. Most of these are shallow-water species from the temperate region, with few studies of anthuroids having been conducted in the subtropical region or deep sea. In this talk, we discuss our recent taxonomic research including representatives from subtropical and deep waters around Japan and present the first global molecular phylogeny of anthuroid isopods.

Keywords: morphology, undescribed species, phylogeny, systematics, taxonomy

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Unraveling the taxonomic identity and phylogenetic relationships of sea cucumber from the genus *Stichopus* (Holothuroidea: Stichopodidae)

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Abstract

The correct taxonomic classification of *Stichopus* species is crucial for their management and conservation, given the expanding fishery of these species. However, the taxonomic classification of the family Stichopodidae, including the genus *Stichopus*, has long been a challenge, leading to frequent misidentification of species. For example, *Stichopus naso* and *Stichopus monotuberculatus*, commonly harvested in the Indo-Pacific region, are often misidentified as "*Stichopus horrens*." In this study, we investigated the taxonomic identity of a *Stichopus* species harvested in Pangkor island, which had long been assumed to be *Stichopus horrens*. Our ossicle examination raised questions about its species identity as it lacked the characteristic tack-like table ossicles in the papillae, which are a definitive feature of *S. horrens*. Additionally, we observed fusiform ossicles in its tentacles, suggesting that the *Stichopus* species harvested in Pangkor island is actually *Stichopus fusiformiossa*. To further investigate the taxonomic status of this species, we extracted DNA from the collected sea cucumber for genome sequencing and mitochondrial genome assembly. The full mitochondrial genome sequence and the Cytochrome c Oxidase Subunit I (COI) sequence were submitted for NCBI BLAST search. Phylogenetic analyses were conducted via the multiple sequence alignment of partial COI sequences and complete mitochondrial genomes (13 coding sequences and 2 rRNA sequences) of different *Stichopus* species for phylogenetic tree construction using maximum likelihood with 1000 bootstraps. The NCBI BLAST result shows that *S. monotuberculatus* had the highest percentage of identity (>99%) with 100% query coverage. Both the COI-based tree and the mitogenome-based tree show that the sea cucumber collected by our group in Pangkor island is clustered with *S. monotuberculatus* instead of *S. horrens*. *S. monotuberculatus* is a variable assemblage that includes several sub-clades with regional differences in body wall ossicles, morphology, and colors. Previous haplotype network analyses with COI and 16S for *S. monotuberculatus* suggest the presence of cryptic species within *S.*

monotuberculatus. Additionally, the sea cucumber collected in this study has unusual fusiform ossicles in its tentacles, which are not found in other *Stichopus* species. Therefore, further research is needed to determine if the variable ossicle shape and genetic relatedness with *S. monotuberculatus* are associated with different yet closely related species, such as *S. fusiformiossa*. In conclusion, this study provides valuable insights into the phylogenetic relationships and taxonomic classification of *Stichopus* species. These findings have important implications for conservation initiatives and further investigations involving these distinct marine invertebrates.

Keywords: sea cucumbers, *Stichopus*, taxonomic classification, phylogenetic analysis

The cryptic diversity of the genus *Andrometra* (Echinodermata, Crinoidea, Antedonidae): taxonomic importance of cirri and arm ossicles

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Abstract

The feather star genus *Andrometra* AH Clark, 1917 (Crinoidea, Comatulida, Antedonidae) is very rare and only accommodates two species: *A. psyche* (AH Clark, 1908) in the Pacific Ocean and *A. indica* (AH Clark, 1909) in the Indian Ocean. The Pacific species, *A. psyche* has been recorded from Japan and Australia. Previous studies reported two brachial (arm ossicle) morphotypes in the species: “everted brachial” and “smooth brachial” types; however, they have been recognized as conspecific. In this study, analyses of mitochondrial cytochrome oxidase I (COI) sequences indicated that the genetic distance between “everted brachial” and “smooth brachial” morphotypes was 6.9%, suggesting that they should be treated as separate species. We examined ossicle microstructure using a scanning electron microscope to reveal the morphological differences between these two morphotypes. Consequently, cirri, division series, and pinnule ossicles as well as brachials successfully distinguished the two types. Morphological characteristics also clearly suggests these two morphotypes are separate species, and "smooth brachial" morphotypes should be an undescribed species.

Keywords: *Andrometra*, *Antedonidae*, taxonomy, diversity, ossicle microstructure

Diversity of octocoral species in submarine groundwater discharge (SGD) influenced sites in Mabini and Tingloy, Batangas, Philippines

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Abstract

Submarine groundwater discharge (SGD) sites are known to alter water chemistry such as salinity and nutrient availability that are essential to coral reef organisms and may hold detrimental effects to the diversity of reef building organisms. On the other hand, octocorals have been observed to be more tolerant to different disturbances such as nutrient loading, increased temperature, and decreased salinity as they may acquire food or nutrients from multiple sources such as harbored zooxanthellae, plankters, dissolved organic matter, or available food in the water column. The SGD areas in Mabini, Batangas, Philippines are known to host multiple types of SGD such as vent, sporadic, continuous, and curtain type related to hydrothermal activities. Octocoral colonies encountered through SCUBA diving within or near established 5x5 m transects, at depths between 2 to 13 m, were documented and sample tissues were collected for morphological analysis for species delimitation.

A total of thirteen (13) species of octocorals were preliminarily identified in all SGD sites namely, *Ovabunda* sp., *Xenia* spp., *Heteroxenia* spp., *Briareum* spp., three (3) morphotypes of *Tubipora musica*, *Sarcophyton* spp., *Klyxum* spp., *Lobophytum* spp., *Sinularia* cf. *flexibilis*, *Paralemnalia* sp., *Lemnalia* sp., *Litophyton* sp., and *Scytalium* sp. These soft coral identifications are yet to be confirmed using a combined analysis of 28S and mtMutS markers for the molecular analysis. It was observed that colonies of Xeniid species were present in almost all SGD-influenced sites, and one site with a shallow vent is dominated by carpets of *Conglomeratuslera coerulea* and *Anthelia* sp.. These results indicate that select octocoral species could thrive in these environmental conditions and may help in the management plan of SGDs.

Keywords: Soft corals, Biodiversity, 28S, mtMutS

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Narrowing the gaps in the fish reference database for effective eDNA monitoring: preliminary surveys at the Malaysian mangrove ecosystems

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Abstract

Although over 200 fish species are known to use mangrove-line estuarine ecosystems in Malaysia for part of or throughout their life history, traditional monitoring of these fish communities can be challenging due to considerations of gear suitability, labor, and spatio temporal variability. Using the Kuala Selangor Nature Park (KSNP) ecosystem as a case study, the current state of fish reference database and the feasibility of environmental DNA (eDNA) metabarcoding as biodiversity monitoring tool was assessed. A two-days concurrent sampling of fish specimens using drift net and trammel net, and samplings of eDNA using sterivex filters were done along the Selangor River, from the river mouth (with salinity of 26 ppt) up to Kampung Bukit Belimbing (0.04 ppt) in November 2021. Then, separate samplings of fish specimens were done along the same river in March 2022, and along the coastal area of Kuala Selangor in May 2022. Whereas, another eDNA collection was done along the river in April 2022. In the field collections, we obtained 183 fish specimens that represented 18 fish families from 30 genera and 35 species. Out of this, we sequenced 23 species from 11 families in our collection that lack reference sequences in the Genbank. In total, 30 sequences of the 12S gene markers and another 30 corresponding COI sequences were generated through sanger sequencing. There is no ambiguous identity between the 12S and COI gene markers at the family level, but the COI sequences have higher percentage of sequence matches in the Genbank compared to the 12S sequences. DNA from the water samples from the eDNA collections were obtained using Next-Generation Sequencing (NGS). Out of the 176 OTUs (operational taxonomic units) generated from the eDNA sequencing, 7 exact matches were found between the 12S sequences of our fish specimens and the 12S MiFish region of the eDNA from our water collections. The gaps in the reference database was very much evident, especially for speciose and/or non-commercial fish families such as Ariidae, Gobiidae, Ambassidae, and Butidae, but dedicated effort into sequencing these fish specimens can help to improve the effectiveness of future monitoring effort through eDNA collection.

Keywords: Kuala Selangor, MiFish, 12S, DNA barcoding, COI

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Species diversity of marine fishes in the Sulu Archipelago, Philippines: Building a DNA barcode reference library at the heart of Coral Triangle

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Abstract

Recently, two DNA barcode reference libraries of marine fishes were published based on market surveys conducted in the Philippines. One documented marine fishes from several sampling localities all over the country, while the other focused on marine fishes of Cebu Province. Despite these extensive works, there is still lacking representation for marine fish diversity in Mindanao, Philippines. Given this paucity of information, intensive market surveys and application of integrative taxonomic approach were done to document the commercially important marine fishes in the major islands of Sulu Archipelago in southern Mindanao, Philippines from 2018 to present. Our market survey efforts reveal a total of 360 marine fish species representing 51 families from Basilan, Sulu, and Tawi-Tawi. To date, we produced 246 DNA barcodes representing 216 marine fish species. These DNA barcodes correspond to whole fish specimens, colored photographs, and preserved tissue samples that may be used for future studies. We also confirm the occurrence of *Pristigenys meyeri* in Tawi-Tawi and recollected the newly described razor wrasse species, *Iniistius bakunawa*, in Jolo, Sulu. Combining the market survey data of Davao Gulf and Sulu Archipelago, we report a total of 662 species of marine fishes in the Celebes Sea marine biogeographic region. This suggests that the area hosts a diverse assemblage of marine fishes despite of persisting anthropogenic threats. Documenting marine biodiversity and developing a DNA barcode reference library for these marine resources are important to inform policies and strengthen management strategies, especially in species-rich but data-poor countries like the Philippines. Moreover, an ecosystem approach to fisheries management is ultimately necessary to ensure the sustainability of marine fishery resources in these biologically diverse islands.

Keywords: DNA barcoding, local fisheries, marine conservation, species richness

DNA barcoding elasmobranchs of Bangladesh: discovery of a new guitarfish species and potential uses in conservation

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Abstract

Elasmobranchs are the most threatened marine megafauna in the world. There is a global need for stock management and sustainable conservation of elasmobranch species to balance the ocean ecosystem. Appropriate taxonomic information is the first step for a proper conservation plan for any species. The present study aims DNA barcoding of elasmobranch species of Bangladesh by amplifying the mitochondrial gene sequences i.e., COI for accurate identification. The fish samples were collected between August 2018 to July 2022 from different fish landing centers of Bangladesh namely Pathorghata, Kuakata, Chattogram and Cox's Bazar. In the study, we identified a total of 37 species of elasmobranchs (i.e., sharks and rays) belonging to 22 genera, 15 families and 5 orders, where 19 species were sharks and 18 species of rays. Among the morphologically identified species, we obtained a total of 59 DNA sequences from 29 species comprising 43 haplotypes with 228 polymorphic sites. The nucleotide diversity was calculated as 0.18 and the haplotype diversity was 0.98. The overall mean nucleotide base frequencies observed for 59 COI sequences were 25.8%, 26.0%, 32.4%, and 16.0 % for adenine (A), thymine (T), cytosine (C) and guanine (G), respectively. Genetic distances among the studied COI sequences ranged from 00% to 32.6%. The overall mean distance of the sequences was 22.1%. From this present study, we also identified a world-new species of giant guitarfish, *Glaucostegus younholeei* sp. nov., which was described from 13 specimens of 730–933 mm total length, collected from a fish landing canter in Cox's Bazar district of Bangladesh. This new species is distinguished from congeners in having the following combination of characteristics: Body brownish or greyish with a narrowly wedge-shaped disc, long narrow bluntly pointed snout (angle 31–40°), and broad oblique nostrils with a narrow anterior opening. Phylogenetic analysis of DNA barcode sequences also shows the clear divergence of *G. younholeei* from other congeneric species obtained from GenBank. The present barcoding study holds out great hope for the ready identification of sharks, shark products and shark fins, and also highlights some taxonomic issues that need to be investigated further. This ongoing study has also planned to construct mitochondrial 12S rRNA reference sequences for elasmobranchs of Bangladesh. The built DNA barcode library of this study will contribute as the reference sequences to the eDNA-based biomonitoring study of this vulnerable animal group which has recently been initiated by the ABR Lab.

Keywords: Sharks, rays, new species, DNA barcoding

Phylogeny and biology of common coastal pricklebacks fish species (Perciformes: Zoarcoidei, Opisthocentridae) of the Northern Pacifica

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Abstract

Opisthocentrids (Opisthocentridae) are marine benthic fishes belonging to the suborder Zoarsoidei (order Perciformes). Widely distributed in coastal waters of the Northern Pacific, they are found in macrophyte and seagrass beds and are an important link in food chains and energy flows of marine ecosystems. Not being a commercial object, these numerous fish species important for the sustainability of marine coastal ecosystems do not attract the attention of systematists and are studied very fragmentarily. At the same time, pricklebacks represent a unique group of fishes that can serve as a model object for studying the mechanisms of evolutionary divergence. The study of pricklebacks fishes of the northern pacifica with a detailed analysis of the mass coastal genera Opisthocentrus and Pholidapus significantly expanded the understanding of morpho-ecological and genetic divergence of closely related marine fish species. Information on the biology and ecology, as well as original data on taxonomic relationships of this group of fishes were obtained for the first time. I have found out that pricklebacks belong to short-cycle fish species, which makes them extremely vulnerable in cases of sharp population decline. Comparison of isotopic analysis and stomach contents showed that high probability of overlapping isotopic niches is not always indicative of food competition. In this case, the similar isotopic signature of syntopic species is due to consumption of the main food object (amphipods) while separation of food niches at the level of species preferences was observed. The results of molecular genetic analysis carried out based on sequences of complete mitochondrial DNA showed that the level of genetic divergence of mtDNA of pricklebacks fishes varies widely. It should be noted extremely low level of intraspecific polymorphism in some species (Pholidapus dybowskii and Kasatkia memorabilis). In general, the results of the conducted morpho-ecological analysis of opisthocenter fishes are confirmed by the results of molecular-genetic studies and support the general phylogenetic scheme of pricklebacks fishes. The phylogenetic hypothesis of taxonomic relationships within the whole suborder Zoarcoidei showed greater affinity of the family Opisthocentridae with the family Pholidae than with the family Stichaeidae, which agrees with earlier studies. The results of this work will serve as a basis for further studies aimed both at

studying the mechanisms of morpho-ecological divergence of different fish species and at clarifying the evolutionary history of the suborder Zoarcoidei.

Keywords: Opisthocentridae, Zoarcidae comparative morphology, mitochondrial DNA, molecular systematics

Discovering marine myxosporean (Cnidaria: Myxozoa) diversity in Malaysian waters: characterization, phylogeny, and host interactions in the northeast region of peninsular Malaysia

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Abstract

Myxosporean is one of the two myxozoan groups, which uses fish as vertebrate host in aquatic environments. Among the 30 myxosporean species described in Malaysia, only six were identified from marine environments in the northwest region of Peninsular Malaysia's. This research aims to further explore characterize existing species and identify novel species through morphological, morphometrical, and genetic analyses, and to investigate the phylogenetic relationships of myxosporeans recovered from marine and estuarine fish species, exploring their associations with host and organ specificity. The outcomes of the study included the description of three novel *Henneguya species* (*Henneguya setiuensis* n. sp., *Henneguya voronini* n. sp. and *H. calcarifer* n. sp.); two *Ceratomyxa* species (*Ceratomyxa bathybius* n. sp., *Ceratomyxa furcosus* n. sp.,); and one *Myxobolus* (*Myxobolus selari* n. sp.). The characterization involved tissue tropism, myxospore morphology, morphometry, and 18S rDNA sequencing, leading to the description of each of the new species. Additionally, the study revealed new host records for *Kudoa pagrusi* and *Myxobolus acanthogobii*. Intra-genetic variations were observed among isolates, and phylogenetic analysis suggested co-evolution in fish hosts during host-parasite interactions. Intra-genetic variations were 0% among *C. bathybius* isolates, 0.1–0.5% among *C. furcosus* isolates, 0.2% between *K. pagrusi* ex *Nemipterus tambuloides* and *K. pagrusi* ex *Pagrus pagrus*, and 1.2% between *M. acanthogobii* ex *N. furcosus* and *M. acanthogobii* ex *Acanthogobius flavimanus*. The findings emphasized the importance of understanding myxosporean diversity in Malaysian waters, particularly in Terengganu, and suggested further investigations to fill gaps in the systematics of Myxosporea from Malaysia. None of the novel species was more than 90% similar to any known myxosporean sequence in GenBank. Low infection prevalence and absence of obvious tissue pathology suggested these myxosporeans may not currently pose a significant threat marine fish population in Malaysia. However, additional surveys at different times of the year are recommended for a comprehensive risk assessment.

Keywords: Cnidaria, South China Sea, myxosporean, parasitism

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Coral community structure in Kota Kinabalu coastal waters, Sabah, Malaysia

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Abstract

Kota Kinabalu is well recognized for its high marine biodiversity, with a protected area in Tunku Abdul Rahman Park established to conserve marine life. The park consists of five islands (Sapi, Sulug, Manukan, Mamutik and Gaya Islands) with surrounding fringing reefs covering approximately 50 km^2. However, rapid urbanization, construction of resorts, harbours, and other infrastructure projects along the Kota Kinabalu coastline have led to increased sedimentation, pollution, and habitat destruction, which negatively impacted coral conditions and species richness. The present study expands on past research by evaluating the current state of coral community structures, including a comprehensive species checklist, as well as the coral condition, diversity and abundance patterns at 27 reef sites around Kota Kinabalu coastal waters. The Coral Video Transect method was used for coral surveys, while the Coral Point Count with Excel Extension software was used for coral coverage measurement. The findings indicate that Kota Kinabalu reefs had a mean live coral cover of 46.9±3.4% , suggesting they were in 'fair' coral condition. A total of 233 species, spanning 71 genera and 16 families of scleractinian corals were identified across all reef sites. Following recent taxonomic classification, coral surveys and past studies revealed 300 species from 74 genera and 18 families of scleractinian corals, with additional 57 new species records for the west coast of Sabah. Among these, 18 identified scleractinian species are considered rare, 51 are vulnerable, and 2 are endangered. The current data also recorded 83 genera of hard and soft corals, with *Porites*, *Fungia* and *Acropora* predominantly found in reef assemblages. The study concludes that extensive coastal developments and uncontrolled human activities may have negatively influenced the variations in coral conditions, diversity and abundance in the study area. Implementing proper regulations and policies for long-term sustainability would help achieve a balance between coastal shoreline development and the well-being of the communities.

Keywords: abundance, conservation, hard coral, Sabah, marine protected area

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Diversity of the picophytoplankton Mamiellophyceae in the West Philippines Sea with emphasis on *Ostreococcus*

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Abstract

Picophytoplankton, which are photosynthetic organisms smaller than 3 µm, play crucial roles in biogeochemical cycles and trophic interactions. Organisms under this category include the genus *Ostreococcus* (Mamiellophyceae), which are amongst the smallest known eukaryotes but remained little studied in the tropics. In this study, we explored the diversity of this genera in the West Philippine Sea (WPS) via shotgun metagenomic and PacBio 18S rRNA gene metabarcoding analyses. For shotgun metagenomics, three samples targeting the picoplankton fraction were collected from two different stations in Northwestern Luzon namely Masinloc, Zambales (MZ1 and MZ2) during the late northeast monsoon period, and a station in Bolinao, Pangasinan (BOL8) during the late southwest monsoon period. Additionally, the metabarcoding samples were obtained from six different stations in Bolinao, Pangasinan at the northwestern side of the Philippines during the late northeast to intermonsoon period (February and May, respectively). Co-assembly of shotgun data and binning of eukaryotic contigs resulted in 12 bins, with only one metagenome-assembled genome (MAG), bin7, exhibiting high completeness (94%) and low contamination (0.6%). Furthermore, single-copy marker genes from bin quality assessment suggest that bin7 belonged to the genus *Ostreococcus*. Phylogenomic analysis revealed that bin7 formed a significantly distinct and separate clade from the other established clades of *O. mediterraneus*, *O. lucimarinus*, *O. tauri*, and *O.* sp. RCC809 (Clade B). For metabarcoding data, taxonomic annotation of amplicon sequence variants (ASV) showed the presence of four *Ostreococcus* ASVs. Phylogenetic analysis revealed that these ASVs belonged to Clades B and E of *Ostreococcus*. These results highlight the diversity of *Ostreococcus* in WPS and strengthen previous findings suggesting a potential novel clade of *Ostreococcus* in the said region. Further studies are needed to conclusively resolve the evolutionary relationship of bin7 with other *Ostreococcus* clades, especially to those that do not have available assembled genomes yet. This study, however, sheds light on the underappreciated diversity of marine microorganisms in the Philippines, emphasizing the need for continued exploration and understanding in this ecologically significant region.

Keywords: *Ostreococcus*, West Philippine Sea (WPS), shotgun metagenomics, metabarcoding, phylogenetics

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Genetic diversity, temporal variability, and host association of parasitic *Amoebophrya* spp. (Syndiniales Group II) in tropical marine waters

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Abstract

Amoebophrya, synonymous to Syndiniales Group II, has been widely investigated due to its capability to control its host at the population level. Despite their significance, our understanding of their diversity and ecology remains incomplete, since many of their hosts are uncultivable. Additionally, most of the reference sequences used to classify Syndiniales were retrieved from temperate or polar regions, which leads to an increase in the number of unassigned Syndiniales taxa, especially since environmental surveys has steadily reported new sequences of the parasite. Therefore, this study aims to investigate the genetic diversity of *Amoebophrya* using molecular methods as well as their association with some potential HAB-forming species in a tropical coastal marine environment. Here, we collected water samples from a single site on an almost weekly or bi-weekly basis in a tropical coastal environment for one year. We then used high-throughput amplicon sequencing of the V4 region of the 18S rRNA gene to generate the taxonomic profiles across time, and to extract the short read amplicons classified as Syndiniales for the phylogenetic analysis. We also collected water samples from six different sites in the area, amplified the environmental DNA, and used PacBio Circular Consensus Sequencing (CCS) to obtain full-length 18S amplicons. These longer amplicon sequences have higher phylogenetic resolution, thus, were used as reference sequences for the phylogenetic tree. Using maximum likelihood analysis, we have constructed a Syndiniales reference tree that can be used for similar tropical coastal habitats. Our analysis revealed the high genetic diversity of *Amoebophrya* in our site as well as the presence of potentially novel phylotypes of these parasites. We also observed strong temporal variation of *Amoebophrya* coinciding with the temporal patterns also observed in dinoflagellates. Canonical correspondence analysis (CCA) demonstrated that *Amoebophrya*, particularly in the intracellular stage, was indirectly affected by nutrients and temperature by influencing availability of their hosts. Lastly, we explored host-parasite relationships of *Amoebophrya* using correlation and network analyses. We report a highly specific association between the parasite and the bloom-forming dinoflagellate host *Paragymnodinium*. We also observed associations of other known HABs in the area

such as *Karlodinum* with generalist phylotypes of *Amoebophrya*, however, further studies are needed to validate the existence of these relationships. Overall, our study provided baseline information on the diversity and host association of *Amoebophrya* in a tropical coastal environment. Further work is needed to incorporate the contribution of these parasites to food web and ecosystem models.

Keywords: marine eukaryotic parasites, Syndiniales, *Amoebophrya*, phylogenetics, diversity

Session B2: Systematics, taxonomy, and phylogenetics of marine life in the Western Pacific

New records of raphidophytes in the Philippines: morphology, phylogeny and their worldwide distribution

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Abstract

Of the 7 genera of harmful algal bloom (HAB) – causing marine raphidophytes, only *Chattonella subsalsa* was reported from the Philippines. In the present study, raphidophyte species were isolated from Zambales, Central Luzon. Three unialgal cultures were established to observe cell morphology and molecular phylogeny was inferred from partial LSU rDNA and ITS sequences. Cells of *Chattonella marina* measuring 30.6 µm long and 23.8 µm wide, were ovoid-shaped, with yellowish-brown chloroplasts that were oval shaped. Cells of *Fibrocapsa japonica* measuring 20.2 µm long and 12.5 µm wide, were ovoid shaped and possessed prominent mucocysts at the posterior end. Cells of *Heterosigma akashiwo* were small, measuring 12.2 µm long and 17.2 µm wide, were ovoid and elongated in shape. Molecular phylogeny showed that the Philippine strain *C. marina* was positioned in a clade with *C. marina* sequences from Korea, Japan, Brazil and Hongkong; *F. japonica* was positioned with *F. japonica* sequences from the USA, Brazil and Germany; and *H. akashiwo* was positioned with *H. akashiwo* sequences from Norway, Japan and USA. The toxicity of the Philippine raphidophyte strains were subjected to brine shrimp lethality assay which show that *F. japonica* at maximal cell concentration of 7.27 x 10^5 L^{-1} exhibited 10% *Artemia* mortality after 48 h exposure, while *H. akashiwo* at maximal cell concentration of 1.11 x 10^6 L^{-1} showed 40% *Artemia* mortality after 48 h of exposure. The detection of *C. marina, F. japonica* and *H. akashiwo* are first reports in the coastal waters of the Philippines. The occurrence of these HABs-causing raphidophytes pose a potential risk to the aquaculture industry in the Philippines.

Keywords: taxonomy, fish kill, red tide, fisheries, distribution

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Session B2: Systematics, taxonomy, and phylogenetics of marine life in the Western Pacific

Genetic diversity of harmful Family Kareniaceae in the Philippines, including the detection of a potentially two undescribed species

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Abstract

The family Kareniaceae is mostly known in the Philippines for recurrent blooms of *Takayama* sp. linked with massive fish kills in Bolinao and Obando Bulacan in Luzon Island. However, species diversity and distribution remain to be underreported in other coastal areas in the country owing to difficulty in identifying small naked dinoflagellates. In an attempt to examine the diversity of kareniaceans in Philippine archipelago, samples were collected from nine sites in southern Luzon and one site in Davao Gulf, Mindanao. Overall, a total of 18 strains of kareniacean dinoflagellates belonging to *Karenia* (*K. mikimotoi*, *K. papilionacea*), *Takayama* (*T. acrotrocha* and *Takayama* sp.1) and *Karlodinium* (*K. ballantinum, K. decipiens, K. gentienii, K. zhouanum*) were established in the laboratory and identified based on their morphology and molecular sequences. Presence of *K. gentienii* and *K. decipiens* in Davao Gulf reported in this study are first country reports. For the undescribed *Karlodinium* sp. (strain GBSUB5) from Subic Bay, Zambales, their cells measuring 10.9 µm long and 6.9 µm wide were the smallest in this genus. In contrast, *Takayama* sp.1 (strain GBSEDIN21) which measured 17.4 µm long and 14.9 µm wide was the largest among *Takayama* species. Based on LSU rDNA marker, the GBSUB5 was closely related to *K. australe* and *K. azanzae* while GBSEDIN21 is related to *T. tasmanica*. However, the GBSUB5 and GBSEDIN21 can be distinguished from closely related species in terms of cell length and shape and nucleus position. Hence, these two strains are novel kareniacean species to be described.

Keywords: harmful algal blooms, taxonomy, red tide, fish mortalities, aquaculture

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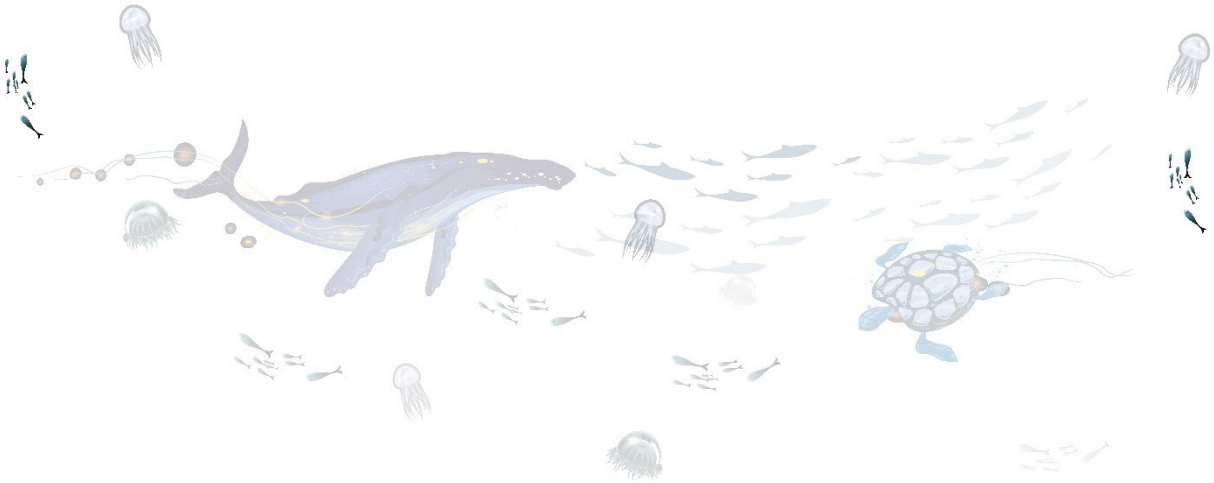
Sub-theme B: Marine Biodiversity, Seafood Safety and Security

Session B3: Vulnerability of the coral reef ecosystem towards extreme environmental fluctuations



Programme

Venue: Jubilee A, 11th Floor
Date: 22 April 2024

Conveners:

Tan Chun Hong — Faculty of Science and Marine Environment, Universiti Malaysia Terengganu, Malaysia

Mathinee Yucharoen — Coastal Oceanography and Climate Change Research Center, Prince of Songkla University, Thailand

Time	Presentation Titles	Speakers
Section 1		
13:30–13:45	Record-setting marine heatwaves lead to large-scale coral bleaching and mortality across the eastern tropical Pacific and wider Caribbean: is the 4th global mass coral bleaching event imminent?	Derek P. Manzello, *NOAA, USA*
13:45–14:00	High temperature and hyposalinity triggered the 2022 coral mass bleaching event in Hong Kong	Apple Pui Yi Chui, *The Chinese University of Hong Kong, China*
14:00–14:15	New warming master model: explaining ocean heat redistribution that exacerbates coral bleaching	Jungang Lu, *East China Normal University, China*
14:15–14:30	A comprehensive experiment on the physiological responses of coral to low oxygen conditions	Long Ying, *Prince of Songkla University, Thailand*
14:30–14:45	Interactive effects of seawater acidification and nutrients enrichment on early planulae stages of coral *Acropora digitifera* from Pulau Bidong, Terengganu, Malaysia	Muhammad Haidhar Almatin Ramli, *Universiti Malaysia Terengganu, Malaysia*
14:45–15:00	Tidal-driven submarine groundwater discharge and its impact on coral reefs: insights from Bidong Island, Malaysia	Wei San Phang, *Universiti Malaysia Terengganu, Malaysia*
Section 2		
15:30–15:45	The effects of pH and temperature variation on early stages of hard coral, *Acropora digitifera* in Pulau Bidong, Terengganu	Asma Aisha Kamarudin, *Universiti Malaysia Terengganu, Malaysia*
15:45–16:00	Study on the effect of sea current to the coral reef life form (*Scleractinia*) to accelerate the restoration effort	Addiena Kesuma, *Institut Teknologi Bandung, Indonesia*
16:00–16:15	Diseases and compromised health signs in coral reefs along the eastern Gulf of Thailand	Vimonrat Boonrattanakom, *Burapha University, Chanthaburi Campus, Thailand*

Time	Presentation Titles	Speakers
16:15–16:30	Coral disease in the Gulf of Thailand: comprehensive review and preliminary findings	Lalita Putchim, *Department of Marine and Coastal Resources, Thailand*
16:30–16:45	Hard coral community in Pulau Bidong under the influence of environmental factors	Mohmad Fuad Nur Qamarina, *Universiti Malaysia Terengganu, Malaysia*
16:45–17:00	Growth of crustose coralline algae (CCA) on ceramic substrates with different addictive material types and composition	Widiastuti, *Universitas Udayana Kampus Bukit Jimbaran, Indonesia*

Session B3: Vulnerability of the coral reef ecosystem towards extreme environmental fluctuations.

Record-setting marine heatwaves lead to large-scale coral bleaching and mortality across the eastern tropical Pacific and wider Caribbean: is the 4th global mass coral bleaching event imminent?

Derek P. Manzello[1], William Skirving[1, 2], Sophie G. Dove[3], Blake L. Spady[1, 2], Andrew Norrie[1, 2], Erick F. Geiger[1, 4], Gang Liu[1], Jacqueline L. De La Cour[1, 4], and Ove Hoegh-Guldberg[3]

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Abstract

Coincident with the arrival of El Niño in June 2023, mass coral bleaching due to anomalously warm sea surface temperatures (SSTs) began throughout the eastern tropical Pacific (ETP) and Caribbean side of central America. Unprecedentedly high SSTs and mass bleaching spread to Florida and the Bahamas by mid-to-late July. By October, a marine heatwave, record-setting in both magnitude and spatial scale, spanned the entire Caribbean biogeographic region; every reef area (except Bermuda) exceeded heat stress levels known to elicit coral mortality (>8°C-weeks). In many reef areas, this historically high heat stress started 1–2 months earlier and was sustained for longer than the typical seasonal changes. For example, in Florida, the previous record-high SST was exceeded for 29 days; many reefs were exposed to more than double the amount of heat stress that is expected to elicit mortality and some sites experienced nearly three times their highest level of heat stress on record. The full ecological impacts of this event will not be fully realized for months-to-years, but preliminary reports have been alarming. The acroporid corals, which were the dominant, shallow-water, reef-building corals throughout the Caribbean for thousands of years, were the most severely impacted, with reports of 90–100% mortality on reefs in Florida, Mexico, and Puerto Rico. Unexpectedly, acute heat shock and rapid tissue loss occurred in gorgonian soft corals in Florida; prior to this event, these taxa had been winners in the Caribbean for the past 40 years, as their abundances had been stable or increasing across the region. This large-scale bleaching event was not limited to the ETP and wider Caribbean, as severe bleaching was also reported from the Persian Gulf, Red Sea, and Gulf of Aden during Northern Hemisphere Summer 2023. As of 29 November 2023, mass coral bleaching has been reported from at least 35 countries and territories spanning 5 different oceans/seas in 2023. Historical data

indicate that the ETP and Caribbean marine heatwave events likely represent the beginning of a global mass coral bleaching event over the next 12 to 24 months as the El Niño phase of the El Niño-Southern Oscillation (ENSO) continues.

Keywords: coral bleaching, climate change, marine heatwaves, sea surface temperature, El Niño, ENSO

Disclaimer: The scientific results and conclusions, as well as any views or opinions expressed herein, are those of the author(s) and do not necessarily reflect the views of NOAA or the Department of Commerce.

Session B3: Vulnerability of the coral reef ecosystem towards extreme environmental fluctuations.

High temperature and hyposalinity triggered the 2022 coral mass bleaching event in Hong Kong

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Abstract

A mass coral bleaching event occurred in the summer of 2022 in subtropical Hong Kong waters. We surveyed 17 sites with substantial coral cover across northern to eastern parts of Hong Kong waters in August 2022. Video-transect surveys were conducted, and 102 bleached coral colonies were tagged for subsequent recovery monitoring. Bleaching was found in all sites, with a 2–43% bleached coral-covered area per site in August, but this dropped to 0.8–8.9% in the follow-up survey in October/November. Among the tagged coral colonies, 96% were found to have recovered in October/November. Analyses of environmental monitoring data revealed that unprecedented elevated seawater temperature and hyposalinity were the most likely causes of this widespread coral bleaching event. The high coral recovery rate showed that the subtropical corals in Hong Kong are resilient to bleaching.

Keywords: high temperature, hyposalinity, coral bleaching, Hong Kong, marginal reef environments

Session B3: Vulnerability of the coral reef ecosystem towards extreme environmental fluctuations.

New warming master model: explaining ocean heat redistribution that exacerbates coral bleaching

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Abstract

Extreme sea temperature rise and ocean heat redistribution in the context of global warming have become one of the major threats affecting the health of coral reef ecosystems. In this study, we combine empirical orthogonal function decomposition and coral bleaching monitoring data to quantify the extent of coral bleaching in eight major coral distribution areas around the world from 1993 to 2020, and propose the coral bleaching process under the influence of ENSO; Combining factors such as ocean current movement and coastal topography, we propose a conceptual model of the main control of warm currents along the east coast of the continent to further explain the effects of heat redistribution on coral bleaching. The results show that the health of global coral ecosystems has long been closely linked to mass coral bleaching events, with fluctuating trends. Global warming has exacerbated the intensity and frequency of ENSO, which in turn has increased the extent of ocean heat redistribution, leading to a more severe coral bleaching situation and an unsustainable risk to coral reef ecosystems. Coral ecosystems in different seas can recover rapidly to a healthy state within 10 years after a severe bleaching event. The ability of coral reefs to recover depends on the length of the interval between two mass bleaching events. A warm current-dominated model for the eastern coast of the continent explains coral bleaching under the influence of ocean heat buildup and redistribution, and the model is applicable to real-world situations in the Caribbean, East Asia, the Western Indian Ocean and Oceania.

Keywords: coral bleaching, heat redistribution, climate abnormalities, ENSO, ocean currents

Session B3: Vulnerability of the coral reef ecosystem towards extreme environmental fluctuations.

A comprehensive experiment on the physiological responses of coral to low oxygen conditions

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Abstract

Ocean deoxygenation, exacerbated by global climate change, poses a significant threat to both local and global marine ecosystems, especially coral reefs experiencing unprecedented challenges inflicted by a metabolic crisis and bleaching-induced mortality. However, the understanding of the potential hazards of low oxygen conditions in tropical regions remains inadequate, and the physiological responses of corals to hypoxia and anoxia conditions are still shrouded in uncertainty. To bridge this knowledge gap, we therefore experimentally exposed colonies with different morphologies—*Pocillopora acuta*, *Porites lutea* and *Turbinaria mesenterina* to deoxygenation stress that was aligned to their natural night-day light cycle for 72 hours. Specifically, these corals were incubated under varying dissolved oxygen (DO) conditions (control with DO of 6.0±0.5 mg/L, hypoxia with DO of 2.0±0.5 mg/L, and anoxia with DO <0.5 mg/L) in closed chambers to measure the maximum quantum yield (MQY), respiration rate, and calcification rate. Strikingly, the mortality of *P. acuta* in the anoxia treatment was observed with tissue loss in all replicates within 24 hours, while *P. lutea* and *T. mesenterina* showed no mortality within the 72-hour timeframe. MQY significantly decreased with time in all species. Coral respiration rate and calcification rate have also been observed to decline in all species. Based on this study, we proposed the nuanced sensitivity of corals to hypoxia and anoxia conditions, emphasizing the substantial impact of low oxygen conditions on both coral survival and the photosynthetic capacity of symbiotic algae. This study emphasized the substantial impact of corals photosynthetic capacity and metabolism on low oxygen conditions and highlights species-specific variations in sensitivity to hypoxia and anoxia conditions.

Keywords: coral physiology, hypoxia, anoxia, climate change, Gulf of Thailand

Session B3: Vulnerability of the coral reef ecosystem towards extreme environmental fluctuations.

Interactive effects of seawater acidification and nutrients enrichment on early planulae stages of coral *Acropora digitifera* from Pulau Bidong, Terengganu, Malaysia

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Abstract

Inshore coral reefs are experiencing the combined pressure of seawater acidification and excess nutrient availability associated with submarine groundwater discharge (SGD) event. Both pressures are known to have detrimental impacts on the early life history stages of hard coral. Here, we aimed to study the cumulative effects of low pH and high nutrients on embryonic development, larval survivorship, and metamorphosis of early life stages of Scleractinian coral *Acropora digitifera* at a SGD-influenced coral reef in Pulau Bidong, Terengganu, Malaysia. Coral larvae (~350 individual) were exposed in four different seawater treatments, corresponding to the current seawater (pH 7.98) as control, pH 7.8, pH 7.6 and pH 7.6 with enriched nutrients (0.4 µM phosphate + 10 µM nitrate) for 10 days. Twenty larvae were collected at intervals of 2, 4, 12, 18, 24, 36 and 96 hours after fertilization for embryonic development observation. After 96 hours, the survivability of swimming larvae (n=50) that settled and metamorphosed were quantified. On the 10th day of post-fertilization, the surface area of the larvae spat was measured by using Image Analysis Software (ImageJ). Results of this study indicated that pH has profound impacts on the coral *A. digitifera* larvae. An irregular cleavage was observed in low pH treatment which was a sign of abnormalities in embryonic development. After 10 days of exposure, the lowest survivorship (mean±SE, 39.56±3.30%) and metamorphosed (46.22±5.65%) larvae were identified in pH 7.6 and pH 7.6 with high nutrients treatment, respectively. Besides that, the smallest surface area of the larvae spat were spotted in pH 7.6 with high nutrients treatment (0.298±0.02 mm^2). In contrast, control conditions showing a highest larval survivorship (74.89±5.73%), metamorphosis (72.44±5.61%), and surface area of larvae spat (0.322±0.03 mm^2). The cumulative impacts of low pH alone or concurrent with nutrient enrichment over all early life history stages would increase the likelihood for failure of larval supply and recruitment for the coral species. These suggest that early life stages of corals that exposed to discharge of submarine groundwater (i.e., acidified water) coupled with nutrients pollution especially at the coastal areas could potentially experience greater impacts from future climate change scenarios.

Keywords: coral, planulae, ocean acidification, nutrients, pH

Session B3: Vulnerability of the coral reef ecosystem towards extreme environmental fluctuations.

Tidal-driven submarine groundwater discharge and its impact on coral reefs: insights from Bidong Island, Malaysia

Wei San Phang[1], Yee Qi Teo[1], Daryl Jia Jun Lee[1], Muhammad Faisal Abd Rahman[1], Jaw Chuen Yong[1], Chun Hong Tan[1, 2], and Seng Chee Poh[1, 2]

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Abstract

Submarine Groundwater Discharge (SGD) serves as a crucial conduit for transporting elements from the mainland to coastal zones, with limited studies on this phenomenon in Malaysia. This research focuses on Bidong Island's coral reefs, employing a time series measurement approach to assess SGD, seawater carbonate chemistry, and nutrient dynamics. The radon mass balance model was employed to quantify nutrient-associated SGD fluxes during different spring and neap tidal events. Our findings reveal that the daily average SGD flux and associated dissolved inorganic nitrogen (DIN) and phosphate flux were marginally higher during spring tides (0.013 m d^{-1}, 2.49x10^{-6} M N d^{-1}, 8.75x10^{-8}M P d^{-1}) compared to neap tides (0.0043 m d^{-1}, 8.08x10^{-7} M N d^{-1}, 2.83x10^{-8} M P d^{-1}). Subsequently, three additional in-situ net primary productivity (NPP) experiments were conducted during both spring and neap tides. The average NPP for spring and neap tides was determined to be 0.431 and 0.235 mg O_2 m^{-3} d^{-1}, respectively. Whereas the daily average pH and pH range were determined (pH7.94, 7.68–8.32 and pH7.94, 7.65–8.25) for both spring and neap. While the total alkalinity was found higher during spring tide (2165 µmol kg^{-1}) compare to during neap tide (2139 µmol kg^{-1}). Furthermore, Aragonite saturation (ΩAr) concentrations were calculated using CO2SYS, revealing average values of 2.92 during spring tide and 2.63 during neap tide for the SGD, respectively. The ΩAr in Bidong Islands was found slightly lower compare to other SGD-impacted coral reefs in this region such as the Sire Bay, Indonesia with ΩAr values between range 2.82 to 5.88 (Benge et. al., 2023). These ΩAr values provide crucial insights into the carbonate chemistry, emphasizing the potential influence of SGD on the local coral reef ecosystem and underscoring the importance of understanding these dynamics for effective marine conservation and management.

Keywords: seawater carbonate chemistry, SGD fluxes, Malaysia water, time-series sampling

Session B3: Vulnerability of the coral reef ecosystem towards extreme environmental fluctuations.

The effects of pH and temperature variation on early stages of hard coral, *Acropora digitifera* in Pulau Bidong, Terengganu

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Abstract

Increased concentration of carbon dioxide in the atmosphere has led to the decrease of ocean's pH and the enhanced the greenhouse effect on the earth which increases Earth temperature. The combination of these two phenomena poses severe threat towards marine ecosystems. Under these threats, calcifying organisms such as hard corals are at risk as they are mainly composed of calcium carbonate skeleton. Increased partial pressure of carbon dioxide has been demonstrated to diminish coral recruit skeletal weight, while increased oceanic temperature have caused algae-symbiont corals to bleach. But, the impacts of acidified ocean and seawater temperature elevation on early developmental stages of coral larvae are still unclear. This study aimed to examine the response of early development stages of a key hard coral species, *Acropora digitifera* to the combined stressors of lowered pH and elevated seawater temperature. The experiment simulated the conditions of the ocean anticipated by the Intergovernmental Panel on Climate Change (IPCC) projections with three different treatments: 1) Control (ambient pH and temperature), 2) pH 7.8 with ambient temperature (28^{O}C), and 3) pH 7.8 with elevated temperature at 31^{O}C. Approximately 350 fertilized *A.digitifera* eggs were collected and placed in each treatment container. The development stages of the embryo were recorded for the next 96 hours since fertilization. After 96 hours, 50 larvae were used to examine the settlement success and survivability. Settlement and metamorphosis phase of larvae was induced by placing terracotta tiles glued with crustose coralline algae (CCA) in each container. The results showed that the development time of *A.digitifera* embryo was shorter in pH 7.8 with elevated temperature but with higher number of deformities. In contrast, no significant effect of lowered pH and elevated temperature on metamorphosis success of planulae. In conclusion, despite shorter development time, a higher incidence of deformities underscores the vulnerability of calcifying organisms to changing environmental conditions while lack of significant effects on the metamorphosis success of planulae suggests a level of resilience or adaptability in this specific phase of coral development.

Keywords: ocean acidification, global warming, *Acropora digitifera*, development, metamorphosis

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Study on the effect of sea current to the coral reef life form (*Scleractinia*) to accelerate the restoration effort

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Abstract

Coral reef ecosystems exhibit complex responses to the dynamic nature of their aquatic environment. Variations in environmental factors contribute to diverse patterns of coral distribution in different locations within each ecosystem. This study aims to investigate the correlation between sea current velocity and the life forms of coral reefs at multiple observation sites in Indonesian waters. The measurement of sea current velocity relies on current real-time global forecasting data obtained from the Copernicus Marine Environment Monitoring Service (CMEMS). Field observations conducted by FDC-IPB and WCS-IP at seven distinct observation stations, provide data on the percentage of the bottom substrate for the coral reef ecosystem, encompassing percent cover and the distribution of hard coral life forms. The research findings reveal variations in the average velocity of sea currents at each observation site, with the highest velocity observed in the waters around Sebesi and Sebuku Islands (0.348 m/s) and the lowest velocity around Mare Island (0.103 m/s). The percentage of coral cover is categorized as "medium" in most observation stations, except for Kei Besar Island and Mare Island, where the coral cover percentage is classified as "good" category. Analysis of hard coral life forms (Scleractinia) identified 13 types of coral life forms present across all observation sites. A "slow" current velocity (0 – 0.25 m/s) is associated with the ruderals (r) life form group, characterized by rapid growth but susceptibility to physical damage. On the other hand, "moderate" current conditions (0.25 – 0.50 m/s) are marked by the presence of the competitors (K) and stress-tolerators (S) groups, exhibiting high resistance to environmental pressure but slower growth rates.

Keywords: conservation class, coral reef, life form, sea current

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Diseases and compromised health signs in coral reefs along the eastern Gulf of Thailand

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Abstract

Over the recent decades, coral reefs worldwide suffered from continuous deterioration due to many factors. Diseases and compromised health signs are major threat against coral reefs ecosystem amongst other factors. Coral reefs in the Caribbean and Indo-Pacific region that were affected by diseases died and declined in numbers. Thailand has very limited case study on this matter. Surveys were conducted to access the prevalence of coral diseases and compromised health signs at 16 sites from four provinces in the Eastern Gulf of Thailand; Chonburi, Rayong, Chanthaburi, and Trat. We collected data of 90 square meters per site using the three-belt transect method. We found nine types of coral diseases and compromised health signs that can be classified into 2 groups; 1) single coral diseases or external abnormalities per colony i.e. Borers: BR, Pigmentation Response: PR, Sediment Damage: SED, Growth Anomalies: GA, Partial Mortality: PM, Competition: CP, Predator: PD, Non-Focal Bleaching: NFB, Yellow-banded tissue loss: YBTL and 2) multiple coral diseases or external abnormalities per colony, i.e., PR + SED, PR + CP, PR+BR, PM+BR, SED+PM.

Keywords: diseases, compromised health signs, coral reef, eastern Gulf of Thailand

Session B3: Vulnerability of the coral reef ecosystem towards extreme environmental fluctuations.

Coral disease in the Gulf of Thailand: comprehensive review and preliminary findings

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Abstract

Coral diseases are a significant threat, resulting in a global decline in coral populations for the past few decades. However, until 2021, this hasn't been the case for Thailand. The Department of Marine and Coastal Resources conducts regular annual monitoring programs consist of more than 150 stations across the Gulf of Thailand to assess status of coral reefs. During these surveys, we observed various signs of coral diseases, such as focal bleaching, non-focal bleaching, ulcerative white spot disease, and abnormal growth. Most of these did not result in coral mortality. However, a confirmed coral-killing disease identified in this study is yellow-banded tissue loss disease (YBTLD). YBTLD is one of the six major diseases causing extensive damage to coral reefs worldwide. We reported for the first time in several coral reefs around the Sattahip-Samaesarn Islands in Chonburi Province during late 2021. Subsequently, the geographic range of YS expanded to include Surat Thani, Chumphon, and Trat Province in 2022–2023. The identification of these diseases relied on available handbooks and publications. We presented the dissimilarity and highlights the unique characteristics and behavior of these diseases in this region. Compared to other coral disease hotspots, there is limited knowledge in various aspects related to coral diseases and the processes to mitigate their impacts in Thailand. The approach to addressing this are to expedite research, build knowledge, and identify the clear causes of disease occurrence. This information will be crucial instrumental in planning future prevention and mitigation strategies.

Keywords: coral disease, Gulf of Thailand, yellow-banded tissue loss disease

Session B3: Vulnerability of the coral reef ecosystem towards extreme environmental fluctuations.

Hard coral community in Pulau Bidong under the influence of environmental factors

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Abstract

Hard coral is an essential component in the development of coral reefs and has gained research interest due to its role in the building and formation of coral reefs. The attention should be centered towards the environmental variability on hard coral even more with the increasing issue of climate change. Therefore, this study investigated the influence of spatial patterns based on location, reef zonation and depth on the distribution of hard coral communities in Pulau Bidong, located in the South China Sea. The surrounding island is exposed to different oceanographic conditions, particularly during monsoon season. It is hypothesized that differences in the spatial pattern are influenced by oceanographic conditions which deter the distribution of the hard coral. The location of the reef is differentiated into the northeast and southwest of Pulau Bidong as there are differences in current circulation at each location. The reef zonation was characterized as either reef flat or reef slope from visual observation. Meanwhile, the site is also defined into three different depths: shallow (1–5 m), mid (6–10 m) and deep (11–16 m). Utilizing video sampling method, this study discovered higher number of genera in the northeast reef (35 genera) as compared to the southwest reef (8 genera). Overall, the study area is predominantly covered with genera *Acropora* (48.43%) and *Porites* (19.81%). Among the hard coral, *Acropora* branching, non-*Acropora* branching, and massive forms contributed the most to the hard coral community where both *Acropora* branching and non-*Acropora* branching mostly occupied reef flat, shallow water area and at the southern part of the island. Meanwhile, massive forms such as *Porites*, *Diploastrea* and *Favites* can be found dominating the northeastern part of the island in deeper areas, particularly at the reef slope. It is suggested that the exposure to the environmental variables in the northeast reef influenced the abundant hard corals in this area. The variation of hard corals between depth and reef zonation may also be due to decreasing light availability in deeper water. Continuous monitoring of the hard coral community along with the implication of environmental variables is necessary for a sustainable coral reef.

Keywords: hard coral, coral community, Pulau Bidong, environmental factors

Session B3: Vulnerability of the coral reef ecosystem towards extreme environmental fluctuations.

Growth of crustose coralline algae (CCA) on ceramic substrates with different addictive material types and composition

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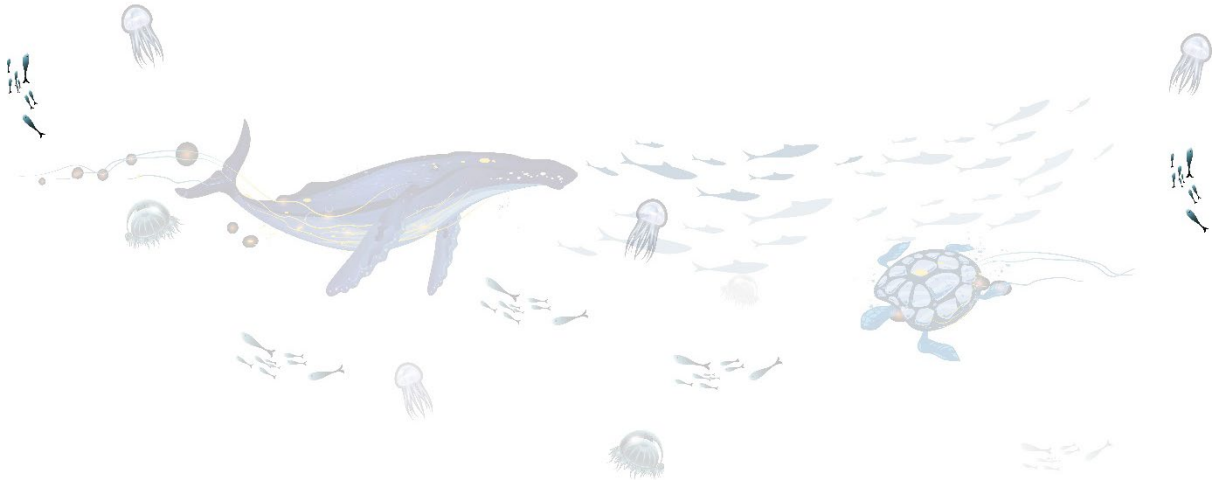
Abstract

Crustose Coralline Algae (CCA) plays a vital role as a trigger for the attachment and metamorphosis of coral planulae because it produces chemical signals that planulae can capture as instructions for attachment to the substrate. Thus, developing proper substrates for CCA settlement is a crucial parameter. Ceramic has the advantage of not causing toxic effects in a marine environment and long-term durability. This study aimed to determine the growth of CCA on ceramic substrates with different addictive material types (coconut charcoal, bread fluor, and aluminum oxide) and compositions (5, 15, and 25%). The 5x5x0.5 cm ceramic substrates consisted mainly of Kalimantan soil (BL1) with different addictive material types and compositions (5 replicates each) were placed in an artificial seawater aquarium under 60–100 µmol photons/m^2s at 12:12 h dark:light regime for a month, and the water quality parameters were maintained at stable levels during the experiment. Each treatment's microscopic surface structure and elemental composition were measured using Scanning Electron Microscopy (SEM) with Energy-Dispersive X-ray Spectroscopy (EDX). The coverage growth of CCA was photographed with a mobile phone camera and was subsequently calculated using ImageJ 1x software. The differences in CCA growth at different addictive material types and compositions were analyzed using the Two-Way ANOVA. The Tukey HSD test further analyzed the treatment that caused the difference. Results demonstrated that substrate with the addictive material aluminum oxide significantly increased the growth of CCA. Moreover, a 5% addition of any addictive materials in the ceramic substrate also significantly increased the growth of CCA. The high growth of CCA at substrates with addictive material aluminum oxide is suggested due to the higher content of Fe (0.9 - 1.1 wt%) in these substrates compared to others. Fe plays an essential role in algae growth because it is required as the enzymatic co-factor in photosynthetic electron transport.

Keywords: ceramic addictive material, ceramic, crustose coralline algae (CCA)

Sub-theme B: Marine Biodiversity, Seafood Safety and Security

Session B4:
Coral reef resilience to climate change and human impacts



Programme

Venue: Jubilee A, 11th Floor
Date: 23 April 2024

Conveners:

Thamasak Yeemin	Department of Biology, Faculty of Science, Ramkhamhaeng University, Thailand
Jing Zhang	East China Normal University, China
Vo Si Tuan	Institute of Oceanography, Vietnam
Takashi Nakamura	University of the Ryukyus, Japan

Time	Presentation Titles	Speakers
Section 1		
10:00–10:15	Effects of anoxia and hypoxia on scleractinian corals oxidative stress responses	Siti Nurtahirah Jaafar, *Universiti Malaysia Terengganu, Malaysia*
10:15–10:30	Symbiodiniaceae diversity hosted by *Palythoa tuberculosa* of adjacent ecoregions – the Straits of Malacca and South China Sea: environmental and climate change perspectives	Hai Ping Yu, *Universiti Kebangsaan Malaysia, Malaysia*
10:30–10:45	Coastal coral reefs and coral reef fish in extreme environmental conditions	Apichit Sonmongkon, *Department of Marine and Coastal Resources, Thailand*
10:45–11:00	Changes in the multi-species fishery production of commercially important nearshore marine invertebrates in Bolinao, Pangasinan, after 30 years (1992–2023)	Jerwin Baure, *University of the Philippines Diliman, The Philippines*
11:00–11:15	Comparative analysis of marine invertebrates settlement & biodiversity in Terengganu's Islands: preliminary insights on their ecological implications	Arham bin Taupek, *Universiti Malaysia Terengganu, Malaysia*
11:15–11:30	Relationship between parrotfish abundance and benthic lifeforms at tropical coral reef ecosystem in Terengganu, east coast of Peninsular Malaysia	Rahman Syahputra, *Universiti Malaysia Terengganu, Malaysia*
11:30–11:45	Mass coral bleaching event of 2022 in Sekisei Lagoon, Japan: insights during and one year post bleaching	Mariyam Shidha Afzal, *University of the Ryukyus, Japan*
11:45–12:00	Effects of repeated bleaching events on the resilience of corals in Sekisei Lagoon	Takashi Nakamura, *University of the Ryukyus, Japan*
Section 2		
13:00–13:15	Epidemiology and etiology of tissue necrosis disease in corals around Okinawa, Japan	Dio Dirgantara, *University of the Ryukyus, Japan*

Time	Presentation Titles	Speakers
13:15–13:30	Interplay of leaching effects of calcium carbonate-enhanced tiles and surface topography: implications for coral larvae settlement and skeleton development in restoration initiatives	Muhammad Alif Kamarul Azman, *Universiti Malaysia Terengganu, Malaysia*
13:30–13:45	Investigation on the effects of substrate materials on the larvae settlement success of hard coral, *Acropora digitifera*	Nur Syafiqah Hashim, *Universiti Malaysia Terengganu, Malaysia*
13:45–14:00	Comparative analysis of resilience in coral restoration methodology: direct transplantation versus larvae enhancement	Chun Hong Tan, *Universiti Malaysia Terengganu, Malaysia*
14:00–14:15	Integrated approach for coral reef conservation and rehabilitation in the Philippines	Hiroyuki Takasuna, *Kajima Corporation, Japan*
14:15–14:30	A review of coral reef restoration initiatives in the Philippines from 1977 to 2023	Maria Vanessa Baria-Rodriguez, *University of the Philippines, Diliman, The Philippines*
14:30–14:45	Coral reef resilience to environment and climate change in the Eastern Gulf of Thailand	Choochai Ruangjaroon, *Burapha University, Chanthaburi Campus, Thailand*
14:45–15:00	Reef corals can be resilient again disasters: resilience in Con Dao Islands, Vietnam for last nearly 25 years	Si Tuan Vo, *Institute of Oceanography, Vietnam*
Section 3		
15:30–15:45	Assessing anthropogenic impacts and resilience of coral reefs in Pulau Redang Marine Park towards improving MPA management strategies	Puteri Nur Adila Megat Yusop, *Universiti Malaysia Terengganu, Malaysia*
15:45–16:00	Mitigation of environmental stresses on reef-building corals and conservation perspective	Tomihiko Higuchi, *The University of Tokyo, Japan*
16:00–16:15	Social-ecological systems approach to mitigate reef degradation and enhance agricultural production for community-based Crown-of-Thorns Starfish and seaweed management	Sefano Moon Katz, *Pacific Blue Foundation, Fiji*
16:15–16:30	Resilience based management of coral reefs for biodiversity conservation and sustainable livelihood in Gulf of Mannar, southeast India	Jasperkamalam Patterson Edward, *Suganthi Devadason Marine Research Institute, India*
16:30–16:45	Linking area-based conservation and resilience-based management to enhance coral reef resilience in Thailand	Wichin Suebpala, *Ramkhamhaeng University, Thailand*
16:45–17:00	**Discussion**	

Session B4: Coral reef resilience to climate change and human impacts

Effects of anoxia and hypoxia on scleractinian corals oxidative stress responses

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Abstract

Coral reefs, vital ecosystems supporting a diverse array of marine life, face increasing threats due to environmental stressors, including anoxia and hypoxia events. These oxygen-depleted conditions can significantly affect coral health and resilience, leading to widespread coral bleaching and mortality. This study investigates the oxidative stress responses in these three coral species; *Pocillopora acuta*, *Porites lutea*, and *Turbinaria mesentari*. Notably, the anoxia treatment led to rapid mortality in *P. acuta*, with tissue loss observed in all replicates within 24 hours. In contrast, *P. lutea* and *T. mesentaria* exhibited no mortality within the 72-hour timeframe. Three different enzymes were measured which are Glutathione S-transferase (GST), Catalase (CAT) and Superoxide dismutase (SOD) to access the oxidative stress response in those corals sp. The results demonstrated variation in those three enzymes responses with all species of corals treated. GST showed higher activities in anoxia for *P. acuta, T. mesentaria* ($p<0.05$) and higher activity in hypoxia for *T. mesentaria* ($p<0.05$). In contrast, no significance difference for all enzymes in *P. lutea.* Whereas for CAT only *P. acuta* showed higher activities in both anoxia and hypoxia. SOD activities showed highest significance ($p<0.05$) in anoxia for *P. acuta* and *T. mesentaria.* However, the present findings suggest that *P. lutea* is resilient to some extent to short-term exposure to anoxia and hypoxia, as predicted to occur with climate change, may still have deleterious effects on corals. This study may shed light on the multifaceted effects of anoxia and hypoxia on coral reefs, emphasizing the importance of studying oxidative stress responses to better comprehend the resilience and adaptability of corals in the face of changing environmental conditions. Such insights are paramount for the conservation and management of these invaluable marine ecosystems.

Keywords: anoxia, hypoxia, scleractinian corals, xoidative stress, coral health

Symbiodiniaceae diversity hosted by *Palythoa tuberculosa* of adjacent ecoregions – the Straits of Malacca and South China Sea: environmental and climate change perspectives

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Abstract

The keystone ecological relationship between the dinoflagellata endosymbionts (Symbiodiniaceae) with coral reef associated organisms has narrow range of environmental tolerance. This is most notable from the threats of global warming due to anthropogenic climate change. Nevertheless, the ubiquitous zooxanthellate zoantharian *Palythoa tuberculosa* (host) demonstrates the ability to survive environmental stressors owing to its flexible association with divergent Symbiodiniaceae typings. The adjacent marine ecoregions of Peninsular Malaysia (The Straits of Malacca and South China Sea) accomodate distinctive environments despite their shared latitudinal and longitudinal proximity. These locations provide an ideal comparative experimental model to examine Symbiodiniaceae diversity within single species host. The samples of *Palythoa tuberculosa* were collected (within depth of 1-18 m) and preserved for molecular works from respective islands sites (South China Sea: Tioman, Bidong, The Straits of Malacca: Payar) while seawater temperature was measured with Hobo Pendent logger. And five-years time series average (2018–2022) of sea surface temperature and chlorophyll-a concentration in Malaysian marine ecoreiongs were derived from MODIS Aqua, NASA. The sea surface temperature and chlorophyll-a concentration in The Straits of Malacca is notably higher than in the East Coast of Peninsular Malaysia. Prelimary phylogenetic analysis of sample DNA sequence revealed distinctive ITS2 profile of *Cladocopium* and *Durusdinium* between sample sites. Further phylogeny inspection with psbA^{ncr} marker revealed possible newly unreported lineage. The correlation between water parameters and Symbiodiniaceae genotypes will be determined. We expect to find different genotypes from two ecoregions respectively and wish to identify the delineation subsequently. The seawater temperature variations offer as a reference to assigning Symbiodiniaceae diversity with the aims to identify stress tolerant genotypes.

Keywords: Zoantharia, dinoflagellate, coral reef, marine ecoregions, Malaysia

Coastal coral reefs and coral reef fish in extreme environmental conditions

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Abstract

Coastal coral reefs are facing various human-induced environmental changes, but the cascading effects of organismal tolerances on the assembly and functioning of reef organisms is not quite well understood. The Sichang coral reefs, located in the inner Gulf of Thailand, serve as the primary reef and are utilized for tourism, fishing, the seafood industry, boating, and maritime activities. This diverse usage pattern exposes these reefs to extreme environmental conditions, offering valuable insights into how reefs may respond or adapt to challenging utilization.

In this study, we examine the differences in habitat characteristics and diversity, abundance, and community structure of local fish species between the Sichang Island which is known for their extreme environmental conditions. While the neighboring Phai Island and Lan Island exhibit comparatively more environmentally favorable characteristics.

Our findings suggested that the corals in the Sichang Island struggle to survive in these extreme environments, displaying lower resilience compared to other areas. These challenging conditions lead to coral communities with reduced diversity, primarily composed of stress-tolerant species that offer limited three-dimensional structure. Despite the low habitat complexity and extreme environmental conditions, the diversity and abundance of reef fish communities in this area are comparable to those in regions outside the Gulf. Particularly note on the significantly higher presence of herbivore fish, typically found in high-nutrient areas, compared to other species.

Projections suggest that the impending extreme environmental conditions could disturb the community structure and productivity of a vital functional group. However, inhabiting such extreme environments may potentially foster resilient habitats for marine organisms in the future.

Keywords: coastal reefs, reef fish, Sichang Island, extreme environment

Changes in the multi-species fishery production of commercially important nearshore marine invertebrates in Bolinao, Pangasinan, after 30 years (1992–2023)

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Abstract

Coral reef, seagrass, and rocky and sandy shore ecosystems surrounding and adjacent to Santiago Island, Bolinao, Pangasinan in northwestern Luzon is known to harbor diverse commercially important marine invertebrates. Many of these are gleaned and thus a source of food and income for many small fisher households. To determine changes in species composition and estimate the current value of invertebrate production, a 4-month daily market survey was conducted from February to May 2023 and compared with the market survey conducted 30 years ago. There were 115 vendors recorded during the 2023 survey, although only 28 of them regularly sold invertebrates per week. A total of 62 invertebrates were recorded during the two surveys. The most common invertebrates sold were mollusks and crustaceans and sea urchins. Among 46 species recorded in 1992–1993, 17 were not found during the 2023 survey, while 14 species not previously found in 1992–1993 were observed in 2023. Among mollusks, cephalopods had the highest production, followed by bivalves and lastly gastropods. Presently, squids, green mussel, and conch snails had the highest production among different mollusk taxa. Among crustaceans, penaeid shrimps had the highest production followed by decapod crabs. Two species of sea urchins are also sold in the local market. Comparison of production data between the two surveys suggest that invertebrate production may have reduced by more than a half of what was produced 30 years ago, which has been attributed to overfishing and environmental degradation brought by intensive mariculture activities since the 1980s. Despite this, invertebrates sold at the local market was estimated to contribute a minimum of Php 5.7 million to the local economy in February–May 2023. However, this amount does not yet include high-value species such as sea cucumbers and sea urchins which are directly sold to traders, lobsters that are directly sold to local institutional markets (e.g., resorts), and invertebrates that are only consumed by fisher households. The contribution of invertebrates in terms of nutrition, domestic food security and ecological services remain undervalued. A more comprehensive study is needed to fully assess the status of the fishery stock and fill in knowledge gaps in the socio-ecological systems in the fisheries of commercially important invertebrates to properly manage these resources. An ecosystem approach to fisheries management must be undertaken by the local government in cooperation with various stakeholders such as coastal communities, academic institutions and other private partners.

Keywords: Bolinao, marine invertebrates, market survey, fisheries management, socio-ecological system

Session: B4 Coral reef resilience to climate change and human impacts

Comparative analysis of marine invertebrates settlement & biodiversity in Terengganu's Islands: preliminary insights on their ecological implications

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Abstract

Coral reef ecosystem of Bidong Island has rapidly faced significant challenges due to climate-related events, such as tropical storms. These events have caused decline in coral cover and a reduction in invertebrate diversity and abundance. For instance, the storm Pabuk in January 2019 decreased live coral cover from 47.9% to 28.75% and increased dead coral cover from 26.3% to 65.09%. The storm also altered the reef framework, leading to uplifted coral rubble and sands in the bay. While coral coverage assessments have been conducted, there's an urgent need to understand the coral reef's recovery, including invertebrate colonization and succession. The COVID-19 pandemic and related Movement Control Orders (MCOs) created a unique opportunity to establish baseline data on marine invertebrate diversity. The main goal of this study is to methodically analyse and compare marine invertebrate settlement and diversity data from a recovering reef (Bidong Island), with data from diverse geographic locations to uncover patterns, similarities, and differences within their populations. To achieve this, comprehensive field research was conducted across 13 islands in Terengganu, namely Ekor Tebu Island, Kerenga Besar Island, Lima Island, Ling Island, Paku Besar Island, Paku Kecil Island, Pinang Island, Redang Island, Kapas Island, Perhentian Island, Tenggol Island, Bidong Island and Yu Island. Data on marine macroinvertebrates diversity were collected using a dynamic combination of Coral Video Transect (CVT) and Line Intersect Transect (LIT) techniques. For settlement pattern Autonomous Reef Monitoring Structures (ARMs) were used at 2 of the islands. These data were subsequently analyzed using a variety of diversity indices, including Shannon's diversity index, Simpson's diversity index, Margalef's diversity index, and the Pielou index, to quantify species richness, evenness, and overall diversity at each island's various sites. Settled organism on ARMs plate were identified to lowest possible taxa. The study's findings have unveiled a total of five marine macroinvertebrate phyla, including Annelida, Arthropoda, Echinodermata, Mollusca, and Platyhelminthes. Furthermore, species richness across the island sites ranged from 4 to 20 species. This research establishes a critical foundational resource for understanding invertebrate colonization, informing future management strategies and assessments, especially considering the unique challenges faced by the coral reef ecosystem in the post-COVID era.

Keywords: post COVID-19, acroinvertebrate, diversity, marine park, settlement

Session: B4 Coral reef resilience to climate change and human impacts

Relationship between parrotfish abundance and benthic lifeforms at tropical coral reef ecosystem in Terengganu, east coast of Peninsular Malaysia

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Abstract

Cumulative disturbance can undermine the resilience of a coral reef, often resulting in Scleractinia corals being replaced by macroalgae or other non-coral organisms. These degraded reef systems have mostly been described in terms of changes in reef benthos composition. There is little understanding of how such changes are influenced by and in turn influence other components of the tropical reef ecosystem, particularly parrotfish. The parrotfish, a herbivorous reef fish, is thought to play an important role in the coral reef ecosystem by keeping algal growth in check so that the slower growing coral recruits can colonize. This study investigated the abundance of parrotfish and in particular their relationship with benthic life forms on the islands of Bidong-Karah and Kapas-Gemia, Terengganu. For the parrotfish abundance survey, a visual census was conducted in a 100-meter belt transect using underwater videography. At the same time, a Coral Video Transect (CVT) was used to record the benthic life forms. Eight species of parrotfish were found during the field survey in this study. There was no significant difference in the abundance of parrotfish between two different depths of 5 meters and 10 meters ($p>0.05$). There was no significant difference in the density of parrotfish between the stations in Kapas-Gemia ($p>0.05$), while there is a significant difference between the stations in Bidong-Karah ($p<0.05$). A high density of parrotfish was found in stations with low human activity or in a more complex coral reef structure. Stations with intensive anthropogenic activities such as resorts or with a less complex coral reef structure harbored a low density of parrotfish. The relationship between parrotfish individuals and hard corals, algae and rocks/sand was not significant ($p>0.05$). Only dead corals showed a significant relationship with parrotfish individuals ($p<0.05$). These results improved the understanding of the role of parrotfish in the tropical coral reef ecosystem and thus serve as a comparatively favorable and easy-to-monitor indicator for the assessment of coral reef resilience.

Keywords: tropical coral reef, parrotfish, Bidong-Karah Island, Kapas-Gemia Island, Terengganu, South China Sea

Mass coral bleaching event of 2022 in Sekisei Lagoon, Japan: insights during and one year post bleaching

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Abstract

High degree heating week and sea surface temperatures ever recorded for Japanese coral reefs occurred in the summer of 2022 where temperatures peaked 1–2 degrees above bleaching threshold resulting in widespread coral bleaching and mortality. Using Point intercept survey method, we sampled 31 reefs of Sekisei lagoon in 2021 (prior to bleaching), 2022 (during bleaching) and 2023 (one year post bleaching). 66% of the Sekisei Lagoon's reefs were severely bleached in 2016, with 13% of mortality, leaving the reefs with just 13% coral cover in the years to come. However, by 2021, coral cover had steadily increased to 20%, demonstrating the reefs' gradual but persistent regrowth. However, in 2022 a second major bleaching event had devastated the reefs of Sekisei lagoon, leaving 53% of the reefs severely bleached and 14.78% of the corals facing bleaching induced mortality. *Acropora* species with branching and tabular morphology were the most severely damaged, and this relationship between coral colony shape and bleaching severity was found in research conducted in 2016 as well. One year post bleaching, in 2023, the overall coral cover of Sekisei lagoon was 27%, an 1% increase compared to 2022. The most dominant substrate category in 2023 surveys were macroalgae and turf algae. Even though most of the sites shows good resilience compared to 2016 bleaching event, some of the notable sites such as Kayama entrance, St. F, St. C shows tremendous decrease in coral cover following the bleaching event of 2022. Given that these bleaching events are more frequent and intense, there will likely be a significant phase change on these Japanese reefs in the years to come. Hence continuous monitoring of these sites is necessary to pin point resilient coral communities to ever changing environment.

Keywords: coral bleaching, coral communities, resilience, Sekisei Lagoon, Pacific Ocean

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Effects of repeated bleaching events on the resilience of corals in Sekisei Lagoon

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Abstract

Extensive coral bleaching was observed in Sekisei Lagoon, the largest coral reef system in Southern Japan, in the summer of 2022. Several bleaching events have been observed in Sekisei Lagoon in the past (2003, 2007, 2016), and bleaching and mortality rates have been reported. However, there is limited understanding of the effects on the fecundity of the surviving population and subsequent population recovery trends. Therefore, we analyzed the results of ongoing surveys at 31 sites in the region from 2003 to 2023.

Maturity surveys of five species of the genus Acropora were conducted in late April of each year, recording bundle maturity status (5 levels) in <20 colonies per species, while juvenile population density (age 1) within a square frame was also conducted in late April of each year. In addition, bleaching surveys (5 levels) were conducted for four species of the Acropora in early September each year.

The results showed that four peaks of bleaching events (2003, 2007, 2016 and 2022) were observed since 2003, and that the reproductive capacity of the surviving population and the density of visible juvenile corals, which are indicators of recovery after bleaching events, tended to decrease gradually. Juvenile coral densities declined to less than 20 percent of peak levels in the years before the major bleaching events, and then showed a gradual recovery trend over the period.

Furthermore, since 2016, when substrate and coral composition were assessed using transect method, there has been an increase in turf algae, which has been followed by a blooming of macro algae. The widespread bleaching event has had a substantial impact on the coral larval supply at these locations. Algae dominance in particular areas may hinder the survival of newly formed polyps. To reduce and control anthropogenic impacts on the coral reefs surrounding these islands, new strategies must be proposed.

This research was supported by Grant-in-Aid for Scientific Research (18K06424 and 23H03560) and the Japan Environmental Restoration and Conservation Agency (JPMEERF20194007).

Keywords: coral bleaching, coral cover, fecundity, Sekisei Lagoon

Session: B4 Coral reef resilience to climate change and human impacts

Epidemiology and etiology of tissue necrosis disease in corals around Okinawa, Japan

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Abstract

Major degradation of coral reefs has been postulated by several factors; one major factor is coral disease. Since its first record, coral disease and lesion has been discovered by over decades. However, inevitable, and significant changes of environmental disturbance to coral reefs are believed to play a role in coral disease and lesion dynamics. Our study aims to discover the coral lesion prevalence and investigate the tissue necrosis disease caused by pathogenic agent in coral reef ecosystem surrounding Okinawa coast, Japan. To pursue the objective of the study, we performed epidemiological survey by conducting in-situ coral lesion prevalence survey and collecting bacterial samples from coral infected by tissue necrosis disease. Aligned with the epidemiological survey, we also conducted etiological investigations on the causative agent of tissue necrosis disease on dominant susceptible corals from Okinawa, Japan. Our study found that during our coral lesion survey efforts, we found consistent occurrence of tissue necrosis/white syndrome disease at 8 out of 9 sites each season. We found previously unreported pathogenic bacteria from genus *Halomonas* that could affect three different corals of *Acropora digitifera*, *Montipora digitata* and *Pachyseris speciosa* by causing tissue necrosis. In addition, healthy coral exposed to these pathogenic bacteria severely affected its physiological performance. This study also attempts to describe the in-situ bacterial identification in the white syndrome infected coral colonies along Okinawa coast, the recent on-going tasks. Our study results identify that white syndrome associated with tissue necrotic/white syndrome disease were prevalent among different coral genera surrounded in the Okinawa coast, while experimental treatments with pathogenic bacteria isolated from white syndrome disease accelerated three different corals to have cell necrotic. Further studies are needed to specifically address the cellular and holobiont mechanism of coral induction of tissue necrosis by pathogenic bacteria of *Halomonas* sp. which we isolated from tissue necrosis infected coral.

Keywords: coral disease, pathogen, physiology, Scleractinia, tissue necrosis

Session: B4 Coral reef resilience to climate change and human impacts

Interplay of leaching effects of calcium carbonate-enhanced tiles and surface topography: implications for coral larvae settlement and skeleton development in restoration initiatives

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Abstract

The recruitment of hard scleractinian corals hinges on success in three sequential early life phases: planktonic dispersal, settlement, and post-settlement. Despite numerous findings on the factors influencing settlement and metamorphosis, the process is also significantly influenced by the material and topography of the substrate. In this study, larval settlement preferences were tested by using terracotta tiles that allow assessment of leaching effects and varying surface textures. A series of tiles enhanced with varying (0%, 10%, 25%) calcium carbonate ($CaCO_3$) concentrations and characterized by both ridged and non-ridged surfaces were employed for the settlement and metamorphosis of *Acropora digitifera* coral larvae. Before the coral larvae settlement experiment, tile leaching concentration was tested by submerging it in seawater within a closed container for 40 days. Meanwhile, coral larvae were collected during the coral spawning event that occurred in September 2023 at Pulau Bidong, Terengganu, Malaysia. Mature colonies were taken from the wild and allowed to spawn in a container. After embryonic, 50 swimming larvae were introduced into individual 600-ml containers, each containing a tile pre-glued with fragments of coralline algae (CCA), and then let the larvae settle. Metamorphosed larval settlements were counted daily with a 10% water change. On day 10, pictures of coral spats were taken for size measurement under a compound microscope and analyzed using Image Analysis Software (ImageJ). Remarkably, the leaching experiment showed that 10% $CaCO_3$ tile exhibited the highest leaching capacity, elevating calcium levels in the water up to 600 ppm and concurrently increasing the alkalinity from 119.85 ppm to 148.47 ppm. On the other hand, a pronounced preference for larvae settlement on ridges' tiles was observed, with a mean settlement of 9±1.7 (mean±SE) compared to non-ridges tiles (6±1.8). Intriguingly, the number of settlements and survival rates displayed an upward trend with increasing $CaCO_3$ percentages in the tiles. Highest mean settlement on 25% $CaCO_3$ tiles, with 9 larvae settled and achieving up to 19% survivability. However, the largest size (0.322±0.07 mm^2) of juvenile coral polyps were recorded on the 10% $CaCO_3$ ridge tile. The findings indicate that a substrate containing elevated levels of CaCO3 enhances successful

recruitment, leading to larger polyp sizes. Additionally, the presence of ridges provides a secure environment for larval settlement. This allows an adaptation to promote settlement on composite material, which may be useful for coral reef rehabilitation projects.

Keywords: leaching, larvae, settlement, ridges, tiles

Session: B4 Coral reef resilience to climate change and human impacts

Investigation on the effects of substrate materials on the larvae settlement success of hard coral, *Acropora digitifera*

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Abstract

Coral reefs are facing various kinds of threats, either anthropogenic or natural disasters, eventually causing the reef ecosystem to diminish over time. However, scientists are addressing these issues globally to increase awareness among people. Conservation and restoration efforts have escalated since then, and many parties have joined to replenish the population. To enhance the effectiveness of restoration efforts, we conducted an experiment to investigate the correlation between the settlement of coral larvae and different substrate materials. The effects of various substrate materials on coral larvae settlements were determined using gametes collected during the annual spawning event at Pulau Bidong, Terengganu, Malaysia. Briefly, two hours prior to the predicted time, five mature *Acropora digitifera* colonies were brought up from the reef and kept in separate containers. After the corals spawned, the egg bundles were collected and stirred for the fertilization processes. Subsequently, the fertilized eggs were cultured in filtered seawater until they reached the larvae stage and were ready to settle. To examine larvae settlement preferences, 50 larvae were placed in new individually containers, each containing different types of custom-made square ceramic tiles (5x5 cm). These tiles comprised three material compositions (0%, 10%, and 25% $CaCO_3$ mixtures) and two surface topographies (ridges and non-ridges) for each composition. A coral skeleton cut to a similar size was included as a control. Water change was conducted daily to maintain the water quality inside the containers. We measured the larvae settlement rate by quantifying the number of settled larvae every 24 hours from the day they were transferred into the experimental setup. Larvae settlement was low on 0% $CaCO_3$ tiles, with only an average 13.33% success rate of settlement and metamorphosis. Similar results were observed in the 10% (mean=19.67%) and 25% (mean=18.33%) $CaCO_3$ tiles. The most preferred material for larvae settlement was the coral skeleton (mean=21.67%). Furthermore, *A. digitifera* was observed to favor ridge tiles compared to non-ridge tiles for all types of tiles, except for 25% $CaCO_3$ tiles where both topographies recorded similar abundance of larvae settlement. This study's results significantly contribute to advancing the effectiveness of coral restoration initiatives. Within the broader global scientific community's endeavors to address threats to coral reefs, comprehensive

comprehension of larvae settlement preferences assumes critical importance. The acquired insights are pivotal for the formulation of well-informed conservation strategies and the sustainable replenishment of coral populations.

Keywords: coral larvae, *Acropora digitifera*, settlement success, curface topography, cubstrate materials

Session: B4 Coral reef resilience to climate change and human impacts

Comparative analysis of resilience in coral restoration methodology: direct transplantation versus larvae enhancement

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Abstract

The precipitous global decline in coral abundance, attributed to an array of environmental stressors and anthropogenic activities, has instigated heightened interest and concerted efforts in the implementation of coral restoration strategies. These initiatives are geared towards mitigating the pervasive loss of live coral cover and contributing to the rehabilitation and fortification of coral reef ecosystems on a global scale. The current study delineates and evaluates two distinct coral restoration approaches: direct transplantation and larvae enhancement. In the direct transplantation method, naturally fragmented coral nubbins (3–5 cm) are affixed to artificial structures, such as small, round (3 inches in diameter) cement cups attached to larger cement blocks or metal poles driven directly into the benthic environment. Conversely, the larvae enhancement approach involves the harvesting of gametes from matured Acropora spp. colonies, with subsequent ex-situ rearing of resulting embryos before their release back into the reef after settling on ceramic tiles. Analysis after a six-month period revealed that direct transplantation exhibited a notably higher mean survival rate (65%) in comparison to the larvae enhancement method. Moreover, shallow reef transplants (<3 m) displayed a heightened growth rate compared to their counterparts at deeper sites (>7 m). However, a subsequent assessment after 18 months uncovered a significant setback for larger (>10 cm) transplanted coral colonies at shallow depths, as they experienced breakage and toppling on the seafloor, resulting in approximately half of them perishing. In stark contrast, all newly settled larvae were found deceased six months after their initial release, with the associated tiles being covered in filamentous algae. While direct transplantation showcased a commendable survival rate, its implementation is marred by substantial costs. Conversely, the larvae enhancement approach encountered challenges, primarily a marked increase in the mortality rate, necessitating a more in-depth scientific investigation to address these complexities. This underscores the intricate interplay of ecological factors influencing coral restoration success and resilience, providing valuable insights for future conservation and management strategies aimed at fostering the sustained health and resilience of coral reef ecosystems.

Keywords: coral restoration, transplantation, larvae, coral reef resilience

Session: B4 Coral reef resilience to climate change and human impacts

Integrated approach for coral reef conservation and rehabilitation in the Philippines

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Abstract

"Integrated Approach for Coral Reef Conservation and Rehabilitation (*In*CORE)" has currently been implemented at Tangalan in the Philippines as a 1.5-year pilot project funded by the Asian Development Bank (ADB) until the end of July 2024. The key challenge of *In*CORE is how to enhance the resilience of the reef ecosystems to recover well during the return period of the episodic disturbances like super typhoons and massive coral bleaching, which are being intensified with the global warming. For this purpose, *In*CORE has introduced the holistic approach, which consists of environmental assessment, installation of Coral Net™ units and their subsequent periodical monitoring, terrestrial load reduction in an inter-watershed framework, and capacity development through training workshops, etc., for the sustainable implementation of the project. The Coral Net™ is a mesh-net type platform to improve substrate condition and thereby to enhance both sexual and asexual reproduction of corals on it. The Coral Net™ was developed by Kajima and has several successful applications in Japan. For the environmental assessment, we have introduced not only onsite survey, but also remote sensing and integrated model system development & applications to properly understand the coral reef ecosystem situation and to find the causes of its degradation. In addition, we closely work together with the local stakeholders including the local government unit and coastal patrol (bantay dagat) staff. In the first phase of the environmental assessment, the habitat conditions in terms of coral cover, seagrass cover, etc., were observed. The remote sensing was conducted for the benthic habitat and land use/land cover mapping, and the water depth estimation. The integrated model system was developed to assess the overall situation of the environmental conditions in Tangalan Bay and its surrounding areas, including waves & current, water temperature, salinity, water quality parameters like turbidity and nutrient concentrations, and associated terrestrial runoff of fine sediments, nutrients, etc., from the adjacent and even distant watersheds. Based on

the environmental assessment, we identified the seven locations for installing Coral Net™ units as their pilot test in Tangalan Bay. In the presentation, the initial Coral Net™ monitoring results will be shared, and the keys for scaling up the *In*CORE approach will be discussed.

Keywords: integrated approach, coral reef, rehabilitation, environmental assessment, integrated monitoring and modelling system

Session: B4 Coral reef resilience to climate change and human impacts

A review of coral reef restoration initiatives in the Philippines from 1977 to 2023

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Abstract

Coral reef restoration initiatives in the Philippines began in the 1970s to accompany marine habitat conservation in mitigating coral reef degradation and assisting reef recovery. However, an overview of existing knowledge on coral reef restoration research and initiatives in the country has not yet been synthesized. This study reports the different coral reef restoration interventions investigated in the Philippines for the past 43 years. Relevant data about their target species, restoration methods, and outcomes were gathered and summarized from primary and grey literature. The types of coral reef restoration applied in the Philippines are substrate enhancement methods such as artificial reef deployment and calcium carbonate accretion, asexual propagation methods such as direct transplantation and coral gardening, and sexual propagation methods specifically, larval enhancement. Preliminary results show that substrate enhancement method was used the most, followed by asexual propagation like direct transplantation and coral gardening, and sexual propagation methods were used the least. This coincides with the introduction of these methods in the country, with substrate enhancement and asexual propagation methods reported as early as 1980s and 1990s whereas sexual propagation methods reported only in the 2010s. Primary and some grey literature reported a total of 28 hard coral genera, most of which are fast growing *Acropora* spp., *Porites* spp., and *Pocillopora* spp. Massive slow-growing species such as *Favites* spp. are also represented. Meanwhile, approximately 32% of the initiatives were done in the Bolinao-Anda Reef Complex, Pangasinan, Northwestern Philippines while the remainder were done in Central and Southern Philippines. Finally, 45% of primary literature use growth and survival as outcome criteria, followed by a combination of growth, survival, and cost at 7.5%. Research efforts geared towards testing more coral genera in more regions in the Philippines is needed for climate adaptation and reef resilience. Furthermore, a re-assessment of these initiatives is necessary to develop a standard protocol for future monitoring and assessment of coral reef restoration initiatives.

Keywords: climate adaptation, coral reef recovery, resilience

Coral reef resilience to environment and climate change in the Eastern Gulf of Thailand

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Abstract

In this study, we aim to assess and evaluate the coral reef resilience at 12 stations in 3 provinces located along the Eastern Gulf of Thailand: Rayong, Chanthaburi and Trat. The data were collected from January to March 2022. The study was conducted using twelve resilience indicators and calculated resilience scores for each site. The results revealed that three sites exhibit high relative resilience, i.e., Yakyai, Thonglang and Raet. Two sites demonstrate medium to high relative resilience, namely., Nomsao and Hinloi. Additionally, six sites display medium to low relative resilience, specifically Ailob, Toei, Kiewnai, Munklang, Wai and Munnai. Finally, one site exhibits low relative resilience, identified as Chaolao. Coral reefs with high relative resilience were associated to a high percentage of hard coral cover and diversity of herbivorous fishes, as well as lower benthic algae cover and human impact. The opposite was observed, as expected, for sites with low relative resilience, which were associated to a high percentage of coral competitors cover, coral diseases, and benthic algae cover. The greatest influence indicators were hard coral cover, coral competitors cover, coral diseases, and the number of herbivorous fishes. The findings of this study could assist in identifying and prioritizing management actions to mitigate disturbances and enhance the resilience of coral reefs.

Keywords: resilience, coral Reefs, Eastern Gulf of Thailand

Reef corals can be resilient again disasters: resilience in Con Dao Islands, Vietnam for last nearly 25 years

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Abstract

Con Dao Islands, Vietnam located in the Sunda shelf (Western South China Sea) are characterized by abundance and diversity of coral reefs. The recent publications indicated the very healthy status of coral reefs therein. The questions were whether there existed threats to damage corals during the past period and how reef corals could recover after risks, if any. Comparative analysis on the trends of changes of hard coral covers were conducted for 3 areas, including: (1) south and east reefs suffered heavy impacts of both typhoon (1997) and bleaching (1998); (2) northwestern reefs damaged by the combined impacts of high temperature and low salinity in 2005; and (3) Ben Dam reefs protected in the bay but influenced by port development and operation. The available monitoring data for (1) at 5 reef sites exhibited significantly decreased average cover during 1998–1999 with values less than 10% at some sites and good recovery with the average cover in 2009/2010 equal to that in 1994, then remaining at high values until 2019. The detailed data of shallow and deep transects available for (2) showed the severe damage of the reefs in 2005, especially at shallow waters. These reefs recovered well to have medium cover (more or less 30%) in the 4th year later and become stable at a high level (50–80%) in 2017 and 2019. In contrast, the data at Ben Dam Bay collected for some years between 1994 to 2018 indicated permanent decline of hard coral covers and the reefs nearly destroyed recently due to anthropogenic threats. The trend of these changes suggested that most coral reefs in Con Dao islands required around 10–12 years to recover and return to their healthy nature, so long as there was no ongoing impacts. The good recovery of reef corals in Con Dao islands following disasters provided a positive point of view on extreme resilience of coral reefs against increased sea surface temperature if they existed in natural conditions. Human beings can support coral resilience by minimizing anthropogenic impacts. In addition, further discussion on coral adaptation or acclimation is also needed.

Keywords: reef corals, disasters, resilience, monitoring, Con Dao Islands

Session: B4 Coral reef resilience to climate change and human impacts

Assessing anthropogenic impacts and resilience of coral reefs in Pulau Redang Marine Park towards improving MPA management strategies

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Abstract

Coral reef is an ecosystem that is rich in species and high productivity. However, natural disturbances and anthropogenic stresses are heavily impacting this precious ecosystem. Resilience assessment plays an important part in prioritizing and targeting appropriate management actions. Using refined IUCN resilience indicators, this study aims to evaluate the relative potential resilience and anthropogenic stresses, and to identify the influence of the selected indicators on the study sites. There were 17 resilience indicators and five stressors had been chosen to be assessed in this study. Sampling was conducted in August 2020 at 11 marine recreational hotspots around Pulau Redang Marine Park (PRMP), Terengganu (Malaysia) with two depths at each site. Benthic substrate data was collected using Coral Video Transect, Belt Transect was applied to survey fishes and invertebrate abundance and diversity, as well as the reef rugosity was examined with Chain-and-Tape method. In addition to the biological data, anthropogenic stressors were assessed in-situ by the surveyors. All data was collected with SCUBA. Results from the data analysis were grouped into four rankings with different resilience categories and stress levels. Resilience assessment showed nearly half (48%) of the sites were in medium-low resilience ranking. About one fifth (19%) of the sites obtained the highest resilience ranking with scores ranging from 0.94 to 1.00, 24% in medium-high rank, and only 9% (two sites) with lowest resilience. For anthropogenic stress assessment, 19% of the sites obtained the lowest stress level with scores of 0.56, while the rest of the sites recorded medium-high to high level of stress. Then, six resilience indicators (sand, silt, rubble, dead coral, hard coral cover and coral diversity) were found to be the most influential indicators in driving the coral reef resilience at PRMP. On the other hand, nutrient input and solid waste pollution were found to be the major contributors for anthropogenic stress. This resilience results could be used to prioritize the conservation areas in PRMP, such as establish of total no access zone for the high resilience sites. Meanwhile the results from anthropogenic stress analysis can be used as guideline improving the tourism and any human activities on-site. Plus, the outcome of this study would contribute to PRMP re-zoning strategy which potentially to improve the coral reef management of PRMP and could lead to elevating coral reef health status in these marine protected areas.

Keywords: resilience, zoning plan, coral reef, ecology, Malaysia

Mitigation of environmental stresses on reef-building corals and conservation perspective

Tomihiko Higuchi

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Abstract

Coral reefs are threatened by multiple environmental stresses at both the global and the local scales. Declining water quality in coastal reefs has been reported as due to red soil runoff, agricultural fertilizers, and anti-fouling chemicals (e.g., Higuchi 2018). Coral bleaching caused by high water temperature has been frequently reported and it is one of big problem declining coral reefs. To solve these issues, the methods for mitigating environmental stresses on corals started to be investigated recently. As the most important process, removing anthropogenic stress such as soil and/or nutrient run off is the best way to conserve the coral reefs. For instance, high concentration of nitrate accelerated coral bleaching under high temperature (Higuchi et al., 2015). Otherwise, several invention methods including genetic, physiological, and environmental management approach with potential scale have been reported by National Academies Press (2019). For example, physical shading of sunlight substantially reduced the degree of bleaching (Coelho et al., 2017, etc.). Also, Biscéré et al. (2018) suggested that manganese enrichment increased coral resistance to heat stress-induced bleaching. Several research show that heterotrophic energy supply (e.g., rotifer, Artemia as diets) mitigate coral bleaching severity and increase the survival rates. Therefore, there are possibilities that these stress mitigation methods can be act for coral reef conservation. However, there are still lots of limitations (and risks) when these methods are conducted in the field. In this presentation, international attempts and inventions for coral conservation are reviewed (including own results), and it is discussed about future conservation perspectives such as where is the best place has high resilience and/or high rate of larval supply.

Keywords: coral bleaching, mitigation of environmental stresses, metal enrichment, heterotrophic energy

Session: B4 Coral reef resilience to climate change and human impacts

Social-ecological systems approach to mitigate reef degradation and enhance agricultural production for community-based Crown-of-Thorns Starfish and seaweed management

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Abstract

Crown of Thorns Starfish (CoTS) outbreaks pose a significant threat to Indo-Pacific coral reefs, causing profound coral mortality. Fijian farming, utilizing synthetic inorganic fertilizers, contributes by introducing inorganic nutrients into coastal waters. This influx triggers seaweed blooms and fosters microalgae proliferation, thereby supporting the survival of juvenile CoTS. In Beqa Lagoon, Fiji, the ongoing CoTS outbreak is responsible for a staggering 40% of hard coral mortality, emphasizing the urgent need for intervention. Coral reefs grapple with an excess of seaweed, recurrently smothering coastlines during the Austral summer months and jeopardizing the integrity of coastal and coral reef ecosystems. Recognizing the pivotal role of reefs in sustaining the coastal and marine food system, economic stability, and the profound cultural and spiritual connections of Indigenous communities, urgent action becomes imperative. Within this context, our applied research and management project unfolds, seeking comprehensive solutions through community-based monitoring and control programs, alongside innovative approaches to repurpose invasive species for sustainable agricultural practices, highlighting a sustainable approach grounded in local practices. Local knowledge, encompassing insights into reef areas and coral cover, guides survey site selection and bolsters the control program. Traditional wisdom and the practice of 'solesolevaki,' emphasizing unity and shared responsibility, actively engage the wider community in the control program, fostering collective ownership. Through a Social-Ecological Systems (SES) approach, the research integrates traditional knowledge with scientific data to design and implement effective strategies for maintaining reef health and enhancing communities' food security, while alleviating economic constraints from purchasing fertilisers and transportation. Chemical analysis, coupled with growth rate trials of tomatoes and capsicums, is employed to determine the optimal ratio of CoTS to seaweed in comparison to commercially used fertilizers. The study reveals that the CoTS-seaweed fertilizer surpasses commercially used synthetic inorganic fertilisers, resulting in crops up to 50% larger in dimension and weighing up to 40% more. This finding not only showcases the viability of community-driven solutions but also

underscores the potential for sustainable agricultural practices derived from the utilization of invasive species to foster active coral reef conservation and incentivised natural resource management. Rooted in the synergy of tradition and science, this applied management strategy not only supports the broader seascape management of Beqa Lagoon but also offers a model for reef communities across the Indo-Pacific. By embracing the richness of traditional wisdom, this program seeks to fortify the resilience and sustainability of Indo-Pacific SESs, enhancing coral reef resilience and vitality for generations.

Keywords: social-ecological systems, traditional knowledge, coral reef management, unity and shared responsibility, sustainable agriculture

Session: B4 Coral reef resilience to climate change and human impacts

Resilience based management of coral reefs for biodiversity conservation and sustainable livelihood in Gulf of Mannar, southeast India

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Abstract

The compound effect of anthropogenic activities and climatic changes has reduced the live coral cover in Gulf of Mannar (GoM), southeast India from 37% in 2005 to 27% in 2021. Of the anthropogenic activities, coral mining (halted in 2005) and destructive fishing practices had been responsible for severe coral degradation till 2010. Thereafter the climate-change triggered coral bleaching and mortality, algal blooms, space competition and bio-invasion along with pollution have been causing major harm and have considerably affected the health of coral reefs, directly resulting in the deterioration of the quality of ecosystem services, mainly coastal protection and fisheries. The major coral reefs in GoM are distributed around the 21 low-lying islands. The recent downscaled climate projections predict that GoM corals will experience annual severe bleaching (ASB) under a high emissions scenario (RCP8.5) before 2070, but a reduced emissions ratio (RCP4.5) will have clear ameliorating effects. GoM corals suffered from bleaching and sustained mortalities in 1998, 2010 and 2016 with significant damage due to prolonged elevated seawater temperature especially in 2010 and 2016. However, the corals recovered gradually after the bleaching events. Though the recovery rate is slow, the corals exhibit resilience, which is a positive sign in GoM. The comprehensive baseline data on coral reefs developed in 2005 and the regular annual reef monitoring undertaken since then have helped in closely watching the health of the reefs and in taking appropriate interventions and management measures to support and improve the coral resilience. The 365-km long GoM coastline is densely populated. The over 100,000 small-scale fisher-folk depend solely on the fishery resources associated with coral reef and seagrass for their livelihood. In consideration of the affected ecosystems and the socioeconomic status of the fishing population on the one hand, and the worsening climatic and non-climatic drivers on the other, an integrated approach has been adopted with the following components to support reef resilience: coral restoration using specially designed stable substrates and native species; deployment of multipurpose artificial reefs for biodiversity enhancement, specifically coral recruits and fish production; regular annual monitoring; alternative livelihood schemes to fisher community for the reduction of pressure on the marine ecosystems; controlling coastal pollution; removal of ghost nets and exotic seaweeds; protection and enforcement; and awareness building. This resilience based conservation and management approach has helped to bring about climate change adaptation by protecting biodiversity and ensuring sustainable livelihood to the fishing population.

Keywords: coral resilience, restoration, management, livelihood, Gulf of Mannar

Linking area-based conservation and resilience-based management to enhance coral reef resilience in Thailand

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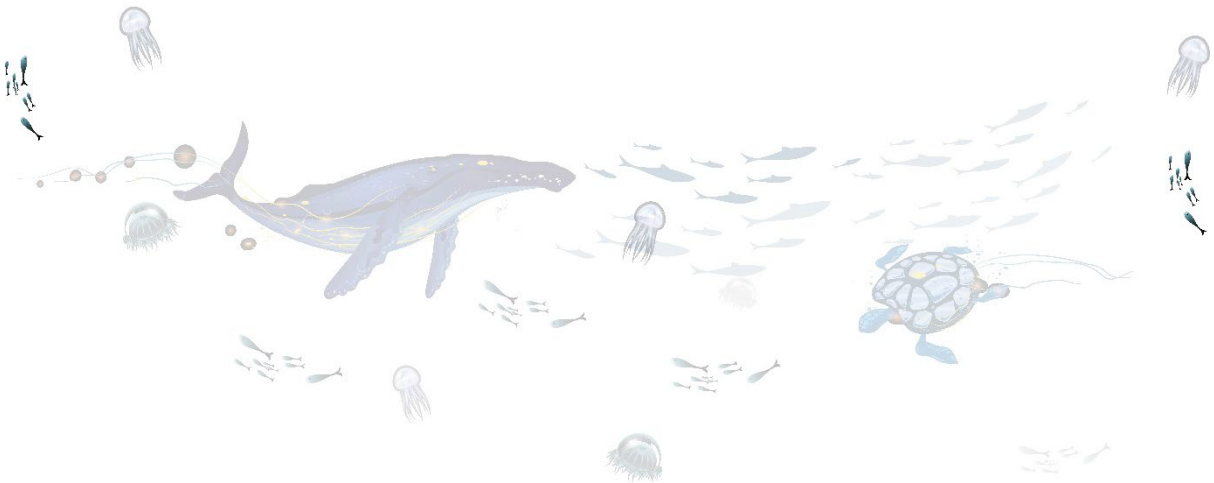
Abstract

Coral reefs around the world have been impacted by anthropogenic and climate change impacts, making them more vulnerable to deterioration which further degrades the quality of ecosystem services. Management paradigm is shifted from ecosystem-based to resilience-based to tackle such challenges, ensuring the sustainability of social-ecological systems. Moreover, area-based conservation measures (MPA and other effective area-based conservation measures, OECMs) have been globally promoted to safeguard marine biodiversity as seen in the 30x30 target of the Kunming-Montreal Global Biodiversity Framework (GBF). In this analysis, we explore the linkage and how area-based conservation measures support resilience-based management of coral reefs in Thailand by analyzing existing policies and lessons learned from implementation. Overall, Thailand has a strong political will to support area-based conservation measures as seen by the adoption of the GBF and joining the High Ambition Coalition for Nature and People (HAC) to commit to the 30x30 implementation. While the authorities continue to designate new MPAs, relevant sectors agreed that OECMs could be one of the possible solutions to help achieve the target and the OECMs Roadmap has been formulated. Such area-based conservation measures greatly contribute to coral reef resilience in various ways, particularly limitation of human impacts, support of ecological connectivity and natural recovery, etc. However, lack of knowledge and capacity seem to be key challenges for future implantation. Building capacity and collaboration are also highly required to support the designation, implementation, monitoring and evaluation as well as ensure management effectiveness. It is also important to seek international collaboration as Thailand still needs financial and technical support from other countries. Policy recommendations from this analysis are valuable for formulating national policies to support resilience-based management of coral reefs in Thailand.

Keywords: area-based conservation, resilience, MPAs, OECMs

Sub-theme B: Marine Biodiversity, Seafood Safety and Security

Session B5: Fisheries, biodiversity and dynamics of mangroves' aquatic ecosystem



Programme

Venue: Chelsea A, 5th Floor
Date: 23 April 2024

Conveners:

Kazi Ahsan Habib	Sher-e-Bangla Agricultural University, Bangladesh
Tadashi Kajita	Tropical Biosphere Research Center, University of the Ryukyus, Japan
Yaya Ihya Ulumuddin	Research Center for Oceanography, BRIN, Indonesia
Alison Kim Shan Wee	University of Nottingham Malaysia, Malaysia

Time	Presentation Titles	Speakers
Section 1		
13:00–13:15	International initiative for eDNA-based biodiversity monitoring: uniting for a sustainable future	Michio Kondoh, *Tohoku University, Japan*
13:15–13:30	Challenges to global mangrove biodiversity studies by eDNA metabarcoding	Tadashi Kajita, *University of the Ryukyus, Japan*
13:30–13:45	Base line data for fish diversity using eDNA metabarcoding on east coast of North Sumatra and Aceh, Indonesia	Mohammad Basyuni, *Universitas Sumatera Utara, Indonesia*
13:45–14:00	Assessing lagoon fish species composition using eDNA: implications for biodiversity monitoring and conservation strategies	Shalika Kumburegama, *University of Peradeniya, Sri Lanka*
14:00–14:15	Evaluating fish biodiversity near mangrove ecosystem using eDNA metabarcoding on World Heritage Island, Okinawa, Japan	Bernadeth Grace S. Pananganan, *University of the Ryukyus, Japan*
14:15–14:30	Surveying ichthyofaunal diversity using eDNA metabarcoding in the mangroves of Peninsular Malaysia	Leanne Frances Yee, *University of Nottingham Malaysia, Malaysia*
14:30–14:45	Building a DNA barcode library of brackish and marine water fishes of Sundarbans, the world's largest mangrove ecosystem	Md. Jayedul Islam, *Sher-e-Bangla Agricultural University, Bangladesh*
14:45–15:00	Genetic variability and population structure of orange mud crab *Scylla olivacea* in the mangrove regions of Northern Indian Ocean inferred from mtDNA sequence analysis	Md. Nazmus Sakib, *Sher-e-Bangla Agricultural University, Bangladesh*
Section 2		
15:30–15:45	Environmental DNA metabarcoding of ichthyofauna in Asian mangrove ecosystems revealed spatial challenges in community-level analysis	Alison Kim Shan Wee, *University of Nottingham Malaysia Campus, Malaysia*

Time	Presentation Titles	Speakers
15:45–16:00	Fish utilization pattern on different proximity of planted mangroves to reefs in Northern Mindanao, The Philippines	Allyn Duvin P. Hinoguin, *Mindanao State University at Naawan, The Philippines*
16:00–16:15	Water quality and carbonate chemistry variability during the wet season along Aklan River and Bakhawan (Mangrove) Eco Park, Aklan, The Philippines	Kristel Joyce T. Occeña, *University of the Philippines Diliman,The Philippines*
16:15–16:30	Influence of fishponds on the water quality and carbonate chemistry dynamics in Batan Bay, Aklan, Philippines during the wet season	Charissa M. Ferrera, *University of the Philippines, Diliman, The Philippines*
16:30–16:45	Mangroves blue carbon assessment of replanted mangrove forest in East Coast of Peninsular Malaysia, Malaysia	Siti Mariam Muhammad Nor, *Universiti Malaysia Terengganu, Malaysia*
16:45–17:00	Typhoon damage assessment of natural and planted mangroves in Bais Bay, Negros Oriental, The Philippines	Myron Gavriel F. Baring, *Mangrove Matters, The Philippines*

International initiative for eDNA-based biodiversity monitoring: uniting for a sustainable future

Michio Kondoh

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Abstract

The biodiversity loss due to human activities have raised concerns about the sustainability of society, necessitating accurate assessment for proper ecosystem management and conservation. However, ecosystems, being highly complex, pose challenges in correctly assessing its biodiversity status. Techniques of biological surveys based on DNA shed by organisms present in water, soil, and the atmosphere, called environmental DNA (eDNA) technology, have garnered attention as cost-effective methods for achieving biodiversity assessment. Leveraging the strengths of eDNA methods, which enable surveys across multiple locations and high-frequency observations, facilitates wide-ranging biodiversity monitoring. Constructing a stable and functional observation network becomes a crucial target when considering the effective utilization of extensive eDNA data for biodiversity assessments. The All Nippon eDNA Monitoring Network (ANEMONE) is a comprehensive biodiversity monitoring network across Japan that employs eDNA metabarcoding. Its origins date back to 2015 when academic scientists initiated the first eDNA monitoring in Maizuru Bay, Kyoto. Since its inception, related projects and ANEMONE have conducted over 5,000 surveys at more than 1,000 sites, successfully identifying and categorizing over 900 distinct fish taxonomic groups. ANEMONE's primary focus lies in monitoring fish biodiversity across various aquatic ecosystems, including coastal and pelagic oceans, rivers, and lakes. Presently, ANEMONE operates 77 fixed monitoring stations, each with different survey frequencies, supported by universities, research institutes, and local governments. As of 2020, local citizens actively engage in eDNA-based surveys, with increasing participation annually. The eDNA metabarcoding procedure follows a standardized protocol provided by The eDNA Society, involving water collection, filtration, DNA extraction, and molecular analysis using MiFish primers and sequencing. Subsequently, Claident, a high-throughput analysis pipeline, translates the sequence data into taxonomic occurrences. This valuable data is accessible to the public through ANEMONE DB, a dedicated database hosted at Tohoku University. Recognizing the vast potential of eDNA monitoring data in addressing various nature-related social issues, a consortium comprising academia, government bodies, and private sectors was established on June 1, 2022. This collaborative effort aims to explore and leverage the transformative power of eDNA monitoring data for innovative solutions across diverse fields. A promising next step would be to establish a foundation for collaboration aimed at building a sustainable society by expanding the

coordination of eDNA monitoring networks within the international community. This initiative seeks to enable scientists to collaborate in acquiring, providing, and accumulating biodiversity information, thereby fostering a framework conducive to the development of a sustainable society based on engagement of local communities.

Keywords: environmental DNA, ANEMONE, monitoring network

Challenges to global mangrove biodiversity studies by eDNA metabarcoding

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Abstract

The revolutionary developments of environmental DNA (eDNA) metabarcoding are changing our ways of the understanding biodiversity. eDNA metabarcoding using aquatic samples, in particular, enables us to assess the species diversity more effectively, rapidly and objectively by non-invasive methods, and providing massive data with relatively less sampling time and effort. eDNA metabarcoding has been becoming a breakthrough tool to understand the biodiversity across mangrove ecosystems worldwide. By obtaining support from JSPS Core to Core program for FY 2020–2023, we established international collaboration networks with members from ten countries in Asia and Africa. Our ultimate goal is to establish a research foundation for eDNA metabarcoding, expecting it to be a standard tool for studying global mangrove biodiversity. We believe that the biodiversity big data obtained in our studies will help our better understandings and conservation of global mangroves in various ways. As the aims of JSPS Core-to-Core programs are (i) the formation of high-potential research hubs, (ii) the construction of sustainable collaborative relationships with overseas core institutions, with (iii) fostering young researchers, we held international workshops, seminars, and training courses involving younger researchers, and disseminated the ideas and methodologies of eDNA metabarcoding in mangroves. MiFish and its related methods are effective in mangroves, and we optimized the technical basis to apply these methods to mangroves. Developing a reference database is another essential factor, and we encourage members to start or perform their research projects in their countries. We are still on the way to

integrating the data accumulated in member countries, and we expect that we can establish a global eDNA database for mangrove biodiversity.

(This presentation is performed as a JSPS Core to Core Seminar supported by JSPS Core to Core Program, as well as e-Asia and AJ-Core)

Keywords: eDNA metabarcoding, MiFish, MiDeca, mangrove biodiversity

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Base line data for fish diversity using eDNA metabarcoding on east coast of North Sumatra and Aceh, Indonesia

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Abstract

Indonesia is known as an epicenter of marine biodiversity and the second largest fisheries producer in the world. Mangrove waters are sources of fish diversity. Traditional fishing is mostly reported from Indonesian mangroves with varied species detected. Furthermore, methodological identification dependent on fish such as DNA barcode have developed to monitor fish diversity adjacent mangroves. Several lines of studies have been reported with small number fish detected. Therefore we still face difficulty to identify fish species either traditional fishing or DNA barcode. eDNA metabarcoding is the alternative solution. eDNA matabarcoding is novel method to asses biodiversity where water samples were taken from environment using universal primers in PCR and sequenced using NGS to generate thousand to million reads. Mangrove in North Sumatra and Aceh are distributed mostly in eastern coast of Sumatra. Mangrove waters are gateway mass water flow from Malacca Straits connects the Pacific Ocean to the east with the Indian Ocean to the west. Here we report 187 OTUs from seven sites: Langsa of Aceh, Percut Sei Tuan, Belawan, Jaring Halus, Lubuk Kertang, Pulau Sembilan, and Pulau Kampai of North Sumatra. About 119 OTUs had more than 98.5% identity as annotated species. This data provided baseline for fish diversity in North Sumatran and Aceh mangrove, Indonesia

Keywords: traditional, eDNA matabarcoding, fish composition, coastal protection

Assessing lagoon fish species composition using eDNA: implications for biodiversity monitoring and conservation strategies

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Abstract

Environmental DNA (eDNA) analysis stands out as an innovative and non-intrusive method for detecting species based on DNA they shed into water. This approach proves invaluable, serving as a potent tool for biodiversity assessment and monitoring of rare, threatened, or invasive species. Hence, eDNA analysis could be a crucial and effective conservation and management strategy that has yet to be utilized in Sri Lanka. Coastal lagoons in Sri Lanka boast high and unique biodiversity compared to other inland ecosystems. Notably, Negombo in the western and Puttalam in the northwestern coastline are lagoons with extensive mangrove cover. These lagoons are among the most productive and sensitive ecosystems that are of significance for fisheries. However, the densely populated surrounding of these lagoons subjected them to high anthropogenic pressures, leading to the degradation of lagoon ecosystem, including mangroves. Hence this study focuses on the Negombo and Puttalam lagoons, for eDNA analysis of lagoon fish. Fish species in the two lagoons were documented from fish landing sites. GPS coordinates and basic physico-chemical parameters of lagoon water were recorded in selected sites. At each site water samples were filtered using sterivex filter units for subsequent eDNA analysis. In the laboratory, the DNA from sterivex filters was extracted and targeted DNA regions were amplified using MiFish primers. Subsequently, next generation sequencing was employed for DNA sequencing, and eDNA metabarcoding for species identification. In Negombo, the mean pH was 6.35, whereas in Puttalam, it measured 7.81. Water temperature ranged from 27–31.2°C in Negombo lagoon and 25–32.8°C in Puttalam. Salinity in Negombo varied from 13.26–26.71 ppt, while in Puttalam, it ranged from 12.8–30.0 ppt. Analysis of fishermen's catch resulted in the identification of 25 species in Negombo lagoon and 36 species in the Puttalam lagoon. In contrast, the eDNA results indicated a higher diversity of fish in the two lagoons. The fauna in these lagoons serves as indicators of the health of the ecosystem, making this study instrumental in highlighting the species composition that could be used in lagoon conservation and sustainable management.

Keywords: eDNA, fish, lagoon, Negombo, Puttalam

Evaluating fish biodiversity near mangrove ecosystem using eDNA metabarcoding on World Heritage Island, Okinawa, Japan

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Abstract

Assessing fish biodiversity over time is critical for monitoring the health and resilience of threatened ecosystems. Although mangrove ecosystem serves as vital habitat, there is limited understanding of the fish biodiversity in its adjacent habitats. Traditional methods are constrained by issues such as subjectivity, invasiveness, limited spatial coverage, and time-consuming processes. In this study, we used eDNA metabarcoding, specifically utilizing 12S MiFish primers and Illumina HiSeq sequencing, to analyze fish biodiversity in 52 seawater samples. Our results revealed 321 Molecular Operational Taxonomic Units (MOTUs) belonging to 68 families and 157 genera, with varying fish community assemblages in different months and years. Species abundance variations were observed, with the top 5 frequently occurring species identified as *Acanthurus triostegus*, *Enneapterygius philippinus*, *Rhinecanthus verrucosus*, *Siganus spinus,* and *Naso unicornis*. Preliminary results revealed a number of species that are considered to be the main components of the local fish community. Additionally, when comparing species composition with previous mangrove eDNA studies on the island, we identified a limited number of shared species within the studied habitats, emphasizing the distinctiveness of both ecosystems. While detailed analyses of changes in the fish community are still ongoing, we expect to gain further insights, exploring potential influences of yearly environmental variations which could be driven by climate change and evaluating ecological connectivity of the shared species observed in the previous mangrove eDNA studies. Furthermore, this study highlights the potential of eDNA-based biomonitoring as a valuable tool for comprehending fish biodiversity, which is essential in developing management strategies on conserving unique ecosystems.

Keywords: fish assemblages, biomonitoring, environmental variations

Surveying ichthyofaunal diversity using eDNA metabarcoding in the mangroves of Peninsular Malaysia

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Abstract

A key to efficient, ecosystem-based management of fish resources is the availability of biomonitoring tools to measure patterns in biodiversity. Conventional sampling methods, such as drift nets are commonly used biomonitoring tools in mangrove estuaries. However, these methods are oftentimes ecologically destructive, costly, and is labour intensive. In the past decade, environmental DNA (eDNA) surveys has emerged as a promising non-invasive tool for detecting the presence of aquatic animals. Much has been studied on single-species detection using species-specific primers. By contrast, the application of eDNA metabarcoding, is still widely underutilised, particularly in Southeast Asian mangroves. The present research aims to further develop eDNA metabarcoding locally to capture and characterize the spatial distribution of biodiversity in Peninsular Malaysia. In this preliminary study to evaluate the efficacy of eDNA in assessing biodiversity, we quantified ichthyofaunal diversity using eDNA extracted from water samples of freshwater, brackish and marine nature. We use the universal *MiFish* primers for metabarcoding, following the amplification and sequencing protocol set by the eDNA Society. We detected DNA signatures for more than 197 fish species, of which 68 could be identified to species/genus based on existing reference databases. While we cannot fully replace conventional sampling, a more accurate documentation of fish assemblage can be drawn by complimenting eDNA sampling with conventional sampling. To fully realize the potential of eDNA as a biomonitoring tool, existing databases must be improved on before reliable assessments of fish communities for mangrove coastal management become possible in Southeast Asia.

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Building a DNA barcode library of brackish and marine water fishes of Sundarbans, the world's largest mangrove ecosystem

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Abstract

Mangroves are one of the most productive and biologically diverse ecosystems in the world which provide significant ecosystem goods and services to human society and coastal and marine systems. Mangrove areas also act as important breeding and nursery habitats for many fish species. The present study aims to build a DNA barcode reference library of the fishes of the Sundarbans mangrove ecosystem of Bangladesh by producing two mitochondrial gene sequences i.e., COI and 16S rRNA for accurate identification of fishes. Fish samples were collected from local fishermen groups from the tidal rivers, creeks, canals, estuaries and coasts at different locations in the Sundarbans and also from the fish landing sites inside or adjacent to the Sundarbans between 2017 and 2022. The collected samples were first identified by examining morphometric characteristics and then assessed by DNA barcoding. The COI and 16S rRNA sequences were discriminated among genera in the phylogeny. We obtained a total of 228 DNA sequences from 138 species, 109 genera, 67 families and 26 orders. Among them, 169 sequences (118 species) were obtained from the COI gene and 59 sequences (20 species) from the 16S rRNA gene region. The COI sequences comprised 153 haplotypes with 248 polymorphic sites. The nucleotide diversity was calculated as 0.21 and the haplotype diversity was 1.00. The overall mean nucleotide base frequencies observed for 169 COI sequences were 24.2%, 29.7%, 28.2%, and 17.8 % for adenine (A), thymine (T), cytosine (C) and guanine (G), respectively. Genetic distances among the studied COI sequences ranged from 00% to 41%. The overall mean distance of the sequences was 26.6 %. The 16s rRNA sequences comprised 47 haplotypes with 197 polymorphic sites. The nucleotide diversity was calculated as 0.13 and the haplotype diversity was 0.99. The overall mean nucleotide base frequencies were 30.2%, 22.3%, 25.3%, and 22.2 % for A, T, C and G, respectively. Genetic distances among the 16S rRNA sequences ranged from 00% to 51%, and the overall mean distance was 15.4%. This ongoing study has also planned to construct mitochondrial 12S rRNA reference sequences for fishes of Sundarbans' aquatic habitats. The built DNA barcode library of this study will contribute as the reference sequences to the eDNA-based biomonitoring study of this biosphere which has recently been initiated by the ABR Lab.

Keywords: DNA barcoding, arimne fish, Sundarbans, mangrove, COI, 16S rRNA

Genetic variability and population structure of orange mud crab *Scylla olivacea* in the mangrove regions of Northern Indian Ocean inferred from mtDNA sequence analysis

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Abstract

Sequence analysis based on the mitochondrial DNA COI gene region was carried out to reveal the genetic diversity, population structure, and historical demography of the *Scylla olivacea*. Nucleotide sequences of 512 bp in length were determined for 213 samples taken from eight mangroves' aquatic habitats of the northern Indian Ocean which are two populations of Bangladesh (SB and CK) in the Bay of Bengal (BoB), two populations (Pakistan, PK & India, IN) of Arabian Sea (AS), and single population from each of the Andaman Sea (AS), Malacca strait (MS) and South China Sea (SC). For all of the populations, nucleotide diversities were low (0.005–0.01) while the haplotype diversities were as high as 0.70–0.96, indicating that the *S. olivacea* has undergone a recent population expansion after experiencing bottleneck. The pairwise population statistics (F_{ST}) revealed that no genetic variation was made between SB and CK populations of BoB. However, these two BoB populations showed separate genetic structure with each of the Andaman Sea (Myanmar coast, MM) and Malacca strait (West coast of Malaysia, MS) populations. On the other hand, BoB populations did not form separate genetic structure from the populations of AS. Larval dispersal-based migration by the East and West India coastal currents probably caused this genetic homogeneity between BoB and AS populations. The MM population showed separate genetic structure from all of the studied populations. Seasonally formed marine gyres in the Andaman Sea are probably responsible for separate genetic structure. The Hierarchical analysis of molecular variance (AMOVA) revealed four large population groups of *S. olivacea* within its distribution range in the Indo-west Pacific region namely, Arabian Sea, Bay of Bengal, Andaman Sea and South China Sea groups. Star-shaped patterns of haplotype network and neutrality test corroborate the recent population expansion of all populations except MM and CK. Mismatch distribution analysis reveals that the demographic expansion of the species started during the late Pleistocene period approximately 125,000 to 365,000 years ago. These results will help to establish the conservation and management strategy for orange mud crab in the Northern Indian Ocean region including the Bay of Bengal.

Keywords: *Scylla olivacea*, population genetic structure, Pleistocene, current, gyre

Environmental DNA metabarcoding of ichthyofauna in Asian mangrove ecosystems revealed spatial challenges in community-level analysis

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Abstract

Environmental DNA (eDNA) is an innovative molecular tool that can vastly improve biomonitoring in mangrove ecosystems. Compared to traditional surveys that are taxa-specific and time-consuming, eDNA metabarcoding offers a rapid, non-invasive, multi-taxa method to detect species and characterize distribution patterns. However, taxon detection could depend on environmental factors such as tidal condition, monsoons, salinity gradient, and the stratification of the water column. Furthermore, the dynamic spatiotemporal heterogeneity in faunal distribution poses a problem of scale in terms of delineating the sampling boundaries for different ecological and ecosystem applications. In this study, we collected eDNA water samples from mangroves in Malaysia, Indonesia and Japan across micro- (forest stand/estuary), meso- (coastline) and macro-scales (transboundary) to examine the spatial and temporal heterogeneity in ichthyofauna utilisation of mangroves. Specifically, we analysed how species detection and distribution vary (1) with tidal fluctuation, (2) between monsoonal seasons, and (3) across marine ecoregions. Our data showed that stationary sampling detected low overlap in community composition across temporal points, indicating the dynamic distribution of fish species and the transient nature of eDNA in tropical waters. Between monsoonal seasons, we detected only an overlap of ~15% of fish species, highlighting the need for seasonal sampling to better estimate the asymptotic number of species present. Comparison between different coastlines revealed the influence of adjacent habitats, with mangrove fish community comprising of more marine and reef-associated fish species in east coast than in west coast Malay Peninsula. Finally, fish communities have higher similarities within as compared to among marine ecoregions, indicating the importance of bioregionalization in designing global studies. Taken together, our results highlighted key spatiotemporal considerations for eDNA research in mangroves to ensure rigorous community-level analysis. Consensus in sampling protocols is necessary to facilitate comparison across mangroves and to realize the potential of eDNA as a reliable biomonitoring tool.

Keywords: coastal, distribution, fish, eDNA, tide

Fish utilization pattern on different proximity of planted mangroves to reefs in Northern Mindanao, The Philippines

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Abstract

Mangroves are recognized to enhance the biodiversity of nearby coastal ecosystems, however, its utilization by fish particularly on planted forest is still not fully understood. This study describes how fishes utilize planted mangroves and the influence of different proximity to nearby coral reefs. Fish survey was done during spring tide using beach seine net (7.5 m long, 1m high, 5 mm mesh size) towed in a 10m distance with its mouth opening maintained at 3 m distance along the edges of the mangrove forest. A total of 15 tows with approximately 5 m distance each were done on three selected sites with different proximity to coral reefs: <100 m, <300 m, <600 m. Collected samples were brought to the laboratory for identification up to the species level, length measurement to the nearest 1mm and further data analysis such as feeding habits. A total of 1,045 individuals belonging to 16 families and 36 species were identified. Across different proximity, planted mangroves having <600 m distance has the most fish abundance while no difference in terms of species richness. Also, Apoginidae showed the most abundant family while *Sphaerima orbicularis* for fish species. For fish feeding habits, most of the fish assemblages are zoobenthos feeders. Lastly, not so many fish recorded were reef-associated despite the adjacent distance to coral reefs and mostly are composed of juvenile and small fishes. These findings showed a different pattern of fish utilization on planted mangroves and has implications on implementing efficient rehabilitation strategies.

Keywords: planted mangroves, proximity, fish assemblage, feeding habits

Water quality and carbonate chemistry variability during the wet season along Aklan River and Bakhawan (Mangrove) Eco Park, Aklan, the Philippines

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Abstract

Mangrove ecosystems are sites of material cycling and export to open seas, and thus influence water physicochemical parameters. The mangrove forests of Bakhawan Eco-Park in northern Panay Island, Philippines, formed in one of the tributaries of the Aklan River from where there is influx of sediments and freshwater. The spatial and temporal variability in water quality and carbonate chemistry was examined during the wet season by analyzing nutrients (ammonium, nitrate, nitrite, and phosphate), pH, total alkalinity (TA), chlorophyll-*a* (Chl-*a*), and total suspended solids (TSS) from water samples collected in the upstream and downstream areas of the Aklan River, and within the Bakhawan Eco-Park. Samples were collected during flood tide and ebb tide to understand their effects on dissolved and particulate material transport. Sites in the upstream Aklan River reflect end-member green carbon characteristics (high average Chl-*a*, TSS, and DO, and low average TA and pH) of terrestrial forests whereas sites along the Aklan River show increased nitrate and phosphate concentrations and elevated TSS from river runoff from coastal communities and sediment load during flood tide. Tributaries going into the Bakhawan Eco-Park showed mangrove blue carbon characteristics (low average DO and silicate concentration, high salinity, and high average TA and pH) due to organic matter decomposition in the mangrove forest. The flood tide generally diluted the downstream river and the eco park with seawater from the Sibuyan Sea with a relatively lower chemical load, while the ebb tide increased nutrient and organic matter concentration as the tide receded and transported dissolved and suspended materials from the rivers to the sea. These results highlight the importance of illustrating the blue carbon-green carbon (B-G) link in mangrove conservation and the need for effective watershed management.

Keywords: water quality, blue carbon, green carbon, tides, Aklan River

Influence of fishponds on the water quality and carbonate chemistry dynamics in Batan Bay, Aklan, Philippines during the wet season

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Abstract

Blue carbon ecosystems such as mangrove forests and seagrass beds provide ecosystem services such as coastal protection, climate mitigation through carbon sequestration, and socio-economic benefits. However, due to the increase in population and development upstream and in coastal regions, blue carbon ecosystems are exposed to threats of anthropogenic pollution such as increased suspended sediment load from rivers and release of nutrients from mariculture effluents, which are particularly heightened during the wet seasons. Batan Bay, located north of Panay Island in Aklan, Philippines, is a shallow embayment previously surrounded by mangrove forests that have been mostly converted to shrimp ponds and fishponds. To understand the impact of mariculture on the overall water quality and carbonate chemistry of the bay, parameters such as nutrients (NO_3^-, NO_2^-, NH_4^+, PO_4^{3-}, SiO_4^{4-}), chlorophyll-*a*, chromophoric dissolved organic matter, and total suspended solids were measured together with temperature, salinity and carbonate chemistry (pH, total alkalinity) from a representative fish pond during the expected water outflow (discharge from fishpond to the bay) and inflow (recharge from the bay to fishpond) cycles. Diel water sampling was conducted at the surface and bottom waters from a time-series station in the bay to capture the variability in fishpond effluents and other nutrient sources on the bay-scale level. Fishpond waters were found to have high chlorophyll-*a* concentrations and distinct nutrient and carbonate chemistry source signatures that may be diluted by seawater and river water discharge during the wet season depending on the tidal cycle. These observations are important for assessing the state of Batan Bay water quality as influenced by mariculture, and for describing linkages to blue carbon dynamics during the wet season.

Keywords: fishponds, effluents, nutrients, diel, blue carbon

Mangroves blue carbon assessment of replanted mangrove forest in East Coast of Peninsular Malaysia, Malaysia

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[2] *East Coast Environmental Research Institute (ESERI), Universiti Sultan Zainal Abidin (UNISZA), Gong Badak Campus, 21300 Kuala Nerus, Terengganu, Malaysia*
[3] *Mangrove Research Unit, Institute of Oceanography and Environment, Universiti Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia*

Abstract

Mangroves are exceptional ecosystems with remarkable ability to sequester and store massive amounts of carbon. Their role in carbon sequestration is crucial in mitigating climate change and maintaining global climate stability. Natural mangroves forest represents long term carbon pool with the largest deposits in belowground. However, mangrove reforestation also can contribute to the substantial carbon storage. Assessing the carbon stock of replanted mangrove forest of different geomorphological settings provides their potential in sequestering carbon. Therefore, this study aims to assess carbon stock of replanted mangrove forest of deltaic and riverine in east coast of Peninsular Malaysia. Non-destructive method through allometric equation was applied to estimate aboveground biomass while in-core method was used to collect mangrove roots and sediment for the belowground biomass and hence the carbon stock. The findings indicated that the deltaic mangroves exhibited greater carbon stock compared to the riverine mangroves. The total carbon stock that comprised of both aboveground and belowground stock, demonstrated this disparity, with the deltaic mangroves storing higher carbon stock (109.7 t C ha^{-1}) compared to riverine mangrove forest (63.3 t C ha^{-1}). Both forest which were replanted with *Rhizophora apiculata*, displayed higher aboveground carbon stock for the mangrove delta (97.4 t C ha^{-1}) than the riverine forest (45.4 t C ha^{-1}). In contrast, riverine forest contained higher belowground carbon than the deltaic mangrove forest 17.8 t C ha^{-1} 12.2 t C ha^{-1} respectively. The distribution of carbon within the soil layer also varies. In the deltaic mangroves, the deepest soil layer (41–50 cm) contained the highest carbon stock, while in the riverine mangroves, the highest carbon stock was found in the upper 30 cm soil depth. Fine root was the main contributor to the belowground carbon stock in both types of forests. This study underscores the significance of considering geomorphological settings when assessing carbon stocks in replanted mangroves. This finding could inform future reforestation strategies and contribute to the understanding of mangrove ecosystems' role in carbon sequestration and climate change mitigation.

Keywords: mangroves, blue carbon, carbon stock, above and belowground mangrove

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Typhoon damage assessment of natural and planted mangroves in Bais Bay, Negros Oriental, The Philippines

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[2] *Silliman University Institute of Environmental and Marine Sciences, Dumaguete City, The Philippines*

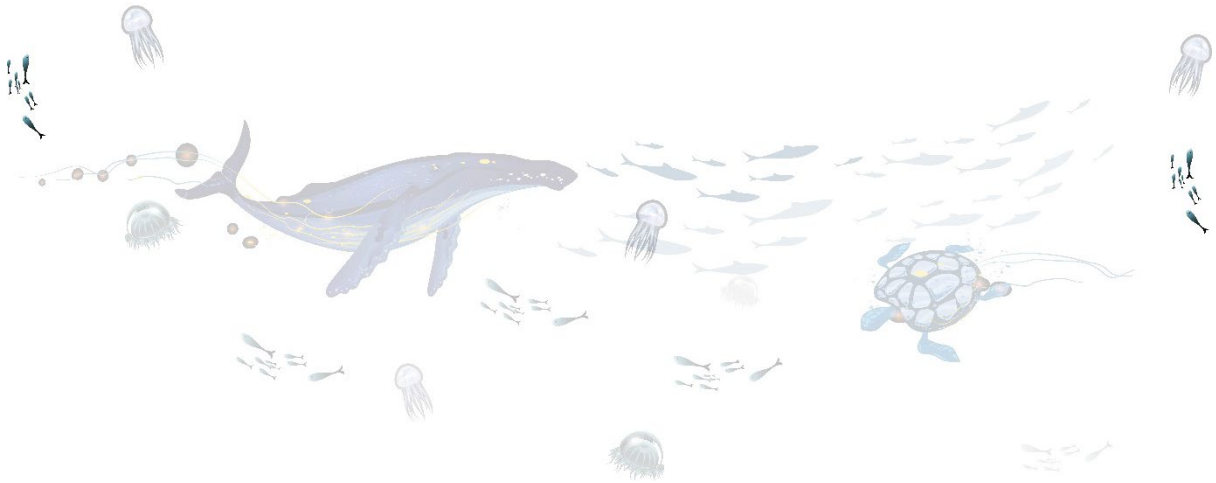
Abstract

Category 5 Typhoon Odette, internationally known as Rai, devastated Central Philippines in December 2021, causing immense damage to the country's infrastructure, agriculture, and ecosystems. Coastal vegetative ecosystems, which include mangroves, are exposed to strong wind and wave energy during extreme weather events. Considering their importance in providing a myriad of ecosystem services to coastal communities, we must be informed of their status post-typhoon in order to guide future rehabilitation efforts. The stand composition and community structure of planted and natural mangrove forests in Bais Bay were assessed, 8 months after typhoon Odette. The differences in damage between natural and planted stands showed statistically significant differences using a Chi-squared test ($\chi 2=5.113$; $p=0.024$). Phi and Cramer's V tests also revealed that the association between stand type (natural or planted) and damage incidence was statistically significant ($p=0.024$) with reforested sites being more associated with damaged trees. Species with the highest mortality rate was Rhizophora stylosa with 15 trees uprooted or with broken primary stems, 14 of which were in planted sites. A considerable amount of R. stylosa also failed to show refoliation 8 months after the typhoon, in contrast to Sonneratia alba and Avicennia marina trees which displayed refoliation as well as new stem sprouts despite also sustaining substantial damage. Low resilience of planted R. stylosa trees has been attributed to the inability for lateral growth and lack of complex root systems due to being situated too closely to each other. Results of the study indicate that future mangrove planting projects should prioritize planting storm-resilient species such as Sonneratia alba and Avicennia marina at seafront areas and provide adequate space between planted trees conducive for lateral growth. This study is also significant to know which type of forest stands can withstand typhoon damage occurrences.

Keywords: Typhoon Odette, Typhoon Rai, mangroves, damage assessment

Sub-theme B: Marine Biodiversity, Seafood Safety and Security

Session B6: Conservation of marine endangered species



Programme

Venue: Chelsea A, 5th Floor
Date: 22 April 2024

Conveners:

Xiaowan Ma	Fourth Institute of Oceanography, Ministry of Natural Resources, China
Watchara Sakornwimon	Department of Marine and Coastal Resources, Thailand
Kit Yue Kwan	College of Marine Science, Beibu Gulf University, China

Time	Presentation Titles	Speakers
Section 1		
10:15–10:30	Footprints in the sand: tracking sea turtle nesting on Khram Island	Bawornnan Jitphong, *Department of Marine and Coastal Resources, Thailand*
10:30–10:45	Conservation of threatened Asian horseshoe crabs in northern Beibu Gulf, China	Kit Yue Kwan, *Beibu Gulf University, China*
10:45–11:00	On the correlation between lipids and cryopreservation in coral embryonic development	Federica Buttari, *National Museum of Marine Biology & Aquarium*
11:00–11:15	Irrawaddy dolphin vocalization across context-dependent patterns and group size dynamics	Hairul Masrini Muhamad, *Universiti Malaysia Sabah, Malaysia*
11:15–11:30	The fate of the dugongs in Guangxi, China	Zhou Haolong, *Guangxi Academy of Marine Sciences, China*
11:30–11:45	Study of Bryde's whale migration by using photo identification in the Gulf of Thailand	Patcharaporn Yaowasooth, *Department of Marine and Coastal Resources, Thailand*
11:45–12:00	Application of stable isotopes analysis ^{13}C and ^{15}N to unravel the trophic dynamics of the charismatic marine fauna in Malaysia: opportunities and challenges	Maizah M. Abdullah, *Universiti Malaysia Terengganu, Malaysia*
12:00–12:15	Sizing up Nusa Penida's Manta Rays: estimating size and maturity using non-invasive low-cost methods	Janis Argeswara, *Marine Megafauna Foundation, USA*
12:15–12:30	Silencing of novel *TtVtg6-like* induced ovarian cell apoptosis in ancient chelicerate *Tachypleus tridentatus*	Kian Ann Tan, *Beibu Gulf University, China*

Session B6: Conservation of marine endangered species

Footprints in the sand: tracking sea turtle nesting on Khram Island

Bawornnan Jitphong[1], Thanaphan Chomcheun[1], Nedrangsee Pranama[3], Ailada Suwan[1], Chalathip junchompoo[2], and Chalida Sapkaew[4]

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[3] *Phuket Marine Biological Center, Phuket, Thailand*
[4] *Chanthaburi Fish Inspection Office, Thailand*

Abstract

Sea turtles conservation in Thailand involves various methods, and managing sea turtle nesting sites is a crucial approach. This emphasis is particularly notable in the coastal areas of Khram island, Chonburi province - a region of significant importance for sea turtle nesting in Thailand. The mentioned area is supervised by the Royal Thai Navy. Tracking sea turtles nesting on Khram island reveals two types of sea turtles: Green turtle (*Chelonia mydas*) and Hawksbill turtle (*Eretmochelys imbricata*). Data collected from 2011 to 2022 (12 years) indicates a total of 3,274 sea turtle nests, comprising 1,078 green turtle nests and 2,196 hawksbill turtle nests. The fewest nests at 157 in 2012, including 63 green turtle nests and 94 hawksbill turtle nests. In contrast, 2022 recorded the highest number of nests at 435, with 116 green turtle nests and 319 hawksbill turtle nests. The trend in the number of Hawksbill turtle nests exhibits a polynomial relationship with R-squared value = 0.93, while the trend for green turtle nests lacks a linear correlation. The top three beaches with the highest nesting activity are Pho Beach (40.96%), Nuan Beach (18.57%), and Kham Beach (16.98%). The peak nesting season occurs from June to August, corresponding to the monsoon season in Chonburi province. Additionally, the maximum hatching success rate for hawksbill turtle eggs is 44.97±32.53% in January ($P<0.05$) but green turtle hatching rate is not different by season ($P>0.05$). Both turtle hatching rates are falling below the recommended threshold of 70%, indicating a need for vigilant monitoring. This could be attributed to maternal health issues impacting egg viability.

Keywords: sea turtle, green turtle, hawksbill turtle, sea turtle nesting, Khram island

Session B6: Conservation of marine endangered species

Conservation of threatened Asian horseshoe crabs in northern Beibu Gulf, China

Kit Yue Kwan, Chun-Chieh Wang, Kian Ann Tan, and Paul K.S. Shin

Guangxi Key Laboratory of Beibu Gulf Marine Biodiversity Conservation, College of Marine Sciences, Beibu Gulf University, Qinzhou, 535011, Guangxi, China

Abstract

As a well-known example of "living fossil", horseshoe crabs are ecologically significant macroinvertebrates in coastal and estuarine ecosystems. Asian horseshoe crabs have been suffered from coastal reclamation, Tachypleus amebocyte lysate production, food consumption, and unintentional harvest, which led to considerable population declines along the west coast of the Pacific Ocean. The declining Asian horseshoe crab populations are expected to have ecological and social impacts. The northern Beibu Gulf, China is widely recognized to accommodate the highest density of Asian horseshoe crabs globally. We adopted BTPAE (Baseline, Threat, Purpose, Action, Evaluation) model to identify the knowledge-action gaps to improve conservation efforts for Asian horseshoe crabs in northern Beibu Gulf. *Asian Horseshoe Crab Observation* Network program has been initiated since 2021 to facilitate the long-term systematic monitoring of Asian horseshoe crab juvenile populations using a systematic monitoring protocol. Responsible stock enhancement programs for Asian horseshoe crabs are also attempted to restore the severely depleted populations. Challenges and future prospects are discussed to call for joint efforts to conserve the remaining Asian horseshoe crab populations.

Keywords: *Tachypleus tridentatus*, *Carcinoscorpius rotundicauda*, baseline, threat, stock enhancement

Session B6: Conservation of marine endangered species

On the correlation between lipids and cryopreservation in coral embryonic development

Federica Buttari[1, 2], Sujune Tsai[3], Zhi-Hong Wen[1], and Chiahsin Lin[2, 4]

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[3.] *Department of Post Modern Agriculture, Mingdao University*
[4] *Institute of Marine Biology, NDHU*

Abstract

The importance of corals as a vital ecosystem and the constant threats they face, many of which result from human activities have highlighted the need to develop conservation measures to safeguard these fragile species. From this perspective, cryopreservation stands as one of the viable strategies for preserving coral reefs. However, the success of coral cryopreservation depends on various factors, including the lipid content and composition. This study aims to explore the relationship of lipids and cryopreservation in *Galaxea fascicularis* embryonic development. Gamete bundles were collected in Houbihu (Pingtung, Taiwan, GPS: 218560 N, 1208440E) during the spawning period and embryos in various embryonic stages were underwent vitrification and nano-laser warming (300 V, 10 ms pulse width, 2 mm beam diameter) procedures. The vitrification solutions were formulated and mixed with 40% (w/v) Ficoll and 10% (v/v) gold nanoparticles (a final concentration of 1.2×10^{18} particles/m^3, ƛ=530 nm). The other set of eggs and embryos were subjected to dry weight analysis, thin layer chromatography and gas chromatography mass spectrometry for examining the total lipid and seven major lipid contents, while transesterification to fatty acid methyl ester was used to determine the fatty acid concentration and composition. Results revealed that the embryos in the morula stage achieved the highest viability after vitrification and laser warming. On the contrary, no significant differences were observed between those thawed embryos in the pawn chip and gastrula stages. Nevertheless, fluctuations were found in sterol ester, wax ester, and triglyceride, particularly at 8 hours of embryonic development. Cholesterol and phosphatidylcholine emerged as dominant lipids in all stages, followed by wax ester and lysophosphatidylcholine with moderate lipids. In the distinction between the various classes of fatty acids, saturated fatty acids appeared to be the predominant ones, followed by polyunsaturated and monounsaturated fatty acids. Pearson coefficiency indicated the correlation between cryopreservation and lipid content and composition. This study will help to improve current vitrification and laser warming protocols for coral eggs and embryos.

Keywords: embryonic development, lipids, cryopreservation, laser warming

Irrawaddy dolphin vocalization across context-dependent patterns and group size dynamics

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[2] First Institute of Oceanography (FIO), Ministry of Natural Resources (MNR), Qingdao 266061, China
[3] Institute of Oceanography and Environment, Universiti Malaysia Terengganu, 21030, Kuala Nerus, Terengganu, Malaysia

Abstract

Irrawaddy dolphins are an endangered species found in coastal and freshwater regions of the Southeast-South Asia, and understanding their behaviours is important to conservation. Irrawaddy dolphins are known to use sounds for communications and navigation purposes. How wild Irrawaddy dolphins used their sounds is still unclear due to insufficient data for context specific for each type of produced signals. This study describes the pattern of each produced signals of Irrawaddy dolphins across their four general surface behaviours in the Bay of Brunei. More than 30 hours of acoustic recordings and surface behaviour observations, 1267 whistles, 1983 click trains, 371 burst pulses, were detected and analysed. Higher whistles production in larger group size indicated a behaviour coordination within the group. The findings suggest a distinct pattern in the usage of produced signals across different surface behaviours for Irrawaddy dolphins. The results will assist future passive acoustic monitoring and conservation management on this population.

Keywords: Irrawaddy dolphin; signals; surface behaviours; group size

Session B6: Conservation of marine endangered species

The fate of the dugongs in Guangxi, China

Zhou Haolang and Qiu Guanglong

Guangxi Academy of Marine Sciences (Guangxi Mangrove Research Center), China

Abstract

On May 14, 1955, a dugong of three meters long was found stranding on the beach at Beihai, Guangxi. This was the first record of dugongs in Guangxi, indicating that dugongs occur in the far north extent of the South China Sea, not only in Indo-Pacific Ocean as commonly believed. Dugongs in Guangxi usually inhabited in the coastal waters of Shatian, Hepu, where they stayed in nearshore deep trench during low tide and moved to shallow waters during high tide to graze on seagrasses (mostly *Halophila ovalis*, *Halodule uninervis*, *Zostera japonica*). Dugongs in Guangxi had not been captured by fishmen until 1958 when the Great Leap Forward Campaign was launched nationwide in China. Since then, from 1958 to 1962, 110 dugongs were captured by the fishmen in Shatian, Hepu, not for the livelihood of local people but for the belief that *man can conquer nature*. Dugong fishing halted from 1965 to 1976 because capturing dugongs were difficult and unprofitable. From 1975 to 1976, 28 dugongs ware captured again and on October 28, 1976, three were captured for science purpose. Dugong fishing was banned in Guangxi since 1977. It is believed that from 1958 to 1976, over 200 dugongs in Guangxi had been captured. In 1986 a dugong field survey was conducted by Guangxi Institute of Oceanography for the establishment of a dugong reserve in Shatian, Hepu. In the survey, no dugong was seen but only feeding trails and dungs of dugongs were detected on intertidal beaches and seagrasses were found still flourishing on beaches. It is estimated out of dugong witness record of local fishmen and researchers that there were still around sixty dugongs in the coastal waters at that time. Apart from being captured, dugongs in Guangxi were also found occasionally stranding on beaches and being killed by blast fishing before 1990, since then dugongs were hardly seen in coastal waters of Guangxi. After 2000, no evidence of the occurrence of dugongs in Guangxi existed. Dugongs were once commonly seen at the Chinese side of Beibu Gulf, not only in coastal waters of Guangxi, but also along the west coast of Leizhou Pennisula, Guangdong and Hainan Island. It is habitat loss (destruction and degradation of seagrass meadows) and anthropogenic disturbance such as blast fishing, poison fishing, electric fishing, and overfishing that resulted in the escape of dugongs from Beibu Gulf to somewhere else.

Keywords: dugong, Guangxi, seagrass, anthropogenic disturbance, escape

Study of Bryde's whale migration by using photo identification in the Gulf of Thailand

Patcharaporn Yaowasooth, Supornchai Rungreung, Surasak Tongsukdee, and Rachawadee chantra

Department of Marine and Coastal Resources, Ministry of Natural Resources and Environment, Thailand

Abstract

Bryde's whale (*Balaenoptera edeni*), generally found in Thai water, is an endangered marine species that is important for the ecosystem, economy and society. It is not only a key source of natural learning but also generate income for the community by whale watching tourism. Bryde's whale is preserved (the highest class of protection for animal species) by the Wildlife Preservation and Protection Act, 2019. Photo Identification technique was used to monitor the Bryde's whales migration. 66 Bryde's whales were identified from sightings and report 659 times during October 2019–September 2023 in the Gulf of Thailand. The collected data was analyzed by using ArcGIS and the IBM SPSS Statistics software (SPSS) Vision 26. GIS Data (spatial and non-spatial data) showed that most Bryde's whales live in the Upper Gulf of Thailand (95.9%) Some of Bryde's whale migrated to middle Gulf of Thailand (4.1%) The Bryde's whales found in Samut Sakhon Province about 70.0%, Phetchaburi Province 19.0%, and Samut Songkhram Province 5.2%. They are often found during May-November in the Upper Gulf of Thailand. From data analysis, it shown the Upper Gulf of Thailand was significantly related to the status (mother 41.7% calf 33.5% adults 16.1%) of Bryde's whales. As the results, it is indicated that the Upper Gulf of Thailand is an important habitat for Bryde's whales. The upper Gulf of Thailand should be declared a protected area for Bryde's whales and marine resources to remain balanced and sustainable marine ecosystem.

Keywords: Bryde's whale (*Balaenoptera edeni*), Photo identification, The Gulf of Thailand

Application of stable isotopes analysis ^{13}C and ^{15}N to unravel the trophic dynamics of the charismatic marine fauna in Malaysia: opportunities and challenges

Maizah M. Abdullah

Faculty of Science and Marine Environment/ Institute of Oceanography (INOS), Universiti Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia

Abstract

Understanding the complex trophic dynamics of marine food webs, particularly interactions involving threatened or endangered species, has become more practical and reliable with the help of advanced ecological tools such as stable isotope analysis of $\delta^{13}C$ and $\delta^{15}N$ (SIA). It offers higher levels of accuracy and precision, greater insights and a deeper understanding of marine systems and processes, and greater accessibility compared to conventional research methods such as gut content analysis, allowing researchers to confidently draw conclusions from the data obtained. In this presentation, several unique cases from ecological studies to unravel the trophic dynamics of charismatic marine species, including the reef shark *Carcharhinus melanopterus*, hatchlings of the globally endangered green sea turtle Chelonia mydas, the Irrawaddy dolphins *Orcaella brevirostris*, and estuarine bamboo sharks and rays in Malaysian marine ecosystems, will be shared. Additionally, research opportunities, including the exceptional findings and their challenges, will be discussed.

Keywords: Marine endangered species, stable isotopes, trophic ecology, conservation, marine ecology

Sizing up Nusa Penida's Manta Rays: estimating size and maturity using non-invasive low-cost methods

Janis Argeswara, Aulia Zeintrinanda, Maulana M Priadhi, and Elitza Germanov

Marine Megafauna Foundation, USA

Abstract

Manta rays have some of the lowest productivity rates of elasmobranchs and are threatened with extinction. Knowledge gaps in birth and growth rates and habitats used by the young persist. A previous study identified critical habitats, a feeding ground and a cleaning station, for *Mobula alfredi* in the Nusa Penida Marine Protected Area, Indonesia. However, vital demographic data are outstanding, including the maturity status of ~20% of females, which lacked visual maturity indicators in the previous study. To further understand their population demographics, life history traits, and habitat use, photo-identification and paired-laser and stereo-photogrammetry were used. We identified a total of 155 individual manta rays in March 2021–December 2022. Based on a total of 275 measurements, female manta rays had a mean disc width (DW) of 3.93±0.06 m, while male manta rays of 3.29± 0.06 m, which shows apparent sexual dimorphism. Sexual dimorphism was present with the largest female (5.54 m) 22.2% larger than the largest male (4.43 m), both encountered at Manta Point. Based on the size of maturity assessed elsewhere, 3.2 m for females and 2.7 m for males, 92.4% of females and 92.72% of males measured were deemed mature. All (n=10) but one individual with DW<2.5 m were encountered at Manta Bay, which may suggest that age-class segregation and site preferences occur. Nusa Penida's manta rays are more similar in size to those reported in Mozambique and Japan, and larger than those in Raja Ampat, Hawaii, and the Maldives. Going forward we will measure more juvenile individuals and aim to measure them repeatedly using stereophotogrammetry to allow growth-rate calculations and assist in testing nursery criteria by identifying Young-of-the-Years.

Keywords: stereo-photogrammetry, paired-laser photogrammetry, Indonesia, growth rates, nursery

Session B6: Conservation of marine endangered species

Silencing of novel *TtVtg6-like* induced ovarian cell apoptosis in ancient chelicerate *Tachypleus tridentatus*

Kianann Tan[1], Karsoon Tan[1], Xiaowan Ma[2], and Kit Yue Kwan[1]

[1] Guangxi Key Laboratory of Beibu Gulf Marine Biodiversity Conservation, College of Marine Sciences, Beibu Gulf University, Qinzhou, 535011, Guangxi, China
[2] Key Laboratory of Tropical Marine Ecosystem and Bioresource, Fourth Institute of Oceanography, Ministry of Natural Resources, Beihai, 536000, Guangxi, China

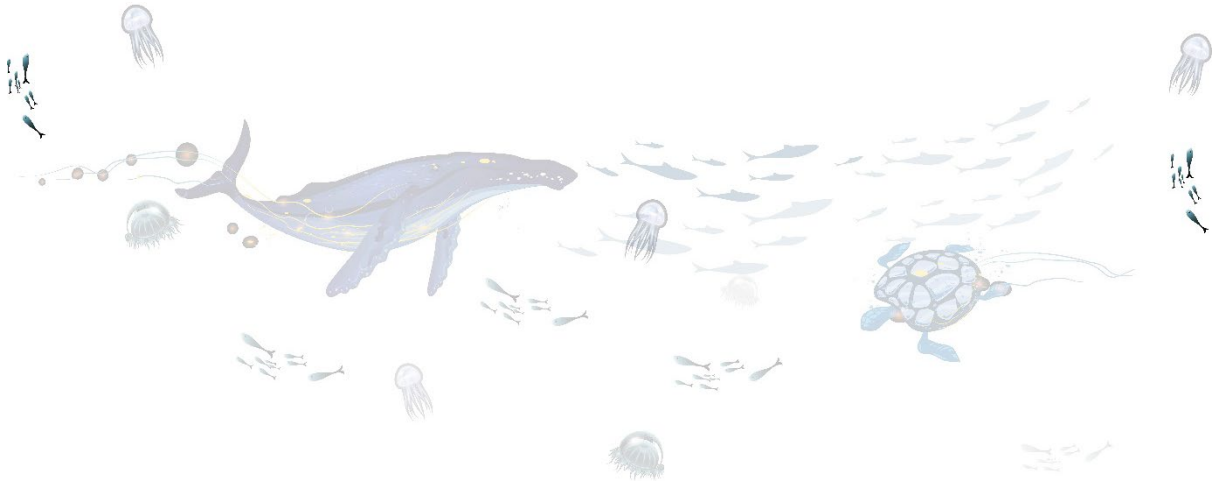
Abstract

Vitellogenin (Vtg) serves as the precursor of yolk protein and exhibits widespread distribution in tissues, including in the ovary of both vertebrates and invertebrates. *Vtg* plays a critical role in facilitating oocyte maturation and embryonic development following oviposition. In this study, we have successfully elucidated the complete transcript sequence of *TtVtg6-like* from an ancient chelicerate *Tachypleus tridentatus*. The *TtVtg6-like* transcript encompassed a length of 4,887 bp and encoded 1,629 amino acids residues. Notably, *TtVtg6-like* was found to contain 25 exons. Furthermore, the molecular weight and isoelectric point of *TtVtg6-like* were determined to be 191.6 KDa and 6.73, respectively. Subsequent mRNA expression analysis demonstrated the specific expression of *TtVtg6-like* in ovary and yellow connective tissue. In addition, *TtVtg6-like* was located and distributed in both ovary and yellow connective tissue. Intriguingly, employing an siRNA approach to silence *TtVtg6-like* resulted in a decrease in *TtVtg6-like* transcription levels. Concomitantly, *TtVtg6-like* silencing led to increase production of ROS, ultimately resulting in DNA damage and cell apoptosis within the ovarian primary cell. The induction of apoptosis ovarian primary cells due to *TtVtg6-like* silencing was further corroborated through TUNEL assay and flow cytometry analysis. Overall, our findings underscore the significance of *TtVtg6-like* in ovarian cell development, revealing its potential association with ovarian cell apoptosis. Consequently, the insights gained from this study contribute to the future exploration of vitellogenesis and ovarian development in *T. tridentatus*.

Keywords: *Tachypleus tridentatus*, Vitellogenin-like, functional analysis; siRNA; apoptosis

Sub-theme C:
Ocean and Human Health

Session C1:
Marine chemical Contaminants of Emerging Concern (CEC)



Programme

Venue: Mayfair C, 11th Floor
Date: 23 April 2024

Conveners:

Kenneth Mei Yee Leung	City University of Hong Kong, China
Zainal Arifin	BRIN, Indonesia
Koji Inoue	The University of Tokyo, Japan
Ahmad Ismail	Academy of Sciences Malaysia, Malaysia
Chong Chen	City University of Hong Kong, China

Time	Presentation Titles	Speakers
Section 1		
10:00–10:15	Advancements in research on emerging contaminants: from monitoring to global collaboration for effective pollution management	Kenneth Mei Yee Leung, *City University of Hong Kong, China*
10:15–10:30	Paracetamol contaminant in the estuaries and pelagic system of Jakarta Bay, Indonesia	Zainal Arifin, *BRIN, Indonesia*
10:30–10:45	Contaminants of emerging concern in the marine environment of the Greater Bay Area of China	Yuefei Ruan, *City University of Hong Kong, China*
10:45–11:00	Australian dolphins have some of the highest contaminant body burdens of marine pollutants anywhere in the world and we need to act now	Chantel S Foord, *Royal Melbourne Institute of Technology, Australia*
11:00–11:15	Bisphenol A effect on sea urchin (*Diadema setosum*) gonad based on their seasonal variation of oxidative stress enzyme activities.	Akbar Awaluddin Hanif, *Universiti Malaysia Terengganu, Malaysia*
11:15–11:30	The affectivity of bioremediation strategies in removing oil from coastal waters: mesocosm experiment	Yeti Darmayati, *BRIN, Indonesia*
11:30–11:45	Chiral pharmaceutical residues in edible oysters in the East and South China Sea and associated health risks to humans and wildlife at enantiomeric level	Rongben Wu, *City University of Hong Kong, China*
11:45–12:00	Modeling pharmaceutical contaminant transport in an urban coastal estuarine system using DELFT3D-FLOW: the case of Manila Bay, Philippines	Ann Elizabeth R. Enova, *University of the Philippines Diliman, The Philippines*
Section 2		
13:00–13:15	Is Migratory Shore under threat of chemical pollution in the coastal areas of the Straits of Malacca?	Ahmad Ismail, *Academy of Sciences Malaysia, Malaysia*

Time	Presentation Titles	Speakers
13:15–13:30	Marine pollution studies using Javanese medaka and mussels	Koji Inoue, *The University of Tokyo, Japan*
13:30–13:45	Evaluation of oil-contaminated sediment during bioremediation using green mussel (*Perna viridis*)	Dwi Hindarti, *BRIN, Indonesia*
13:45–14:00	Fish ingest and eliminate microplastics differently in seawater and freshwater: A lesson from euryhaline fish, Javanese Medaka (*Oryzias javanicus*)	Hilda Mardiana Pratiwi, *The University of Tokyo, Japan*
14:00–14:15	An initiation study on the anthropogenic pollution and evolutionary toxicology in Javanese Medaka (*Oryzias javanicus*)	Nurul Izza Ab Ghani, *Universiti Putra Malaysia, Malaysia*
14:15–14:30	How much do commonly monitored organic contaminants explain species-specific *in vitro* Toxicity of Seawater?	Xintong Liu, *The Hong Kong Polytechnic University, China*
14:30–14:45	Seasonal variations of heavy metals concentration in surficial sediment of Sungai Terengganu, Malaysia	Ong Meng Chuan, *Universiti Malaysia Terengganu, Malaysia*
14:45–15:00	Another emerging contaminant in the sinking city: the first evidence of metformin detected in Jakarta waters	Wulan Koagouw, *BRIN, Indonesia*
Section 3		
15:30–15:45	The latest progress and future prospects of the global estuaries monitoring programme	Chong Chen, *City University of Hong Kong, China*
15:45–16:00	Knowledge, awareness, and perceptions towards Fukushima nuclear wastewater discharge among the students of MSU-Iligan Institute of Technology, Philippines	Hernando P. Bacosa, *Mindanao State University-Iligan Institute of Technology, The Philippines*
16:00–16:15	A systematic study of occurrence and transformation of tire additives in urban water networks of a metropolis	Shaopeng Xu, *City University of Hong Kong, China*
16:15–16:30	Pharmaceutical and personal care products in representative aquatic environments of the Philippines	Caroline Marie B. Jaraula, *University of the Philippines – Diliman, The Philippines*
16:30–16:45	Spatial and temporal trends of organotins contamination in the marine environment of Hong Kong	Yan Jiang, *City University of Hong Kong, China*
16:45–17:00	POPs in Pacific Salmon from the Russian part of the Northwest Pacific (Russian Far East)	Aleksandra D. Borovkova, *Far Eastern Federal University, Russia*

Advancements in research on emerging contaminants: from monitoring to global collaboration for effective pollution management

Kenneth M. Y. Leung

State Key Laboratory of Marine Pollution and Department of Chemistry, City University of Hong Kong, Hong Kong SAR, China

Abstract

Over the past 50 years, the field of environmental sciences, including environmental chemistry, pollution monitoring, and environmental quality management, has witnessed remarkable progress propelled by instrumental technologies. These advancements have revolutionized our capacity to detect and quantify chemical contaminants of emerging concern (CEC) at ultra-low concentrations, while also enabling the development of tools for contaminant source tracking and the assessment of organism and ecosystem health. Monitoring priority contaminants and CEC plays a crucial role in water quality management by identifying pollution issues, improving water quality, and safeguarding aquatic ecosystems and human health. As Professor Peter Drucker famously stated, "*If you can't measure it, you can't improve it*." Therefore, the mission of environmental authorities, practitioners, and researchers should be centered around the principle of "*Measure to Improve*." This presentation will provide an overview of marine pollution and ecotoxicology research achievements in Hong Kong over the past 30 years. Real cases exemplifying successful environmental quality improvements resulting from management interventions on priority and emerging contaminants will be highlighted. Moreover, the presentation will address the global challenges posed by CEC, emphasizing the urgent need for international collaboration. Lastly, the presentation will introduce the Global Estuaries Monitoring (GEM) Programme which is an endorsed Decade Action under the UN Decade of Ocean Science for Sustainable Development (2021–2030). The GEM Programme aims to establish a global network for pollution monitoring, unravel the pollution status of estuaries worldwide, and co-design solutions to combat marine pollution, ultimately making our estuaries cleaner and safer for all.

Keywords: pollution monitoring, environmental quality management, emerging contaminants, global collaboration, ecotoxicology, water quality criteria

Paracetamol contaminant in the estuaries and pelagic system of Jakarta Bay, Indonesia

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Abstract

Jakarta Bay has become a major study site of marine pollution over the last two decades. This is due to two main reasons, i) Jakarta city is the most densely populated city in Indonesia, and the supporting cities around it have fast grown, and ii) the Bay is an area for tourism, fisheries, and industrial activities. Recent contaminants of emerging concern include microplastics, pharmaceuticals, personal care products, and various persistent organic contaminants. A preliminary study on paracetamol contaminant was done along the coast of Jakarta Bay in 2017, our current study covers a wide area, encompassing 22 sites in the estuarine system (river mouths) and 23 sites at the pelagic system or off-shore of Jakarta Bay. The seawater sampling was done twice in March and September 2023. Paracetamol concentrations in seawater were analyzed using LC-MS/MS method. The result showed that the paracetamol concentrations ranged from 0.185 to 3.971 ng/ml (March), and 0.020 to 1.213 ng/ml (September) in the estuarine system. In the pelagic system, paracetamol concentrations ranged from 0.184 to 6.457 ng/ml (March), and were not detected (nd) to 0.068 ng/ml (September). Paracetamol was detected in most sites of the estuarine system, and the highest concentration was in Muara Karang site, while in the pelagic system, the highest paracetamol concentration was detected in the middle of Jakarta Bay. There is a high variation of paracetamol concentration between estuarine and pelagic systems, and among the different months. Compared to other regions both in the tropical and sub-tropic coastal ecosystem, the concentration of paracetamol in Jakarta Bay was almost 10 to 100 times depending on the area. Hence, the management of pharmaceutical waste and the technology for treating pharmaceutical waste should be a priority for improvement by both governments and industries.

Keywords: contaminants of concern, paracetamol, estuaries, pelagic system, Jakarta Bay

Contaminants of emerging concern in the marine environment of the Greater Bay Area of China

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Abstract

Rapid economic expansion, urbanization, industrialization, infrastructural development, and an increase in construction and manufacturing activities in the Greater Bay Area (GBA) of China which comprises the nine cities of Pearl River Delta (PRD) region in Guangdong Province plus the Special Administrative Regions of Hong Kong and Macao, contribute to a substantial release of various environmental pollutants, including contaminants of emerging concern (CECs) as a recent research hotspot, into the Pearl River Estuary (PRE) and the adjacent northern South China Sea (NSCS). Indo-Pacific humpback dolphin (*Sousa chinensis*) and finless porpoise (*Neophocaena phocaenoides*) are two resident marine cetaceans in the NSCS. As apex predators, marine cetaceans can bioaccumulate and are particularly susceptible to exposure to high amounts of many pollutants, especially the persistent ones. This makes them ideal biomonitors for tracing environmental pollutants in the marine environment with a large time scale. Here we introduced two prominent groups of environmental pollutants with persistence potential, per- and polyfluoroalkyl substances (PFASs) and halogenated flame retardants (HFRs), both comprising legacy substances as globally banned/restricted chemicals and substantial manufactured replacements/alternatives becoming CECs of considerable significance. Target analysis and nontarget/suspect screening were applied for the investigation of the temporal trends of legacy and emerging PFASs and HFRs in Indo-Pacific humpback dolphins and finless porpoises stranded in Hong Kong waters in recent ten years. We found that: (1) significant increasing temporal trends were observed in the concentrations of two emerging PFASs, perfluoroethylcyclohexane sulfonate and 2,3,3,3-tetrafluoro-2-propanoate in porpoises stranded between 2012 and 2018, indicating increasing pollution by these substances; (2) forty-four PFASs from nine classes were additionally identified by nontarget/suspect screening, among which fifteen compounds were reported for the first time in marine mammals; (3) significant decreasing temporal trends were observed in the concentrations of tetra-/penta-/hexa-bromodiphenyl ethers (tetra-/penta-/hexa-BDEs) in adult porpoises stranded from 2013–2015 to 2016–2020, probably because of their phasing out in China; and (4) eight brominated compounds were additionally identified via suspect

screening, where a positive correlation was found between the concentrations of tetra-BDE and methyl-methoxy-tetra-BDE (Me-MeO-tetra-BDE), indicating the metabolism of tetra-BDE as a potential source of Me-MeO-tetra-BDE in marine mammals. Our results reveal the recent pollution status of PFASs and HFRs in the GBA of China with the highlight of replacements/alternatives as CECs, and provide evidence for evaluating the effectiveness of various control measures on banned/restricted chemicals.

Keywords: CEC, PFAS, HFR, South China Sea, marine cetacean

Australian dolphins have some of the highest contaminant body burdens of marine pollutants anywhere in the world and we need to act now

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Abstract

Marine mammals are at the top of the food chain are and are an excellent indicator species for the bio-accumulation and magnification of toxicants within an ecosystem. Often ecotoxicology studies investigate the contaminant burdens within human consumed portions of lower trophic individuals but do not take into consideration the entire body burden or ecosystem wide impacts. Contaminants such as Per- and poly-fluoroalkyl substances (PFAS) and mercury have been documented to bioaccumulate and magnify in aquatic systems with links to immunce supporession, hepatic toxicity, nureological and developmental issues, as well as increased risk of some cancers. Dolphins from Australia have been reported with the highest global concentrations of both PFAS and mercury, pointing to potential localized source issue. The critically endangered Burrunan dolphin from inshore waterways of southeast Australia have liver concentrations of PFAS and PFOS ranging from 662–19,500 ng/g and 494–18,700 ng/g respectively. One individual juvenile dolphin recorded concentrations (PFAS 19,500 ng/g, PFOS 18,700 ng/g) 30% higher than any other dolphin reported globally. The Burrunan dolphin is not alone, at least two other inshore populations of dolphins within Australia have recorded PFOS concentrations at the same magnitude. Mercury was also found to be at globally significant concentrations in liver samples from both the Burrunan dolphin (641±1,405 mg/kg) and the common bottlenose dolphin (730±655 mg/kg) from Australia's south east. Both these contaminant concentrations pose potential threat to the populations with 90% of the Burrunan dolphins recording concentrations of PFOS above previously reported tentative critical concentrations of (677–775 ng/g). Additionally, mercury-to-selenium (Hg:Se) molar ratios raise concerns, as almost all adults studied in south east Australia surpass the 1:1 molar ratio threshold for hepatic toxicity concentrations. Whilst Ahas historically been seen as a pristine environment, however with concentrations at globally significant levels across trace elements and persistent organic pollutants in top order dolphins this may not be the case. This research highlights the value in using top order species as indicators for what is bioavailable and accumulating within a system. We need to take note of these accumulated compounds and do more to stop the continuance within our marine environment.

Keywords: dolphin, PFAS, Mercury, contaminant

Bisphenol A effect on sea urchin (*Diadema setosum*) gonad based on their seasonal variation of oxidative stress enzyme activities

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Abstract

Bisphenol-A (BPA) poses a significant threat to marine animal physiology, which can act as an Endocrine Disrupting Chemical (EDC) due to its resemblance to estradiol molecules. Sea urchins (*Diadema setosum*) are chosen due to their sensitivity and their role as indicators of pollution and ecosystem health. Studying their responses contributes valuable information to our understanding of the impact of contaminants on marine environment. Sea urchin was sampled at Pantai Tok Jembal, Terengganu in November 2021, February 2022, May 2022, and August 2022 and dissected to get the gonad. Water samples and sediment samples were also collected simultaneously. The gonad sample undergo cleanup using C-18 cartridge and went through detection using high performance liquid chromatography (HPLC-PDA). The recovery percentage of BPA was calculated and offered relative recovery of >84%. Meanwhile, for enzymatic analysis, the gonad was homogenized, and protein concentration was determined by using Bradford assay method as a baseline data for all enzyme assays. Three enzyme assays were conducted on sea urchin gonads to investigate seasonal variations which were Glutathione S-Transferase (GST), Catalase (CAT) and Superoxide Dismutase (SOD). The results indicate dynamic changes in enzyme activities within sea urchin gonads over time. BPA concentration in gonad showed a slight decrease from November 2021 to February 2022, then increase from February 2022 to May 2022, and a sharp increase from May to August 2022. GST activity showed a significant increase from November 2021 to February 2022, followed by a gradual rise from May to August 2022. Conversely, CAT activity decreased from November 2021 to August 2022. This could be associated with altered oxidative stress levels within sea urchin gonads over time. SOD activity initially decreased from November 2021 to February 2022, then increased from February to May 2022, followed by a subsequent decrease until August 2022. These variations could be linked to changing levels of reactive oxygen species (ROS) with potential connections to BPA exposure. The observed increase in GST activity and simultaneous decrease in CAT could suggest a potential relationship. Elevated GST activity might signify an increase in need for detoxification, possible due to presence of xenobiotics like BPA.

The decrease in CAT activity may indicate a reduced ability to manage oxidative stress possibly due to altered environmental conditions such as seasonal variations. Overall, based on our findings on enzyme assay GST, CAT, and SOD activities, suggest that sea urchin gonads could be valuable bioindicators of BPA in seawater.

Keywords: Bisphenol A, endocrine disrupting chemical, high performance liquid chromatography, antioxidant enzyme

The affectivity of bioremediation strategies in removing oil from coastal waters: mesocosm experiment

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Abstract

Oil spill is one of the latent threats to the waters of Seribu Islands, Indonesia. Pari Island waters is one of the most vulnerable areas to oil pollution in this area. The aim of this preliminary study was to assess the affectivity of bioremediation methods in removing oil from oil-contaminated Pari island sandy beach. This experimental study was conducted in Pari Island using mesocosm approach for 60 days. Oil contaminated sediment was treated with single culture bacteria, mix culture bacteria, slow-release fertilizer (SRF), mix culture + SRF. Parameter measured was oil reduction, bacterial growth, water quality and chronic effect on microalgae. Sampling was conducted in 0, 30 and 60 days after treatment. The results showed that the application of tested strategies increase oil reduction rate. Combination of bioaugmentation and biostimulation using mix-culture (*Alcanivorax* sp., *Pseudomonas balearica* and *Bordetella* sp.) and SRF gives the best result in oil removal (almost 3 times faster than control). No toxicity effects of the bioremediation treatments sediments were detected to microalgae growth. We conclude that bioremediation is effective in increasing the rate of oil degradation and safe for marine biota. However, trials on sandy beach ecosystems with more replications and different seasons will be needed to get more convincing conclusions.

Keywords: bioremediation, oil, coastal, mesocosm, microalgae

Chiral pharmaceutical residues in edible oysters in the East and South China Sea and associated health risks to humans and wildlife at enantiomeric level

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Abstract

The investigation of pharmaceuticals as emerging contaminants in marine biota has been insufficient. In this study, we examined the presence of 51 pharmaceuticals in edible oysters along the coastline of East and South China Sea. Only nine pharmaceuticals were detected. The mean concentration of all measured pharmaceuticals in oysters per site ranged from 0.804 to 15.1 ng g^{-1} dry weight, with antihistamines being the most common. Brompheniramine and promethazine were identified in biota samples for the first time. Although no significant health risks to humans were identified through consumption of oysters, 100–1000 times higher risks were observed to wildlife like water birds, sea snails, and starfishes. Specifically, sea snails that primarily feed on oysters were found to be at risk of exposure to ciprofloxacin, brompheniramine and promethazine. These high risks could be attributed to the monotonous diet habits and relatively limited food sources of these organisms. Furthermore, taking chirality into consideration, chlorpheniramine in the oysters was enriched by the *S*-enantiomer, with a relative potency 1.1–1.3 times higher than when chlorpheniramine was considered as a racemate. Overall, this study highlights the prevalence of antihistamines in seafood, and underscores the importance of studying enantioselectivities of pharmaceuticals in health risk assessments.

Keywords: antibiotics, psychiatric drugs, antihistamines, enantiomers, seafood safety

Modeling pharmaceutical contaminant transport in an urban coastal estuarine system using DELFT3D-FLOW: the case of Manila Bay, Philippines

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Abstract

The increasing global prevalence of pharmaceuticals and personal care products (PPCPs) and their effects on ecosystems and human health categorize them as contaminants of emerging concern. In the Philippines, there is limited data on its occurrence on coastal waters especially inside Manila Bay, an important coastal estuary in the Philippines urban center. This study determined PPCP concentration in major rivers of Manila Bay using LC-MS, modeled pharmaceutical contaminants transport inside Manila Bay using an open-source software, DELFT3D-FLOW, and explored key factors affecting the pollutant transport model and its applicability to other urban coastal estuarine systems. PPCPs mostly detected in Pasig River and Pampanga River were anhydro-erythromycin and caffeine. The distribution of PPCPs may be affected by the difference in land use and concentration of hospitals in the area. It was determined that pollutants mostly come from Pasig River going to the southern part of Manila Bay (Paranaque and Cavite) during Southwest monsoon, and Pasig River going to the middle northern part of the bay (Bulacan and Pampanga) during Northeast Monsoon. River discharges have a significant contribution to the resulting water circulation and pollutant transport trends in a coastal estuary. Presence of non-point sources affect the accuracy of model results. However, this is challenging to account for in modeling. Seasonal factors such as wind and dilution also affect contaminant transport. Hydrodynamic modeling using simple open-source tools such as DELFT3D-FLOW coupled with quantification of the concentration of dissolved PPCPs in major rivers is valuable and useful for predicting transport of pollutants and determining areas with high risk of exposure to pharmaceuticals and may be applied to other urban coastal estuarine systems for modeling other dissolved pollutants. It is recommended to conduct targeted analysis of PPCPs in fish, corals, mussels and sediments in Manila Bay. Furthermore, management of the increasing occurrence of pharmaceutical contaminants in aquatic ecosystems need a multi-step and trans-disciplinary approach by lowering usage and dosage of pharmaceuticals, better product design, and ensuring proper wastewater treatment systems.

Keywords: pharmaceuticals and personal care products (PPCPs), pollutant transport modeling, contaminants of emerging concern

Is Migratory Shore under threat of chemical pollution in the coastal areas of the Straits of Malacca?

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Abstract

Chemical pollution in the coastal environment has been a great concern for many years. Over 60% of the human population lives in the coastal areas. This will promote more development and cause pollution in the coastal environment. Coastal areas along the Straits of Malacca are important stopover sites for the migratory shorebirds during their migration southwards and northwards. Malay Peninsular and Sumatera are among the important flyways for bird migration in the East Asian-Australasian Flyway (EAAF). Shorebirds fly from the northern hemisphere to the southern hemisphere escaping cold winter to hotter areas for their food, survival, and other ecological functions. Along their migration routes, they stop over at important areas, especially in the coastal areas which provide them enough food and shelter. A lot of risks to the migratory shorebirds such as loss or declination of feeding areas, less abundance of food, and contaminated diet by chemicals such as heavy metals, pesticides, plastic, and other new emerging chemicals produced by industrial and agricultural activities. Human economic activities in the coastal areas including ecotourism may cause an ecological crisis for the sustainability of shorebirds' population. Past studies on chemical pollution in the Straits of Malacca should be assessed in order to predict any potential effects of chemical pollution on migratory shorebird populations.

Keywords: migratory shorebirds, chemical pollution, Straits of Malacca, coastal, EAAF

Marine pollution studies using Javanese medaka and mussels

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Abstract

Marine pollution has been a serious problem in the world. While chemicals released from industries, or those derived from agricultural and house wastes have been major contaminants for decades, microplastics are emerging threats to marine ecosystems. Although field studies are important to understand the status of marine pollution, laboratory studies are also essential to understand the impact of pollution on organisms. For laboratory studies, we have proposed Javanese medaka (*Oryzias javanicus*) and shallow-sea mussels of the genera *Mytilus* and *Perna* as vertebrate and invertebrate models, respectively. Javanese medaka is a small fish species widely distributed in South and Southeast Asia. It inhabits seawater and brackish water but can adapt to freshwater. It is easily culturable in the laboratory as its congeneric species, Japanese medaka (*O. latipes*). Javanese medaka is also suitable for studies at molecular levels because whole genome sequences and genome-editing techniques have become available. For example, we have established a cytochrome P450 1a (*Cyp1a*) gene-knockout Javanese medaka strain to understand the mechanisms to metabolize pollutants. Mussels are also suitable models for pollutant-exposure experiments in the laboratory. They are tough enough to be maintained in the laboratory, and known to filtrate enormous amount of ambient water, and absorb chemicals included in it. We have already obtained whole genome sequences of green mussel (*Perna viridis*) to analyze molecular responses to pollutants. Whole genome sequences are also available in several *Mytilus* species. We have conducted microplastic (MP) exposure experiments using Javanese medaka and mussels. We found that medaka fishes “drink” 1-μm MPs with water, and MP ingestion and elimination processes were under the influence of environmental salinity. We also demonstrated that mussels actively ingest MPs by filter feeding and retention time of the ingested MPs in the intestine is dependent on particle sizes. Javanese medaka and the green mussel are common species in Southeast Asia. They occupy important positions in the estuarine and coastal ecosystems. They prefer shallow waters and thus easily collectable. Therefore, these species are also useful targets for field researches, and have potential to connect laboratory and field studies.

Keywords: Cyp1a, microplastics, *Oryzias javanicus*, *Perna viridis*, polyaromatic hydrocarbons (PAHs)

Evaluation of oil-contaminated sediment during bioremediation using green mussel (*Perna viridis*)

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Abstract

Research on oil bioremediation in Indramayu sandy beach has been done by using mesocosm approach. The bioremediation treatments were applied to oil contaminated sandy beach to evaluate the efficacy of the treatment in degrading oil content in sandy beach after 90 days of exposure. Oil contaminated sediment was evaluated by monitoring total petroleum hydrocarbon, development and mortality of the green mussel (*Perna viridis*). Embryo-larval of bivalve mollusk were exposed to sediment overlying water of the seven bioremediation treatments and control for 48-h of exposure in triplicates. The test was terminated when 90% or more of normal D-shaped larvae were developed in the control. All of normal and abnormal larvae were counted from each replicate to calculate the EC50 (Effective Concentration 50%), LOEC and NOEC values. Water quality parameters including temperature, dissolved oxygen, pH and salinity were measured in the beginning of the test. To evaluate the consistency of the test procedures and the sensitivity of the test biota, reference toxicant test using cadmium was conducted concurrently. The results reveal that oil residue in the sediment of bioremediation affected more to the development of the larvae than to the mortality. However, relatively no significance ($p<0.05$) effects of oil-contaminated sediment resulted from bioremediation treatments were observed in the development of embryo-larval of *P. viridis* compared to the control. The use of consortium bacteria and addition of slow-release fertilizer show the most efficient in the degrading oil content in sediment and consider as relatively no impact on embryo-larval development of *P. viridis*.

Keywords: oil, bivalve, embryo-larval development, bioremediation, sediment

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Fish ingest and eliminate microplastics differently in seawater and freshwater: A lesson from euryhaline fish, Javanese Medaka (*Oryzias javanicus*)

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Abstrac

In recent decades, microplastics (MPs), plastic particles smaller than 5 mm, have emerged as one of the biggest environmental challenges in aquatic environments. Numerous studies have reported the detection of MP in various animals, mostly in fish, a major member of aquatic ecosystems. However, the basic mechanism of how fish ingest and deal with MPs in seawater (SW) and freshwater (FW) remains unclear, although physiological conditions of fish differ significantly in the two environments. Medaka fishes are well-known as excellent models for studying ecotoxicology and seawater adaptation. In the present study, we investigated the ingestion and elimination mechanism of MP and its related factors in fish under SW and FW environments using Javanese medaka (*Oryzias javanicus*). This Southeast Asian origin medaka inhabits SW/brackish water but is also adaptable to FW. Here, we exposed *O. javanicus* larvae (21 days post-hatching) to 0.25 mg/L of fluorescence polystyrene microsphere (1 μm) for up to 7 days. Using tissue transparency and automatic counting techniques, MPs were predominantly detected in the gastrointestinal tracts (GITs) in both FW and SW larvae, but the latter contained higher numbers of particles. Additionally, observation of water-drinking activity using a fluorescent marker revealed that larvae swallowed more water in SW than in FW. These results imply that MPs were ingested with water drunk for osmoregulation. For MP elimination tests, *O. javanicus* larvae in both media were exposed to a similar concentration of 1 μm MP for 24 hours, transferred to MP-free SW or FW, and observed for up to 5 days. The results showed that the gut retention time (GRT) of MP is longer in FW than in SW, indicating that MP elimination occurs more quickly in SW than in FW. Additionally, using a fluorescent marker, gastrointestinal fluid was found to move more rapidly in the SW group. This finding indicates that water drinking accelerates gastrointestinal fluid movement, which forwards MPs to a posterior direction in SW larvae. In addition, MP elimination was found to be faster under food availability, suggesting that feeding status can also affect the MP elimination process in fish. In conclusion, we propose that osmoregulation is an important factor influencing MP ingestion and elimination in fish. The results obtained in this study are applicable to most fish in various osmotic environments because the osmoregulatory mechanisms are essentially common among teleosts. Therefore, this study provides valuable insights into the potential impacts of MP pollution in aquatic ecosystems.

Keywords: marine pollution, medaka fish, fluorescence microbeads, osmoregulation

Session C1: Marine chemical Contaminants of Emerging Concern (CEC)

An initiation study on the anthropogenic pollution and evolutionary toxicology in Javanese Medaka (*Oryzias javanicus*)

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Abstract

The Straits of Malacca which is the busiest narrow shipping lane is covered by mangroves with surrounding areas are densely populated with settlements, industries, plantations, recreations, and fisheries. Hence, mangroves across the Straits of Malacca are trapping areas for various anthropogenic pollution. Many studies assessing chemical pollution from anthropogenic activities and their impacts on biodiversity and ecosystems of marines/mangroves have been done. However, the implication of pollution adaptation through evolutionary toxicology that can be explained through genetic erosion due to natural selection for resistant individuals using marine/mangrove life is still new. In this initiation evolutionary toxicology study, the Javanese medaka (*Oryzias javanicus*; Bleeker, 1854) which is abundant in the waters of mangroves across the Strait of Malacca was used as a focal species. Three populations were evaluated for their genetic erosion including Bagan Lalang, Selangor (a surrounding area with settlements, industries, oil palm plantations, recreations, fisheries, and a power plant), Kuala Triang, Langkawi (an island population surrounded by settlements and recreations), and Kuala Perlis, Perlis (a surrounding area with settlements, paddy fields, and fisheries). The results showed all populations deviated from the Hardy-Weinberg Equilibrium when tested for allele frequencies, the highest heterozygosity in Kuala Triang (no genetic erosion), moderate heterozygosity in Kuala Perlis (possibility of genetic erosion in the future), and high homozygosity in Bagan Lalang (genetic erosion and selection for resistance). In conclusion, different anthropogenic pollutions have driven evolutionary toxicology in *O. javanicus* populations along the Straits of Malacca and it may also occur in other marine/mangrove species.

Keywords: anthropogenic pollution, evolution toxicology, Javanese medaka, mangroves, the Strait of Malacca

How much do commonly monitored organic contaminants explain species-specific *in vitro* Toxicity of Seawater?

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Abstract

The Indo-Pacific finless porpoise and Indo-Pacific humpback dolphin are iconic threatened marine mammals in Hong Kong. Chemical pollution is amongst the multiple stressors that impact their health. While there have been studies successively devoted to different groups of contaminants in the seawater where the porpoise and dolphin inhabit, it remains elusive to what extent these commonly monitored contaminants contribute to the overall toxicity of seawater and whether there is an imperative to resolve other contributing toxic pollutants. To fill this knowledge gap, we developed species-specific cell lines to assess the cytotoxicity of Hong Kong's marine water and employed mixture-toxicity modeling to determine the quantitative role of 32 chemicals previously detected thereof, including polycyclic aromatic hydrocarbons, polyfluoroalkyl substances, brominated flame retardants, organotins, ultraviolet filters, and algal toxins. These chemicals collectively accounted for a greater proportion of seawater cytotoxicity in the northern, eastern, central, and southern waters (25–43%) than in the western waters (6%). Consistent to this pattern, pectenotoxin-2, which is produced by *Dinophysis* spp. and the major driver of all the studied chemicals, explained 22-36% of seawater cytotoxicity in most of the waters except for the western waters (4%). In contrast, di-butyltin, one component of the antifouling agents in shipping activities, contributed consistently to seawater toxicity across the coastal waters (2–6%). These results pinpointed zone-specific focus in identification of marine pollutants potentially impacting the cetacean health (e.g., more on anthropogenic chemicals in the western waters vs. more on natural biotoxins in the rest of the coastal waters) by suspect/non-target screening combined with artificial intelligence-facilitated toxicity profiling. Similar approaches should be directed towards chemical mixtures accumulated in the porpoise and dolphin. The development of effect-based trigger values for mixture effects should be prioritized as a tool for managing the overall risk of chemical cocktails in coastal waters to protect these threatened marine mammals.

Keywords: marine contaminants, cytotoxicity, mixture toxicity effects, threatened marine mammals

Seasonal variations of heavy metals concentration in surficial sediment of Sungai Terengganu, Malaysia

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Abstract

Sungai Terengganu is the main river of the state of Terengganu in terms of industrial and urban development which draws attention to the status of heavy metals pollution of the area. A heavy metals contamination assessment is carried out to access and determine the status of the metals of the surficial sediment of Sungai Terengganu. Sixty-one samples were collected in October 2016 and April 2017, respectively to represent pre-monsoon and post-monsoon seasons. Inductively Coupled Plasma Mass Spectrometer (ICP-MS) was used to analyze the samples after the samples were digested with mixed acid (HNO_3, HCl, HF) under closed digestion. The mean concentration of heavy metals studied such as Pb, Zn, Cu, Cr and As in post-monsoon season was much higher when compared to the mean concentration of heavy metals in pre-monsoon season. The surficial sediments at the mouth of estuary contained a higher concentration of metallic elements during both pre and post-monsoons. The Pollution Load Index (PLI) also suggested that the mouth of the estuary is the most contaminated area possibly from the increasing anthropogenic activities in the area. Further monitoring should be implemented for better future development of the area.

Keywords: heavy metals, Sungai Terengganu, sediment, pollution load index, seasonal

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Another emerging contaminant in the sinking city: the first evidence of metformin detected in Jakarta waters

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Abstract

Pharmaceutically active compounds are increasingly considered contaminants of emerging concern due to evidence suggesting that these substances may adversely affect non-target organisms. Metformin, the most commonly prescribed anti-diabetes medicine worldwide, has been detected in numerous freshwater systems and seawater at various sites over recent years. However, its presence has not been reported in the Indonesian capital city, Jakarta. Recent studies have highlighted the ecotoxicological effects of this medicine on aquatic organisms. This study presents the first evidence of metformin in Jakarta's waters, with samples collected from six sites along the Angke River, a primary waterway. Metformin was detected at three sites with concentrations ranging from 27 ng/L to 414 ng/L. As one of the most detected active pharmaceutical ingredients (APIs) in aquatic environments globally, metformin's impact on wildlife and human health is of increasing concern. This report, a first for Jakarta waters, adds to the evidence of potentially escalating pharmaceutical pollution, as noted in previous studies. With the absence of natural degradation processes, these chemical compounds can easily re-enter the food chain and impact human health. The effects of metformin on aquatic life are also discussed.

Keywords: emerging contaminants, metformin, pharmaceuticals, Jakarta, water pollution

The latest progress and future prospects of the global estuaries monitoring programme

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Abstract

Currently, more than 100,000 chemical substances are used in our daily lives and industries. Among them, 4,000 pharmaceuticals are used for preventing and treating human and animal diseases. Many of these chemicals eventually find their way into estuaries through various pathways, such as rivers, surface runoff, and partially treated wastewater discharged from treatment plants. There is a lack of information at a global level regarding the occurrence and environmental risks of different chemical contaminants in urbanized estuaries, particularly in Africa, South America, Southeast Asia, and Oceania coastal areas. To address this issue, the Global Estuaries Monitoring (GEM) Programme aims to develop standardized methods for sampling, extracting, detecting, and quantifying priority chemical contaminants in water samples collected from major urbanized estuaries worldwide. These methods will enable a scientifically sound comparison of contamination profiles across various estuaries. The GEM Programme is one of the first Ocean Decade Programmes endorsed by the United Nations Decade of Ocean Science for Sustainable Development (2021–2030) on June 8, 2021. The study focuses on six key aspects, including capacity building, standardization of research methods, promotion of best practices in pollution monitoring and control, data sharing, co-designing research strategies, and revealing the estuary health status. Over the past two years, we have been fully committed to method development and establishing connections with global collaborators. GEM has already developed and verified a robust analytical method to quantify 65 pharmaceuticals in river, estuary, and marine water samples for the GEM Programme, using only a small sample volume. This allows for economical transportation of collected samples to State Key Laboratory of Marine Pollution in Hong Kong for chemical analysis. We have also received contributions from 163 estuaries across 54 countries. Currently, samples are being collected from these major urbanized estuaries globally. The GEM Programme aims to contribute to unveiling the global pollution situation and promoting best practices to combat pollution problems, thus achieving cleaner estuaries for a better and greener future. We warmly welcome everyone to share and contribute to the GEM programme. We expect to share our latest findings and co-design the second phase of GEM with our collaborators in 2nd UN Ocean Decade Regional Conference & 11th WESTPAC International Marine Science Conference.

Keywords: marine pollution, global estuaries monitoring, pharmaceutical, occurrence, environmental risks

Knowledge, awareness, and perceptions towards Fukushima nuclear wastewater discharge among the students of MSU-Iligan Institute of Technology, Philippines

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Abstract

The announcement by the Japanese government to release the treated nuclear wastewater into the Pacific Ocean prompted criticism and concerns from its neighbors. Environmentalists are warning about potential harm to the marine ecosystem even though the International Atomic Energy Agency (IAEA) has approved it. Regardless of its proximity and sharing of marine waters, the Philippines did not lodge any complaints against Japan's move to release the treated nuclear wastewater. The study aims to examine the knowledge about Fukushima nuclear wastewater, awareness of possible negative effects, and perceptions towards Fukushima nuclear wastewater discharge among selected college students from MSU-IIT. A questionnaire was developed to measure the research variables and was distributed online. Results show from the collected sample (n=275; male=123; female=152), that the college students have little to no knowledge (mean=2.68, 1–5) of the treated nuclear waste. The students also have little to no awareness (mean=2.62, 1–5) of the issues about the release and its possible negative effects on the marine ecosystem. Furthermore, the students also perceive the release of the treated nuclear wastewater as dangerous (mean=3.95, 1–5) to human health and marine ecosystems. Spearman's rank correlation was used to determine the relationships between the variables. Knowledge about nuclear wastewater discharge is positively correlated with awareness on issues and possible impacts to the marine ecosystem ($r=0.471$, $p=<.05$), this suggests that a low level of knowledge on nuclear wastewater leads to a low level of awareness of its issues and possible impact to the marine ecosystem. Knowledge and awareness are also positively correlated with Perception, which suggests that low knowledge and awareness lead to a negative perception of the release of treated nuclear wastewater. The study's findings suggest that there is a need to monitor bodies of water for possible radioactive contamination and the IEC campaign on Fukushima nuclear wastewater discharge to improve understanding regarding the topic.

Keywords: nuclear wastewater, perception, awareness, knowledge, contamination

A systematic study of occurrence and transformation of tire additives in urban water networks of a metropolis

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Abstract

Tire particles released during driving are one of the main sources of microplastics in natural water. Tire particles can also release tire additives (TAs) and their transformation products (TPs) into the aquatic environment. Transformation of TAs in natural water and potential ecological risks from co-exposure to TAs and their TPs are largely unclear. Therefore, a novel framework combining field investigation, target analysis, suspect screening, and nontarget analysis was employed to understand aquatic persistence and health impacts of TAs. In this study, we collected 55 surface water samples distributed in 6 rivers and 7 stormwater drains and 6 sewage samples from 3 sewage-treatment plants. Samples were collected in both dry and wet seasons in Hong Kong, which is a metropolitan city in south China. Meanwhile, the suspended particulate matter with a diameter greater than 0.45 μm was separated from water samples to further study the partition behavior of TAs and their TPs. The results showed that 30 TAs were detected in all samples, and more than 22 TPs were identified. This study provided a new perspective on interpreting the environmental behavior of TAs in urbanized waters of coastal metropolis, while also indicated that incorporating TPs into the scope of the ecological risk assessment is crucial in future studies. This is the first comprehensive study on TAs in the urban waters of a coastal metropolis.

Keywords: tire additives, transformation products, urban water system

Pharmaceutical and personal care products in representative aquatic environments of the Philippines

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Abstract

The coastal Philippines is susceptible to pharmaceutical and personal care products (PPCP) as wastewater treatment is still developing with less than 20% of septage safely treated and disposed of, 5% of the total wastewater treated. PPCP contamination was evaluated in representative coastal tourist areas, mixed-use watersheds, a pristine atoll, and hospital wastewaters can provide a broader view of the state of PPCP levels in the country's coastal waters. Target analyses of thirty-four PPCPs from these key aquatic environments revealed distributions primarily due to population density and land-use, then influenced by seasonality and physicochemical factors. Ubiquitous to all the sites was caffeine, reaching 1848.57 ppb. In lesser concentration and distribution is acetaminophen detected at concentrations up to 289.17 ppb in freshwater samples, and at concentrations of up to 253.39 ppb in seawater samples. In two watershed continuums (Davao Gulf, Davao City; Macajalar Bay, Cagayan de Oro City), land-use was a critical factor in the concentrations of PPCPs: population density in urban centers and the lack of wastewater treatment facilities enhanced the concentrations. Light rainfall, high frequency of streams, and steep slopes contributed in diluting the concentrations downstream. Close to the river mouth, the surface concentrations were higher compared to bottom water concentrations due to the stratification of the water column with untreated wastewaters associated with the buoyant freshwaters. In the two tourism areas, Boracay Island, Aklan and Mabini, Batangas, the carbonate bedrock does not enhance stream formation such that runoff from land mostly passes through drainages. With the lack of waterways connecting inland waters to the coastal waters, PPCP concentrations from inland point sources, such as drains or wetlands, tend to accumulate and have higher PPCP concentrations compared to the coastal sites. There are exceptions, however, where wastewater pipes from establishments extend and drain offshore. Carbonate bedrock with porous sediments and structures like joints, fractures, and faults also enhances conduits of groundwater to the sea as submarine groundwater discharge and is a potential mechanism of transport. In the pristine atoll (Tubbataha Reefs, Palawan), the area is susceptible to ship-based PPCPs. The presence of pharmaceutical residues and antibiotics in these areas and the potential impact on the environment indicate the need for stricter wastewater management measures, particularly in communities located near water bodies.

Keywords: pharmaceuticals, PPCPs, marine pollution, emerging contaminants

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Spatial and temporal trends of organotins contamination in the marine environment of Hong Kong

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Abstract

Organotin compounds (OTs), such as tributyltin (TBT) and triphenyltin (TPT), have been widely utilized as antifouling paints and biocides. These compounds have the potential to cause morphological abnormalities in marine organisms at low concentrations (ng/L). Since the 1960s, they have been extensively incorporated as active ingredients in antifouling paints on ship hulls, as well as biocides in agricultural and textile industries. Consequently, contamination of coastal marine environments with OTs has become a common and widespread issue. The Marine Environment Protection Committee of the United Nations' International Maritime Organization adopted a global prohibition on the use of OT-based biocides on sea-going vessels in 2008. Hong Kong, a densely populated coastal city and the 7th busiest container port globally, has faced significant contamination of organotin compounds (OTs) in its marine environment. OTs have historically entered the marine ecosystem through shipping activities, surface runoff, and discharge from the Pearl River. However, recognizing the ecological risks posed by OTs, Hong Kong implemented legislation to ban their use on ships, effective from January 1, 2017. This proactive measure aimed to mitigate the further introduction of OTs into the marine environment and protect the coastal ecosystem. This study, hence, aims to assess the effectiveness of the policy intervention in reducing organotin (OT) contamination in the marine environment of Hong Kong. Samples of seawater, sediment, and the rock shell *Reishia clavigera* were collected from various locations in Hong Kong between 2022 and 2023. The concentrations of six OT compounds in these samples were quantified. The results clearly indicated that there was a decreasing trend of OTs contamination when compared with the data obtained in 2014–2015, indicating the positive effect of the local legislation. TPT was found to be the most prevalent OT compound across the rock shell tissue, seawater, and sediment samples, which was consistent with the previous trends. The highest tissue concentration of total OTs (936.3 ng/g d.w.) was detected in *R. clavigera* from Waterfall Bay, while those collected from Po Toi Island exhibited the lowest tissue concentration (1.6 ng/g d.w.). However, concentrations of OTs remained high in seawater and sediment in areas with busy marine traffic such as Sai Kung and Aberdeen. These findings highlight the effectiveness of the policy intervention in reducing OT contamination, while also identifying areas that require further attention for mitigation measures.

Keywords: organotin compounds, pollution, coastal environment, policy intervention

POPs in Pacific Salmon from the Russian part of the Northwest Pacific (Russian Far East)

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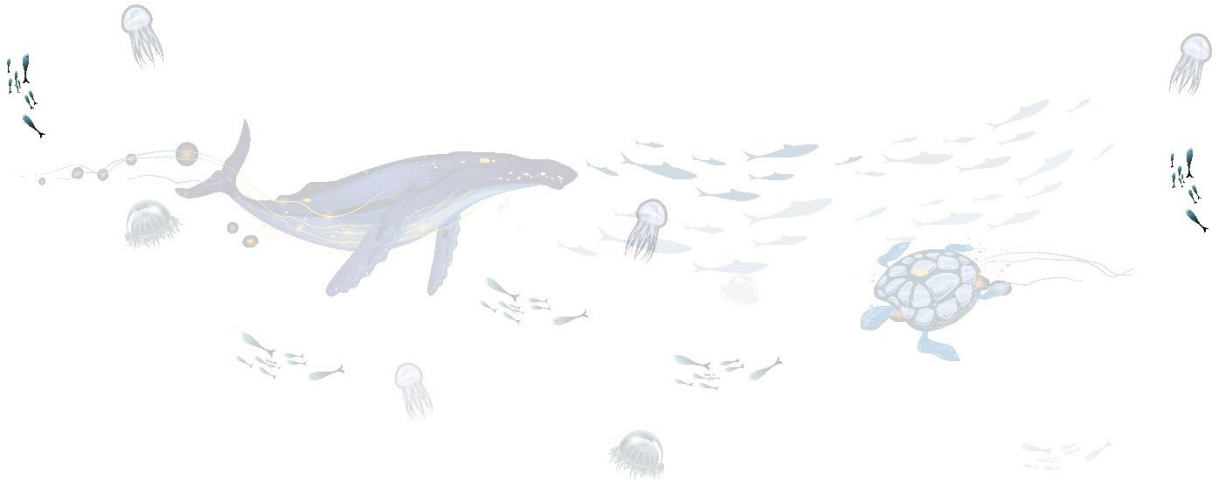
Abstract

In our study, we selected the following species to be analyzed for persistent organic pollutants (POPs) content: pink (*Oncorhynchus gorbuscha*), chum (*O. keta*), masu (*O. masou*), Chinook (*O. tshawytscha*), and sockeye salmon (*O. nerka*). Fish samples were taken from various regions of northwest Pacific. Muscles, liver, male gonads, and eggs were analyzed. Concentrations of organochlorine pesticides (OCPs) (isomers of HCH (α-, β-, γ-HCH), DDT, and its metabolites (DDD, DDE)) and polychlorinated biphenyls (PCBs) (28, 52, 155, 101, 118, 143, 153, 138, 180, 207 PCB) in samples were measured by gas chromatography–mass spectrometry (GC–MS) and additionally by gas chromatography with electron capture detector (GC–ECD) for validation. The distribution of POPs in lipids of fish organs in almost all samples was in the following order: Muscles<Liver<Eggs<Male gonads. In reproductive products, the ratio “more lipids–more POPs” was not observed due to the lower fat content of the male gonads compared to eggs. A data comparison between pollutant contents in the organs of salmon from the Far Eastern seas and other parts of the world’s oceans shown that HCH in Far Eastern fish prevailed over DDT, while the ratio is inverse in almost all other regions. DDT was barely used on the northern coast of the Russian Far East, but lindane (γ-HCH) or a technical mixture of HCHs (dominated by α-HCH), that are more volatile than DDT, were actively applied and are now commonly detected in northern and temperate latitudes. A comparison of PCB levels in salmon from the Far Eastern seas and other regions of the world’s oceans has clearly shown lower concentrations of these pollutants in almost all samples from the Russian Far East. While feeding in the ocean and, especially, before spawning migration, salmon accumulate lipid reserves both to meet energy expenditure and to provide gonadal development during the migration. Along with lipids, various lipophilic POPs, including OCPs and PCBs, coming from the marine environment also congregate in fish body. Thus, migrating fish can act as a vector that provides biotransport of organic pollutants from subtropical and southern boreal ecosystems to boreal and subarctic ones. Likewise, we assessed the biotransport of POPs by Pacific salmon on the northwestern coast of the Pacific Ocean. This work was supported by the Russian Science Foundation (agreement no. 23-74-10032).

Keywords: POPs, OCPs, PCBs, Pacific Salmon, Northwest Pacific

Sub-theme C:
Ocean and Human Health

Session C2:
Source, transport, fate, impacts and mitigation strategies of marine plastics and microplastics



Programme

Venue: Mayfair B, 11th Floor
Dates: 22–23 April 2024

Conveners:

Daoji Li	East China Normal University, China
Phaothep Cherdsukjai	Department of Marine and Coastal Resources, Thailand
Ho Van The	VAST, Institute of Oceanography, Vietnam
Agung Dhamar Syakti	Raja Ali Haji Maritime University, Indonesia
Lixin Zhu	East China Normal University, China

Time	Presentation Titles	Speakers
22 April 2024		
Section 1		
10:30–10:45	Marine litter in Asia and Pacific: plastics as masters of the aquatic benthic environment	Pierpaolo Consoli, *Stazione Zoologica Anton Dohrn, Italy*
10:45–11:00	Microplastics in estuarine mysid shrimp	Jitrapat Hattaya, *East China Normal University, China*
11:00–11:15	Macroplastics flux and accumulation in a mangrove environment	Maria Kristina O. Paler, *University of San Carlos, The Philippines*
11:15–11:30	Exploring microplastic pollution in the Northwestern Pacific fishing grounds: environmental impacts and mitigation strategies	Yinan He, *East China Normal University, China*
11:30–11:45	Microplastics in sandy beaches in Khanh Hoa province, Vietnam	Le Hung Phu, *VAST, Vietnam*
11:45–12:00	Vertical distribution of microplastic along the main gate of Indonesian Throughflow pathways	Corry Yanti Manullang, *BRIN, Indonesia*
12:00–12:15	Microplastic pollution in the biota of the North Pacific region	Chengjun Sun, *First Institute of Oceanography, China*
12:15:12:30	Small microplastics detected in the intermediate layer in the North Pacific Ocean -field surveys and possible pathways-	Mao Kuroda, *Kyushu University, Japan*
Section 2		
13:30–13:45	Understanding microplastic pollution in the ‘cleanest’ river in Luzon, Philippines using optimized image-based and machine-learning methods	Kim John Balboa, *University of the Philippines Diliman, The Philippines*
13:45–14:00	Autonomous microplastic detection system modified from a coffee extraction machine in conjunction with hyperspectral imaging and AI	Ryota Nakajima, *JAMSTEC, Japan*

Time	Presentation Titles	Speakers
14:00–14:15	Applications of hyperspectral imaging with unsupervised machine learning for plastic detection in aquatic environments	Alwi Nurmadi Widyananda, *Swinburne University of Technology, Malaysia*
14:15–14:30	The first volunteer monitoring project to reveal distributions of microplastics larger than 1μm in global oceans by a Japanese giant ship company	Yutaka Kameda, *Chiba Institute of Technology, Japan*
14:30–14:45	Accumulation of plastic debris and plastic-biodegradation potential of sediment microbes in select coastal environments in western Philippines	Norchel Corcia F. Gomez, *University of the Philippines Diliman, The Philippines*
14:45–15:00	Seasonal variation and transport of microplastics from the Soan River into the Indus River	Khalida Jabeen, *East China Normal University, China*
Section 3		
15:30–15:45	Ocean Hitchhiker Project: plastic debris as emerging vector for transport of harmful microorganisms in Southeast Asia	Victor S. Kuwahara, *Soka University, Japan*
15:45–16:00	Source and movement of marine debris particles tracking in the Nusa Penida marine protected area, using a 3D numeric model	Ivonne Radjawane, *Bandung Institute of Technology, Indonesia*
16:00–16:15	The simulated fate and seasonal distribution of floating debris from Thailand's major river mouths	Kittipong Phattananuruch, *Kasetsart University, Thailand*
16:15–16:30	Spatial modelling to predict accumulation of floating marine debris in coastal zone – a case study in northeast coast of the USA	Phuc TD. Le, *University of Tasmania, Australia*
16:30–16:45	2D hydrodynamical model of marine microplastic transport and accumulation in mangrove environments in Sarawak, Malaysia	Christabel Sim, *Swinburne University of Technology, Sarawak Campus, Malaysia*
16:45–17:00	Influence of monsoon seasonality and tidal cycle on microplastics presence and distribution in the upper Gulf of Thailand	Haruka Nakano, *Kyushu University, Japan*
23 April 2024		
Section 4		
13:00–13:15	Microplastics in seawater and zooplankton from estuarine fronts of Kuala Terengganu, Malaysia during Southwest monsoon	Roswati Md Amin, *Universiti Malaysia Terengganu, Malaysia*
13:15–13:30	Neurotoxicity of microplastics exposure with changed neuronal activity, activated microglia,	Lei Li, *Chinese Academy of Sciences, China*

Time	Presentation Titles	Speakers
	disturbed brain metabolism and abnormal behavioral outputs	
13:30–13:45	Genomic analysis of bacteria isolated from marine sediments in Manila Bay reveals genes potentially involved in plastics (LDPE) degradation	Juri Nazareth M. Ochotorena, *University of the Philippines Diliman, The Philippines*
13:45–14:00	Effect of environmental conditions on the carbonyl index using specific area under the band (SAUB) method during degradation of commercially-available plastics	Francis Dave C. Siacor, *University of San Carlos, The Philippines*
14:00–14:15	Removal of polyethylene and polypropylene from water by using rice husk ash	Waritta Bongchompho, *King Mongkut's University of Technology Thonburi, Thailand*
14:15–14:30	How much should we reduce plastic waste emission to achieve the Osaka Blue Ocean Vision? – global predictions of marine plastic litter abundance	Chisa Higuchi, *Kyushu University, Japan*
14:30–14:45	Current marine microplastic research and monitoring program in Thailand	Phaothep Cherdsukjai, *Department of Marine and Coastal Resources, Thailand*
14:45–15:00	Trends, gaps, and future directions to support evidence-based action on marine plastic pollution in the Philippines	Ronan Q. Baculi, *University of the Philippines Diliman, The Philippines*
Section 5		
15:30–15:45	PlastiCount Pilipinas: bridging gaps in understanding and addressing marine plastics pollution in the Philippines through open data	Ricardo C. Alindayu II, *University of the Philippines Diliman, The Philippines*
15:45–16:00	Whole chain control of plastic pollution in the Pearl River Estuary, China	Zhao Xiao, *South China Institute of Environmental Sciences, China*
16:00–16:15	Empowering a city: a model case for plastic circularity in the Philippines	Jeanie T. *Orate, University of San Carlos, The Philippines*
16:15–16:30	Catalyzing global solutions: the AOMI initiative in unifying data against marine plastic pollution	María Belén Alfonso, *Kyushu University, Japan*
16:30–17:00	**Discussion**	

Session C2: Source, transport, fate, impacts and mitigation strategies of marine plastics and microplastics

Marine litter in Asia and Pacific: plastics as masters of the aquatic benthic environment

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Abstract

In the last decade, the exponential increase of marine debris in the world's oceans has been followed by an ever-greater interest in this matter by marine scientists and governing agencies. As a consequence of this, there are increasingly more studies being carried out on the abundance, composition, sources, and effects of trash on marine ecosystems worldwide, delivering information that is crucial for guiding policies to tackle the issue. Despite this, most of the studies are focused on stranded litter, while fewer studies investigate seafloor litter and most of them take place in European countries. Marine litter monitoring, usually conducted by specialized agencies, scientists and consultants are expensive and cannot be performed on a large spatial scale. At this aim, Citizen Science initiatives aiming at collecting debris can deliver useful data for filling gaps in the distribution and accumulation of litter over large geographical areas, otherwise excluded by scientific investigation due to resource constraints related to time, staff, funds, etc. In this contest, Dive Against Debris®, a worldwide citizen-science program carried out by PADI Aware Foundation can provide valuable information about underwater benthic debris at large scale. From 2006 to 2021, a total of 4,272 survey dives (more than 900 in Thailand) were conducted in ASIA AND PACIFIC, collecting data on quantity, typology and distribution of benthic litter. Overall in the region, plastics represented 69% (73% in Thailand) of the total abundance, followed by metal at 14% and glass/ceramic at 7%. Single Use Plastics constituted 37%. The top ten marine litter items identified in the dataset contributed to 61% of the total litter abundance, with plastic fragments as the most abundant items (12%), followed plastic food wrappers (11%) and fishing lines (8%). Overall, lost fishing gears items accounted for 17% of the total litter. This study provides useful information for directing environmental policies towards precise actions to be taken against the most polluting human-made items in the region.

Keywords: marine litter, pollution, citizen science, plastics, debris

Session C2: Source, transport, fate, impacts and mitigation strategies of marine plastics and microplastics

Microplastics in estuarine mysid shrimp

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Abstract

Although microplastics have been identified in zooplankton, uncertainties persist regarding their dynamics within biota. This study focuses on a commercial mysid shrimp, *Mesopodopsis orientalis* (W. Tattersall, 1908) from the Inner Gulf of Thailand in February 2022. We examined microplastics in mysid bodies and fecal pellets, considering attachments to external body parts and ingestion. In addition, microplastic feeding experiments were conducted with different treatments, including pure seawater with microplastics, with or without two different microalgae species. These experiments highlighted the prevalence of microplastics in estuarine mysid shrimp, providing insights into their interaction with these organisms. Our findings reveal an average of 0.10 microplastic items per individual within the mysid's body cavity, escalating to 0.19 when accounting for items adhered to external body parts and appendages. These microplastics in mysids closely resemble those in seawater, with blue polyethylene terephthalate (PET) microfibers being prominent, indicating a direct impact of seawater microplastics on mysids. Observations indicate active microplastic ingestion by mysids, with microalgae, particularly the diatom *Navicula* sp., identified as active contributors. This illustrates the dynamic fate of microplastics, emphasizing the role of microalgae in influencing mysid behavior towards these particles. Furthermore, the study emphasizes the potential for passive adherence, facilitated by the accumulation of free-floating microplastic items in the water column, indicating extremely heavy pollution with concentrations averaging 5,633 items per cubic meter. This passive exposure potentially expands our understanding of how mysids interact with microplastics in their ecosystem. In summary, our research not only addresses the prevalence of microplastics in estuarine mysid shrimp but also reveals the dynamics of active ingestion influenced by microalgae and passive

adherence facilitated by the high accumulation of microplastics in the water column. These findings significantly contribute to a broader understanding of the impact of microplastics on aquatic ecosystems.

Keywords: microplastics, mysid shrimps, seawater, ingestion, adherence

Session C2: Source, transport, fate, impacts and mitigation strategies of marine plastics and microplastics

Macroplastics flux and accumulation in a mangrove environment

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Abstract

Plastic studies report excessively high plastic loads observed in the mangrove ecosystem. Many of these one-time sampling studies highlight that mangroves can effectively retain and accumulate plastic debris due to its complex and unique forest structure; although, it is known that the use of one-time data may not conclusively establish steady-state plastic accumulation. Indeed, long-term assessment and monitoring is necessary to further understand plastic fluxes and accumulation in the mangrove ecosystem. Hence, this study aims to assess the average plastic retention in mangrove areas across nine selected sites around Cebu Island, Philippines. In each site, two 10x10 plots were established landward and another two seaward. One served as the control while the other as the experimental plot. For a period of more than a year, a total of four samplings were conducted in which surface plastics were collected and counted in the experimental plot while plastics were not removed in the control plot until the last sampling period. Results show no significant difference observed in the control vs experimental plot where the latter had a mean plastics loading value of 0.89±1.36 pieces m^{-2} whereas the former had 0.92 ± 1.67 pieces m^{-2}. Furthermore, the mean plastics accumulation values for all sites per sampling period are 0.1222±0.3207, 0.1136±0.2441, 0.0476±0.0727 pieces m^{-2} $week^{-1}$ with no significant difference across sampling period despite the declining trend in the last sampling period ($p>0.05$). Furthermore, of the 18 plots repeatedly surveyed, the landward sides of two specific sites, namely: Balamban and Barili had significantly higher accumulation rates ($p < 0.05$), which is most likely attributed to higher plastic flux towards the mangrove since it is near a river where land input is known to be high. These findings indicate that while mangrove may trap plastic debris, plastics will still be eventually transported out of the mangrove forest. Some sites however have a higher flux and higher retention capacity than others, yet this indicates that mangroves ecosystems are temporary plastic sinks. This suggests that inconsistent and infrequent mangrove clean-up activities may remove only a miniscule of plastics while a larger proportion may end up into the sea. Also continued input of plastic into the

mangrove may pose a risk into this crucial ecosystem and may lead to a disequilibrium of the services it provides. Essentially, this calls on the need to stem the tide of plastics into this system.

Keywords: plastic sinks, plastic accumulation patterns, mangrove ecosystem

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Exploring microplastic pollution in the Northwestern Pacific fishing grounds: environmental impacts and mitigation strategies

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Abstract

The Northwestern Pacific is considered a hotspot for ocean plastic pollution, however, the contamination status of microplastics in this region, crucial for human food security and highly impacted by human activities, remains undisclosed. In light of this, an investigation of floating microplastics using a manta trawl was conducted in the Northwestern Pacific Fishing Grounds (NPFG) between 148°E and 162°E from June to July 2022. Characterization of extracted microplastic particles was carried out using optical microscopy, micro-Fourier transform infrared spectroscopy, and scanning electron microscopy. Results revealed heterogeneity in the abundance, shapes, colors, and sizes of microplastics. Furthermore, this study deeply explored the sources and transportation mechanisms of microplastics in NPFG. Our research provides empirical data support for the potential ecological risks posed by microplastics in NPFG, revealing the diversity and extent of microplastic pollution in this area. These findings offer new scientific insights for formulating strategies to mitigate plastic pollution.

Keywords: microplastic, Northwestern Pacific, fishing grounds, Kuroshio extension, mitigation strategies

Microplastics in sandy beaches in Khanh Hoa province, Vietnam

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Abstract

Microplastics (MPs) are small plastic debris (<5 mm) that pose negative impacts on marine ecosystems. Plastic litter on beaches is degraded to smaller fragmentation by weathering. For this reason, sandy beaches might act as a source of microplastic pollution. On the other hand, a sandy beach is considered a filtering system. Microplastics with low density might be easily moved and captured into the beaches. Hence, concentrations of microplastics in the beaches might reflect a degree of plastic pollution in adjacent areas. Therefore, the occurrence of MPs on sandy beaches has become an important concern for scientists worldwide. In this study, the microplastic pollution on the sandy beaches was evaluated at 06 locations along the coast of Khanh Hoa province, Vietnam. Sandy samples were collected at the transect (100 m) in the middle of intertidal areas. Samples were taken from the top layer about 5 cm of core and the deeper layer from 5–10 cm. The results showed that fiber was the most abundant microplastics in the samples, comprising from 73% to 90% of the total microplastics. Fragment and film were reported with lower percentages, ranging from 10% to 27%, and from 1% to 2%, respectively. In addition, the effect of grain sizes on microplastic abundance in two sediment layers was also observed. At Doc Let and Cam Lam, sediments were mainly of fine grain sizes, and microplastic concentrations were decreased as the sampling depth increased. Otherwise, at Nha Trang beaches, sediment sizes ranged from medium to coarse sizes, and the difference in microplastic levels in the two layers was not significant.

Keywords: microplastics, sandy beaches, grain sizes, Khanh Hoa, Vietnam

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Vertical distribution of microplastic along the main gate of Indonesian Throughflow pathways

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Abstract

Even though Pacific–Indian Ocean exchange [Indonesian throughflow (ITF)] has been measured for the last three decades, very limited data of microplastic in the region. This study was the initial investigation of the vertical distribution of microplastic in the deep-sea areas across the ITF Pathway. Niskin water samples were utilized to obtain the samples from a water column in a range of 5 to 2450 meters. A total of 924 microplastic particles with an average abundance of 1.062±0.646. n/L were found in the water column. Our findings indicate that water temperature and water density are the most significant factors correlated to the microplastic concentration. This study will be the first report discussing the distribution of microplastics in the deep-sea water column that could be highly significant in determining the fate and transport of microplastic within Indonesian waters that exits into the Indian Ocean.

Keywords: vertical distribution, microplastic, Indonesian Throughflow, Makassar Strait, Lombok Strait, Alas Strait

Microplastic pollution in the biota of the North Pacific region

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Abstract

Marine microplastics are ubiquitous in the global oceans. The North Pacific region has been most actively monitored for microplastics and show comparatively high levels of microplastic pollution in a global context. Research results show that roughly half of all fish and seabird specimens and more than three-quarters of sea turtles and bivalve specimens examined in this region contain plastic. As the Pacific Ocean is constantly receiving plastic waste and microplastic from the land, secondary microplastic coming from the fragmentation of large plastic debris would be a potential large source of microplastic in the area. Therefore, a long-running program for monitoring microplastic in the Pacific region is necessary. This talk will focus on the microplastic pollution characteristic in the biota of the North Pacific region and propose a series of guidelines with regard to standardizing microplastic and marine debris monitoring. Related work will serve the Global Plastic Ingestion Bioindicators project under UN Ocean Decade and support the sustainable development goals of the UN.

Keywords: microplastic, biota, North Pacific, bioindicator

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Small microplastics detected in the intermediate layer in the North Pacific Ocean - field surveys and possible pathways -

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Abstract

Approximately 70% of ocean-bound plastics having an untraceable fate (Isobe & Iwasaki, 2022, Sci. Total Environ.) involves a significant portion presumed as microplastics (MPs: <5 mm) from the ocean surface to the deep-sea floor. However, in general, field surveys overlooked MPs below 300 μm (S-MPs), unmonitorable in the current observation frameworks. To effectively reduce marine plastic pollution, focusing on these less buoyant S-MPs potentially penetrating in the subsurface layers is crucial. Previous studies are uncovering a significant concentration of S-MPs around 200-300 meters deep (e,g, Choy et al., 2019, Sci. Rep.), possibly influenced by water mass structures during sinking (Liu et al., 2020, Water Res.). However, a lack of offshore vertical distribution surveys remains the relationship between water mass structures and S-MPs' vertical distribution unclear. Thus, this study which established onboard S-MPs sampling methods investigated the vertical distribution of S-MPs to examine the influence of water mass structures.

In this study, CTD observations with seawater sampling using a Rosette Sampler were conducted at seven stations in the western North Pacific Ocean from the surface to 1000-m depth. S-MPs present in the sampled seawater were extracted. To avoid contamination, the sampled seawater was processed in a clean booth installed on the ship. Subsequent analysis in the laboratory included measurements of quantity, size, and polymer types of the obtained S-MPs.

The results of this study revealed a peak in the size distribution of S-MPs collected at each sampling point, ranging from 20 to 60 μm, throughout the water column. At three locations around 201–30 degrees N, a subsurface maximum in S-MP concentration was observed within the 231–25 sigma-theta layer, referred to as North Pacific Tropical Water (TW). In addition, secondary concentration maximum was found just below the North Pacific Intermediate Water (NPIW; 26.61–27 sigma theta). These results suggest the s-MPs were subducted along with TW and NPIW from their formation seas and were thereafter transported within the isopycnal layers over long distances in the North Pacific. This study underscores the relationship between MP and water mass structures, providing insights into the previously undisclosed global distribution and behavior of subsurface ocean plastics. It represents a significant step towards unraveling the fate of missing plastics.

Keywords: microplastics, marine pollution, North Pacific Intermediate Water, North Pacific Tropical Water, missing plastic

Understanding microplastic pollution in the 'cleanest' river in Luzon, Philippines using optimized image-based and machine-learning methods

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Abstract

The Southeast Asian region has been included among the top countries polluting the marine environment. However, pathways and sources, such as the role of riverine environments in the transport of microplastics (<5 mm) have been relatively little studied. One challenge is the wide variation in extraction methods due to differences in local environmental conditions and resource availability, resulting in difficulty in comparing and integrating baselining results. In this study, we optimized the extraction method by incorporating best practices from existing protocols (MicroSEAP consortium and NOAA). Recovery efficiency was evaluated by comparing it with prepared spiked samples. The hybrid method had higher recovery than the NOAA method, especially those of the plastic types that are heavier than the density of the separating solution (1.2 g/mL) and also those microplastics smaller than 0.3 mm. Environmental samples collected from Balingasay River, tagged as the 'cleanest' river in Luzon, were then processed using the optimized protocols. Initial results showed that there is a high concentration of microplastics from the upstream and gradually decreases up to the river mouth. In addition, the highest plastic-type based on morphology observed in all sites was plastic fibers while the lowest observed was pellet/bead type across all sites. Factors that may be potentially contributing to the observed patterns will then be discussed.

Keywords: microplastics, isolation, quantification, optimization

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Autonomous microplastic detection system modified from a coffee extraction machine in conjunction with hyperspectral imaging and AI

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Abstract

We report the development of an autonomous analysis system that combines an automatic coffee filtration extraction mechanism with a short wave infrared (SWIR) hyperspectral camera to continuously measure microplastics (MPs) in seawater collected by ships. The developed system consists of a filtration system, which filters and photographs MPs, and an analysis system, which analyzes the photographed MPs. During the filtration and photographing of particles, a series of processes are automatically performed: (1) Seawater is supplied to the system from a seawater tap to concentrate particles of >100 μm for a certain period of time, (2) Seawater containing particles of >100 μm is filtered through a rolled paper filter with a mesh size of ca. 100 μm using an automatic coffee extraction mechanism and then washed and desalted with fresh water, (3) Water is removed from the filter by suction dehydration, (4) Acquisition of images and their associated short-wavelength infrared 2D spectrum (900–2500 nm) by a hyperspectral camera, and (5) Sample archiving by filter winding. For the detection and polymer type identification of MPs particles, the processes are: (6) Particle recognition by AI (semantic segmentation), spectrum extraction and polymer type identification of each particle, and (7) Output of size and polymer type of each particle. Basically, the system enables continuous monitoring of MPs (>100 μm) by periodically changing paper filters.

Keywords: hyperspectral imaging, microplastics, autonomous analysis

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Applications of hyperspectral imaging with unsupervised machine learning for plastic detection in aquatic environments

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Abstract

Remote sensing has shown potential in detecting floating plastic targets with the advantage of periodic observations and extensive area coverage. Plastic accumulation has been reported in global regions, however, there is insufficient knowledge on faster methods of detecting floating plastics through hyperspectral imaging systems. This work aims to develop an algorithm based on hyperspectral imaging using the Analytical Spectral Devices (ASD) Fieldspec® HandHeld 2 spectroradiometer, in conjunction with the HydraSpectra (HS) sensor from the Commonwealth Scientific and Industrial Research Organization (CISRO). Data from the HS was analyzed through Aquawatch Data Integration and Analytical Services (ADIAS). Both sensors acquired spectral data in the range of 325 to 1075 nm for further use with unsupervised machine learning. Supplementary data was collected through satellite imagery from Sentinel-2 with the Sarawak region as the Region of Interest (ROI). Spectral data of the water surface from the Sibu River were collected by the ASD spectroradiometer and the data was compared with data collected from a fixed HS sensor. The main study site was at a jetty at Telaga Air, Kuching, Sarawak, Malaysia. Further spectral samples were taken of water surfaces from three water bodies, including a river near a tourist area, a small lake and a swimming pool. Plastic detection was based on spectral readings of a floating plastic bottle at the three study sites. Additional reflectance readings were taken of different water samples and different plastic samples in laboratory conditions. Graphical results show different reflectance peaks depending on the turbidity of the water as well as sky conditions, indicating several factors that impact spectral data collection. Moreover, the ASD spectroradiometer was able to discern the plastic bottle on all water surfaces.

Keywords: plastic, hyperspectral, spectroradiometer, HydraSpectra, Sentinel-2

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The first volunteer monitoring project to reveal distributions of microplastics larger than 1μm in global oceans by a Japanese giant ship company

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Abstract

Microplastics (MPs) are recognized as one of the pollutants with numerous environmental impacts. There are lots of studies of MPs in specific areas of the ocean with different methods and different polymers and sizes. This is the first study of distribution of MPs larger than 1μm in global oceans with a harmonized method. We are investigating the numbers, sizes and polymer types of MPs greater than 20 μm in the global oceans starting from March 2020 and now started monitoring of MPs larger than 1 μm from 2023. Sampling of MPs in the ocean was carried out by 14 volunteer ships with the cooperation of a Japanese shipping company. Two hundred samples had been collected by November 2022. Approximately 1 m^3 of sea water samples at depths of 3 to 14 meters were obtained from the hydrant of the ships. Particulate matters were collected by plankton nets (10 μm mesh) on site. The filtered samples were pretreated by H_2O_2 oxidative digestion and NaI density separation. The MPs polymers were characterized by a spectrum imaging method using micro-Fourier transform infrared spectroscopy. The MPs smaller than 20 μm were measured by a spectrum imaging method using Raman microscope.

The observed concentrations of MPs larger than 20 μm ranged from 22 to 4,660 pieces m^{-3} in the ocean. Their geometric mean value was 260 pieces m^{-3}. Remarkably high concentrations exceeding 1,000 pieces m^{-3} were found at Kuroshio Current, California Current, Kamchatka current and North Atlantic Gyre. These results indicated that distribution of MPs was heterogeneous in the oceans. The median diameter of the MPs size distribution was approximately 60 μm. The dominant polymer is polyethylene (PE), polypropylene (PP), polyethylene terephthalate (PET) and polymethyl methacrylate (PMMA). PET was the most dominant fibrous polymer. Interestingly, PMMA was detected predominantly in the Pacific Ocean. There were some PMMA hotspots in Kuroshio Current. Polymer types and shapes may be influenced by land-based input, ocean currents and wave-driven. The PMMA contamination might be unique to Asia.

This project will continue several years later and can provide data on MPs abundance to further the understanding of MPs pollution in the ocean, especially Asian sea. This data will also be used to develop numerical models to predict MPs in the global ocean. I hope many collaborators in Asian countries will join the monitoring program and share these valuable data.

Keywords: microplastics, volunteer ships, fine microplastics, global ocean, monitoring program

Accumulation of plastic debris and plastic-biodegradation potential of sediment microbes in select coastal environments in western Philippines

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Abstract

The Philippines has been consistently suggested to be among the top ten global contributors to mismanaged plastic wastes, which are mostly ending up in the oceans. Their presence and eventual accumulation in the different coastal environments pose threats to both organisms and habitats. Baseline studies on the distribution and composition of marine plastics in the environment, is a crucial step in understanding how to navigate the problem. To understand the potential drivers contributing to plastics pollution in the Philippines, 56 sites in the western coasts with varying demography and economic activities were surveyed. Results showed that plastics were present in all locations but varied in composition. Specifically, Manila Bay had the highest concentration of single-use plastics (SUPs) while Palawan coasts were dominated by fishing-related materials. Among the plastic types, SUPs were identified as "high exposure" due to their high abundance and occurrence across sites. Areas with high plastic accumulation were suggested to also have enrichment of microorganisms with biodegradation potential, such as Manila Bay. Thus, biodegradation potential of sediment microbes from Manila Bay were also investigated using in vitro bioassays coupled with 16S rRNA gene sequencing. Here, enrichment of microbial groups associated with hydrocarbon degradation were observed on the surface of the plastics. The appearance of carbonyl and vinyl products on the plastic surface indicated structural surface modifications attributed to polymer degradation. Several bacterial taxa, including those associated with the degradation of hydrocarbons, correlated with biodegradation indices, suggesting their active role in plastic degradation. The presence of other taxa possibly consuming by-products or providing nourishment, indicates synergy in utilizing the plastic as the

main carbon source and creating a microenvironment within the plastics biofilm. Our findings suggest that sediment microbes from Manila Bay harbor naturally occurring microbial groups that may have the potential to partially degrade plastics. This work is the first comprehensive assessment of plastic pollution in the Philippines and provides insights for more effective management and policy-making.

Keywords: plastics accumulation, macroplastics, archipelago, plastics biodegradation, sediment microbes

Seasonal variation and transport of microplastics from the Soan River into the Indus River

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Abstract

Plastic pollution in freshwater systems receives extensive concerns for its accumulative trend and potential ecological impacts. This is the first annual case study that investigated the monthly profile of plastic pollution in the mouth of the Soan River. Plastic pollutants comprising microplastic content up to 91.7%, ranging from 132.7 items/m^3 to 641.3 items/m^3 were abundantly found during different seasons around the year. The average abundance of plastics was significantly higher in the summer (August, 641.3±23.7 items/m^3) than those in the spring. Overall, fiber, large microplastics (L-MPs), and transparent items were dominant by shape (57.7%), size (61.9%), and color (24.6%), respectively. Variations in the abundance and morphotypes were seemingly not only influenced by the seasonal change but also might be due to hydrological characteristics of the river, especially riverbed morphology and flow of the water. μ-FTIR (micro-Fourier Transformed Infrared Spectroscope) analysis revealed that polyethylene terephthalate was an abundantly found polymer that largely prevailed in the form of fibers. Being an urban river, the polymeric profile demonstrated that anthropogenic activities had a significant impact on polluting the river. These findings are a very important source to understand the profile of plastic pollution in the Soan River and also a significant reference for policy-making in controlling plastic pollution among the riverine networks. In addition, more research must be done to document the plastic pollution in the biota of the Soan River and determine the potential risk that may cause the biological impairment of the river ecosystem. It is strongly recommended that future investigations be not only conducted on plastic monitoring in the riverine networks but also on the transport of riverine plastic load into the marine environment and evaluate their potential impacts.

Keywords: Microplastics, Surface water, Abundance, Fibers, Polymers

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Ocean Hitchhiker Project: plastic debris as emerging vector for transport of harmful microorganisms in Southeast Asia

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Abstract

The Asia Pacific region is responsible for nearly eighty percent of the plastic debris that flows into the world's oceans, with Southeast Asian countries shouldering a disproportionate amount of this pollution that accumulates predominantly within the littoral zone. Harmful and beneficial microorganism biofilms attach to all plastic debris, acting as "hitchhiking" vectors for the potential transport of the organisms to other regions where ideal environmental conditions may trigger blooms. The objective of our international collaboration is to spatially and temporally quantify microorganism biofilms on multiple plastic debris types accumulating in the littoral zone using advanced image recognition techniques coupled with genetic sequencing techniques in Southeast Asia. Preliminary results suggest that the type of plastic may influence the hitchhiking microorganism community, while the relationship with environmental factors remains unclear. Moreover, the coupled application of advanced image analysis techniques and machine learning/training shows great potential in accurately identifying and quantifying the distribution of plastic debris along coastlines. We also conducted a series of *in situ* plastic submersion experiments in multiple environments suggesting site-specific biofilm diversity rather than dependability of plastic types. Further, 3-D fluorometric confocal microscopy revealed the unique layering of microorganisms in the early stages of biofilm development. Our study contributes to the poorly understood relationship between harmful microorganism biofilms and plastic debris in the littoral zone of Southeast Asia, offering a new perspective on monitoring plastic debris and insight to the expanding potential of harmful microorganism outbreaks. (237/400)

Keywords: plastic debris, harmful micro-organisms, littoral zone, remote sensing

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Source and movement of marine debris particles tracking in the Nusa Penida marine protected area, using a 3D numeric model

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Abstract

Nusa Penida is a region located in the province of Bali. The area of Nusa Penida is designated as a Marine Protected Area (NP-MPA). One of the challenges faced in the NP-MPA is the presence of marine debris that inhabits and washes up in its waters. This marine debris consists of various forms, including macro and microplastics, with plastic waste being the dominant type found. To address this issue, the present study aims to investigate the distribution of both macroplastics and microplastics simulated in backward and forward mode, focusing on the NP-MPA. The investigation was carried out using the FVCOM. Validation is conducted using several data sets: tide elevations, current velocity components, and particle movements. The comparison results between model data and tide elevation observation show almost similar patterns and elevations, with a correlation coefficient of 0.9 and a coefficient of determination of 0.8. Furthermore, the analysis of errors shows an RMSE value of 0.05 m and an Index Willmott value of 0.96. Based on the validation results of the current components, correlation coefficients of 0.93 and 0.96 are obtained for the u and v components, respectively. Additionally, the determination coefficient values are found to be 0.87 and 0.92, respectively. The RMSE values are 0.21 m/s and 0.07 m/s for the u and v components, while the Index Willmott values are 0.65 and 0.81, respectively. The validation of particle movements shows that the model and observation data produce almost similar patterns. The model data for tide elevations, currents, and particle movements can represent field data. Seasonal wind conditions and surface currents greatly influence the movement of macroplastic particles. Similarly, microplastic particles are also affected by seasonal wind conditions and surface currents. Moreover, microplastic particles are influenced by surface currents and settling velocity, which causes them to sink more easily than microplastic particles, resulting in slightly different movement patterns. The backward analysis of particles reveals that macroplastic particles originate from the provinces of South Kalimantan (22.48%), East Java (1.84%), and Bali (18.21%). Meanwhile, microplastic particles come mainly from the provinces of Central Java (9.86%), East Java (8.46%), and Bali

(1.60%). In the seasonal analysis, the highest particle density is found in the western, northern, and eastern areas of NP-MPA. Additionally, during the seasonal period, particles tend to linger longer in the southwestern to southeastern parts of NP-MPA.

Keywords: FVCOM, NP-MPA, macroplastic, microplastic

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The simulated fate and seasonal distribution of floating debris from Thailand's major river mouths

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Abstract

Floating marine debris, particularly plastic, is a significant global environmental issue, widespread not only in coastal regions but also in remote areas. Its impact on marine life, birds, humans, and economies is well recognized. Rivers act as major pathways for land-based debris to reach the oceans. Notwithstanding an expected increase in plastic debris, our understanding of its fate, distribution, and seasonal accumulation areas remains insufficient for effective environmental assessment and addressing the problem. Numerical models, such as hydrodynamic and particle tracking models, have the capability to simulate the spread (fate and distribution) of floating debris on the ocean surface. The Gulf of Thailand (GoT) is a semi-enclosed sea surrounded by nations identified as major sources of marine debris. This study used a 3D hydrodynamic model and conservative floating particle tracking model to simulate the distribution of floating debris from major rivers within Thailand's boundaries. Floating objects were released every six hours from six river mouths: Tapee River, Mae Klong River, Tha Chin River, Chao Phraya River, Bang Pakong River, and Prasae River. The model's results aligned with observed data on water levels, temperature, salinity, current velocity, and satellite drifter paths. The positions of the simulated objects in April, August, October, and December respectively represented the seasonal distributions during different monsoon periods, including the 1st monsoon transition, southwest monsoon season, 2nd monsoon transition, and northeast monsoon season. Results indicated noticeable seasonal changes in the quantity and sources of floating objects in the GoT, with higher concentrations in the upper GoT compared to areas along the coasts of Cambodia and Vietnam. Object distribution patterns varied more during the monsoon seasons than during the monsoon transitions, as evaluated by changes in the quantity of floating debris in different areas. Around 20% of the total released objects ended up outside the GoT by the end of the simulation, highlighting the export of debris from semi-enclosed seas to adjacent waters.

Keywords: floating debris, simulation, accumulation zone, debris transportation, riverine debris

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Spatial modelling to predict accumulation of floating marine debris in coastal zone – a case study in northeast coast of the USA

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Abstract

Floating marine debris (FMD) has considerable influence on ecologically and biologically important coastal areas via interactions with wildlife, fragile ecosystems and as a transport mechanism for invasive species. Accordingly, identifying FMD accumulation is useful in regard to marine life protection and marine resources management. Frontal zones, (areas water convergence) which are formed by various oceanographical factors are found to drive FMD distribution. We developed a coastal spatial model to predict the probability of FMD accumulation zones, using data from the northeast coast of the USA (North Atlantic). Here, frontal formation is related to various physical processes including tide, current and interaction with seafloor which in turn can play an important role in FMD accumulation. We used a FMD dataset of the Sea Education Association (North Atlantic) collected using surface plankton net tows between 1986 and 2015, and applied sea surface temperature (SST) data from the Moderate Resolution Imaging Spectroradiometer to identify SST fronts over a 20-year period (2002 – 2022). By applying regression modelling, frontal frequency and their associated physical factors was used to predict high concentration zones of FMD in coastal waters of the northeast USA. Models showed that FMD tends to accumulate along the edge of the frontal zones but not at the convergent center. Results can be applied to global categorization of FMD accumulation zones in coastal areas for prioritization of conservation measures to protect against the impacts of FMD.

Keywords: floating debris, MODIS, GIS-modelling, accumulation, hotspots

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2D hydrodynamical model of marine microplastic transport and accumulation in mangrove environments in Sarawak, Malaysia

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Abstract

Plastic is one of the most widespread materials in the world, favoured for its cheap production cost, affordability, durability and light weight properties. However, overproduction of plastic, coupled with its lengthy break down period, has caused plastics to accumulate in and contaminate freshwater systems. These microplastics can mesh into a complex mixture of particles with varying polymer type, particle size, shapes and density. Microplastic transport is affected by these physical characteristics mentioned, as well as hydrodynamics such as laminar and turbulent flow conditions. Marine debris can travel long distances and eventually wash up onto coastal shores and offshore waters. In this study, a model will be made to simulate the transport pathways as well as make a prediction on the hot spots for accumulation of marine microplastics at the Kuching Wetlands National Park (KWNP) in Sarawak, Malaysia. This study area is chosen because the KWNP is an important mangrove ecosystem, classified in the Ramsar Wetlands of International Importance. Monthly sampling will be implemented to collect water samples (~2.5 L per sample) spanning from June 2023 to July 2024, from eight sites along the KWNP watershed, which will be collected in glass bottles via a boat. These samples will be filtered and analyzed monthly via a 3-day process. Potassium hydroxide will be used to digest the organic material on the first day, zinc chloride will be used to separate out the inorganic material from the microplastics via density separation on the second day, followed by Nile Red staining on the third day. MPVAT2 software will then be used to determine microplastic quantity. Fourier-transform infrared spectroscopy (FTIR) will also be used to further identify microplastic shape and type. Bathymetry, atmosphere, river flow and water properties will be collected and input into the hydrodynamic model made using Deltares Open-Source Software. The output data from the model will then be used as the input data for PARCELS, which is the particle tracking model. The particle tracking model will then be able to determine particle trajectory and transport pathways. At this point, four sets of samples have been collected and processed from June 2023 to October 2023. The microplastic count for each set was 67.6±11.97

pieces L-1, 22.8±4 pieces L-1, 34.33±7.87 pieces L-1 and 71.53±19.67 pieces L-1 sampled in the months of June, July, August and October, respectively. Further study will be done to investigate if the high and low tides during sampling have a correlation with the microplastic count.

Keywords: microplastics, particle tracking, hydrodynamic model, mangrove

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Influence of monsoon seasonality and tidal cycle on microplastics presence and distribution in the upper Gulf of Thailand

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Abstract

Southeast Asian countries were nominated among the top ten countries emitting plastic waste into the Ocean. In this study, we conducted neuston net surveys in Si Chang Island of the Gulf of Thailand, a coral reef conservation area, to determine the presence of microplastic (MP) pollution. The survey, conducted during the wet (southwesterly monsoon), transition, and dry seasons (northeasterly monsoon), revealed that the MP abundance was in the range of 0.02–42.46 particles m^{-3}. The precipitation, wind, and current direction induced by monsoons influence the abundance and distribution of MP presenting a significant seasonality. The cluster analysis for colors and polymer types of MPs suggested that the origin of plastic particles is diverse. Based on our results, a proposal for the generation, sources, and pathways for MPs in the Gulf of Thailand is presented: 1) plastic wastes exposed to strong UV light during the dry season get fragmented around the river, and 2) heavy rains wash away the particles during the wet season. This proposal is applicable to tropical regions, including the Gulf of Thailand. Therefore, this paper concluded that ocean currents induced by monsoons and the unique climate accelerate MP presence and distribution in Southeast Asia countries. Furthermore, coral reef ecosystems can be particularly threatened by MPs in these areas. so an increase in MP monitoring on coral ecosystems from Thailand and the world is highly recommended.

Keywords: microplastics, seasonality, Gulf of Thailand, monsoon

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Microplastics in seawater and zooplankton from estuarine fronts of Kuala Terengganu, Malaysia during Southwest monsoon

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Abstract

Estuarine front caters microplastic transport from riverine to ocean through daily tidal regime. Microplastic debris was collected at three main regions of estuary that were plume, front and shelf during May and August 2022 to compare the microplastic concentration throughout the estuary and to understand the transport mechanism of riverine microplastic to the open waters. Microplastic recorded according to three sizes (>350 µm, >200 µm, 20-200 µm) conclude that in May, 2022, estuarine front has high concentrations of microplastic compared to plume and shelf region while for August, 2022, plume recorded higher concentrations of microplastic than adjacent frontal and shelf region. Yet, plume region of the estuary recorded comparably high microplastic concentration in both months explains the transport of riverine microplastic into the ocean through the front formation. The total ingested microplastic found in zooplankton in May, 2022 and August, 2022 was 38 and 34 particles respectively. The ingestion incidence recorded highest in both months at the frontal region during high tide with the record of 0.032 particles ind^{-1} for May, 2022 and for August, 2022 was 0.009 particles ind^{-1}. Fragments was commonly ingested by the zooplanktons and mostly ingestion incidence was recorded from copepod group. The concentration of ingested microplastic varied from 0.002 to 0.032 particles ind^{-1} across all the regions for both months. Through statistical analysis, microplastic size range >200 µm and 20-200 µm indicated have a correlation between these two months suggesting high abundance of smaller microplastic throughout the estuarine front region. No correlation was recorded between microplastic in water and microplastic in zooplankton indicating the selectivity of zooplankton feed in the estuarine front waters.

Keywords: estuarine front, tidal, microplastic, water, ingestion

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Neurotoxicity of microplastics exposure with changed neuronal activity, activated microglia, disturbed brain metabolism and abnormal behavioral outputs

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Abstract

The increasing incidence of neurological and psychiatric disorders is closely associated with environmental pollution. Exposure to microplastics is an emerging environmental issue that raises significant global public health concerns. Despite the protection provided by the blood-brain barrier (BBB), the brain is not immune to the toxic effects caused by exposure to microplastics. Using C57BL/6 adult mice as a mammalian animal model, microplastic exposure was conducted through either dietary intake or nasal drops. Evans blue injection illustrated a disrupted BBB after exposure to microplastics (1 um). Fluorescence-labeled microplastics, combined with IBA-1 immunostaining, demonstrated the penetration of microplastics into several brain nuclei, including the hypothalamus, and the activation of microglia, indicating an immune response in the brain. Furthermore, whole-brain mapping of c-Fos staining revealed abnormal brain activation in the locus coeruleus, hippocampus, and hypothalamus. Behavioral assays disclosed reduced locomotor function and sickness-like behavior at high doses and disturbed emotional-related behaviors at low doses of microplastic treatment. Brain metabolomics analysis reveals disruptions in the blood-brain barrier and neurotransmitter-related pathways. Additionally, gestational exposure to microplastics led to maternal placental-fetal barrier disruption, accumulation of microplastic particles in the abnormal placenta, and disturbed fetal brain development using tissue clarity and 3D imaging construction. Our previous data also indicated disrupted locomotion function and sleep fragmentation using a Drosophila model. In summary, our data demonstrate the neurotoxic effects of microplastics and underscore the necessity for environmental measures to mitigate microplastic pollution for the preservation of brain health.

Keywords: microplastics, blood-brain barrier, brain, mental health

Genomic analysis of bacteria isolated from marine sediments in Manila Bay reveals genes potentially involved in plastics (LDPE) degradation

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Abstract

The ubiquitous use of plastics has resulted in an increasing ecological catastrophe with no clear understanding on their fate when released to the environment. Studies showed that plastic debris in the marine environment is readily colonized by microorganisms that may initiate biodegradation of the pollutant. Here, we isolated bacteria from the sediments of Manila Bay via double enrichment method and monitored potential biodegradation detected as chemical modifications using FTIR spectroscopy. Co-incubation of bacteria with low-density polyethylene (LDPE) resulted in the oxidation of the plastic substrate. Two out of ten isolates showed high carbonyl consumption and low double bond production, indicating their potential roles in the transformation of the substrate. Comparative whole-genome sequencing identified the isolates to be closest to *Halomonas sp. 1513* and *Bacillus nealsonii AAU1,* respectively. The genome of *H. sp. 1513* (MB4) consists of 3,877,341 bp with 67.20% GC content and encodes 3,541 protein coding genes, while *B. nealsonii AAU1* (MB9) has 4,902,953 bp with 64.15% GC content, encoding 4,702 protein coding genes. Further genomic mining showed putative genes encoding for aldehyde dehydrogenase, PETase, carboxylate dehydrogenase, esterase, cutinase, depolymerase, hydrolase and laccase. These genes have been suggested to produce enzymes potentially involved in the degradation of different plastic types, including LDPE. This study further confirms the biodegradation capability of both isolates, the roles they play in influencing the fate of plastics in the marine environment, and their potential biotechnological applications in managing plastics pollution.

Keywords: genomics, biodegradation, plastics, LDPE

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Effect of environmental conditions on the carbonyl index using specific area under the band (SAUB) method during degradation of commercially-available plastics

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Abstract

Plastic waste is ubiquitous in the environment and may undergo different degradation mechanisms, such as photooxidation, thermooxidation, and hydrolytic degradation. However, there is still a lack of understanding, especially for plastics used in real-world applications, of which environmental compartment they degrade faster, leading to accelerated production of microplastics when improperly disposed of on land or at sea. This study evaluates the degradation of the commonly used plastics, namely: High Density Polyethylene (HDPE), Low Density Polyethylene (LDPE), and Polyethylene Terephthalate (PET), in two different environmental media (air and seawater). The Specified Area Under the Band (SAUB) method is used to calculate the carbonyl index (CI) to assess the extent of plastic degradation. This study will serve as a baseline for the fate of plastics ending up in marine ecosystems, providing valuable insights into the long-term impacts of plastic pollution on the environment. The results of this study show that the degradation of HDPE does not vary between the two environments ($p>0.05$). It can be observed that the CI of the sample decreases after 5 months of exposure which can be due to the release of particles on the surface and the formation of carbon monoxide. Meanwhile, LDPE and PET exhibits higher degradation rates in air as compared to seawater ($p<0.05$). The degradation process of these two plastics in the air is accelerated by increased UV, temperature, and oxygen availability. The differences in HDPE, LDPE, and PET degradation behavior in air and seawater could be attributed to the different chemical structures and properties of these plastics, as well as the environmental media to which they are exposed. The marine environment differs from the terrestrial environment in terms of UV and oxygen availability, temperature, and salt content. This study highlights the degradation patterns of plastics once they enter the various ecosystems during their end-of-life fate, which results in the expedited production of microplastics in the environment.

Keywords: plastics, degradation, photooxidation, carbonyl index, SAUB

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Removal of polyethylene and polypropylene from water by using rice husk ash

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Abstract

This research aimed to study the effects of microplastic types (polypropylene (PP) and polyethylene (PE)) and microplastic particle sizes (50–75 µm and 100–125 µm) on the removal of PP and PE from water by rice husk ash (RHA) at the laboratory scale. The RHA was analyzed for pH value, pH_{PZC}, surface area, and pore volume. The effect of contact time on the PP and PE removal by RHA was performed at an initial PP or PE concentration of 60 mg/L, RHA dosage of 1.2 g/L, initial solution pH of 7.0 and shaken at 150 rpm at 28±2 °C for 24 h in batch studies. The effect of PP or PE concentrations on PP or PE removal capacities by the RHA was conducted at initial PP and PE concentrations of 0, 10, 20, 40, 60, 80, and 100 mg/L, whereas other conditions were like the previous experiment. The pH, pH_{PZC}, surface area and pore volume of RHA were 9.19, 9.7, 17.946 m^2/g and 0.03 cm^3/g, respectively. Results showed that the equilibrium time for PE and PP by the RHA was obtained within 2 h and the PP removal capacities were 14.93 mg/g and 9.59 mg/g for particle sizes of 50–75 µm and 100–125 µm, respectively. Compared to PP, lower equilibrium PE removal capacities were observed, about 8.55 mg/g and 4.71 mg/g for particle sizes of 50–75 µm and 100–125 µm, respectively. This finding showed that the RHA had the highest removal ability for PP at 50–75 µm while having the lowest removal efficiency for PE at 100–125 µm. This is likely due to the net negative charge of PP, which attracts positively charged RHA through electrostatic forces at a solution pH of 7.0 in the polluted water. This research work highlights that the RHA can be used for microplastic removal from polluted water. In addition, this study suggests that the RHA can be used as a value-added byproduct material to promote waste utilization in the agricultural and/or agro-industrial sectors.

Keywords: adsorption, equilibrium time, microplastics, rice husk ash

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How much should we reduce plastic waste emission to achieve the Osaka Blue Ocean Vision? – global predictions of marine plastic litter abundance

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Abstract

Marine plastic pollution is growing all over the world, and it will spread further if we continue to emit plastic waste as it is or even more due to an economic development. To quantify responses of reduction in land-based plastic emissions to marine pollution, we established a probability distribution model (PDM) based on a particle tracking model to predict the abundance of marine macro- and microplastics which undergo the generation, transport, and removal processes in the upper ocean. The PDM estimated the abundance of marine plastic litter generated in different scenarios of future land-to-sea plastic emissions. We here clarified the amount of reduction required to achieve the Osaka Blue Ocean Vision, which aims to reduce additional pollution by marine plastic litter to zero by 2050. The prediction using the PDM with several emission scenarios stated that at least 32% reduction of plastic emission compared to the 2019 value must be realized over the world by around 2035 at the latest.

Keywords: microplastics, Osaka Blue Ocean Vision, ocean plastics pollution, future prediction, particle tracking model

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Current marine microplastic research and monitoring program in Thailand

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Abstract

Since 2017, the Department of Marine and Coastal Resources (DMCR) has undertaken a comprehensive project to combatting and monitoring microplastics pollution in the marine ecosystem in Thailand. To accelerate the project, especially during the initial stage, a study of microplastics was proposed to be a project under Thailand-China marine cooperation on climate and marine ecosystem during the 9th Thailand-China joint workshop to facilitate knowledge transfer and technical support from experts of the First Institute of Oceanography (FIO), with additional support from the IOC/WESTPAC through training workshops. Significantly, DMCR has made substantial progress in establishing a standardized procedure for microplastic monitoring in Thai waters as well as generating observational data in line with Sustainable Development Goals (SDG) Target 14.1.1b. From all monitoring stations (thirty stations in the surface water and ten stations on the sandy beaches), the most abundant microplastic is polyethylene, followed by PET, and polypropylene respectively. Notably, some areas experienced high levels of polystyrene, primarily attributed to fisheries activity. The scope of research also extended beyond the marine environment to explore contaminations in marine life such as Green mussel (*Perna viridis*) and Hump coral (*Porites lutea*) were investigated, revealing textiles of PET in filament shape in their tissues, providing valuable insights for DMCR to consider in selecting a bioindicator for evaluating microplastic contamination. Lastly, the distribution of both macroplastic and microplastic from coastal areas to offshore areas was also examined. This comprehensive analysis is vital for DMCR to assess environmental risks associated with microplastic contamination in marine ecosystems and create an effective plan for future efforts in plastic waste management and utilization. The collaborative efforts and research undertaken by DMCR represent significant strides in preserving marine ecosystems and safeguarding the environment. The findings and procedures established through this initiative contribute valuable knowledge toward addressing the global challenge of microplastic pollution.

Keywords: microplastic, SDG indicator, bioindicator, plastic waste management

Trends, gaps, and future directions to support evidence-based action on marine plastic pollution in the Philippines

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Abstract

Southeast Asia emerges as a significant source of marine plastic pollution on a global scale owing to densely populated coastal regions, presence of major rivers systems, and absence of efficient waste management systems. Omeyer et al. (2022) highlighted priority areas to further understand the fate, degradation, associated impacts of this issue to the marine ecosystem, and directions for research in the region. Using this framework, we examined the current trends in the context of Philippine marine plastic research, identified the knowledge gaps, and examined the current efforts to address these gaps using literature review of published articles deposited in PlastiCount Pilipinas. Notably, there were only 54 published studies from 2015–2023 dealing with both macro- and microplastics in freshwater and marine environments, with most focusing on quantification, identification, and baselining work. Further, there was a bias towards plastics in specific compartments such as water surface (22.22%) and shoreline sediments (25.92%) in marine environments. Plastics present in the water column, river and seabed sediments, mangroves, estuaries, and coral reefs have received less attention and scrutiny. Majority of the published papers (53.70%) are on survey and monitoring of plastic pollution particularly on the marine environment. Ecological and environmental impacts were investigated in about 31.48% publications, predominantly on the ingestion of plastics in the wild. Only 10 studies have incorporated aspects of sources and pathways mainly on potential accumulation zones and hotspots. The number of studies in freshwater systems lag behind those of the marine environment. Only 17% of the publications examined have included a freshwater perspective despite the fact the majority of marine plastics come from land-based sources. The current research efforts in the Philippines are geared towards a harmonized and comprehensive plastic pollution baseline to generate conclusions about the extent and impacts of the problem. Despite the growing number of publications, there is still limited data on the sources, pathways, fate, and impacts of plastic litter in the marine environment including studies on ecotoxicity, ecological hazards, and biodegradation. There's also emphasis on the need to adopt more efficient and new technologies for plastic monitoring, which will help fast-track the mapping of plastic waste densities in different marine habitats. In light of the need for evidence-based mitigation strategies and plastic pollution

regulation policies, more comprehensive and harmonized monitoring systems will guide policy actions in generating more data-driven and long-term solutions for marine plastic pollution both locally and regionally.

Keywords: marine plastic pollution, research framework, policy interventions, plastic pollution baselining, harmonization

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PlastiCount Pilipinas: bridging gaps in understanding and addressing marine plastics pollution in the Philippines through open data

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Abstract

The Philippines has consistently ranked among the top polluters of plastic in the world's oceans. However, these rankings are based on estimates made by statistical models that do not reflect the true extent on the ground. Validated baseline data are necessary to identify the top contributing sectors to plastic pollution, allowing key decision makers to craft data-driven policies that effectively mitigate the problem. Four publicly available websites with marine litter data relevant to the Philippines lack the granularity required to come up with localized solutions. In response to this gap, the PlastiCount Pilipinas web portal (https://plasticount.ph/) was developed to provide crucial plastic pollution baseline data into a unified repository for public access. The Plastics Tracker of the portal provides visualizations for plastic pollution density and classification data from prior peer-reviewed publications and ongoing baselining research studies. The portal also allows submissions from the public to contribute to the national baseline. An initial review of the data reported from 24 provinces and 14 regions from 2019 to November 2023 reveal that single-use plastics and fishing gear dominate plastic pollution in the country. Thin plastic wraps, foamed fragments, straws, and food containers were dominant in urban areas such as Metro Manila, Cavite, and Cebu. On the other hand, foamed fragments, fishing lines, and ropes and strings were dominant in fishing-dependent areas such as Palawan. These preliminary results provide the opportunity to craft localized policies and interventions given the disparity in plastic pollution profiles across provinces. From the data, policy makers can mandate regulation of specific product types, and circular economy practitioners can design specific products and systems that address the top polluting categories. However, differing data reporting strategies hinder progress towards a unified monitoring framework. These challenges emphasize the need to harmonize methods toward generating a more refined national baseline for marine litter. The PlastiCount Pilipinas portal serves as a direct contribution towards the implementation of the Philippines' National Plan of Action for the Prevention, Reduction and Management of Marine Litter (NPOA-ML). Likewise, as a public website, the PlastiCount Pilipinas portal may also be used as a basis for developing the regional marine litter database for the Asia-Pacific region given the transboundary nature of plastics pollution.

Keywords: plastic pollution, open data, web repository, database, policy generation

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Whole chain control of plastic pollution in the Pearl River Estuary, China

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Abstract

The key of marine litter management is the prevention and control of plastic pollution. Since 2020, China has unveiled a plan on controlling plastic pollution over the next five years, aiming to effectively curb white pollution by 2025. The details measures include cutting the production and use of plastics, developing alternatives for plastics, and substantially reducing the amount of plastic waste in landfills and environmental leakage during 2021–2025. The Pearl River Estuary (PRE) is the core sea area of the Guangdong-Hong Kong-Macao Greater Bay Area, where China has set out a construction plan with timetable and tasks, aim to build an international leading livable as well as business and tourism friendly bay area by 2035.

In PRE, the whole-chain control system of plastic pollution was comprehensively improved and the whole-life cycle management of plastic waste was implemented. The key sectors such as retail, e-commerce, and express delivery, are expected to drastically cut the unreasonable use of disposable plastics. It will promote the use of alternatives to plastic, such as bamboo, wood, paper, and degradable plastics. It will also ramp up research on degradable-plastic technologies and encourage the orderly development of related industries.

In PRE, some specific studies were done including: 1) Analyzed the distribution and sources of plastic pollution. 2) Studied the generation and treatment of plastic pollution. 3) Identified the main problems for plastic pollution control. 4) Proposed short-term and Long-term measures for strengthening the whole chain control of plastic pollution in PRE.

The short-term measures included: 1) Cleaning up the stock, carry out special initiative of plastic waste in estuaries and coastal waters. 2) Curbing the increase, organize the responsible departments to block the plastic waste into the sea. 3) Different measures for different plastic waste categories, strengthen the recycling and resource utilization of plastic waste.

The long-term measures included: 1) systematic planning, promote the source reduction of land-based plastic waste. 2) multi-party governance, promote the area cooperation of Guangdong, Hong Kong and Macao for plastic waste pollution prevention and control. 3) clear responsibilities, promote the coordination level of various departments to carry out plastic waste management. 4) Explore and carry out tracking analysis and risk assessment of plastic pollution.

Keywords: marine litter, plastic pollution, Pearl River Estuary, whole chain control

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Empowering a city: a model case for plastic circularity in the Philippines

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Abstract

Achieving plastic circularity has remained elusive and is still a global challenge nowadays. The multifaceted nature of plastic pollution, entangled with social, economic, and political complexities makes it very challenging. In Cebu Island, Central Philippines, the bustling city of Mandaue, has been identified as a high-plastic pollution zone based on a study which determined plastic wastes distribution in the island's mangrove areas. The city's continuous economic growth is definitely beneficial but along with it comes the rising consumption of goods and its subsequent waste generation. Establishing collaborative relationships among cities such as Mandaue which has the capability to either harm or protect the environment is important in holistically addressing plastic pollution. Thus, this study is conducted to test and document the process of addressing plastic pollution, specifically in mangrove sites of highly urbanized cities such as Mandaue, by planning and implementing key strategies and activities which can lead to the desired results in effectively managing plastic wastes and eventually achieve plastic circularity. The approach included a series of Focus Group Discussions (FGD) with key stakeholders of the city to gain a better understanding of their perspectives on mangrove ecosystem services and plastic waste management. Key findings revealed that common people need to have a good understanding of the relevance of protecting marine environments such as the mangrove ecosystems. This can be achieved by emphasizing its significant provisioning and regulating roles and in correcting the misconception that these habitats serve as filters for plastic waste. On the other hand, the top solutions identified by stakeholders to address plastic pollution are to support the full implementation of the Ecological Solid Waste Management Act, amended recently to include the Extended Producer Responsibility policy, along with its community-based implementation strategy; and above all, the effective integration of these policies into the Philippines' educational system. During the implementation process with Mandaue City, a community-based Citizen Science approach was conducted. Insights from this activity led to the formulation of the ABCG (Academe, Business, Community, and Government) stakeholder framework, which shows the

various activities, outputs, and outcomes of each stakeholder sector which can lead to the desired impact. Mandaue City's journey serves as a small yet meaningful step in the grand scheme of achieving plastic circularity in the Philippines. It emphasizes the importance of community empowerment, stakeholder collaboration, and sincere commitment for meaningful change in the pursuit of a sustainable future.

Keywords: plastic pollution, plastic circularity, community empowerment, citizen science

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Catalyzing global solutions: the AOMI initiative in unifying data against marine plastic pollution

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Abstract

Global plastic pollution poses a critical and escalating threat, transcending borders and impacting diverse ecosystems. Urgent action is imperative, particularly in the context of marine pollution. Addressing the pervasive issue of plastic waste in oceans needs a concerted global effort, underpinned by the sharing of comprehensive scientific data on plastic waste distribution. This initiative emphasizes the crucial need for open-source, worldwide data to inform both policy-making and public awareness, fostering a comprehensive understanding of the implications for global ecosystem health. While microplastic monitoring is carried out by many institutions around the world, current insufficient harmonization of observation methods and available data hinder the development of effective predictive models concerning marine litter pollution and its far-reaching consequences. To overcome this challenge, the Guideline for Harmonizing Ocean Surface Microplastic Monitoring Methods was developed. In addition, a global datacenter is proposed, tasked with collecting and sharing data on plastic waste monitoring conducted worldwide. By leveraging open-source data and collaborating with existing information systems, a unified approach can be achieved to enhance data comparability and accessibility. This initiative aligns with Sustainable Development Goal 14, striving to develop evidence-based policies that combat marine pollution. The Ministry of Environment of Japan (MOEJ) spearheads the Atlas of Ocean MIicroplastics (AOMI) database project, supported by the Center for Ocean Plastic Studies and leading experts in this area, focusing on data collection, processing, and management. AOMI aims to provide a concise and transparent overview of publicly available data on floating microplastics. Challenges in reformatting opportunistic data, ensuring reliability, and leveraging it for policymaking are addressed. A key aspect involves harmonizing existing definitions and establishing mandatory requirements for metadata and data reporting on global-scale marine debris indicators. This adaptive framework is designed to accommodate technological evolution. In this sense, the AOMI initiative collaborates with established global observation networks and databases, such as GOOS, GPML, NOAA, EMODnet, and others, functioning as a coordinated network. Continuous efforts are underway to achieve consensus on standardized metadata and data requirements, fostering the

development of a federated and interoperable global-scale data management system. This collaborative approach emphasizes the importance of a unified strategy to combat the escalating crisis of plastic pollution in oceans.

Keywords: microplastics, datacenter, harmonization, plastic, Japan

Sub-theme C:
Ocean and Human Health

Session C3:
Deoxygenation in the Western Pacific: Implications for coastal and open ocean ecosystems

Programme

Venue: Kensington A, 5th Floor
Date: 23 April 2024

Conveners:

Gil Jacinto	University of the Philippines, The Philippines
Aileen Tan Shau Hwai	Universiti Sains Malaysia, Malaysia
Denise Breitburg	Smithsonian Environmental Research Center, USA

Time	Presentation Titles	Speakers
Section 1		
13:00–13:15	Hypoxia: nothing could be worse!	Rudolf Shiu Sun Wu, The Education University of Hong Kong, China
13:15–13:30	Persistent eutrophication and hypoxia in the coastal ocean	Minhan Dai, Xiamen University, China
13:30–13:45	A new generation of Dissolved Oxygen Sensor using replaceable photo-sensing film	Ron Chi On NG, NerOcean Limited, Hong Kong Science Park, China
13:45–14:00	Oxygen measurements in low-oxygen environments	Desmond Lee, Xylem, Singapore
14:00–14:15	The cross-tolerance and metabolic coordination in abalone under long-term thermal acclimation and hypoxia stress	Weiwei You, Xiamen University, China
14:15–14:30	Divergent carry-over effects of hypoxia during the early development of abalone	Yawei Shen, Xiamen University, China
14:30–14:45	Main factors dominating the development, formation and dissipation of hypoxia off the Changjiang Estuary (CE) and its adjacent waters, China	Lianbao Chi, Chinese Academy of Sciences, China
14:45–15:00	Deoxygenation in Manila Bay, Philippines: hydrodynamic and water quality modeling	Lara Sotto, University of the Philippines Diliman, The Philippines
Section 2		
15:30–15:45	Dissolved oxygen variation and oxygen minimum zone in the southern regions of the East Vietnam Sea	Ho Van The, VAST, Vietnam
15:45–16:00	Signatures and variations of oxygen-depleted waters along the Sumatra-Java coasts in the Southeastern Tropical Indian Ocean	Faisal Hamzah, BRIN, Indonesia
16:00–16:15	Mechanisms controlling seasonal hypoxia along the shallow coast of the Eastern Upper Gulf of Thailand	Phatcharaporn Kaewkhong, Kasetsart University, Thailand

Time	Presentation Titles	Speakers
16:15–16:30	Socioeconomic drivers of eutrophication and deoxygenation in the linked system of the central plain of Thailand and the Upper Gulf of Thailand	Khanittha Uthaipan, Xiamen University, China
16:30–16:45	Historical eutrophication and deoxygenation in marginal marine environments in the northwestern Pacific: Paleobiological of the Anthropocene	Moriaki Yasuhara, The University of Hong Kong, China
16:45–17:00	Simulation of the eutrophication of the Berau River Estuary, East Kalimantan: temporal development of nutrients, chlorophyll and primary production in comparison to observation	Idris Mandang, *Mulawarman University, Indonesia*

Session C3: Deoxygenation in the Western Pacific: Implications for coastal and open ocean ecosystems

Hypoxia: nothing could be worse!

Rudolf Shiu Sun Wu

Department of Science and Environmental Studies, The Education University of Hong Kong, Hong Kong SAR, China

Abstract

Over the last few decades, hypoxia has caused major changes in structure and function of marine ecosystems as well as biogeochemical cycles over large area. Since the 1960s, the number of “Dead Zones” has doubled every decade, and more than 400 “Dead Zones” have now been identified worldwide. Due to global warming, the problems will be further exacerbated in the coming years. For the first time, we showed that hypoxia can alter the balance of sex hormones, impair reproduction, cause malformation and lead to a male-biased population in fish. Our recent studies further showed that parent fish exposed to hypoxia may cause epigenetic changes, leading to reproductive impairment in subsequent generations, despite their offspring have never been exposed to hypoxia before. Risk assessment based on ecological consequences, area affected, economic loss, probability of occurrence suggest that hypoxia is probably the most important stressor in the global marine environment in the coming decades, and therefore warrant urgent attention.

Persistent eutrophication and hypoxia in the coastal ocean

Minhan Dai

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Abstract

Coastal eutrophication and hypoxia remain a persistent environmental crisis despite the great efforts to reduce nutrient loading and mitigate associated environmental damages. Symptoms of this crisis have appeared to spread rapidly, reaching developing countries in Asia with emergences in Southern America and Africa. The pace of changes and the underlying drivers remain not so clear. To address the gap, we review the up-to-date status and mechanisms of eutrophication and hypoxia in global coastal oceans, upon which we examine the trajectories of changes over the 40 years or longer in six model coastal systems with varying socio-economic development statuses and different levels and histories of eutrophication. Although these coastal systems share common features of eutrophication, site-specific characteristics are also substantial, depending on the regional environmental setting and level of social-economic development along with policy implementation and management. Nevertheless, ecosystem recovery generally needs greater reduction in pressures compared to that initiated degradation and becomes less feasible to achieve past norms with a longer time anthropogenic pressures on the ecosystems. While the qualitative causality between drivers and consequences is well established, quantitative attribution of these drivers to eutrophication and hypoxia remains difficult especially when we consider the social economic drivers because the changes in coastal ecosystems are subject to multiple influences and the cause–effect relationship is often non-linear. Such relationships are further complicated by climate changes that have been accelerating over the past few decades. The knowledge gaps that limit our quantitative and mechanistic understanding of the human-coastal ocean nexus are identified, which is essential for science-based policymaking. Recognizing lessons from past management practices, we advocate for a better, more efficient indexing system of coastal eutrophication and an advanced regional earth system modeling framework with optimal modules of human dimensions to facilitate the development and evaluation of effective policy and restoration actions.

Keywords: eutrophication, hypoxia, coastal ocean

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A new generation of Dissolved Oxygen Sensor using replaceable photo-sensing film

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Abstract

Aquatic hypoxia (low oxygen content) leads to severe global environmental damage and economic loss. Therefore, long-term continuous dissolved oxygen (DO) monitoring is essential. As spatial and temporal variations of DO are typically large, frequent or continuous DO measurements are required to gain valuable insights into the DO levels in the marine environment. Although commercial Clark-type electrodes are commonly utilized for measuring DO levels, they are not ideal for continuous or prolonged monitoring. This is due to the fact that contaminants and biofouling can significantly impact the diffusion of oxygen across the electrode's membrane, leading to inaccurate measurements. As a result, monthly/biweekly maintenance and replacement of the DO sensors are necessary. This further increases the cost of their long-term operation, especially for remote areas. To tackle this global bottleneck of long-term water quality monitoring, we developed sensor devices based on a revolutionary new methodology based on the photo-sensing technology, co-invented by City University of Hong Kong and the Education University of Hong Kong. The mechanism of DO quantification is based on the photo-oxidation reaction of the sensing material with the DO in the aquatic environment under irradiation. In contrast to existing DO monitoring technologies, including optical and electrochemical methods, the performance of the sensors developed based on our photo-sensing technology is not affected by biofouling. Therefore, we can reduce the DO sensor cost by 80% and the maintenance cost by 90% for long-term continuous water quality monitoring. Our sensor technology received a Silver Medal in Inventions Geneva Evaluation Days (IGED) 2022 and Top 10 Best Invention Awards, Gold Medal, and International Special Award (OCIIP) in iCAN 2022. We established a start-up company, NerOcean Limited, in 2021 to commercialize the DO sensor and monitoring systems using this technology.

Keywords: dissolved oxygen, DO sensor, water quality monitoring, IoT monitoring network, ocean big data

Oxygen measurements in low-oxygen environments

Desmond Lee

Xylem, Singapore

Abstract

Oxygen is an essential parameter in aquatic research, monitoring and aquaculture. Advancement in oxygen sensors technology and methods doesn't guarantee accurate measurements. There are still many end users who do not have a sufficient understanding of how to make oxygen measurements with sufficient quality and assessing data quality. This presentation is intended to present recent findings on oxygen dynamics and how sensors can be handled in the field to improve the data quality. The challenges of measuring in low oxygen environments and the shortcomings of the reference method, Winkler titration, will be discussed. Results from new developments like trace O_2 detection and sensing foils technologies will address these challenges, particularly in low-oxygen environments in shallow waters.

Keywords: low oxygen, trace oxygen, Optode, winkler titration, sensing foil

The cross-tolerance and metabolic coordination in abalone under long-term thermal acclimation and hypoxia stress

Yawei Shen, Xuan Luo, Caihuan Ke, and Weiwei You

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Abstract

The global ocean is getting warm and losing oxygen due to anthropogenic activities. Short-term and long-term fluctuations of water temperature and dissolved oxygen may become a further challenge for aquatic organism in aquaculture areas where are under the combined impacts of global climate change and human activities. Here, a controlled laboratory study was conducted by exposing four abalone populations/species, to long-term thermostatic acclimation at two temperatures (20°C and 28°C) and acute hypoxia (~0.5 mg O_2/L). Long-term thermal acclimation would increase the sensitivity of abalone to hypoxia, indicated by the behavior activities that more abalones left the shelter, lost adhesion, and died under acute hypoxia exposure after long-term thermal acclimation. Long-term thermal acclimation induced metabolic depression in abalone and shaped the hypoxia responses of abalone by reducing phosphorylated metabolites involved in carbohydrate and amino acid metabolism. The cross-tolerance between temperature acclimation and hypoxia tolerance varies among different abalone populations/species, reflecting their various resistance to environmental stressors. Overall, this study provides novel insights into the interactive effects of high temperature and hypoxia on metabolic coordination in abalone as well as the response and adaptation mechanism of abalone to environmental multi-stressors. We also encourage future research that uses aquaculture systems as the model for studying environmental stress and biological responses.

Keywords: abalone, hypoxia, carry over, cross-tolerance

Divergent carry-over effects of hypoxia during the early development of abalone

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Abstract

Environmental hypoxia events that caused by global warming and coastal eutrophication are becoming one of the most important changes in the open ocean and coastal waters worldwide. Hypoxia can have significant effects on marine organisms, but for breeding programs and other practical applications, it is important to further explore the long-term physiological effects of early hypoxia exposure in economically significant species. In this study, the Pacific abalone *Haliotis discus hannai* was exposed to moderate hypoxia (~4 mg/L) from zygote to trochophora, and the assessments of hypoxia tolerance were conducted on the grow-out stage. The results revealed that both juvenile and adult abalones exposed to hypoxia at the early development stages were more hypoxia-tolerant, but with slower weight growth during hypoxia exposure, a phenomenon called the trade-off between growth and survival. These phenotypic effects driven by the hypoxia exposure were partially explained by selection of genes involved in signal transduction, autophagy, apoptosis, and hormone regulation. However, epigenetic variations were more substantial, since lncRNA regulation plays an important role modulating carry-over effects by controlling DNA replication and repair, signal transduction, myocardial activity, and hormone regulation. This study revealed that the ability to create favorable phenotypic differentiation through genetic selection and/or epigenetic regulation is important for the survival and development of aquatic animals in the face of rapidly changing environmental conditions.

Keywords: Hypoxia, Abalone, Phenotype differentiation, Acclimate, Transcriptome

Session C3: Deoxygenation in the Western Pacific: Implications for coastal and open ocean ecosystems

Main factors dominating the development, formation and dissipation of hypoxia off the Changjiang Estuary (CE) and its adjacent waters, China

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Abstract

Hypoxia off the Changjiang Estuary (CE) and its adjacent waters is purported to be the most severe in China, attracting considerable concern from both the scientific community and the general public. On the basis of multidisciplinary investigations and *in situ* experiments carried out off the CE and its adjacent waters, the spatiotemporal variations in and main dominating factors of hypoxia throughout the annual cycle were elucidated in detail. In addition, the contribution of Sediment Oxygen Demand (SOD) to the hypoxia was quantitatively estimated. Overall, hypoxia experienced a consecutive process of expanding from south to north, then disappearing from north to south. The annual variations in hypoxia were mainly contingent on stratification variations. Among different stages, there was significant heterogeneity in the dominant factors. Specifically, low-DO waters initially appeared from the intrusion of nearshore Kuroshio branch current (NKBC), as NKBC intrusion provided a low-DO background and triggered stratification. Thereafter, stratification was enhanced and gradually expanded northward, which promoted the extension of low-DO areas. The formation of hypoxia was regionally selective, and more intense organic matter decomposition at local regions facilitated the occurrence and discontinuous distribution of hypoxia. Hypoxic zones were observed at the Changjiang bank and Zhejiang coastal region from August (most extensively at 14800 km^2) to October. Moreover, the two hypoxic zones exhibit differences in behavior, physical and biochemical characteristics. And the phytoplankton sinking rates (PSR) and sediment oxygen demand (SOD) were measured and compared between the two hypoxic regions. PSR and SOD ranged 0.75–3.34 m day^{-1} and 5.67–16.19 mmol m^{-2} day^{-1}. Interestingly, PSR and SOD in southern region were higher, implying more intense pelagic-benthic biogeochemical coupling, than those in northern region. SOD accounted for approximately 44% and 51% of DO net consumption in the northern and southern regions from July to August, respectively. The southern hypoxic region appeared to be a system with intense DO consumption and faster DO supplementation, while the northern hypoxic region seemed to be a system with slow consumption and supplementation.

Key Words: heterogeneity, phytoplankton sinking rates, SOD, hypoxia, Changjiang estuary

Deoxygenation in Manila Bay, Philippines: hydrodynamic and water quality modeling

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Abstract

A hydrodynamic and water quality model was developed for Manila Bay, Philippines, an embayment affected by hypoxia and eutrophication using Delft3D Flow and Delft Water Quality. Key inputs included freshwater discharges, NH_4, dissolved oxygen, and CBOD5 concentrations from major rivers. The model reproduced wet season stratification and the pycnocline depth (5–15 meters), with stratification forming and dissipating in 10–15 days. Modeled water levels aligned with tide gauge observations, and salinity and temperature profiles resembled field surveys. The model replicated the general dissolved oxygen distribution observed during field studies, capturing lower levels near the coast and the formation of low dissolved oxygen near the bottom. Dry season runs had higher dissolved oxygen levels throughout most of the water column compared to wet season model runs. River loading influenced the surface waters up to 10 meters, while sediment oxygen demand impacted the near bottom and the water column below the pycnocline. The effects of river loading manifested in less than a week, while an increase or decrease in sediment oxygen demand affected the system in about 14 days. Boundary conditions were found to be important for improving the water quality of the bay. The model showed that the bay's deoxygenation is not permanent and that it could be alleviated with lower river nutrient loads and lower sediment oxygen demand. The relationship between stratification and lower dissolved oxygen levels was highlighted by the model, even though near-bottom hypoxia seasonality was not entirely resolved. Efforts to improve the water quality in Manila Bay by reducing the organic and nutrient loading from rivers may only be relevant at the surface. The importance of sediment oxygen demand shown in the model points to the possible time lag of the effects of efforts to clean up the bay due to residual SOD (from old sediments). However, with decreased SOD, DO/hypoxia clears up in the near bottom waters in about two weeks, suggesting that the feature may not be permanent in Manila Bay.

Keywords: deoxygenation, hypoxia, water quality modeling, DELWAQ, DELFT3D-Flow

Dissolved oxygen variation and oxygen minimum zone in the southern regions of the East Vietnam Sea

Phan Minh Thu, Ho Van The, and Nguyen Minh Hieu

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Abstract

Among the essential parameters influencing the health of the marine environment, dissolved oxygen (DO) stands out as a critical factor. The variation in concentration of DO on seawater bodies is subject to a complex interplay of seasonal changes, oceanographic phenomena, and anthropogenic influences. Further, the DO concentration in the southern regions of the East Vietnam Sea is significantly influenced by strong upwelling, the Mekong River water mass, and anthropogenic activities. Therefore, understanding the patterns and drivers of dissolved oxygen variation in these marine regions is important for comprehending the intricacies of its marine ecology, informing conservation efforts, and addressing the potential impacts of human activities on this vital and diverse marine environment. Data from the cruises during 2013–2019 and at station Bio-agro0348 (2014–2016) showed the spatial variation of DO concentration in the southern region of the East Vietnam Sea. The DO concentration was 2.48–6.25 mg/L or 1.86–4.70 mL/L. Notably, surface layers exhibit pronounced fluctuations, whereas deep water layers consistently form an oxygen minimum zone (OMZ) distributed between 450 m to 1,200–1,300 m, with a 650–850 m thickness. This variation is intricately tied to the hydrodynamic regime and specific weather conditions. The resulting water column stratification into four distinct zones - oxygen-rich surface zone, reducing DO zone, OMZ, and oxygen-rich bottom zone - further underscores the complexity of factors influencing the marine environment in this region.

Keywords: dissolved oxygen, minimum oxygen zone, East Vietnam Sea

Session C3: Deoxygenation in the Western Pacific: Implications for coastal and open ocean ecosystems

Signatures and variations of oxygen-depleted waters along the Sumatra-Java coasts in the Southeastern Tropical Indian Ocean

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Abstract

A prominent ocean region exhibiting low oxygen concentration is the northern Indian Ocean (e.g., Arabian Sea, Bay of Bengal), whose projected ocean deoxygenation as a response to global climate change must account for complex ocean dynamics. By combining in-situ data acquired from cruises and Argo floats with reanalysis products between 2010–2022, here we identify oxygen-depleted water masses along the western Sumatera and Java coasts of Indonesia attributed to the intrusion of the northern Indian Ocean waters and regional ocean upwelling. Both observational and reanalysis data corroborate a deepening of the oxygen-depleted waters over the study period with an oxygen-limited zone (OLZ; dissolved oxygen <60 µmol kg^{-1}) at 500-800 m depths, while the in-situ data reveals another OLZ at a shallower depth. The oxygen-depleted Arabian Sea waters evident at our site are mixed with the Indonesian subsurface water mass. We characterize the roles of the regional monsoon showing the upwelled oxygen-depleted deep-water masses during the boreal summer and the imprint of the Arabian water mass during the transition period advected by the equatorial jet of the Indian Ocean. During the boreal winter, we observe a shoaling of the OLZ that might be attributed to subsurface currents. An upwelling event can potentially shoal the oxygen-depleted waters, suggesting the settling of organic matter and its remineralization becomes shallower. The imprints of interannual Indo-Pacific climate variability are evident at its thermocline depth, concurrent with the positive pole of the Indian Ocean Dipole in southern Java. Taken together, high-frequency DO variations may improve our understanding of detecting any secular deoxygenation trend in the Indian Ocean.

Keywords: deoxygenation, oxygen limited zone, western Indonesian coast, southern Java, upwelling system, southeastern tropical Indian Ocean

Session C3: Deoxygenation in the Western Pacific: Implications for coastal and open ocean ecosystems

Mechanisms controlling seasonal hypoxia along the shallow coast of the Eastern Upper Gulf of Thailand

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Abstract

The Upper Gulf of Thailand (UGoT) is significantly influenced by many major rivers. These rivers transport freshwater and nutrients into the Gulf, create conditions conducive to the development of hypoxia and affect the eastern Upper Gulf of Thailand (eUGoT). Influx of the nutrient from the rivers and together with local influx from various anthropogenic activities such as tourism, marine aquaculture, maritime transport, industrial estates, and community in this area contribute to eutrophication problems in the eUGoT. In excess, nutrients can stimulate phytoplankton blooms, leading to deoxygenation. In the nearshore shallow areas, hypoxia and anoxia are common, causing damage to coastal aquaculture and ecosystem. Understanding the mechanism of deoxygenation in the eGoT is important to mitigation and management. In this study, we applied time-series data from a telemetry marine measurement station namely “GOT001”. Typical DO values around GOT001 remains around 6 mg/l throughout most of the year. However, the values may elevate to exceeding 8 mg/l within a day around July, August, and September. To investigate the causing mechanism, a three-dimensional hydrodynamic model and water quality model of the whole UGoT were developed. Modeled results indicated that these sudden fluctuations are not only controlled by the biochemical processes but also by physical processes. Monsoonal winds has an indirect control over nutrient input in the UGoT. Notably, during the southwest monsoon the overall surface circulation in the UGOT is clockwise bringing in nutrients in to the eUGOT causing plankton blooms and subsequent hypoxia. The hypoxia nearshore extinguished quickly from strong tidal, wind and wave mixing while it sustained for a longer period in the subsurface offshore. Model results also indicate that at water depth more than 15 m wind and tidal force could not break halocline generated by high river discharge. Intermittent pause of the prevailing southeastern wind by the north wind during this period can trigger westward Ekman transport along the eUGoT coast. These phenomena bring about the coastal upwelling of the high salinity and hypoxia. Persistence of the north wind can cause further reduction of the DO levels and bring about the coastal anoxia.-In summary, the seasonal hypoxia in the eUGoT is a result of the intricate interplay of tidal and residual current, wind, and biochemical processes. A comprehensive understanding of these short-lived processes is essential for devising effective strategies for sustainable management healthy ecosystems in this area.

Keywords: anoxia, dissolved oxygen, hydrodynamic model, water quality model, upwelling

Session C3: Deoxygenation in the Western Pacific: Implications for coastal and open ocean ecosystems

Socioeconomic drivers of eutrophication and deoxygenation in the linked system of the central plain of Thailand and the Upper Gulf of Thailand

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Abstract

Human-induced nutrients enrichment, known as eutrophication, poses a persistent environmental threat. Socioeconomic development is influenced by multitude of factors, and the cause-effect relationship is often nonlinear. This environmental crisis is prevalent in Thai waters. The underlying causes and impact are still being investigated in the vulnerable freshwater-seawater continuum system, encompassing the Central Plan of Thailand (CPoT) and the Upper Gulf of Thailand (UGoT). This study employs multiple approaches through a human-ecological system lens to examine the effects of population density and land use changes in five river basins of CPoT, which drain into the UGoT. We found that low dissolved oxygen concentrations (62.5 µmol/kg) have been recorded in the lower reaches of the Mae Klong, Tha Chin, and Chao Phraya Rivers since 1972. The Chao Phraya and Bang Pakong Rivers currently exhibit a decreasing trend in dissolved oxygen. The development of coastal eutrophication and hypoxia in the UGoT is closely linked to the development of watersheds in the CPoT since 1970s. Population density in the CPoT increased from 18.3 to 18.5 million between 2005 and 2019. Between 2000 and 2017, aquacultural land increased by 31.4%, urban and built-up land increased 28.6%, and agricultural land increased 6.5%. These transformations have resulted in increased non-point sources of nutrients and organic matter, leading to oxygen depletion in the lower reaches of rivers, particularly in areas with intensive human activities, such as urbanization and aquacultural land. Excessive nutrient pollution has led to increased eutrophication and hypoxia in the UGoT since 2000. Studies suggest that deoxygenation is a cause of environmental quality and quantity susceptibility in the linked system of CPoT and UGoT, which is the heart of Thailand. To address the challenge of eutrophication and its consequences, reducing barriers and fostering collaboration across a wide range

of perspectives, including actionable science, accountable governance, effective nutrient load reduction, and measurable outcomes, as well as implementing adjustable strategies for this region, is essential.

Keywords: eutrophication, deoxygenation, socioeconomic, the central plain of Thailand, the Upper Gulf of Thailand

Historical eutrophication and deoxygenation in marginal marine environments in the northwestern Pacific: Paleobiological of the Anthropocene

Moriaki Yasuhara

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Abstract

Eutrophication and deoxygenation are serious problems in marginal marine environments in the northwestern Pacific. Bays and estuaries have been negatively affected. Paleobiological research has been conducted, as an essential way to know long term historical trend beyond contemporary biological monitoring, to investigate histories of human-induced ecological degradation in this region, including those by eutrophication and deoxygenation related to industrialization and urbanization for the past century or longer. In this presentation, I will showcase some of such conservation Paleobiological research in the northwestern Pacific region, including case studies from Hong Kong, Japan, etc., from our research group, and also introduce ongoing and future research and research interests.

Keywords: eutrophication, hypoxia, paleoecology, Anthropocene, Holocene

Simulation of the eutrophication of the Berau River Estuary, East Kalimantan: temporal development of nutrients, chlorophyll and primary production in comparison to observation

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Abstract

Berau River Estuary is located east of the Island of Borneo and bordered by the Sulawesi Sea. Located north of the equator, which is degrees north latitude, on the upper side of the Berau River, two rivers are formed, which join at Tanjung Redeb City. Berau River Estuary has a high level of productivity, which allows eutrophication and knowing eutrophication levels. Areas suspected of eutrophication can be seen from parameters such as total nitrogen, phosphate, oxygen, and chlorophyll-a. These parameters are taken from the results of field measurements and then become the initial values in the model. This study simulates nutrient content for one year using the ERSEM (European Regional Seas Ecosystem Model). From the model simulation results, it is found that the area that is suspected of eutrophication is the Segah River. This is because, during the rainy season in that area, the total nitrogen and phosphate have a high value, high chlorophyll-a, while the dissolved oxygen content is low; otherwise, it is the dry season. This also impacts the surrounding ecosystem as it can cause excess fish mortality.

Keywords: nutrients, chlorophyll, Berau River Estuary, primary production, ecosystem model

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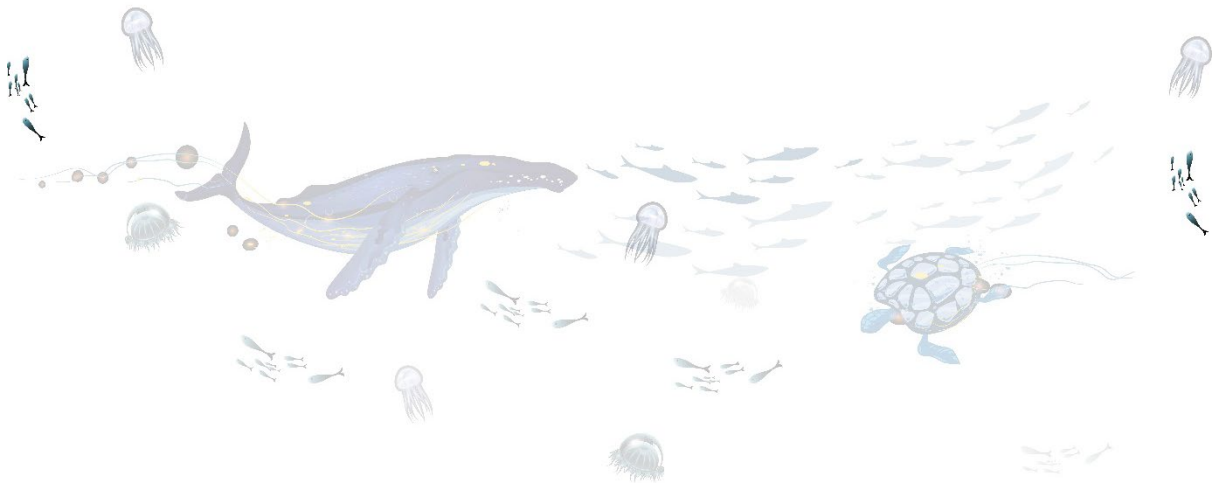
Sub-theme C:
Ocean and Human Health

Session C4:
Ocean acidification and its impacts on marine ecosystems



Programme

Venue: Kensington A, 5th Floor
Date: 23 April 2024

Conveners:

Maria Lourdes San Diego-McGlone	University of the Philippines, The Philippines
Aileen Tan Shau Hwai	Universiti Sains Malaysia, Malaysia
Liyan Zhang	Third Institute of Oceanography, China
Chalermrat Sangmanee	Department of Marine and Coastal Resources, Thailand

Time	Presentation Titles	Speakers
Section 1		
10:00–10:15	Distribution of seawater carbonate chemistry in the Straits of Malacca	Seng Chee Poh, *Universiti Malaysia Terengganu, Malaysia*
10:15–10:30	Dynamics of ocean acidity, CO_2 fluxes and metabolic rates on a shallow reef of Weizhou Island: a buoy-based observational study	Xu Dong, *Third Institute of Oceanography, China*
10:30–10:45	Variability of carbonate chemistry in Pattani Bay, Thailand: a potential role of macrophytes in ocean acidification mitigation and the use of citizen science	I-Hsin Yao, *Prince of Songkla University, Thailand*
10:45–11:00	Community shift of sargassaceae-dominated ecosystem around novel CO_2 seep off Himeshima Island, Japan	Shigeki Wada, *University of Tsukuba, Japan*
11:00–11:15	Physiological response of *Alexandrium* spp. to CO_2 variations	Yee Qi Teo, *Universiti Malaysia Terengganu, Malaysia*
11:15–11:30	Benthic diatom primary production under short-term exposure to acidification and warming may vary due to the influence of grazers and nutrients	Jerwin G. Baure, *University of the Philippines Diliman, The Philippines*
11:30–11:45	Independent and combined effect of low pH and elevated temperature of a non-native and native mussel species in the Philippines	Cabiguin Maryjune, *University of the Philippines Diliman, The Philippines*
11:45–12:00	Investigation of present and projection of possible future ocean acidification states in the Bungo Channel area of the Seto Inland Sea, Japan using numerical simulation	Lawrence Patrick C. Bernardo, *The University of Tokyo. Japan*

Distribution of seawater carbonate chemistry in the Straits of Malacca

Seng Chee Poh[1, 2], Yee Qi Teo[1], Wei San Phang[1], Daryl Jia Jun Lee[1], Muhammad Faisal Abd Rahman[1], Yuzwan Mohamad[1], Nur Hidayah Roseli[1, 2], and Mohd Fadzil Mohd Akhir[2]

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Abstract

The Straits of Malacca, a critical trade route connecting the Indian Ocean to the South China Sea and Pacific Ocean, sustains essential fishing grounds, diverse marine cultures, and natural habitats such as coral reefs. Despite extensive research on oil pollution, there has been insufficient attention to climate change, specifically ocean acidification, posing a threat to the region's marine ecosystems. In this study, measurements of total alkalinity (A_T) and pH were conducted in the Malacca Strait (3°N, 98°E – 6°N, 100°E) in August 2019 and March 2022 to characterize the carbonate system in the Malacca Strait. pH measurements were carried out using an onboard spectrophotometric technique, and discrete total alkalinity measurements were conducted through direct titration with hydrochloric acid, following the methodology outlined by Dickson et al. (2007). The remaining carbonate chemistry parameters were computed using CO2SYS. In Malacca Straits, surface pH ranged from 7.951 to 8.076, and total alkalinity ranged from 1995 to 2368 $\mu molkg^{-1}$. Thus, pCO_2 concentration calculated from pH and total alkalinity, ranged from 415–594 µatm in the middle region to 414–574 µatm in the middle of the Malacca Straits. Spatiotemporal variability in sea-air CO_2 fluxes was observed, reflecting different responses in the strength of biological and physical processes. The dissolved CO_2 concentration in the water column of the Straits of Malacca was consistently oversaturated relative to the atmosphere, indicating that the region acted as a net source of atmospheric CO_2 during the study periods. The median aragonite saturation state (Ω_A) value at the surface of the Malacca Strait was 2.99, slightly below the level considered adequate for the growth of tropical shallow water scleractinian corals (Ω_A=3.25). Consequently, these findings suggest that the Malacca Straits are susceptible to ocean acidification.

Keywords: seawater carbonate chemistry, aragonite saturation state, Malaysia water

Dynamics of ocean acidity, CO_2 fluxes and metabolic rates on a shallow reef of Weizhou Island: a buoy-based observational study

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Abstract

The metabolic processes of calcification and production are significant indicators of the impact of ocean acidification on reef health. Previous studies have suggested that net ecosystem calcification is primarily driven by net ecosystem production, not seawater aragonite saturation state. However, the inherent connection between these two metabolisms is not well understood. Here, we utilized a mooring buoy approach to provide the first simultaneous, high-frequency measurements of seawater pH, aragonite saturation state, CO_2 fluxes, and metabolic rates over a coral reef on Weizhou Island for 37 consecutive days. We found a strong correlation between net ecosystem calcification and production on both diurnal and day-to-day scales, as well as during periods without light. This indicates that there is a correlation between metabolisms that is independent of light. The tight coupling between these metabolic rates can be explained by the sediment Carbonate Critical Threshold mechanism. The seawater aragonite saturation state was only weakly correlated with net ecosystem calcification, likely due to metabolic feedback. The daily net ecosystem calcification and production were estimated to be -937 to 51 mmol $CaCO_3$ m^{-2} d^{-1}, and -898 to 117 mmol C m^{-2} d^{-1}, respectively. These results suggest that $CaCO_3$ dissolution is more likely to occur in waters with heterotrophic conditions, indicating that heterotrophy may drive $CaCO_3$ dissolution. Our study highlights the significance of ambient respiration in driving reef ecosystem-scale $CaCO_3$ dissolution. This process releases alkalinity into the seawater, which helps neutralize the respiration-induced acidification. Finally, we identified the driver of CO_2 emissions over the studied reef.

Keywords: net ecosystem calcification; net ecosystem production; seawater pH; aragonite saturation state; CO_2 fluxes

Variability of carbonate chemistry in Pattani Bay, Thailand: a potential role of macrophytes in ocean acidification mitigation and the use of citizen science

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Abstract

Ocean acidification plays a role of altering the carbonate composition in the ecosystems and impacting on a range of calcifying organisms and macrophytes may have the potential to mitigate the low pH environment. The study site, Pattani Bay in Thailand, is a semi-closed estuarine with rich natural resources of mangroves and provides the livelihood of fishery for the communities around. This research aims to study the role of macrophytes and the temporal and spatial variations of carbonate chemistry. Water samples were collected *in situ* from three sites: 1) macrophyte area (seagrass), 2) non-macrophyte area in the mangrove, and 3) bare sand at Bang Pu community of Pattani Bay for three times for pH, salinity, dissolved oxygen (DO) and total alkalinity (TA) data. One-way ANOVA test indicated the significant differences in pH among sites and seasons and the significant difference in TA among different seasons. The results showed, the mean pH is highest in bare sand site, and lowest in macrophyte area. The mean TA is highest in macrophyte area and lowest in the non-macrophyte area in the mangrove. In terms of temporal variations, the mean pH is highest in rainfall period and lowest in low rainfall period and the mean TA is highest in low rainfall period and lowest in medium rainfall period. The correlation test of water parameters shows that pH is strongly correlated with DO among three different sites and moderately correlated with DO, salinity, and temperature among three different seasons. This result provides better understanding on carbonate chemistry of water in Pattani Bay and the physiological setting and roles of macrophytes. However, long term date monitoring are needed to explain the mechanisms and parameters related to carbonate chemistry in this area.

Keywords: ocean acidification, pH, macrophytes, seagrass, Pattani Bay

Community shift of sargassaceae-dominated ecosystem around novel CO_2 seep off Himeshima Island, Japan

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Abstract

Ocean acidification (OA) is a serious threat on marine organisms and ecosystems. Shallow CO_2 seeps have been used as natural laboratories of OA to predict holistic impact on coastal ecosystems, and we have developed ICONA Network (International CO_2 Natural Analogues Network) to foster the research exchange and collaboration using natural analogues. We have recently found novel CO_2 seeps around Himeshima Island, western Seto Inland Sea, Japan where Sargassaceae-dominated algal beds are spread widely. Algae in Sargassaceae family are cosmopolitan spanning group of macroalgae from temperate to tropical regions, and our finding site would be firstly discovered CO_2 seep in Sargassaceae-dominated ecosystems. We carried out quadrate survey along 100 m line to evaluate the coverage of benthic organisms. Some Sargassum algae (*Sargassum horneri*, *Sargassum macrocarpum*, and *Sargassum micracanthum*) were a dominant species in the reference site, while Sargassaceae in high CO_2 site was almost *Myagropsis myagroides* (>90% coverage). In the survey in January 2023, we measured length of algal body to evaluate the three-dimensional biogenic structure in the algal bed. As a result, body length of *M. myagroides* in high CO_2 site was 2–3 times longer than those of Sargassum algae appeared in the reference site. Algal body of Sargassaceae has an ecological function provisioning habitats for other organisms, and in general, algal biomass is related with epibiont. Therefore, dominance of macroalgae with larger body size in high CO_2 site suggests enhancement of biodiversity in Sargassaceae-dominated ecosystems under ocean acidification.

Keywords: CO_2 seep, Himeshima Island, Sargassaceae, *Myagropsis myagroides*, Sargassum

Physiological response of *Alexandrium* spp. to CO_2 variations

Yee Qi Teo[1], Seng Chee Poh[1, 2], Kieng Soon Hii[3], Chui Pin Leaw[3], and Po Teen Lim[3]

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Abstract

Climate change affects Harmful Algal Blooms (HABs) through various factors, including warming waters, altered precipitation patterns, and changing stratification. Additionally, ocean acidification, resulting from the absorption of excess atmospheric CO_2, may contribute to the global spread of HABs, but its effects on HABs are not as well understood as other climate change factors. In this study, we investigated the impact of projected end-of-century carbonate chemistry conditions on the the physiological response of *Alexandrium minutum* and *Alexandrium tamiyavanichii*, which originated from estuarine and coastal environments near the Peninsular Malaysia. This condition is based on the IPCC's CMIP6 modeled worst-case scenario, SSP5-8.5, where the incubation CO_2 concentration was set at 950 ± 50 ppm. Our results showed that there was an increase in the growth rate of *Alexandrium tamiyavanichii* when exposed to high CO_2 concentration. However, no significant change in growth rate was observed from *Alexandrium minutum*. Our findings underscore that difference adaptive capability among both *Alexandrium* spp. from estuarine and coastal environment under the future high CO_2 scenario. The results from cell diameter and biovolume measurement also revealed that increase of cell size of both *Alexandrium* spp. might be one of the consequences of the elevated CO_2 in the future.

Keywords: ocean acidification, harmful algae, elevated pCO_2, future ocean

Benthic diatom primary production under short-term exposure to acidification and warming may vary due to the influence of grazers and nutrients

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Abstract

The increase in ocean pCO_2 is expected to stimulate the growth of periphyton. Conversely, ocean acidification (OA) and warming (OW) can differentially affect the feeding of invertebrate grazers, which could indirectly affect primary producers such as benthic diatoms. The direct effects of OA and OW on microalgae and its interaction with grazers under such conditions warrants further study. This study investigated the effects of four treatment combinations of lowered pH and elevated temperature simulating ambient (PRESENT), ocean acidification (OA), ocean warming (OW) and combined OA and OW (FUTURE) conditions on the primary production of periphyton composed of multi-species benthic diatoms (*Navicula jeffreyii*, *N. ramosissima*, *Amphora* sp. and *Cocconeis* sp.) in the absence or presence (No Grazer vs With Grazer) of two seagrass-associated invertebrate grazers, namely *Stichopus* cf. *horrens* and *Trochus maculatus*, in two separate experiments. Primary production was measured based on the total biomass (ash-free dry weight) of the periphyton and autotrophic biomass (chlorophyll-a content) of benthic diatoms. Comparison of primary production among treatments in the absence of grazers was done to determine the effects of lowered pH and elevated temperature. Given the unexpected difference in nutrient concentration between the two experiments, additional comparison of primary production under PRESENT conditions between experiments was done to tease out the effect of nutrients. To determine the effect of grazers, comparison of the total and autotrophic biomass between the No Grazer and With Grazer treatments per pH-temperature treatment was done. In the absence of a grazer, no significant differences were found in the 8-day average of the total and autotrophic biomass among treatments for both experiments. However, mean autotrophic biomass in Experiment 1 was higher than Experiment 2, which was likely influenced by differences in the water nutrient levels. *Stichopus* significantly reduced the total and autotrophic biomass in all treatments, except under OW after 1 day grazing. *Trochus* significantly reduced the total biomass in the OA and OW treatments after 5 days, and the autotrophic biomass in the OA treatment after 1 and 5 days of grazing. In treatments where total and autotrophic biomass were not reduced, nutrients from the fecal matter and metabolic wastes of grazers seemingly stimulated the regeneration of microalgal biomass. Understanding the complexities on how

microalgal primary production is affected by environmental factors (i.e., pH, temperature, nutrients) directly or indirectly through grazers could provide insights on how ecosystem functioning and resilience is maintained amid projected environmental change.

Keywords: benthic diatoms, grazers, ocean acidification, ocean warming, nutrients

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Independent and combined effect of low pH and elevated temperature of a non-native and native mussel species in the Philippines

Cabiguin, Maryjune[1], Harold Monteclaro[2], and Marie Antonette Juinio-Meñez[1]

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Abstract

Sea surface temperature and pH level are predicted to worsen under future ocean conditions wherein marine calcifiers such as mussels are one among at threat. Non-native and native mussel species might have species-specific tolerance wherein it might indicate potential success of the former. This study investigated the effects of four treatment combinations of increased temperature and lowered pH simulating ambient (ambient), ocean acidification (OA), ocean warming (OW) and combined OW and OA (Future) conditions on net calcification rate (NCR) and compared the survival rate and byssus thread regeneration of a non-native mussel, *Mytella strigata* (charru mussels) and a native mussel, *Perna viridis* (green mussel), over a 7-day short-term experiment. Results showed calcification in all treatments except OA, which was also supported in the total alkalinity increase during the experimental period. Charru mussels had a lower over-all survival rate (58%) compared to green mussels (98%). The mean survival rate of charru was significantly lower and low survival probability under OA indicates greater sensitivity to low pH conditions. For byssus thread, charru mussels had a constant daily byssus thread regeneration while green mussels had a significantly increasing byssus thread regeneration within the experimental period. This response could be in indication of immediate compensatory mechanism when subjected to mechanical stress. The positive responses of green mussels to short-term exposure to elevated temperature and low pH indicates that it has better tolerance compared to charru mussels. Charru mussels may not be as successful in long-term exposure under conditions similar to climate change.

Keywords: invasives, mussels, ocean acidification

Investigation of present and projection of possible future ocean acidification states in the Bungo Channel area of the Seto Inland Sea, Japan using numerical simulation

Lawrence Patrick C. Bernardo[1], Masahiko Fujii[1], Naoki Yoshie[2], Tsuneo Ono[3], and Takehiro Tanaka[4]

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Abstract

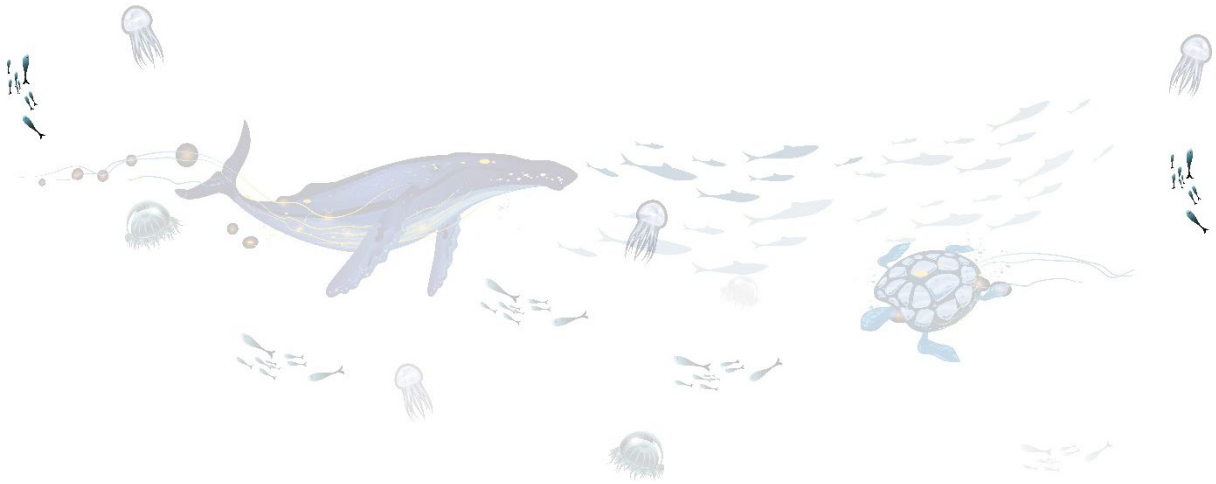
The impacts of climate change on marine ecosystems and important fishery species have become a worldwide concern in recent decades. Aside from global warming, calcifying organisms that form calcium carbonate shells and skeletons, such as shellfish and corals, are also susceptible to ocean acidification, which is also a result of excessive anthropogenic CO_2 emissions. While drivers of ocean acidification in the open ocean are relatively well understood, the situation in coastal areas may be influenced by various regional and local factors and requires further elucidation. The purpose of this study is to use numerical modeling to evaluate and project future states of ocean acidification around the Bungo Channel in the western Seto Inland Sea, Japan. The CROCO modeling system (ver. 1.3; Jullien et al., 2022), which can couple the ROMS ocean model (Shchepetkin and McWilliams, 2005) with the marine biogeochemical model PISCES (Aumont et al., 2015), was selected. The current model setup features a horizontal grid resolution of 1.5 km, with initial and boundary forcing of physical parameters derived from the Japan Coastal Ocean Predictability Experiment reanalysis dataset (JCOPE2M; Miyazawa et al., 2017). Biogeochemical forcing is derived by combining data from seasonal spatial monitoring, the World Ocean Atlas 2009 (WOA 2009), and literature-based approximations. Inputs from 12 major rivers are also included, which were derived from seasonal or monthly monitoring data. To run future projections, a candidate dataset for deriving model forcing is the Future Ocean Regional Projection 2 km model for Japan (FORP-JPN02; Nishikawa et al., 2021), which features future projections under various Representative Concentration Pathway (RCP) emission scenarios based on climate prediction models such as the MRI-CGCM3 (Meteorological Research Institute (MRI), Japan Meteorological Agency (JMA)). Values of pH and aragonite saturation state (Ω_{arag}), indicators of ocean acidification, are estimated using CO2SYS (Pierrot et al., 2006) from temperature, salinity, total alkalinity (TA), and dissolved inorganic carbon (DIC) values obtained from model outputs. Preliminary comparisons with limited observations show that the model setup is able to realistically simulate physical and biogeochemical parameters. However, as the model domain

features a relatively dynamic area at the intersection of three of the largest islands in Japan, additional comparisons with observations at various locations are needed to further evaluate model performance before attempting to make future projections. With further development, the model setup can be used to help determine which mitigation measures will be most appropriate to address ocean acidification concerns in the area.

Keywords: ocean acidification, biogeochemical model, Seto Inland Sea, Bungo Channel

Sub-theme C:
Ocean and Human Health

Session C5:
Mitigation and management of harmful algal blooms



Programme

Venue: Kensington B, 5th Floor
Date: 22 April 2024

Conveners:

Kazumi Wakita	Tokai University, Japan
Pengbin Wang	Second Institute of Oceanography, Ministry of Natural Resources, China
Aletta T. Yñiguez	University of the Philippines, the Philippines
Po Teen Lim	University of Malaya, Malaysia

Time	Presentation Titles	Speakers
Section 1		
10:30–10:45	Harmful algal bloom dynamics in Singapore waters	Sandric Chee Yew Leong, *National University of Singapore, Singapore*
10:45–11:00	Harmful algal blooms in Sabah, Malaysia: an overview	Teruaki Yoshida, *Universiti Malaysia Sabah, Malaysia*
11:00–11:15	Seasonal occurrence of harmful kareniacean dinoflagellates in Mombetsu, the northern coast of Hokkaido, Japan	Wai Mun Lum, *Japan Fisheries Research and Education Agency, Japan*
11:15–11:30	Unprecedented bloom of a harmful marine dinoflagellates *Tripos furca* (Dinophyceae) at the aquaculture area of Penang, Malaysia	Nur Fatihah Mohd Azmi, *University of Malaya, Malaysia*
11:30–11:45	High-throughput sequencing and imaging reveal a multispecies bloom of *Pseudo-nitzschia* in Bolinao, Pangasinan, Philippines	Gian Carlo S. Gaetos, *University of the Philippines Diliman, The Philippines*
11:45–12:30	**Discussion**	
Section 2		
13:30–13:45	The economic analysis of harmful algal bloom (HAB) management: A case study	Yingze Xu, *Chinese Academy of Sciences, China*
13:45–14:00	Environmental health study of Gili Matra Marine Tourism Park, Lombok, West Nusa Tenggara, Indonesia	Suhendar I Sachoemar, *BRIN, Indonesia*
14:00–14:15	The resilience of coastal and marine ecosystems to harmful algal blooms in Kamchatka (Russia)	Kirill A. Vinnikov, *Far Eastern Federal University, Russia*
14:15–14:30	Coastal eutrophication and regional nutrient criteria: A case study in the Bohai Sea, China	Baodong Wang, *First Institute of Oceanography, China*
14:30–14:45	Phytoplankton-virus dynamics during a toxic bloom in Bolinao, northwestern Philippines	Andrian Gajigan, *University of Hawai'i at Mānoa, USA*

Time	Presentation Titles	Speakers
14:45–15:00	**Discussion**	
Section 3		
15:30–15:45	Rapid detection technology for harmful algal blooms in the West Pacific Region	Pengbin Wang, *Second Institute of Oceanography, China*
15:45–16:00	Application of modified clay in enclosed aquaculture ponds, beyond HAB control	Isaac Yongquan Yuan, *Chinese Academy of Sciences, China*
16:00–16:15	HABs Watch: learnings from a concerted and coordinated archipelagic understanding of harmful algal blooms in the Philippines for mitigation and management	Deo Florence L. Onda, *University of the Philippines Diliman, The Philippines*
16:15–16:30	Efforts on HAB mitigation in a HAB hotspot, the Eastern Visayas, Philippines	Leni G. Yap-Dejeto, *University of the Philippines Tacloban College, The Philippines*
16:30–16:45	Diatoms as a potential regulator of a *Margalefidinium* sp. bloom in Sabah during 2018	Jerome Kok, *National University of Singapore, Singapore*
16:45–17:00	**Discussion**	

Harmful algal bloom dynamics in Singapore waters

Sandric Chee Yew Leong[1, 2], Timothy Jia Rong Chan[1], Emily Curren[1], Amily Jia Hui Gan[1], Audrey Ern Lee[1] and Denise Ching Yi Yu[1]

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[2] *St. John's Island National Marine Laboratory, Singapore*

Abstract

The increasing frequency and intensity of harmful algal blooms (HABs) in Singapore's coastal waters pose significant ecological and socio-economic challenges, amplified by global climate change. This study offers a comprehensive analysis of these changes from 2015 to 2023, highlighting the urgent need for enhanced monitoring and adaptive management strategies. The issue's origins date back to December 2009, when severe fish kills along the northern coast of Singapore were linked to toxic dinoflagellates *Karlodinium australe* and *Karenia mikimotoi*. A similar event in January 2014 intensified monitoring and research efforts from 2015. Between 2015 and 2016, significant HAB events involving *Karlodinium* were linked to massive fish kills. A prolonged early 2016 bloom of *K. mikimotoi* marked a shift in HAB persistence. From 2017 to 2019, diatom-dominated blooms emerged, differing from previous dinoflagellate patterns. Monitoring expansion from 2020 to 2023 to the southern coast identified minor blooms by *Karlodinium*, *Margalefidinium*, and *Pseudo-Nitzschia*, with no associated fish kills. In 2023, sporadic blooms of dinoflagellate *Blixaea* indicated a diversification in HAB species composition. Eutrophic conditions in northern waters are significant factors in sustaining HABs. The appearance of new HAB species and unprecedented bloom records reflect the impact of environmental changes on HAB dynamics. This evolving HAB dynamic has profound implications for regional marine biodiversity, impacting fisheries and the broader ecosystem. The dependency on marine resources and potential health risks necessitates efficient, rapid, and cost-effective monitoring. The study emphasizes continuous, advanced monitoring and multidisciplinary approaches. It advocates for adaptive strategies to manage the complex interactions between climate change, marine pollution and ecological responses, aiming to mitigate HAB impacts on Singapore's coastal ecosystems and communities.

Keywords: *Karenia*, *Karlodinium*, fish-kills, HABs, Singapore

Session C5: Mitigation and management of harmful algal blooms

Harmful algal blooms in Sabah, Malaysia: an overview

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Abstract

In 2022, Sabah's fisheries and aquaculture sectors collectively achieved a positive trade balance of MYR1.45 billion. The Sabah Agriculture Blueprint (2021–2030) had acknowledged the significant potential for expanding the state's marine resources, anticipating a rapid increase in hatchery numbers. However, the fisheries and aquaculture industries were grappling with a major challenge: the prevalence of harmful algal blooms (HABs). Our research focused on these critical environmental and health issues affecting Sabah's coastal waters. This investigation served as an in-depth case study, examining the causes, seasonal patterns, and geographic spread of HABs, particularly noting their growing frequency and severity in Sabah's marine ecosystems. The primary aim of this study was to evaluate the negative effects of HABs on these ecosystems, with a special focus on the risks they posed to seafood safety. We proposed a range of strategies for the effective monitoring and management of HABs to mitigate their harmful impacts. Through this research, we sought to raise awareness and advocate for the adoption of comprehensive measures to address this escalating environmental challenge. Our findings provided vital insights into the complex nature of HABs. We emphasized the urgent need for integrated approaches to protect seafood security and public health in Sabah, highlighting the severity of this ongoing environmental challenge.

Keywords: harmful algal blooms, monsoonal variation, monitoring, seafood safety

Session C5: Mitigation and management of harmful algal blooms

Seasonal occurrence of harmful kareniacean dinoflagellates in Mombetsu, the northern coast of Hokkaido, Japan

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Abstract

Harmful algal blooms (HABs) have rarely occurred in the coastal waters of Hokkaido, and regular monitoring has been focusing on toxic dinoflagellates such as *Dinophysis* and *Alexandrium*. In 2021, a catastrophic bloom of an unarmored dinoflagellate *Karenia selliformis* in Hokkaido urged clarification of the presence of harmful kareniacean dinoflagellates in this region. In this study, metabarcoding was applied to ten-year weekly collected samples in Mombetsu, the northern coast of Hokkaido facing the Okhotsk Sea. Environmental DNA was collected by filtering seawater through a 1 µm membrane, extracted using 5% Chelex buffer and analyzed using three primer sets (18S, 28S and dino28S). Subsamples of seawater were analyzed for environmental parameters. In Mombetsu, water temperature ranged -1.7–23.4°C, salinity 20.1–34.2, nitrate concentration 0.01 to 24.6 µM L^{-1} and phosphate concentration 0.01 to 1.48 µM L^{-1}. Three genetic markers yielded slightly different results. A total of 28 OTUs were identified as kareniaceans, i.e., five *Karenia*, 14 *Karlodinium* (including three unidentified *Karlodinium*), seven *Takayama* (including a *Takayama* sp.) and two unidentified Kareniaceae. Only *Karlodinium veneficum* appeared every year. The constrained correspondence analysis (CCA) suggested that its occurrences were positively correlated to nitrate and phosphate ($p < 0.05$, Pearson) but negatively related to water temperature and chlorophyll *a* ($p < 0.05$, Pearson). Other frequently detected kareniaceans over the years included *Karenia mikimotoi*, *Karenia papilionacea*, *Karlodinium antarcticum*, *Karlodinium australe*, *Karlodinium decipiens*, *Karlodinium gentienii*, *Karlodinium jejuense*, *Karlodinium zhouanum*, *Takayama acrotrocha, Takayama helix* and *Takayama tasmanica*. Correlations of their occurrences with environmental factors were mostly insignificant, except for *Takayama* spp., which showed a positive correlation to temperature, and *Kl. zhouanum* which positively correlated with water temperature ($p < 0.05$). Our study also showed that *Kr. selliformis* was rarely detected in Mombetsu, suggesting that the *Kr. selliformis* that formed bloom in 2021 in Hokkaido did not originate from Tsushima warm current.

Long-term eDNA metabarcoding allows both the detection of small and scarce harmful dinoflagellates, and the chance to investigate their occurrence pattern due to environmental changes, as demonstrated in this study where the possible occurrences of *Kl. antarcticum*, *Kl. ballantinum*, *T. xiamenensis* and *T. tasmanica* in Hokkaido were first reported.

Keywords: environmental DNA, *Karenia*, *Karlodinium*, metabarcoding, *Takayama*

Unprecedented bloom of a harmful marine dinoflagellates *Tripos furca* (Dinophyceae) at the aquaculture area of Penang, Malaysia

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Abstract

Over the past decade, marine finfish aquaculture in Malaysia has been growing rapidly to meet the rising domestic and international food demand. However, the industry frequently suffered severe losses due to massive fish mortality attributed to various environmental issues, including harmful algal blooms. In May 2022, a remarkable bloom event with strong red discoloration was observed along the Penang Strait. The bloom was first detected on 28 May at Merbok estuary, and subsequently sighted at the northern side of Penang Island. Our field survey revealed a high-density algal bloom of a marine dinophyte *Tripos furca*. In this study, we examined the composition changes and bloom dynamics of *T. furca* in the Penang Strait from May to November 2022, covering 19 stations. Our results showed that the densities of *T. furca* varied spatio-temporally, and peaked at Aman Island during late June 2022 (8.2×10^5 cells L^{-1}). Also, metabarcoding of V7-V9 of the 18S ribosomal RNA gene (18S rDNA) revealed a high read abundance of *T. furca* amplicon sequence variants (ASVs), comprised 88% of the total ASV abundances. The blooms were associated with high water temperatures (29.5–31.6 °C) and pH (7.6–8.4). This study further confirmed the co-occurrence of other species during the bloom, including *Skeletonema* spp., *Thalassiosira* spp., *Chaetoceros* spp., *Coscinodiscus* spp., and *Lauderia* spp. Several HAB species including, *Akashiwo sanguinea*, *Dinophysis caudata*, and *Margalefidinium fulvescens, Pseudo-nitzschia* spp., *Alexandrium* spp., and *Prorocentrum* spp. Early detection of the blooms has successfully prevented severe economic losses to the aquaculture industry during the bloom event in the year 2022.

Keywords: environmental DNA, harmful algal blooms, finfish aquaculture, metabarcoding, *Tripos furca*

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High-throughput sequencing and imaging reveal a multispecies bloom of *Pseudo-nitzschia* in Bolinao, Pangasinan, Philippines

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Abstract

Studies showed that harmful algal blooms (HABs) are usually caused by co-occurring species within the same genera, a phenomenon also referred to as 'blooms within the bloom'. However, conventional microscopy approaches are limited in identifying and detecting such co-occurrences especially in cases where species are difficult to distinguish through their morphological landmarks. Here, high-throughput and high-resolution imaging and sequencing approaches were utilized to investigate the co-occurrence of multiple species of *Pseudo-nitzschia* (Pn) during a toxic bloom observed in Bolinao, Pangasinan. Cell counts showed that Pn-looking cells started to increase in the second week of May 2023, reaching peak abundance in the first week of June, and started to decline towards the second week of June 2023. High-throughput sequencing (HTS) targeting the V4 region of the 18S rRNA gene further showed potential succession of eight (8) different phylotypes of Pn, Meanwhile, four phylotypes did not cluster significantly with the recognized Pn species, indicating potential novel phylotypes. This was further confirmed by cloning of the 18S-ITS-28S rRNA, which generated sequences that are phylogenetically distinct from the rest of the reference sequences. Imaging Flow CytoBot coupled with machine learning was also used on different Pn-looking cells, which were used to determine potential factors influencing bloom dynamics using multivariate approaches. The application of high-throughput and high-resolution imaging as well as molecular methods provide fresh insights into the ecology of *Pseudo-nitzschia* in the Philippines, which will further help improve early warning systems and monitoring programs specifically for amnesic shellfish poisoning outbreaks.

Keywords: harmful algal bloom, *Pseudo-nitzschia*, IFCB, high-throughput sequencing

The economic analysis of harmful algal bloom (HAB) management: A case study

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Abstract

Harmful algal blooms (HABs) have received greater attention in recent years due to the increasing outbreak frequency and growing negative impacts, thus a scientific HAB management has been emphasized increasingly. Besides the measure and technology of mitigation, HAB management also involves the economic issues to balance mitigation efficiency, environmental impacts, costs, and stakeholder's needs, of which economic theory and method are playing significant roles. In this paper, we took the Modified Clay (MC) technology as a case study and conducted an economic analysis of HAB management from the three aspects of human health impact, the eco-environmental impact and the social impact. Based on relative economic theories, those impacts are valued reasonably and accurately. With the analysis of economic and technological feasibility of MC, a cost-benefit trade-off assessment model is set up eventually for scientific HAB management, which provides an essential guidance for the implementation of HAB mitigation and decision-making of stakeholders.

Keywords: Harmful algal blooms (HABs), Management, Mitigation, Modified Clay (MC)

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Environmental health study of Gili Matra Marine Tourism Park, Lombok, West Nusa Tenggara, Indonesia

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Abstract

Gili Matra Marine Tourism Park, hereinafter referred to as MTP Gili Matra, has an area of 2,954 Ha, consisting of 665 Ha of land and the rest is marine waters. Gili Matra Marine Tourism Park, is located in the coastal waters of North Lombok, West Nusa Tenggara Province and consists of three islands, namely Gili Meno, Gili Air and Gili Trawangan. Gili Matra Marine Tourism Park is a tourist destination for tourists from various countries. The economic life of coastal communities in Gili Matra Marine Tourism Park is highly dependent on tourism activities with the main attractions being swimming and diving at several coral reef and turbid coral spots. In order to maintain the sustainability for marine tourism-based economic life, it is deemed necessary to maintain the health of the aquatic environment and its aquatic ecosystem. This is also in accordance with the implementation of the SDGs point 14 program concerning conserve and sustainably use the marine resources for sustainable development. For this reason, the biophysical and chemical data of the aquatic environment has been collected from 16 stations at the Gili Matra Marine Tourism Park in 2022. The data was obtained from field surveys and analysis in the laboratory from 4 seasons (southeast monsoon, northwest monsoon, 2 transition seasons of southeast and northwest monsoon). These data need to be further processed to determine the environmental health level of the seawater based on the level of eutrophication and other environmental health indicators.

Keywords: environmental health study, Gili Matra Marine Tourism Park, Lombok, West Nusa Tenggara, Indonesia

Session C5: Mitigation and management of harmful algal blooms

The resilience of coastal and marine ecosystems to harmful algal blooms in Kamchatka (Russia)

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Abstract

The comprehensive studies of coastal and marine ecosystems of Kamchatka Peninsula are being held since 2021 to assess their sustainability to harmful algal blooming events and to various anthropogenic impacts. The annual offshore coastal surveys took place along the southeastern and southwestern coastal areas of Kamchatka. They included hydrobiological surveys at depths from 5 to 20 m using divers and dredgers, phytoplankton and zooplankton sampling, water and soil sampling for geochemical and toxicological analyses. Temperature, salinity, dissolved oxygen content, concentration of mineral and organic forms of phosphorus, permanganate index and many other water parameters were measured during the expeditions. Divers conducted quantitative studies of marine macrobenthos with photo/video surveys. At all stations, water samples were collected for genetic analysis of environmental DNA to identify species and concertation of toxic microalgae. The data collected during the expeditions confirmed that the main cause of mass mortality of marine organisms along the eastern coast of Kamchatka in September-October 2020 was a big HAB event. It is proposed that the HAB was caused by simultaneous and very intensive vegetation of several species of microalgae - mainly dinoflagellates from *Karenia*. It can be concluded that the benthic communities of the coastal water areas of southeastern and southwestern Kamchatka are gradually recovering. Nevertheless, there are now observed reorganizations of coastal communities of marine organisms by changing dominant species before and after the HAB of 2020. The species richness of coastal marine macrobenthos was estimated to 119 species from 22 taxonomic groups. Red and brown algae, ten-legged crustaceans, bivalves and gastropod mollusks dominated in terms of the number of species. Echinoderms, formerly one of the dominant groups in terms of abundance, are now represented by five species at sufficient densities to support populations: two species of regular spherical urchins, two species of sea stars and one species of ophiuroids. In addition to natural factors, we considered other potential environmental risks associated with anthropogenic impact on the unique nature of Kamchatka and its marine inhabitants. The assessment of the coastal marine environment revealed localized contamination with organic matter and phenols. Other pollutants such as heavy metals, persistent organic pollutants and radionuclides were at the background level and did not exceed sanitary and hygienic levels. This research was supported by the Russian Ministry of Science and Higher Education, project No. FZNS-2023-0020 “Assessment of ecological security of river and coastal aquatic ecosystems of Kamchatka”.

Keywords: *Karenia*, dinoflagellates, marine surveys, mass mortality, marine toxins

Coastal eutrophication and regional nutrient criteria: A case study in the Bohai Sea, China

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Abstract

Coastal eutrophication may cause harmful algal blooms, depleted dissolved oxygen, and loss of submerged aquatic vegetation and benthic fauna, leading to deteriorated coastal ecosystem and impairments for human use. Identifying trophic status shift and developing regional nutrient criteria were considered important for mitigation and management of coastal eutrophication. The trophic status has changed significantly in the Bohai Sea because of anthropogenic perturbations. The elevated nutrient levels combined with the resulting changes in nutrient structure have caused a series of ecological effects in the Bohai Sea. Phytoplankton biomass increased by 6-fold over the past half century, and red tides have occurred periodically and frequently since the 1990s. The community structure of phytoplankton as well as the dominant species of macrozoobenthos changed also. By applying the sequential t-test analysis of regime shifts and assessment of coastal trophic status models, four distinct periods of trophic status were identified in the Bohai Sea: unimpaired (1980–1989), minimally impacted (1990–1994), tipping point (1995–1999) and severely degraded (2000–2016). Using the reference conditions at different trophic status, a frequency distribution analysis was performed to develop candidate nutrient criteria. By considering other factors such as the quantity and quality of data and long-term nutrient variations, we determined the recommended values for nutrient criteria in the Bohai Sea. This study provides a novel and feasible approach to establish regional specific nutrient criteria for nutrient management in coastal waters.

Keywords: coastal eutrophication, nutrient criteria, Bohai Sea

Session C5: Mitigation and management of harmful algal blooms

Phytoplankton-virus dynamics during a toxic bloom in Bolinao, northwestern Philippines

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Abstract

Bolinao harmful algal blooms (HABs) are a significant public health and economic concern. They are attributable, in large part, to intensive marine aquaculture (mariculture) that leads to restricted circulation and eutrophication. Since the 2000s, annual recurrences of mostly diatom- or dinoflagellate-dominated HABs have occurred. Thus, it has been a multi-decade long effort to monitor, predict, and alleviate Bolinao HABs. It is paramount in HAB mitigation to understand the interaction of the phytoplankton and other microbial players, including viruses that can play a role in the bloom's demise and plankton succession. Thus, this study was implemented to examine the plankton and viral dynamics associated with Bolinao HABs. We employed a multi-faceted approach to monitor plankton and viruses during two seasons (Nov–Dec 2021 and Apr–May 2022) across an environmental gradient from a nutrient-rich mariculture site to a less eutrophic offshore site. Our sampling encompassed a saxitoxin HAB episode lasting almost three months (April–June 2022) and a fish kill event (May 15–16, 2022). We utilized complementary methods to identify the dominant phytoplankton and red tide species, specifically, a low-cost flow camera (PlanktoScope) and 18S rRNA amplicon sequencing. The PlanktoScope allows estimates of cell counts, albeit at low taxonomic resolution, while 18S rRNA gene sequencing allows higher taxonomic resolution but only provides relative abundances. Of the saxitoxin-producing alga, we observed the presence of *Alexandrium* sp. in both the PlanktoScope and 18S sequencing that coincided with the Bureau of Fisheries and Aquatic Resources (BFAR) toxin alert. Furthermore, we observed diverse morphologies of viral-like particles (VLPs), including tailed and non-tailed small VLPs and "giant" icosahedral viruses (~170-200 nm capsid diameter). We focus on the latter type of virus-like particles called "giant viruses" since they putatively infect phytoplankton. We collected cells and viruses, which were then subjected to DNA extraction and metagenomic sequencing. Through binning to construct GV-MAGs (giant virus metagenome-assembled genomes), we showed that the diversity of giant viruses putatively infecting phytoplankton across our time series and environmental gradient belonged to the families Phycodnaviridae and Mimiviridae. These giant viruses encode diverse auxiliary metabolic genes that might confer host or virus advantage in a eutrophic environment, such as those involved in transporter systems, galactose degradation, polysaccharide lyases, and sulfate reduction. The diversity and spatiotemporal dynamics of plankton and their viruses described in this study further expand our understanding of biological controls of HABs.

Keywords: harmful algal bloom, giant virus, Bolinao, PlanktoScope, metagenome

Rapid detection technology for harmful algal blooms in the West Pacific Region

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Abstract

In the past decades Harmful Algal Blooms (HABs) have expanded globally and drawn a great attention of coastal countries worldwide, because of their multiple effects on marine ecosystems and the public health. The HABs studies have been done much in the last several decades, especially on their taxonomy, biodiversity and geographical distribution. However, there still remains a big gap towards the early warning and effective management of HABs, especially in the West Pacific Region. With the scientific and technological progress, molecular probe or diagnosis has been significantly developed. Remote sensing can also be applied in many fields with a high resolution. Although more and more new rapid detection technologies for HAB were developed, there is still some distance for the application of these technologies to HAB monitoring and detecting on an operational level, due to technical constraints of each technology, such as efficiency, accuracy, manpower. Here, we share the knowledge on the latest studies on the rapid detection technology for HABs, and wish the more HABs researchers can starting the co-works.

Keywords: rapid detection technology, harmful algal blooms, West Pacific Region

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Application of modified clay in enclosed aquaculture ponds, beyond HAB control

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Abstract

The problems recorded in enclosed aquaculture ponds can be categorized into multiple aspects, including deterioration of water quality, invasion of pathogenic organisms, imbalance of phytoplankton structure, etc., beyond the frequent occurred harmful algal blooms (HABs). Those problems have attracted extensive attentions from aquaculture stakeholders of China, as yield and quality of cultured organisms are strongly influenced consequently. Aiming at the regulation of biological and environmental factors in such enclosed ponds, a new series of functional Modified Clay (MC) products was developed, and was initially applied in shrimp (*Penaeus vannamei*) culture ponds of Dongying city, based on multi-scale tests and demonstrations on both effect and safety since 2020. It's proved that the frequently occurred harmful blooms in aquaculture ponds, e.g., *Heterosigma akashiwo* dominated blooms, could be effectively controlled by MC, while the diversity of other species benefiting cultured organisms would be improved, thus the community structure is regulated normal. In the meantime, the water quality can be regulated because of the absorption of nutrients threating the health of cultured organisms, like ammonia and nitrite. The concentration of organic compounds, e.g., the TOC, could be declined as much as 60%. Moreover, the invasion and proliferation of harmful micro-organisms, like vibrio, can be inhibited by MC addition. As a result, an apparent increasing trend of shrimp yields was recorded among varied MC controlling ponds in field, and the difference could be enlarged almost 10 times between each. Being accepted by the stakeholders, new functional MC products have been widely applied in aquaculture ponds in several cities of Shandong provinces, like Dongying, Qingdao, Rizhao, etc. In summary, MC is a promising solution to the problems being recorded in enclosed aquaculture ponds, and has the potential to be widespread in such aspect further.

Keywords: functional modified clay, enclosed aquaculture ponds, regulation yield

HABs Watch: learnings from a concerted and coordinated archipelagic understanding of harmful algal blooms in the Philippines for mitigation and management

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Abstract

The Philippines has been tagged as one of the 'hotpots' for harmful algal blooms (HABs) in Southeast Asia due to the pervasive and expanding occurrence of HABs events in the country. However, most studies on HABs and phytoplankton ecology in general have remained limited both in technology used and in terms of geographic/temporal scope, with most sampling efforts focused on certain localities. This results in our limited understanding on the ecology of the different HABs species at an archipelagic scale, and in turn, in designing large scale monitoring efforts. The HABs Watch project is a consortium of eight universities belonging to different biogeographic regions in the country doing concerted and coordinated periodic sampling using the same techniques and analytical methods with the goal to understand HABs ecology at large temporal (annual) and spatial (archipelagic) scales. It also adopted new technologies to aid in processing and analysis such as the use of high throughput sequencing (molecular) and Imaging Flow Cytobot (IFCB) coupled with machine learning. Analysis of current information dissemination tools for effective public alerts and announcements were also evaluated. This collaboration resulted in establishment of new culture collections used to understand ecology, identification of potential new species that are of threat, upgrading of capacity for identification and monitoring to help in local efforts, increased understanding of HABs ecology in localities, strengthened coordination with local governments for information sharing, and stronger collaborations among local stakeholders and scientist, among others, to mitigate and manage the effects of HABs in their local communities. Implications and insights from these learnings will then be discussed.

Keywords: harmful algal blooms, Philippines, IFCB, monitoring, management

Session C5: Mitigation and management of harmful algal blooms

Efforts on HAB mitigation in a HAB hotspot, the Eastern Visayas, Philippines

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Abstract

It has been almost 40 years from the first report of Paralytic Shellfish Poisoning in Eastern Visayas, Philippines. This region is the most affected region in the country in terms of PSP cases and red tide bans. This is caused by the dinoflagellate, *Pyrodinium bahamense*. From the year 2015, Harmful algal blooms (HABs) and the consequent shellfish bans have occurred almost monthly here, shifting from one bay to the other, in the waters of the different islands that comprise the Eastern Visayas region. These red tide bans are sometimes prolonged to almost half a year. The mussel farmers are severely affected. The past, present and future efforts to address the problems brought about by these blooms in the region will be showcased. The results of a recently concluded two-year program funded by the Philippine government to find solutions and mitigate the impact of HABs in this part of the country will be presented. Since the Bureau of Fisheries and Aquatic Resources (BFAR) monitors only *Pyrodinium bahamense*, there is paucity of data on physico-chemical parameters and other co-occurring phytoplankton, especially other HAB causing species. Thus, a database on seasonal variability of phytoplankton community was established. Experiments to capture blooms by diatomite clay that were done in the laboratory set up proved to be successful. In addition, cyst maps, for five bays in the region were made. Knowledge, beliefs and practices of people living with HABs were acquired to facilitate communication with communities the hazards caused by PSP. Information and education materials in print and video forms were produced to address the misconceptions of people living with HABs. Long term programs are necessary to minimize the impacts of HABs in this region, and the whole Philippines.

Keywords: paralytic shellfish poisoning, HAB mitigation, monitoring, *Pyrodinium bahamense,* HAB impact

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Session C5: Mitigation and management of harmful algal blooms

Diatoms as a potential regulator of a *Margalefidinium* sp. bloom in Sabah during 2018

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Abstract

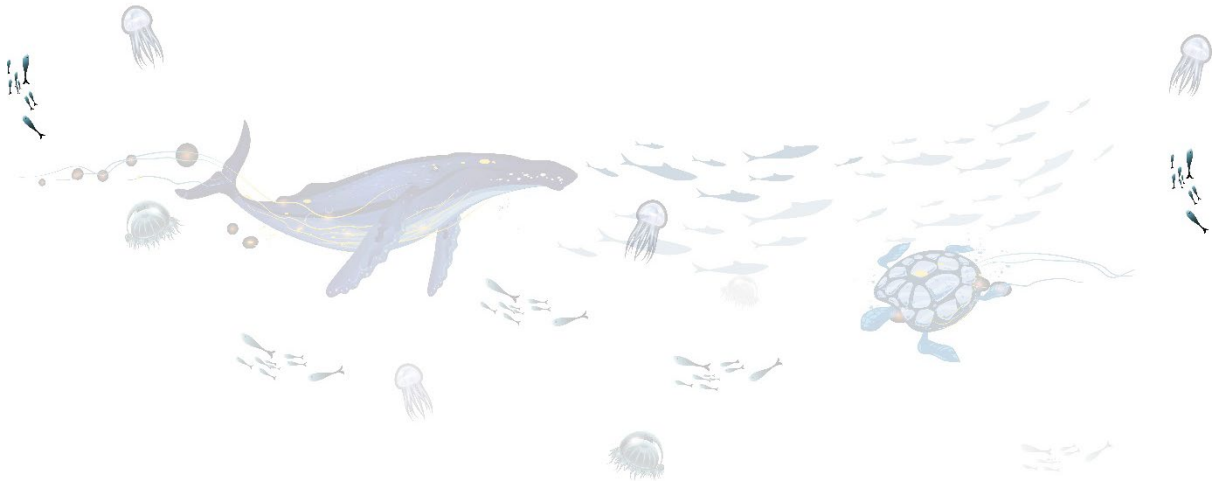
Marine waters especially around Southeast Asia typically exhibit high levels of phytoplankton biodiversity. Accordingly, bloom occurrences in some countries like Singapore occur as a sequence of different causative species. Some species, however, are known to be highly recurrent once they have established within the waters. *Margalefidinium polykrikoides* (previously *Cochlodinium polykrikoides*) is a problematic bloom-forming taxon in many countries around the world including South Korea and North America. The species is known to be toxic to marine organisms, but the mechanism of toxicity is not well-characterised. In Southeast Asia, *Margalefidinium polykrikoides* blooms have also been associated with mass fish-kill events. Accordingly, this study therefore aimed to examine the water conditions of Sepanggar Bay, Sabah, leading up to a bloom occurrence in November 2018. Daily point sampling was carried out at approximately 24-hour intervals, and this effort was supplemented by a total of five transect measurements across the bay area. Two of these were carried out prior to the bloom, and three were during the bloom event. In general, the bloom occurred and spread across the bay in patches, with concentrations across the bay waters ranging from below detection limit to a maximum of 3.6×10^6 cells mL^{-1} on 13 November. It was possible that prevailing wind patterns might have driven the heterogeneity. Prior to the bloom occurrence, we observed a persistent decline in diatom concentrations from around 1.2×10^6 cells mL^{-1} on 29 October to around 500 cells mL^{-1} on 11 November (i.e., one day before the bloom was recorded). Accordingly, silicate concentrations declined from around 16µM-Si on 7 November (pre-bloom) to around 7µM-Si on 12 November (i.e., start of the bloom). On 15 November, we observed a sharp elevation in silicate concentrations to >50µM-Si near a river mouth, at the Eastward side of Sepanggar Bay, downwind of the prevailing wind during the sampling period. This spike in silicate coincided with a bloom of *Cylindrotheca* sp. diatoms (around 25×10^6 cells mL^{-1}), indicating a potential pattern of recovery. These results therefore demonstrated very transient and sudden bloom occurrences within Sepanggar Bay that seem to be driven by diatom productivity. Prevailing winds and the open waters of the environment likely resulted

in the patchy movement of the bloom across the bay. More broadly, closer study is needed to identify whether Sepanggar Bay is intrinsically prone to *Margalefidinium polykrikoides* blooms, or whether the source of cells might be further upwind.

Keywords: *Margalefidinium polykrikoides*, diatoms, harmful algal bloom, Sabah, fieldwork

Sub-theme C:
Ocean and Human Health

Session C6:
Marine toxins and seafood safety



Programme

Venue: Kensington B, 5th Floor
Date: 23 April 2024

Conveners:
Dao Viet Ha Institute of Oceanography, Vietnam
Wu Jiajun City University of Hong Kong, China

Time	Presentation Titles	Speakers
Section 1		
10:00–10:15	Phthalic acid esters (PAEs) and food safety in Viet Nam: A case study in Khanh Hoa province	Xuan-Vy Nguyen, *Institute of Oceanography, VAST, Vietnam*
10:15–10:30	A latest noticeable phenomena in widespread dispersal of lipophilic marine phycotoxins in the representative tropical coral reef areas, China	Liu Yang, *Chinese Academy of Sciences, China*
10:30–10:45	Embryonic development toxicity in marine medaka (*Oryzias melastigma*) caused by brevetoxins	Xian Qin, *City University of Hong Kong, China*
10:45–11:00	Rapid toxin screening and characterization of new toxins from *Gambierdiscus balechii* via mass fragmentation analysis	Xiaowan Liu, *City University of Hong Kong, China*
11:00–11:15	The occurrence, trophodynamics, and potential health risks of marine lipophilic phycotoxins in coral reef fish of representative small island developing states	Jingyi Zhu, *City University of Hong Kong, China*
11:15–11:30	Microbial in seafood spoilage	Pham Thi Mien, *Institute of Oceanography, VAST, Vietnam*
11:30–11:45	Diversity of benthic harmful dinophytes revealed by eDNA metabarcoding coupled with artificial substrate sampling method	Nur Syazwani Kassim, *University of Malaya, Malaysia*
11:45–12:00	Frequent occurrence of Tetrodotoxin in the marine gastropod *Nassarius glans* causing a food poisoning in Khanh Hoa province, Vietnam	Khanh Hy Le Ho, *Institute of Oceanography, Vietnam*

Phthalic acid esters (PAEs) and food safety in Viet Nam: A case study in Khanh Hoa province

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Abstract

Microplastic pollution is a global problem that revealed a critical impact on food safety. PAEs were used as important plasticizers in industrial processes of plastic production. During plastic aging, PAEs were naturally released to the environment. Unfortunately, PAEs are a certain risk to the human body. Via food chains, PAEs were accumulated in our body finally. This present study shows the PAEs concentration including dimethyl phthalate (DMP), diethyl phthalate (DEP), dibutyl phthalate (DBP), butyl benzyl phthalate (BBP), di(2-ethylhexyl) adipate (DEHA) and di(2-ethylhexyl) phthalate (DEHP) in seawater, marine sediment and five species of seafood along the coast of Khanh Hoa, Viet Nam were evaluated by GC-MS/MS at The Marine Toxins and Seafood Safety-Research, and Training Center (MTSS.RTRC), Nha Trang, Viet Nam. The results indicated that very low or no detection of PAEs in seawater. However, PAEs highly accumulated in the marine sediment, and DEHP occupied more than 95%. For seafood species, the mussels *Marcia hiantina* showed highest accumulation of DEHP with 1,667µg/kg, following by Snubnose pompano fish - *Trachinotus blochii* (609 µg/kg), shrimp *Litopenaeus vannamei* (18.96 µg/kg) and finally the snail *Babylonia areolata* (6.94 µg/kg). Sites of industrial activities showed higher DEHP concentrations in both marine sediment and seafood than site of aquaculture. Therefore, data of PAEs found from this present study generated herein raises a challenge for immediate plastic pollution management and seafood safety in Viet Nam

Keywords: DEHP, PAEs, seafood safety, Viet Nam

Session C6: Marine toxins and seafood safety

A latest noticeable phenomena in widespread dispersal of lipophilic marine phycotoxins in the representative tropical coral reef areas, China

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Abstract

Lipophilic marine phycotoxins (LMPs) are toxic and hydrophobic natural substances primarily produced by toxigenic dinoflagellates, human prolonged low-dose exposure to potent LMP components can have various adverse health effects. Previous studies have mainly focused on the presence and harmful effects of LMPs in coastal waters that are prone to harmful algal blooms due to eutrophication. However, our current understanding of the distribution of potent LMP components in remote oligotrophic coral reef ecosystems is still limited. To address this knowledge gap, field seawater, phytoplankton, and benthic shellfish samples closely reflected the occurrence of phycotoxins in the marine ecosystem were collected and analyzed in the Xisha, Zhongsha, and Nansha Islands areas of the South China Sea (SCS) from 2019 to 2021. The study aimed to uncover the presence of LMPs that might exist but have not yet been discovered in these offshore tropical reef ecosystems. The analysis utilized solid-phase extraction combined with high-performance liquid chromatography-tandem mass spectrometry (SPE-HPLC-MS/MS) to detect and quantify LMPs. The results revealed that LMPs were stably and evenly dispersed in the aquatic environment of coral reefs. The most predominant toxin component detected in seawater samples was OA toxin, followed by PTX2 and GYM, but toxins YTX, homo-YTX, DTX1 and AZA2 were with occasionally detection rate. In contrast, phytoplankton samples from the same areas showed extremely low levels and limited toxin components (OA, PTX2, homo-YTX, and YTX) in a small proportion. Benthic shellfish samples indicated that marine organisms may be exposed to low doses of toxic phycotoxins over an extended period. Although information about multiple toxigenic algal species was sensitively provided through high-throughput sequencing (HTS) in oceanic environment, no captured images of toxigenic algal cells and low biomass of dinoflagellates based on CHEMTAX analysis for diagnostic pigment components in phytoplankton samples, this suggests that the stability components of LMPs are more certain to be present in the hydrographic environment. Analyzing phycotoxins dispersed in the aquatic environment is therefore an appropriate and effective approach to understand the widespread distribution of LMPs in remote oligotrophic coral reef waters. The study provides valuable insights into the distribution extension of LMPs in aquatic ecosystems and their potential migration behavior in coral reef ecosystems away from the Asian mainland. These findings can serve as a scientific basis for ecological risk assessment in the global marine environment.

Keywords: lipophilic marine phycotoxins; seawater; SPE-HPLC-MS/MS; coral reef areas; the South China Sea

Embryonic development toxicity in marine medaka (*Oryzias melastigma*) caused by brevetoxins

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Abstract

Harmful algal blooms (HABs), due to climate change and eutrophication, have become significant problems worldwide and lead to socioeconomic and health issues in society. Oxygen depletion, algal toxins, and gills-related disruptions are three main ways HABs affect marine life and potentially human health via the food chain. Among these proposed mechanisms, some studies have been related to hypoxia induced by oxygen depletion. However, there are fewer studies about algal toxins, such as azapiracids (AZAs), brevetoxins (BTXs), and ciguatoxins (CTXs), especially for their underlying molecular mechanisms. In this study, three BTXs were selected for toxicological exposure, including BTX-2B, BTX3, and BTX9. Newly fertilized marine medaka (*Oryzias melastigma*) embryos were used for 7-day exposure. The whole process of embryogenesis was observed and recorded for the assessment of impacts in embryonic development induced by BTXs, with endpoints such as embryo developmental rate, heart rate, survival rate, hatching rate, and larval locomotion. Our results suggested that BTX-2B, BTX3, and BTX9 would stop embryonic development before the appearance of fish bodies at concentrations of 440, 10, and 1 ng/L, respectively. The heart rate was significantly reduced by BTX-2B at the concentration of 44 ng/L. The hatching rate also showed a decreasing trend after BTXs' exposure. Further transcriptomic data analysis will be conducted in the larvae to explore the mechanisms of BTXs-induced impairments in embryonic development. Summarily, our study provides a comprehensive assessment of the impairments in embryos induced by BTXs.

Keywords: harmful algal blooms, brevetoxins, embryo development, heart rate, hatching

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Rapid toxin screening and characterization of new toxins from *Gambierdiscus balechii* via mass fragmentation analysis

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Abstract

Gambierdiscus is a genus of marine autotrophic epi-benthic dinoflagellate that grows on the surface of macroalgae, corals, and sand grains. This dinoflagellate has gained scientists' attention due to its production of ladder-shaped polyether toxins, including ciguatoxins (CTXs), maitotoxins (MTXs), gambierones, gambierol, gambieric acids, and gambieroxide. Most of these toxins can bioaccumulate in the food chain, and the consumption of fish or shellfish contaminated with these toxins can cause ciguatera food poisoning (CFP), which is the most common non-microbial food-borne illness occurring in the tropical and subtropical regions of the world. However, the commercially available standards for them are limited, which hinders the advancement of toxin analysis methods resulting in numerous toxins escaping from detection, especially unknown ones. This situation poses challenges in assessing the risk of toxins and managing fisheries in relation to controlling the CFP. In this study, we applied high-performance liquid high-resolution mass spectrometry (HPLC-HRMS) with the assistance of computational tools to investigate the toxin profile of *Gambierdiscus balechii* 1123M1M10, which was isolated from Marakei Island, Republic of Kiribati, located in the central Pacific Ocean. We also identified six toxins, including four novel toxins named 12,13-dihy-dro-44-methylgambierone, 38-dehydroxy-44-methylgambierone, 38-dehydroxy-12,13-dihydro-44-methylgambierone, and desulfo-hydroxyl gambierone, and two known compounds, gambierone and 44-methylgambierone from the *G. balechii* 1123M1M10.

The occurrence, trophodynamics, and potential health risks of marine lipophilic phycotoxins in coral reef fish of representative small island developing states

Jingyi Zhu [1, 2], Jiajun Wu [1, 3], Xiaowan Liu [1, 2], and Leo Lai Chan [1, 2, 3]

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Abstract

The United Nations recognizes Small Island Developing States (SIDS) as a unique category of developing nations due to their small size, restricted resources, and vulnerability to diverse environmental and economic risks. Marine lipophilic phycotoxins (MLPs) can have detrimental effects on SIDS that heavily depend on the fisheries industry for food and revenue, as they can raise food safety concerns and cause economic loss. The Republic of Kiribati was selected as one of the representative SIDS in our study, and 17 representative MLPs, including ciguatoxins (CTXs), azaspiracids (AZAs), brevetoxins (BTXs), gymnodimine (GYM), spirolides (SPXs), okadaic acid (OA), dinophysistoxins (DTXs), pectenotoxins (PTXs), and yessotoxins (YTXs), were investigated to assess potential risks in 55 coral reef fish species. Our results showed that CTXs remained the predominant MLPs, ranging from 0 to 42 ng/g ww, and fish species containing CTXs might be considered harmful for human consumption, with an Estimated Daily Intake value of 3.18 ng/kg/day. The presence of brevetoxin-3, okadaic acid, dinophysistoxin-1, and dinophysistoxin-2 were first reported but the results of the hazard quotient indicated negligible health risks associated with these toxins. MLPs exhibited biomagnification with a trophic magnification factor of 2.30. Our correlation analysis suggested policymakers cannot use fish body size or tropic position as a threshold to prevent contaminated fish. In conclusion, the present study reveals a more complex contamination status of MLPs in Kiribati, posing a new concern for food safety and fisheries management.

Keywords: ciguatoxins; okadaic acid; dinophysistoxins; biomagnification; risk assessment.

Microbial in seafood spoilage

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Abstract

Seafood products including of fish, shellfish, and crustaceans are highly susceptible to spoilage due to microbial growth and metabolism. Recently studies have been reported that the spoilage of seafood has crucial relative to associated microbial consortia. The associated microbial with fish, shellfish, and crustaceans varies considerably during storage and influenced by many factors (e.g., aquaculture environment, processing handling, storage temperatures, storage specifications, and various quality control techniques). In this review, we collect and present the relationship between microbial composition and seafood, prove the factors affecting to the microbiota living with seafood, outline the mechanism which caused seafood spoilages. In addition, some preservation techniques and warning of seafood poisoning caused by microorganisms are also outlined.

Keywords: microbial consortia, seafood spoilages, caused and prevent

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Session C6: Marine toxins and seafood safety

Diversity of benthic harmful dinophytes revealed by eDNA metabarcoding coupled with artificial substrate sampling method

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Abstract

Harmful algal blooms in the benthic system (BHAB) have emerged as a significant environmental concern on a global scale, given the fact that their incidence continues to rise in the face of global climate change. However, monitoring the public health risks posed by BHAB as a result of ciguatera (CP) and palytoxin (PlTX) poisonings was hampered by a lack of viable and reliable sampling methods. For BHAB research, the key research question remains unresolved on the understanding of the spatial-temporal dynamics of BHAB species in CP hotspot areas, and the relationships with the benthic community, the substrates where the BHAB species inhabit. This study was conducted to investigate the molecular diversity of BHAB community assemblages on a fringing reef of Perhentian Islands, Malaysia by applying DNA metabarcoding method utilizing the artificial substrate sampling method (AS). We evaluated the potential of this application in quantitative species representation and compared the effectiveness of AS and natural substrate (NS) sampling methods. Our findings showed that the method is highly sensitive in the identification of BHAB species, with a higher taxonomic resolution, especially on the BHAB-targeted taxonomic groups, including *Coolia, Prorocentrum*, *Amphidinium*, and the taxonomically difficult genera of *Gambierdiscus* and *Ostreopsis*. High abundances of *Amphidinium* and *Ostreopsis* were detected, with 3.6 and 2.4×10^7 ASV reads per 100 cm^2, respectively. We also discovered several new records of benthic dinophytes. Strong correlations were observed for *Ostreopsis* between microscopic cell counts and ASV reads per 100 cm^2. Total cell densities collected on the screens ranged from 38 to 12,487 cells per 100 cm^2. Furthermore, the genetic diversity of toxic ribotypes of *Ostreopsis ovata* was revealed by this approach. Our results revealed that the molecular approach coupled with the AS sampling method is useful for BHAB monitoring in areas with high risk of CP or BHAB-related poisoning.

Keywords: artificial substrate, benthic harmful algal bloom (BHAB), ciguatoxin, Malaysia, palytoxin

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Frequent occurrence of Tetrodotoxin in the marine gastropod *Nassarius glans* causing a food poisoning in Khanh Hoa province, Vietnam

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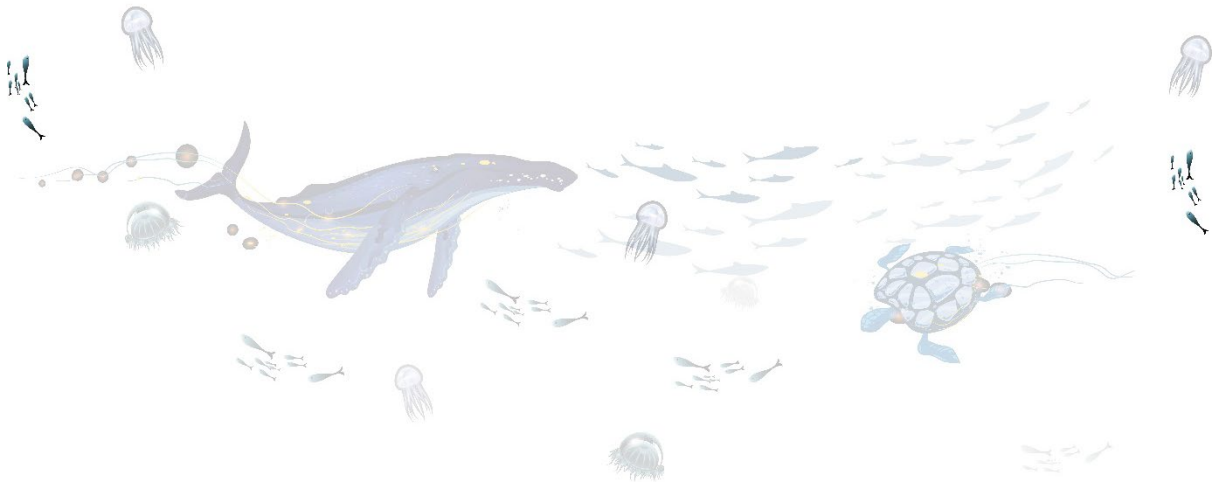
Abstract

After 3 hours of eating a certain number of marine gastropods, one of the 3 patients died and this fatal neurotoxic poisoning case happened in Khanh Hoa province in 2020. These marine gastropods were later identified as *Nassarius glans*, one of the common marine gastropods in Vietnam. LC/MS-MS analysis detected a certain level of TTX and its derivatives (Anh-TTX and 4epi-TTX) were also found in all of 62 specimens of remaining causative food in the incident. 100% of studied specimens exhibited toxicity (556±821 MU/g) beyond the regulatory level of consumption (10 MU/g) for puffer(fish) recommended in Japan. The result pointed out that only 5 g of soft tissue from *N. glans* (equivalent to 2–3 specimens) containing maximum toxicity detected in the present study may cause human death if consumed. For the first time, this study identified TTXs in the gastropods as a causative toxin in the poisoning in Vietnam. Moreover, 64.5% of studied specimens with toxicity higher than 100 MU/g, including 16.1%, showing extremely high toxicity (>1000 MU/g). The results suggested that this gastropod is quite dangerous for human consumption and should be stronger public awareness.

Keywords: LC/MS-MS, *Nassarius glans*, poisoning, Tetrodotoxin, Vietnam

Sub-theme C:
Ocean and Human Health

Session C7:
Harmful jellyfish in the Southeast Asian region:
Networking across the oceans



Programme

Venue: Jubilee A, 11th Floor
Date: 22 April 2024

Conveners:
Aileen Tan Shau Hwai — Universiti Sains Malaysia, Malaysia
Ahmad Khaldun Ismail — Hospital Canselor Tuanku Muhriz UKM, Malaysia

Time	Presentation Titles	Speakers
Section 1		
10:30–10:45	Jellyfishes (Cnidaria: Medusozoa) reported from the first-ever systematic jellyfish survey carried out in the coastal waters of Sri Lanka	Krishan D. Karunarathne, *Wayamba University of Sri Lanka, Sri Lanka*
10:45–11:00	First recording of the ctenophore *Bolinopsis* sp. (Ctenophora, Bolinidae) in Bali coastal waters, Indonesia	Widiastuti Widiastuti, *Universitas Udayana Kampus Bukit Jimbaran, Indonesia*
11:00–11:15	Jellyfish biodiversity in the southeast coast of Bangladesh	Sadia Sultana, *University of Chittagong, Bangladesh*
11:15–11:30	Fatal jellyfish envenomation in Sabah from 2006 to 2022	Muhamad Naim Bin Ab Razak, *Hospital Lahad Datu, Malaysia*
11:30–11:45	Managing an unidentified jellyfish sting with significant clinical effects at a non-coastal hospital	Naresh Kumar Sivanasworn, *Universiti Kebangsaan Malaysia, Malaysia*
11:45–12:00	Indonesia first aid and traditional first aid	Tri Maharani, *Ministry of Health, Indonesia*
12:00–12:15	The jellyfish (Medusae) monitoring & blue citizenship outreach program in the tourist attractions of Penang, Malaysia	Sim Yee Kwang, *CEMACS, Universiti Sains Malaysia, Malaysia*
12:15–12:30	JellyGo: bridging science and application through an in-situ-based jellyfish abundance prediction model	E Chern Wong, *Universiti Malaya, Malaysia*

Jellyfishes (Cnidaria: Medusozoa) reported from the first-ever systematic jellyfish survey carried out in the coastal waters of Sri Lanka

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Abstract

Jellyfish, belonging to the Hydrozoa and Scyphozoa, exert ecological and socioeconomic impacts globally. In Sri Lanka, only two jellyfish species (*Crambionella orsini* and *Lobonemoides gracilis*) are currently harvested. Additionally, three species (*Acromitus flagellatus, Cassiopea andromeda,* and *Chrysaora* cf. *caliparea*) are utilised in the aquarium industry, and two species (*A. flagellatus* and *Lychnorhiza malayensis*) serve as live bait in trap net fishery. However, ten species (*Alatina alata, Chironex* cf. *indrasaksajiae, Chiropsoides buitendijki, Chrysaora* cf. *caliparea, Cyanea* cf. *buitendijki, Cyanea* cf. *nozakii, L. gracilis, Pelagia* cf. *noctiluca, Physalia physalis*, and *Rhopilema hispidum*) pose hazards to humans. Additionally, the regular clogging of jellyfish into nets is reported to diminish commercial fish catches in Sri Lanka. Despite these impacts, jellyfish species, their abundance, and distribution remain poorly understood due to the absence of taxonomic and population studies. To address this gap, a comprehensive, year-round jellyfish survey named "*Waya-jel*-Survey" was conducted at 205 sampling stations in the coastal waters of Sri Lanka from 2016 to 2020. The survey collected more than 2000 specimens representing 40 species using a towed net, scoop nets, and various commercial fishing gears. The specimens were taxonomically identified using keys. The collection included 18 species from five hydrozoan orders (3 anthoathecates, 12 leptothecates, one limnomedusa, one siphonophore, and one trachymedusa) and 22 species from two scyphozoan orders (4 cubomedusae and 18 discomedusae). Notably, twenty-five species were identified as the first records for Sri Lankan waters, and a novel cubomedusa species*, Carybdea wayamba*, was described. Additionally, a few taxa reported only up to the genus level appear to be novel species, with detailed descriptions planned for upcoming studies. These taxonomic findings contribute to understanding the geographic distribution of jellyfish species in the central Indian Ocean, extending from the western Pacific region, which is known for its rich jellyfish diversity.

Keywords: Indo-Pacific, marine stingers, medusae, morphology, siphonophores

First recording of the ctenophore *Bolinopsis* sp. (Ctenophora, Bolinidae) in Bali coastal waters, Indonesia

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Abstract

Ctenophores are poorly known in the tropical West Pacific, including Indonesia. The ctenophores were collected by scooping from a boat in the surface water of Selini Beach on the north coast of Bali Island, Indonesia, in April 2021. According to the morphological features, they were *Bolinopsis vitrae* and *B. rubripunctata*. However, molecular identification using the nuclear 18S rRNA gene, internal transcribed spacer region I region (ITS1), and 16S rRNA gene and BLAST search revealed that the sequences were closely related to *B. ashleyi* and *Bolinopsis* sp. subsequently. Moreover, neither species of *Bolinopsis* spp. was reported to inhabit the West Pacific waters. Therefore, further studies are needed in order to confirm its identities. This finding is significant in establishing the status of these species in Indonesian waters, as there was no recorded distribution in these regions. The *Bolinopsis* spp. preferred prey are zooplankton, eggs, and small fish larvae. Thus, the status of *Bolinopsis* spp. in this region should be monitored for its harmful potency towards socio-ecology.

Keywords: ctenophore, *Bolinopsis*, Bali Island, Indonesia

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Jellyfish biodiversity in the southeast coast of Bangladesh

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Abstract

Jellyfish are members of planktonic communities and well-known as key components of the ocean ecosystem because of their negative impacts on fisheries and tourism. Despite their ever-increasing socio-economic role, data on the jellyfish diversity, abundance and distribution are scarce from the northern Bay of Bengal. Here, we report on different types of jellyfish species found in the southeast coast of Bangladesh. A total of 22 jellyfish specimens belonging to six species and five genera were studied. Of these, two species namely *Marivagia stellata* and *Phyllorhiza punctata* were reported for the first time from Bangladesh marine waters. The white spotted jellyfish, *P. punctata* is recognized as highly invasive, with a history of invading tropical and subtropical marine environments. There was an edible jellyfish *Crambionella annandalei*, which was recognized as a common bloom-forming jellyfish species in the area. Moreover, two species of crowned jellyfish, *Netrostoma* spp., as well as *Lychnorhiza malayensis* useful as fish bait were identified. The results of this study will enhance our knowledge about the jellyfish's distribution and species composition in the Asia-Pacific region.

Keywords: cnidaria, jellyfish, Bay of Bengal, new record, plankton

Session C7: Harmful jellyfish in the Southeast Asian region: Networking across the oceans

Fatal jellyfish envenomation in Sabah from 2006 to 2022

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Abstract

The phylum cnidaria consists of over 11000 species from class Anthozoa, Cubozoa, Hydrozoa, and Scyphozoa, with an estimated 100 species of them known to be harmful to humans. It has been estimated that 150 million cases of jellyfish sting occur per year globally, with 20-50 deaths particularly following chirodropid box jellyfish envenomation. There are many unverified reports regarding children from various states of Sabah being stung by unidentified jellyfish and died. Unfortunately, most of the victims were not brought to the hospital, and the events were not documented. Furthermore, jellyfish sting incidents are not classified as mandatory notifiable diseases. The true burden of the issue could be underestimated. There is scarce data available with regard to jellyfish sting cases and deaths in Sabah. This is a retrospective analysis based on a literature review, newspaper archives, medical reports, post-mortem records, and records from referrals for nematocyst skin sampling analysis for jellyfish species identification following sting death cases conducted from 2006 to 2022. Our review finds that six fatalities involving children have been recorded from 2006 to 2022 and attributed to multi-tentacled box jellyfish envenomation. Most of the deaths can be prevented if early preventive measures, appropriate first aid, and cardiopulmonary resuscitation are instituted. Clinical presentation, examination of tentacle lashes imprinted on victims' skin, nematocyst skin sampling, and knowledge of jellyfish species endemic to Sabah coastal water can aid in the verification of jellyfish stings.

Keywords: *Chironex* sp., marine envenomation, fatal jellyfish sting

Managing an unidentified jellyfish sting with significant clinical effects at a non-coastal hospital

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Abstract

Jellyfish stings are the most common cause of marine envenomation in humans. Various species of box jellyfish have been identified around Penang Island, Malaysia, and these include multitentacled and four tentacled box jellyfish (class Cubozoa). The typical syndrome following envenomation from these jellyfish has been poorly documented, posing a greater challenge when managing an unidentified jellyfish sting from Penang Island. We report a case of a 32-y-old man from Penang Island who was stung by an unidentified jellyfish while walking into the sea. The patient reported that he felt an immediate and severe electric current–like pain over both thighs, left flank, and left forearm, followed by chest discomfort and breathlessness. Vinegar was applied over the affected areas, and he was rushed to a hospital, where he was treated with analgesia, steroids, and antihistamine. He refused hospitalization and was discharged against medical advice. He then presented to a noncoastal hospital 377km south in Kuala Lumpur on the following day with severe pain over the affected sites as well as chest discomfort, shortness of breath, and abdominal cramps. The electrocardiograph demonstrated features of Wolff-Parkinson-White. Serial blood test results showed elevated creatine kinase but normal troponin I levels. The patient was managed symptomatically over a period of 4 days and was discharged with cardiology follow-up. Appropriate health-seeking behavior needs to be emphasized. This case report provides an opportunity to document the signs and symptoms of envenomation from possibly an undescribed jellyfish species near the coastal waters of Penang Island.

Keywords: clinical toxinology, cubozoa, emergency, Malaysia, Penang

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Indonesia first aid and traditional first aid

Tri Maharani

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Abstract

Jellyfish (cnidarians) have a distribution throughout the world especially Indonesia. Although most are harmless, some species can cause local and systemic reactions. Many cases in Indonesia wrong treatment in first aid. Treatment of jellyfish envenomation is aimed at: reducing the local effects of the venom, preventing further release of nematocysts and controlling systemic reactions, including shock. In severe cases, the most important step is to stabilize and maintain vital functions. Traditional first aid with urine make fatality in Indonesia, many first aid example oral/topical analgesics, hot air and ice packs use in Indonesia and vinegar (4%–6% acetic acid) for 30 seconds to prevent is new use after education from Indonesia toxinology society.

Methods: the research is survey in 2017 until 2023 all training in Indonesia, this respondent is doctor, nurse, midwife, student, health worker, patients and teacher in school or university.

Result: only 2% in 2017 participant know and true first aid in jellyfish. In 2023, over than 70% participant know about vinegar but is wrong use 50%.

Conclusion: guideline Indonesia about jellyfish first aid make many people have good knowledge and true first aid, training very aggressive from Indonesia toxinology society and ministry of health in 2022 and 2023 give good result. Dissemination of appropriate treatment modalities must be undertaken to provide better information and education to those at risk. Adequate signage should be installed on beaches to inform tourists of the risk of jellyfish. Swimmers in risk areas must wear personal protective equipment.

Keywords: jellyfish, cnidarians, cubozoa, stings, envenomation, pain, evidence-based medicine, vinegar

The jellyfish (Medusae) monitoring & blue citizenship outreach program in the tourist attractions of Penang, Malaysia

Sim Yee Kwang and Aileen Tan Shau Hwai

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Abstract

In this research initiative, we introduce an innovative approach that integrates scientific research with citizen science to cultivate 'blue citizens' dedicated to ocean conservation in the tourist attractions of Penang, Malaysia. Over a meticulous 24-month sampling period from August 2020 to July 2022, extensive baseline field data were collected, enabling the development of simplified sampling methods accessible to individuals without a formal scientific background. Selected student or public volunteers from diverse interdisciplinary fields were trained through hands-on sessions, a detailed field guide, and a Standard Operating Procedure (SOP) to acquire the skills needed to accurately identify various jellyfish species and actively participate in monthly jellyfish sampling sessions. Identified Scyphozoan and Cubozoan species, including *Chrysaora chinensis*, *Phyllorhiza punctata*, *Aurelia* sp., *Rhopilema hispidum*, *Lobonemoides rebustus*, *Cyanea* sp., *Chiropsiodes buitendjki*, and *Morbakka* sp., reveal insights into their distribution. The predominant species, *C. chinensis*, constitutes 70% on the northern island and 85% on the western island. While no significant compositional difference is noted between islands, the mangrove habitat displays higher jellyfish abundance (2.2091×10^{-3} Individual/m^3) compared to tourist attractions (0.9609×10^{-3} Individual/m^3). These sessions, marked by enjoyable yet meaningful activities, serve to introduce 'Blue Citizenship for a Clean Ocean,' aiming to inspire ocean understanding, exploration, and proactive conservation measures. This citizen science initiative enhances both data collection and broader environmental education, presenting a novel strategy for promoting ocean conservation through the empowerment of individuals from diverse academic backgrounds.

Keywords: jellyfish monitoring program, citizen science outreach initiatives, marine biodiversity assessment, coastal ecosystem research & environmental education strategies

Session C7: Harmful jellyfish in the Southeast Asian region: Networking across the oceans

JellyGo: bridging science and application through an in-situ-based jellyfish abundance prediction model

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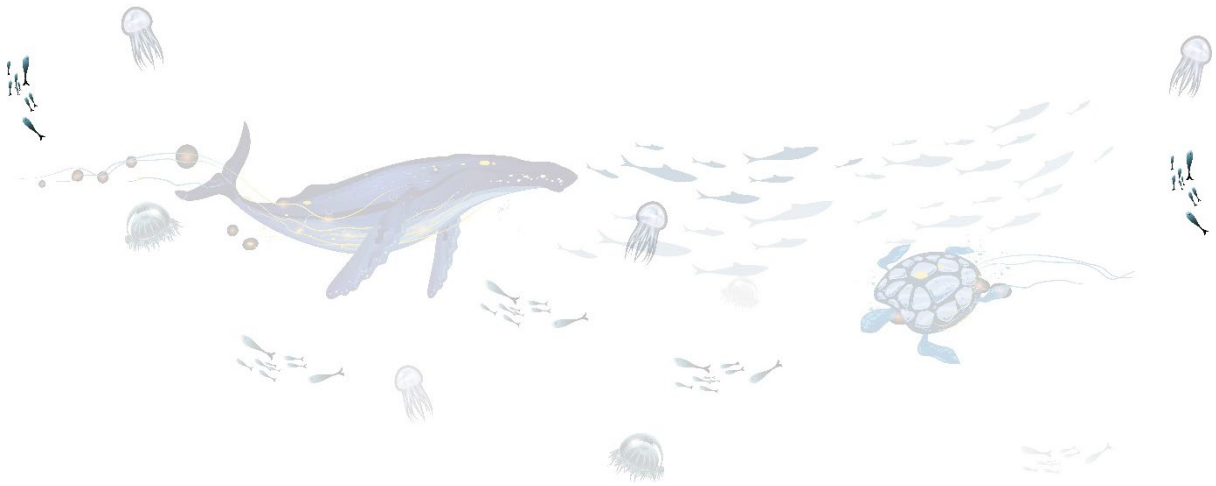
Abstract

Fluctuations in jellyfish population is a common occurrence along the coastal area of Penang Island. The dynamic nature of jellyfish abundance, coupled with inadequate stings management have posed a significant challenge in local ecosystems and beach safety. This study presents a transition from scientific research to practical application with the development of the JellyGo app, addressing the escalating threat of jellyfish blooms in Malaysian waters, particularly around Penang Island. The innovative mobile application has integrated three main features: (1) Monthly Jellyfish Abundance Prediction, (2) Emergency Action Plan and (3) Citizen Science. Two years of In-situ research data (2021–2022) comprising jellyfish abundance and environmental parameters were collected from 10 sampling locations covering the northern and western costs of Penang Islang. A vector autoregression analysis was employed to forecast site-specific monthly jellyfish abundance in unit of individuals per cubic meter. The React Native and Next JS framework was used to develop an immediate distress alert for medical attention. A supervised learning approach was used to incorporate scar detection and identification feature in app with reference to published jellyfish data. Besides, a citizen science platform was implemented in the application to compliment data collection through proposed sampling programs. As a result, the abundance prediction model has demonstrated precision with a standard deviation of 1.45 individuals per cubic meter, offering valuable insights into jellyfish abundance patterns for advanced preparation and risk mitigation. Finally, JellyGo wishes to bridge science and practical application with the aims to support multiple Sustainable Development Goals (SDGs) by addressing the scarcity of jellyfish data and to steer environmental stewardship and public safety in Malaysia.

Keywords: jellyfish blooms, abundance prediction, eco-tourism app., marine safety, Sustainable Development Goals

Sub-theme D: Emerging Ocean Science and Cross-cutting Issues

Session D1: Ocean observing technology and systems in the Indo-Pacific: Major advances and challenges



Programme

Venue: Chelsea A, 5th Floor
Date: 22 April 2024

Conveners:

Zexun Wei	First Institute of Oceanography, China
Lei Zhou	School of Oceanography, Shanghai Jiao Tong University, China
R. D. Susanto	Department of Atmospheric and Oceanic Science, University of Maryland, USA

Time	Presentation Titles	Speakers
Section 1		
13:30–13:45	Objective array design for three-dimensional temperature and salinity observation: application to the South China Sea	Tengfei Xu, *First Institute of Oceanography, China*
13:45–14:00	Using combined uncrewed systems to observe the air-sea transition zone	Chidong Zhang, *NOAA Pacific Marine Environmental Laboratory, USA*
14:00–14:15	Submesoscale processes observed by high-frequency float in the Western South China Sea	Dongxiao Wang, *Sun Yat-Sen University, China*
14:15–14:30	Ocean subsurface impacts on tropical cyclones in the Pacific	Lei Zhou, *Shanghai Jiao Tong University, China*
14:30–14:45	The marine environment sensing network research and monitoring buoy – a modular design for R&D and test-bedding of marine technologies	Shaun Wee, *National University of Singapore, Singapore*
14:45–15:00	China-Indonesia joint observation in the Indonesian seas during the past decade	Tengfei Xu, *First Institute of Oceanography, China*
Section 2		
15:30–15:45	Observations reveal equatorial waves modulating currents in the tropical Indian Ocean	Gengxin Chen, *Chinese Academy of Sciences, China*
15:45–16:00	Internal tide integrated observations in the western Pacific Ocean	Zhenhua Xu, *Institute of Oceanology Chinese Academy of Sciences, China*
16:00–16:15	Quantifying the contribution of salinity effect to the variability of the Indonesian throughflow with observations and simulations	Shijian Hu, *Institute of Oceanology Chinese Academy of Sciences, China*
16:15–16:30	Assessment of the Relationships Between Fish Distribution using Hydroacoustic and Oceano-graphic Parameters in Small Island Waters	Henry M. Manik, *IPB University, Indonesia*
16:30–17:00	**Discussion**	

Session D1: Ocean observing technology and systems in the Indo-Pacific: major advances and challenges

Objective array design for three-dimensional temperature and salinity observation: application to the South China Sea

Mengxue Qu[1, 2], Zexun Wei[1, 2], Yanfeng Wang[1, 2], Yonggang Wang[1, 2], and Tengfei Xu[1, 2, *]

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Abstract

In this study, a moored array optimization tool (MAOT) was developed and applied to the South China Sea (SCS) with a focus on three-dimensional temperature and salinity observations. Application of the MAOT involves two steps: (1) deriving a set of optimal arrays that are independent of each other for different variables at different depths based on an empirical orthogonal function method, and (2) consolidating these arrays using a K-center clustering algorithm. Compared with the assumed initial array consisting of 17 mooring sites located on a 3°×3° horizontal grid, the consolidated array improved the observing ability for three-dimensional temperature and salinity in the SCS with optimization efficiencies of 19.03% and 21.38%, respectively. Experiments with an increased number of moored sites showed that the most cost-effective option is a total of 20 moorings, improving the observing ability with optimization efficiencies up to 26.54% for temperature and 27.25% for salinity. The design of an objective array relies on the ocean phenomenon of interest and its spatial and temporal scales. In this study, we focus on basin-scale variations in temperature and salinity in the SCS, and thus our consolidated array may not well resolve mesoscale processes. The MAOT can be extended to include other variables and multi-scale variability and can be applied to other regions.

Keywords: optimal array design, Observation System Simulation Experiment (OSSE), South China Sea, Empirical Orthogonal Function (EOF), K-center clustering

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Using combined uncrewed systems to observe the air-sea transition zone

Chidong Zhang

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Abstract

The local and global impact of the ocean critically depends on air-sea interaction. Air-sea interaction does not occur only at the air-sea interface, but through the entire column of the upper ocean, air-sea interface, and marine atmospheric boundary layer. These three components, when take as a single identity, constitutes the air-sea transition zone (ASTZ). A comprehensive understanding of air-sea interaction relies on our knowledge of the coherent variability in the ASTZ column. Conventionally, the ASTZ can be observed only from research vessels and, to a lesser degree, research aircraft. Recent developments of uncrewed observing technologies have opened a door to new possibilities of using different types of uncrewed systems in coordination to observe the ASTZ. This presentation introduces recent practice of such coordinated uncrewed system observations and envisions the future.

Session D1: Ocean observing technology and systems in the Indo-Pacific: major advances and challenges

Submesoscale processes observed by high-frequency float in the Western South China Sea

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Abstract

Submesoscale currents (SMCs), characterized by scales of a few kilometers and days, exist widely in the ocean's boundary layer. These processes, including surface fronts, filaments, and submesoscale eddies, have been attracting increasing scientific interest due to their significant roles in ocean dynamics. However, their small horizontal scale and rapid evolution present substantial challenges for traditional observation methods, such as cross-sectional and satellite observations, often leading to inadequate data capture. To address this, advanced observational tools like underwater gliders, autonomous underwater vehicles, and floats have emerged as invaluable assets for submesoscale observations. Unlike the conventional Eulerian approach, these tools employ Lagrangian sampling techniques, which are particularly effective in tracking and closely observing the intricate, small-scale flows prevalent in the upper ocean, along with their submesoscale evolution. This shift towards more focused and mobile observation methods is significantly enhancing our understanding of SMCs and their impact on oceanic systems. The Navis-SL1 float, a product of Seatrec's innovation, is an integration of the Sea-Bird CTD with the Navis float technology, offering an economical yet efficient solution for high-frequency ocean sampling over multiple years. The float utilizes the Seatrec solid-to-liquid (SL1) thermal engine, which harvests energy from the temperature differential between the warmer surface waters and the colder deep waters. Analysis of year-long data collected from Navis floats deployed in the South China Sea (SCS) has revealed that strong wind events are key drivers in the formation of intense submesoscale processes within the mixed layer. By using the streamfunction parameterization of the Mixed Layer Instability (MLI), it is observed that two ageostrophic overturning circulation cells formed. Such overturning circulation cells induced by the MLIs would tilt isopycnals from the vertical toward the horizontal. In the future, the Navis-SL1 float is expected to carry more biochemical probes, which is crucial for advancing our understanding of material transport and biogeochemical cycles within the upper ocean in the SCS. Moreover, the integration of data from these floats with cooperative observations from multiple gliders will significantly enrich the quality and scope of oceanographic research, enabling a more comprehensive analysis of ocean processes in this vital region.

Keywords: high-frequency float, submesoscale process, ageostrophic overturning circulation

Ocean subsurface impacts on tropical cyclones in the Pacific

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Abstract

The central-north Pacific is between the eastern and the western tropical Pacific. The latter two regions have received intensive attention in the research on the weather and climate dynamics, while there are few studies focusing the central-north Pacific. In this study, it is found that the subsurface ocean variabilities over the central-north Pacific also have significant and broad impacts spanning from extreme weather to short-term climate, specifically, the tropical cyclone (TC) and ENSO. Both observations and simulations with high resolutions show that the subsurface variation can modulate the TC genesis via the Ekman pumping and the upper layer heat content. The relationship between the subsurface variation and sea surface temperature (SST) deviates from common assumption in canonical ENSO theories. In practice, a better capture of such special relationship over the central-north Pacific leads to a better simulation of ENSO in CMIP6 models, which implies that such relationship should be incorporated into the ENSO theory. Meanwhile, the specific dynamics about the influences of ocean subsurface variabilities on TC and ENSO call for dedicated further explorations, which are expected to promote our understandings in TC and ENSO dynamics and to improve the simulation/prediction of TC and ENSO.

Keywords: tropical cyclone, ENSO, central-north Pacific, ocean subsurface variability, Ekman pumping

The marine environment sensing network research and monitoring buoy – a modular design for R&D and test-bedding of marine technologies

Shaun Wee[1], Koay Teong Beng[1], Choo Heng Kek[1], Leong Wai[1], Chen Mengli[1], Joleen Chan[1], Wu Yusong[1], Vikas Reddy[1], Leong Chee Yew Sandric[1], Than Shermaine[1], Patrick Martin[2], Woo Oon Yee[2], Zhang Meilun[2], Ong Whee Cheng[3], Ong Dee Nai[3], Eddie Tan Beng Sing[3], Zhuang Xiongwu[3], and Jani Tanzil[1]

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Abstract

The marine environment is facing increasing threats. From climate change to urban development, there is a need to better understand ocean processes to accurately predict impacts and guide policies for effective and sustainable solutions. The Marine Environment Sensing Network (MESN) project presents an effort to expand marine environmental monitoring capabilities in Singapore waters, enable marine science R&D, and catalyse research collaborations through increased data access and by providing an extensible platform for scientist, industries and stakeholders to onboard sensor technologies, machine learning capabilities, and algorithms. Here, we share a novel modular design of a research and monitoring buoy developed as part of the MESN project. It collects various environmental parameters and serves as a platform for marine sensing technology test-bedding. The ~2.7 m diameter MESN buoy is designed as a two-tiered modular buoy: a core module houses a resident suite of selected research-grade sensors, while peripheral modules and moon pools provide room for extended sensing capabilities (e.g. add-on monitoring equipment) and experimental test-bedding (e.g. novel sensing technologies). This open architecture system with standard mechanical, electrical and software interfaces supports innovation and allows for scalability. Data collected from sensors deployed on the MESN buoys is streamed near real-time through its online data platform “Ombak” (ombak.mesn.sg) with tiered access granted for research and education purposes. To ensure that the MESN data is reliable and of high quality, regular (monthly) maintenance, on-site validation and data quality control is conducted. The near real-time, high sampling frequency (minutes interval) MESN data is not only useful for enabling faster detection and response times to anomalous events, but also in developing greater understanding of variability in seawater parameters or marine processes that occur in shorter time frames (e.g., chlorophyll concentration vs. diel and tide cycles).

Keywords: marine environment, ocean observation, marine sensors, sensing technology, Singapore

Session D1: Ocean observing technology and systems in the Indo-Pacific: major advances and challenges

China-Indonesia joint observation in the Indonesian seas during the past decade

Shujiang Li[1, 2, 3, *], Zexun Wei[1, 2, 3], Tengfei Xu[1, 2, 3], R. Dwi Susanto[4], N. Radiarta[5], A. Setiawan[6], N. Hananto[6], T. Agustiadi[6], F. Muhammad[6], and A. Kuswardani[5]

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Abstract

The Indonesian seas locate in the center of global atmosphere convection and warm water convergence, which provide the only connecting pathway between the Pacific and Indian Oceans in the tropics. It plays an important role in regulating the interocean exchange between the Pacific and Indian Oceans, and influencing the regional and global climate change. During the past decade, China-Indonesia and USA have cooperated to launch a series of research projects to explore the ocean dynamics issues in the Indonesian seas. This includes direct measurement of the Pacific-Indian Ocean throughflow (PIOT), investigation of tidal mixing along the exit passages of the Indonesian seas, etc. Until now, there are over twenty joint cruises have been carried out successfully, and extensive ship based and mooring based observations have been completed. Based the observation, many new discoveries and increasing understandings have been obtained. The South China Sea branch of PIOT is the first confirmed and quantitative assessment in the Karimata Strait based on 10-year observations. The multiscale variations are also revealed in the Indonesian Seas, including tidal, intraseasonal, seasonal and interannual variations. However, there are still a lot of scientific issues to be solved through ocean observations in the Indonesian Sea. In future, we should cooperate to apply the new ocean observation technologies to the Indonesian, to further enhance our understanding of Indonesian Seas and to support the ocean numerical forecasting. On the other hand, the interdisciplinary research should be encouraged, to reveal how the physical processes influence on the ecosystem in Indonesian seas.

Keywords: Indonesian seas, direct measurement, Pacific-Indian Ocean throughflow, multiscale variability

Observations reveal equatorial waves modulating currents in the tropical Indian Ocean

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Abstract

The Indian Ocean is a key conveyor linking the global mass and heat exchanges, and has contributed to a quarter of the global oceanic heat uptake over the last two decades, fundamentally affecting weather and climate globally and regionally, especially its rim countries hosting one-third of the world's population. Due to the deficiency of data records, our knowledge of the complex Indian Ocean circulation that reverses with the monsoon is the poorest among the three tropical ocean basins. Based on the Research Moored Array for African–Asian–Australian Monsoon Analysis and Prediction and the eastern Tropical Indian Ocean Observation Network by the Chinese Academy of Sciences, recent studies have substantially enhanced our understanding of features and dynamics of the Indian Ocean circulation. These results suggest a dynamic framework of equatorial waves regulating ocean currents. The equatorial waves effectively modulate the equatorial and off-equatorial currents, through transmitting energy to deep layer along the equator and regions far from the equator, respectively. The equatorial waves can also affect the currents in the western basin through delayed signals representing the time change of layer thickness at the eastern boundary. The framework allows a deeper understanding of physical dynamics and biogeochemical properties in the tropical Indian Ocean.

Keywords: equatorial waves, Indian Ocean, circulation

Internal tide integrated observations in the western Pacific Ocean

Zhenhua Xu , Baoshu Yin , Yijun Hou, and Fan Wang

Institute of Oceanology Chinese Academy of Sciences, China

Abstract

The northwestern Pacific Ocean features the strongest internal tide generation among the Global Ocean, but most previous knowledge of internal tides here is acquired by numerical simulations. Basin-covered measurements of internal tides are needed to verify the simulations and further reveal their spatiotemporal variations. By now, only satellite altimetry and Argo data can cover the whole basin area. This study represents the first attempt to combine these two kinds of multisource datasets to map internal tide energy fields in the northwestern Pacific. The Argo data can further reveal mixing distributions in the ocean interior. The combination of multisource datasets, including the measurements and simulations, a 3D (from the upper layer to abyssal trench) map of internal tide energy and mixing field in the northwestern Pacific can be constructed, which can support the improvement of internal tidal mixing parameterization in ocean and climate models.

Keywords: internal tide, mixing, western Pacific, observations

Session D1: Ocean observing technology and systems in the Indo-Pacific: major advances and challenges

Quantifying the contribution of salinity effect to the variability of the Indonesian throughflow with observations and simulations

Shijian Hu[1, 2, 3, *], Xi Lu[1, 3], Janet Sprintall[4], Cong Guan[1, 2, 3], Mingting Li[5], Fan Wang[1, 2, 3], and Dunxin Hu[1, 2, 3]

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Abstract

The Indonesian seas represent the only pathway that connects different ocean basins in the tropics and the Indonesian Throughflow (ITF) through it plays a pivotal role in the interbasin exchange between the Indian and Pacific Oceans. The classical theory holds that the Indo-Pacific pressure gradient and the Indo-Pacific wind forcing control the multi-scale variability of the ITF. However, in recent years, we found that the salinity change of the Indo-Pacific Ocean has a very important impact on the variability of ITF on multiple time scales. We use the measurements from the Monitoring ITF program and the Global Ocean Physics Reanalysis product to quantify the impact of the salinity effect in the seasonality of the Makassar Strait throughflow (MST), which is a significant component of the ITF. We find that the halosteric variability due to the salinity effect contributes to approximately 69.6±11.7% of the total seasonal variability of surface dynamic height gradient along the Makassar Strait, and dominates the seasonality of the upper layer MST. The primary drivers for freshwater forcing are horizontal advection through the Karimata Strait and precipitation in the Java Sea. On multi-decadal time scales, we find that a combined effect of strengthened halosteric and weakened thermosteric components has resulted in a weak strengthening for the total ITF during the past six decades with large uncertainties. The importance of salinity effect is likely increasing given the enhanced water cycle under global warming.

Keywords: Indonesian throughflow, salinity effect, Makassar Strait throughflow

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Session D1: Ocean observing technology and systems in the Indo-Pacific: major advances and challenges

Assessment of the Relationships Between Fish Distribution using Hydroacoustic and Oceanographic Parameters in Small Island Waters

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Abstract

The impact of oceanographic parameters on the distribution of fish in small island waters is concerned, little is known. Sound propagates very well within the water column, making underwater acoustic technology is indispensable technology for underwater exploration. Underwater acoustic technology was used in this study to analyze the distribution of fish in the waters of Lancang Island using the mean target strength (TS) value and oceanographic parameters. Acoustic data was collected using a 200 kHz single beam echosounder in the waters of Lancang Island, Seribu Islands in relation to oceanographic factors. Acoustic integration process was carried out to obtain the Target Strength and volume backscattering strength (SV) values. The results showed the distribution of fish in the waters of this area is significantly influenced by the temperature and salinity of the waters.

Keywords: Small Island, Underwater Acoustic, Echo integration, Target Strength, Volume Backscattering

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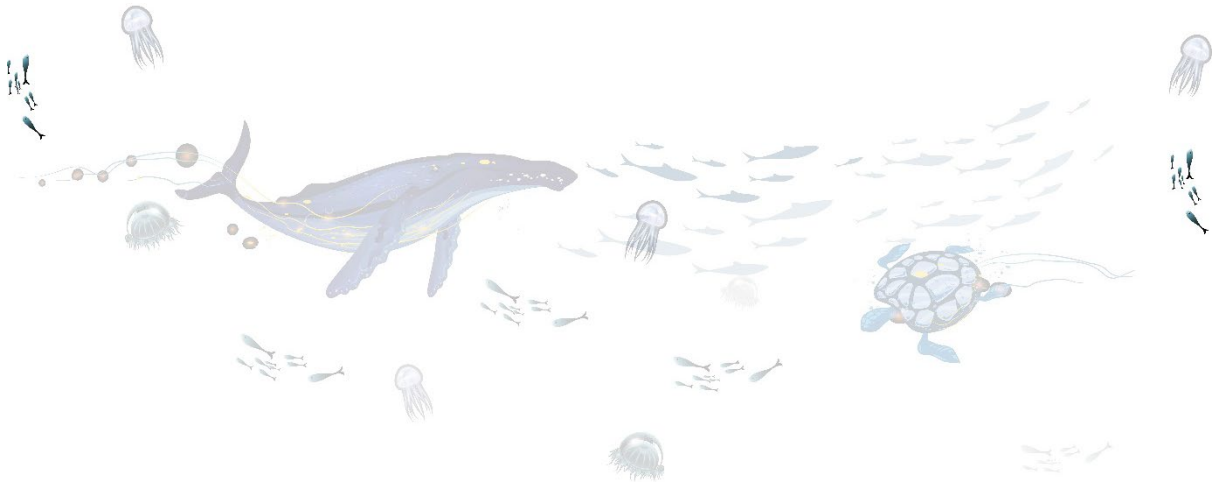
Sub-theme D: Emerging Ocean Science and Cross-cutting Issues

Session D2: Advanced molecular technologies in marine ecosystem research



Programme

Venue: Somerset A, 5th Floor
Date: 23 April 2024

Conveners:

Po Teen Lim	University of Malaya, Malaysia
Haifeng Gu	Third Institute of Oceanography, Ministry of Natural Resources, China
Satoshi Naga	Fisheries Technology Institute, Fisheries Research and Education Agency, Japan

Time	Presentation Titles	Speakers
Section 1		
10:00–10:20	Assessing marine phytoplankton diversity and coral-symbionts composition using next generation sequencing (NGS) and metabarcoding approaches	Po Teen Lim, *University of Malaya, Malaysia*
10:20–10:40	Taxonomic composition of microalgae and distribution of HAB species in Malaysian coastal waters (South China Sea) using eDNA metabarcoding analysis	Aini Hannani Abdul Manaff, *University of Malaya, Malaysia*
10:40–11:00	Unveil the diversity and seasonal occurrence of Haptophyta in the South China Sea based on metabarcoding	Haifeng Gu, *Third Institute of Oceanography, China*
11:00–11:20	Micro-eukaryotic and bacterial plankton community dynamics in aquaculture ponds of whiteleg shrimp *Litopenaeus vannamei*	Siti Nursyuhada Baharudin, *University of Malaya, Malaysia*
11:20–11:40	AFISsys – an autonomous instrument for the preservation of water samples for microbial metatranscriptome analysis	Julian von Borries, *Hydro-Bios Apparatebau GmbH, Germany*
11:40–12:00	Comparative whole transcriptomic analyses of toxic and non-toxic species of marine dinoflagellates, *Azadinium* (Dinophyceae)	Kieng Soon Hii, *University of Malaya, Malaysia*
Section 2		
13:00–13:20	Diversity and biogeography of dinoflagellate cysts with metabarcoding targeting two fragments of ribosomal DNA	Junyue Wang, *Nanjing University of Information Science and Technology, China*
13:20–13:40	Detecting benthic toxigenic *Ostreopsis* species (Dinophyceae) by DNA metabarcoding	Chui Pin Leaw, *University of Malaya, Malaysia*
13:40–14:00	Unveiling the diversity of coastal microbial mats	Emily Curren, *National University of Singapore, Singapore*

Time	Presentation Titles	Speakers
14:00–14:20	A study to identify and characterize microplastic degrading microorganisms	Arooj Fatima Tul Zahra, *Swinburne University of Technology Sarawak, Malaysia*
14:20–14:40	Metagenomic investigation of plastic-associated biofilms in mangrove ecosystems	Clement Sim Jun Wen, *Swinburne University of Technology Sarawak, Malaysia*
14:40–15:00	Profiling beach plastics: detection of plastic-associated taxa	Denise Ching Yi Yu, *National University of Singapore, Singapore*
Section 3		
15:30–15:50	Colonization of plastics by microorganisms	Audrey Ern Lee, *National University of Singapore, Singapore*
15:50–16:10	Towards improving the application of environmental DNA metabarcoding in the Philippine ecosystems	Venus E. Leopardas, *Mindanao State University at Naawan, The Philippines*
16:10–16:30	Genome-wide SNP analyses for stock delineation of commercially-harvested scallops, *Bractechlamys vexillum* in the Visayan Sea, Philippines	Inggat Laya N. Casilagan, *University of the Philippines – Diliman, The Philippines*
16:30–17:00	**Discussion**	

Assessing marine phytoplankton diversity and coral-symbionts composition using next generation sequencing (NGS) and metabarcoding approaches

Po Teen Lim[1,*], Kieng Soon Hii[1], Monaliza Mohd Din[1], Li Keat Lee[1], Sing Tung Teng[2], Minlu Liu[3], Haifeng Gu[3], and Chui Pin Leaw[3]

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Abstract

For the past two decades, the advancement of next-generation sequencing (NGS) technologies and metabarcoding has catalyzed its widespread application in marine biodiversity research, not only in marine microbial community studies but also in flora and fauna conservation research at both spatial and temporal scales. In this presentation, the use of NGS and metabarcoding to assess biodiversity changes of phytoplankton assemblages and host-symbiont relationships in the coral ecosystem of Malaysian waters will be shared. Using the method targeting the ribosomal RNA gene (rDNA) markers, high genetic diversity of marine phytoplankton was discovered, including many new records of diatom and dinoflagellate species. Harmful microalgal species previously reported to cause mass mortality of finfish maricultures or known to produce biotoxins were detected on a broader spatial scale, and their distributions were mapped. Despite the technological advancements, precise species annotation to the lowest taxa was hampered by an incomplete reference sequence database for selected genetic markers. Furthermore, the order-of-magnitude differences in inter- and intraspecific gene copy numbers make it technically infeasible at the time to quantify species abundances. For NGS application on coral-symbionts composition, the study was undertaken for both complex and massive coral types by collecting minute fragment of coral specimens from various water depths of reef ecosystems from marine park islands. ITS2 profiling of the coral symbionts was analyzed by Symportal, an analytical framework for coral-algal symbionts. In addition, the coral species were identified molecularly using the cytochrome oxidase I marker. The identification of temperature-resilient coral symbionts of *Cladocopium* and *Durusdinium* suggests that particular coral species might thrive in environments with elevated temperatures. Together, these findings revealed that molecular tools are useful in assessing the marine phytoplankton biodiversity.

Keywords: amplicon sequencing, coral-symbionts, harmful algal blooms (HABs), high throughput, ITS2 profiling

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Taxonomic composition of microalgae and distribution of HAB species in Malaysian coastal waters (South China Sea) using eDNA metabarcoding analysis

Aini Hannani Naqiah Abdul Manaff[1], Kieng Soon Hii[1], Zhaohe Luo [2], Minlu Liu[2], Ing Kuo Law[1], Sing Tung Teng[3], Mohd Fadzil Akhir[4], Haifeng Gu[2], Chui Pin Leaw[1,*] and Po Teen Lim[1,*]

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Abstract

In the east coast of Peninsular Malaysia, South China Sea, the frequency of Harmful Algal Bloom (HAB) events alongside the damage that caused by the causative HAB species have been increased in recent years. Despite intensive HAB studies in the country, knowledge on the distribution of HAB species is scattered and localized. Moreover, a broader-scaled distribution of harmful microalgae across the Malaysian waters was not completely understood. Previous studies were mostly relied on morphological identification which has been proven challenging in identifying the organisms. In this study, an effective multispecies detection by high throughput sequencing (HTS) of 18S rDNA V4 and V9 markers was adopted to analyse samples collected from 30 sampling stations along the coastlines of eastern Peninsular Malaysia during a research cruise in August 2016. The utilization of both regions served as a complement in assessing HAB species distribution and Chlorophyta taxonomic composition. Our study revealed a total of 29 HAB molecular taxa. *Margalefidinium polykrikoides* and *Azadinium dexteroporum* were found for the first time along the east coast of Peninsular Malaysia. This study further confirmed the widespread distribution of *Alexandrium tamiyavanichii*, *Pseudo-nitzschia* species, *Margalefidinium polykrikoides*, and *Karlodinium veneficum*. The results of this study revealed an appealing spatial distribution pattern, with a marked signal of compositional turnover between latitudinal regimes of water masses, and provide updated HAB species occurrence records that could facilitate existing HAB monitoring in the region.

Keywords: community, harmful algal bloom, metabarcoding, diversity, rDNA

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Unveil the diversity and seasonal occurrence of Haptophyta in the South China Sea based on metabarcoding

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Abstract

Haptophyta is a major component of marine micro and nano-plankton communities. Previous research on marine microalgae focused on diatoms and dinoflagellates, with relatively limited attention on haptophyta due to their small size. The northern South China Sea is experiencing increasing eutrophication due to the impact of human activities. This escalation in eutrophication has led to harmful algal blooms by haptophyta. From an ecological monitoring perspective, several key research questions often arise: What is the temporal dynamic and diversity of haptophyta? How do the seasonal variations in different fractions of Phaeocystis globosa relate to the distribution of haptophyta of different sizes? In this report, we employed DNA metabarcoding approach to study the diversity of haptophyta in the northern South China Sea. We compared the differences between two pairs of primers targeting 18S V4. The results indicate that each primer pair has its advantage in terms of total sequences number or haptophyta species number. We also detected six harmful species of haptophyta. Furthermore, we explored the distribution of haptophyta of different sizes in the Beibu Gulf, revealing the seasonal variations and genetic diversity of different fractions of Phaeocystis globosa. Finally, we discussed the applicability of the two primer pairs as a fundamental consideration for analyzing the community structure of haptophyta.

Keywords: Haptophyta, highthroughput sequencing, metabarcoding,18S V4

Micro-eukaryotic and bacterial plankton community dynamics in aquaculture ponds of whiteleg shrimp *Litopenaeus vannamei*

Siti Nursyuhada Baharudin[1], Nur Fatihah Mohd Azmi[1], Kieng Soon Hii[1], Minlu Liu[2], Haifeng Gu[2], Chui Pin Leaw[1,*], and Po Teen Lim[1,*]

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Abstract

Aquaculture industries are growing rapidly to meet the domestic and export demands, and to fulfill the decline of captive fisheries. White-leg shrimp aquaculture is one of the significant farmed organisms in the Southeast Asian region, including Malaysia, owing to its high yield and fast returns. However, shrimp farmers often face challenges due to deterioration of water quality, infection of various diseases from bacterial or viral origins, and eventually mass mortality. This study aimed to investigate the microeukaryotic and bacterial plankton community dynamics in pond waters of whiteleg shrimp *Litopenaeus vannamei*. The plankton and water samples were collected over the shrimp growth cycle from three shrimp ponds at Marang, Terengganu. The temporal dynamics of microeukaryotic and bacterial plankton communities were investigated using high-throughput sequencing of metabarcoding approach. The microeukaryotic and bacterial plankton compositions were detected using the 18S rDNA V7-V9 region and 16S rDNA V3-V4 regions, respectively. A total of 1,667 ASVs of micro-eukaryotic plankton and 6,843 ASVs of bacteria were detected in this study. Dinoflagellates recorded the highest taxa (126 ASVs), with two harmful species that were previously known to be harmful to shrimp: *Luciella* sp. (46 ASVs, 16,041 ASV reads) and *Pfiesteria* sp. (14 ASVs, 1,321 reads). The highest read abundance was detected in S3 (51%). A total of 76 ASVs (42% of total ASVs) belonged to diatoms Bacillariophyta. The read abundances of diatoms in ponds S1 and S2 were at least 2 times higher than S3, indicating water quality in S1 and S2 was better than S3. Cyanobacteria was the most abundant phylum of bacterioplankton detected, with 2,296 ASVs (33% of total ASVs), followed by Proteobacteria (2,118 ASVs; 30% of total ASVs). This study provides essential baseline data on the bacterial and plankton communities in shrimp aquaculture ponds. It also provides important information on the water quality and the microbial compositions in the aquaculture ponds. The data will be useful in developing a shrimp health monitoring system for shrimp farmers.

Keywords: harmful algae, metabarcoding, Malaysia, parasitic dinoflagellate, whiteleg shrimp

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AFISsys – an autonomous instrument for the preservation of water samples for microbial metatranscriptome analysis

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Abstract

Microbial communities are main drivers of biogeochemical cycling of multiple elements sustaining life in the ocean. The rapidity of their response to stressors and abrupt environmental changes implies that even fast and infrequent events can affect local transformations of organic matter and nutrients. Studying dynamics in microbial functionality at temporal and spatial scales is complicated. Modern molecular techniques now allow for monitoring of microbial activities and functions in the environment through the analysis of genes and expressed genes (messenger RNA) contained in microbial assemblages. However, gene transcript turnover in cells can be as short as 30 seconds and stability varies between transcripts. Traditional sampling involves an inevitable delay (hours, not minutes) between the collection and the extraction of its RNA, leaving the bacterial communities sufficient time to alter their gene expression. To address these challenges, we designed an autonomous *in situ* fixation multi-sampler (AFISsys) for reliable sampling of microbial metatranscriptomes for refined temporal and spatial resolution. To advance the development of such a sampling tool, we examined the minimal seawater volume necessary for adequate coverage of community gene expression, the suitability of phenol/ethanol fixation for long-term preservation of transcripts, and the field eligibility of the instrument itself. AFISsys is able to collect, fix and store water samples independently off-shore at high temporal resolution. It can conserve sensitive mRNA directly in the environment for up to a week. Thus, it constitutes an invaluable tool for the integration of molecular functional analyses in environmental monitoring in aquatic environments.

Keywords: metatranscriptomics, mRNA, microbiology, in situ fixation, sampling

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Comparative whole transcriptomic analyses of toxic and non-toxic species of marine dinoflagellates, *Azadinium* (Dinophyceae)

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Abstract

Several species in the genus of marine dinoflagellates, *Azadinium*, are known to produce a suit of neurotoxins, Azaspiracids (AZAs), which can lead to azaspiracid poisoning in humans. While chemical structures of the toxins Azaspiracids have been well characterized, the biosynthesis of Azaspiracid in the dinoflagellate *Azadinium* and the underlying mechanism remain poorly understood. In this study, a comparative transcriptomic approach was adopted to compare two toxic strains of *Azadinium poporum*, TIO256 (*A. poporum* ribotype A2 from the Mediterranean Sea) and AZF25 (*A. poporum* ribotype B from the East China Sea), with two non-toxic strains (TIO420, TIO213). Our results showed that all *Azadinium* species consistently exhibit a G+C content ranging from 59-61%, irrespective of their toxin production. Larger transcriptomes size was observed in non-toxic strains compared to their toxic counterparts. In-depth transcriptomic analysis of the strains AZFC25, TIO256, TIO420, and TIO213 revealed unique genetic compositions, with individual strains displaying unique genes accounting for 32.97%, 3.29%, 6.82%, and 44.24% of their respective genomes. All four strains shared 58,444 homologous genes. We also identified 1,556 genes exclusively expressed in the toxic strains, with a subset of 2,878 of these genes unique to *A. poporum* but absent in *A. zhuanum*. Importantly, genes involved in ATP binding and DNA activities were found to be more prevalent in the toxic strains, indicating a heightened requirement for ATP. Interestingly, genes associated with polyketide synthase (PKS), previously hypothesized as crucial in biosynthesizing of the carbon backbones of AZAs, were more abundant in non-toxic *A. zhuanum*. This comprehensive study advances our understanding of the transcriptomic variances between toxic and non-toxic *Azadinium* strains, offering critical insights into their roles in the biosynthesis pathways of AZAs.

Keywords: *Azadinium*, transcriptome analysis, Azaspiracids (AZAs), toxic and non-toxic strains, ATP binding and DNA activities

Diversity and biogeography of dinoflagellate cysts with metabarcoding targeting two fragments of ribosomal DNA

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Abstract

Cysts are produced by some dinoflagellates as a survival mechanism in adverse environments, which is a crucial stage in the life cycle of dinoflagellate. Given that dinoflagellate cysts distributed in seafloor sediments can potentially serve as the source of algal blooms, their geographical distribution and diversity hold significant ecological importance and serve as a fundamental basis for monitoring dinoflagellate blooms. Hence, the precise identification of dinoflagellate cysts has assumed significant importance, wherein molecular biological techniques offer notable advantages in terms of time efficiency, labor reduction, and accuracy. This study employed DNA metabarcoding approach to investigate the diversity of dinoflagellate cysts from the South China Sea to the Chukchi Sea, spanning from subtopical to the Arctic region. We also compared the disparities between the targeted large subunit ribosomal (LSU D1-D2) and internal transcribe spacer (ITS1) fragments. The findings revealed that LSU and ITS1 possessed distinct advantages in terms of comprehensiveness and specificity, respectively. By conducting a combined analysis of both data, we successfully identified eleven cysts of toxic dinoflagellate. Importantly, our analysis uncovered sequences of *Heterocapsa* spp., symbiotic and parasitic dinoflagellates, which have not been previously documented. Finally, we discussed the correlation between the distribution of dinoflagellate cysts and various environmental factors, shedding light on the biogeography of these cysts.

Keywords: dinoflagellate cysts, diversity, biogeography, metabarcoding

Detecting benthic toxigenic *Ostreopsis* species (Dinophyceae) by DNA metabarcoding

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Abstract

Benthic harmful algal bloom (BHAB) occurs when benthic harmful microalgal species proliferate in coastal benthic habitats. With the degradation of coastal ecosystems, the surge of nutrient supply from land-based sources, and changes in climatic conditions, the risk of BHAB species expansion should be assessed and monitored. Despite the foodborne poisoning, BHAB is also responsible for an airborne human illness after exposure to aerosol toxins. The illness was discovered in 1990s following the reports of a respiratory syndrome in humans in the Mediterranean, which was attributed to the blooms of the benthic dinophyte *Ostreopsis* cf. *ovata*. The species was then confirmed to produce a suite of Ovatoxins (analogs of palytoxins). Our past studies revealed the presence of *Ostreopsis* across the Malaysian coral reef ecosystems. In this study, we assessed the sensitivity of DNA metabarcoding in detecting the species. Our results demonstrated that the method is capable of detecting the species with a higher taxonomic resolution, distinguishing between the two toxigenic but morphologically similar *O. ovata* and *O. siamensis*. Additionally, metabarcoding allowed for precise identification of the toxic ribotypes of *O. ovata*. While the maximum cell abundances of 30,000 cells/100 cm^2 detected were two orders of magnitude lower than those associated with human illness, and no human illness has been recorded in Malaysia to date, assessing the potential risk and exposure to aerosol toxins should be prioritized given its significant public health and socio-economic impacts.

Keywords: benthic harmful algal blooms, climate change, dinophyte, *Ostreopsis ovata*, *Ostreopsis siamensis*

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Unveiling the diversity of coastal microbial mats

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Abstract

Cyanobacterial mats are complex microbial communities which have important functions in aquatic ecosystems. In marine environments, these mats fix atmospheric nitrogen and function mainly in primary production. A cyanobacterial mat also consists of other organisms such as eukaryotic algae, bacteria and fungi, which result in a laminated structure with vertically stratified layers. The presence of toxic cyanobacterial species within these mats raises concerns due to their potential to induce harmful algal blooms. Hence, this study aimed to characterize the vertical structure of cyanobacterial mats and to identify the different species of organisms present in each layer, through morphological and molecular methods. The 16S rRNA gene was used to analyse the species composition of individual layers of the mat through Nanopore sequencing technology. For each layer, species richness indices were compiled. Results from this study reveal a diverse assemblage of cyanobacterial taxa within the mat, with the presence of toxic genera. The integration of microscopy and third-generation sequencing methods allows for the identification of toxic cyanobacteria and heterotrophic bacteria within the mat. This could also provide insight to cyanobacterial blooms, by identifying supporting heterotrophic bacteria species which could promote and maintain a bloom. This study provides critical insight into the potential for harmful algal blooms in the future and its associated risks to the public health and food security.

Keywords: cyanobacteria, mat, structure, nanopore, blooms

A study to identify and characterize microplastic degrading microorganisms

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Abstract

In the face of escalating plastic pollution, a paramount environmental crisis, the resilience of marine life, human health, and the global ecosystem is severely threatened. Microplastics, due to their exceptional durability and resistance to natural breakdown, present a substantial obstacle in waste management. This research explores the field of bioremediation using various scientific techniques, primarily investigating microplastic-degrading microbes residing in mangroves, a significant yet understudied biome. Employing DNA Stable Isotope Probing (DNA-SIP), we aim to unravel the intricate interplay between microbial communities and their functional roles in the Southeast Asian mangroves, specifically in Pasir Pandak, Sarawak, Malaysia. This method facilitates the detection of microorganisms actively metabolizing a specific substrate into cellular biomass by tracing the flow of carbon when provided with a stable isotope, e.g., 13C-labeled substrate. In this study, plastic samples were collected from the mangroves, and biofilm from the samples was extracted. The biofilms were then incubated for one month with 13C and 12C-labeled polystyrene (PS) and (poly) lactic acid (PLA) microplastics. Identification of the microbial communities degrading PS and PLA will be accomplished using the Illumina MiSeq platform. From the incubated samples, four microbial isolates (3 bacterial strains and 1 fungal strain) capable of degrading plastics like PLA, PS, and Polyurethane (PUR) were isolated and underwent initial characterization through 16S rRNA sequencing and gram staining. The identified bacteria included *Pseudomonas* sp., *Staphylococcus* sp., and *Brevundimonas* sp., while the fungal stain was identified as *Aspergillus* sp. Following isolation and initial identification of the microbial strains, their plastic degradation capabilities were studied by growing them in different Dissolved Organic Carbon (DOC) concentrations in seawater. Notably, it showed no significant impact on the degradation abilities of the isolated strains. Furthermore, the plastic degradation abilities of isolated *Pseudomonas sp.* and *Staphylococcus sp*. were gauged pre- and post-long-term preservation through lyophilization and cryopreservation techniques in three different mediums—LB, DMSO, and glycerol solutions. Both lyophilization and cryopreservation methods yielded positive results,

but only the lyophilization technique showed significant degradation after post-preservation of the isolates. These findings aim to contribute to the field of plastic bioremediation by revealing local microorganisms that have the potential to degrade PS, PLA, and PUR polymers.

Keywords: Mangroves, Plastics, DNA Stable Isotope Probing (SIP), Bioremediation

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Metagenomic investigation of plastic-associated biofilms in mangrove ecosystems

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Abstract

The plastic polluting the environment has drastically increased with the growth in plastic production over the last century. In recent years, plastic pollution in marine environments has become a cause of global concern due to the ubiquity and adverse impacts of plastic debris. Particularly, estuarine and coastal environments have been highlighted as plastic accumulation hotspots. The plastic accumulation is amplified in mangrove ecosystems as the branches and roots of mangroves trap and retain plastic debris. This problem has been reported in mangrove ecosystems in China, Malaysia, and Singapore. Several factors affect plastisphere composition, including polymer type, geography, and nutrient availability. Geographical location has been found to have the most impact on biofilm formation and plastisphere composition. Notably, tropical regions have been associated with faster biofilm formation and greater plastisphere complexity and diversity than sub-tropical and temperate regions. However, the number of studies about the plastisphere in tropical regions (10) is vastly outnumbered by that in sub-tropical (29) and temperate (30) regions. Consequently, studies about the plastisphere in mangrove ecosystems are also scarce. Thus, this research aimed to reduce the knowledge gap regarding the plastisphere in mangrove ecosystems by investigating plastic-associated biofilms from a mangrove forest in Malaysia. This study investigated the plastisphere on plastic waste obtained from a mangrove forest in Pasir Pandak, Malaysia. The plastisphere communities of four plastic samples were screened for plastic-degradation activity and sequenced for taxonomic and functional classification. *Pseudomonas stutzeri*, *Pseudomonas chengduensis*, *Acinetobacter venetianus*, and one unidentified fungus strain with plastic-degrading activity were isolated via the plastic degradation assay. Analysis of the taxonomical classifications revealed significant differences between the microbial communities of the biofilm and soil samples, including differences in the relative abundances of the genera *Erythrobacter*, *Roseobacter*, *Ruegeria*, *Cyanothece*, *Nostoc*, *Acaryochloris*, *Exiguobacterium*, *Flavobacterium*, *Gramella*, *Maribacter*, *Psychrobacter*, and *Robiginitalea*. Additionally, analysis of the functional classifications revealed differences in the relative abundances of function-related genes between the biofilm and soil samples, especially in genes related to porphyrin and chlorophyll metabolism, ABC transporters and biotin metabolism.

Keywords: biofilm, mangrove, plastics, plastisphere

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Profiling beach plastics: detection of plastic-associated taxa

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Abstract

The ubiquitous presence of marine plastics in the ocean is extensively documented, presenting a significant global environmental concern. Plastics infiltrate the sea through diverse human-driven pathways, such as improper waste disposal, shipping activities, and various coastal interactions. Beaches serve as both an introduction point and a destination for plastics. Moreover, plastics from other regions may also temporarily accumulate on beaches before being transported to sea. These plastics serve as substrates for microorganisms to attach onto, including harmful and toxic species that pose potential threats to ecosystems and human health. Hence, there is a need to comprehend the characteristics of plastics and their associated taxa on beaches. This study aimed to examine the temporal distribution of marine plastics on Singapore's beach, characterise the diversity of plastic-associated communities, and highlight potentially harmful species. Metabarcoding targeting ribosomal genes was performed using Nanopore sequencer to investigate the eukaryotic communities associated with these plastics. Plastic abundance was highest prior to the Northeast monsoon, with foam plastics dominating across time. Diverse eukaryotic communities were found colonising the beach plastics. Furthermore, the presence of toxic phytoplankton such as *Karlodinium* and *Scrippsiella* were identified. This study reveals insights into the temporal availability of plastics as substrates in Singapore and their role as a dispersal vector of harmful eukaryotes.

Keywords: plastic, vector, nanopore sequencing, harmful microalgae

Colonization of plastics by microorganisms

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Abstract

Plastic debris is ubiquitous in the marine environment, resulting from extensive human activities and inadequate waste management. Marine plastic debris can act as entanglement and ingestion hazards and are also known to constitute suitable matrices for microorganism attachment and growth, forming dense biofilms called plastisphere. Marine plastic debris can act as transport vectors for a variety of microorganisms, including harmful species that pose threat to ecosystems and human health. Biofouling mechanisms and the influence of location, seasonality and substrate type have yet to be established. This study investigated the diversity and selective attachment of microorganisms on five commonly encountered types of marine plastic debris: polypropylene (PP), polyethylene (PE), polystyrene (PS), polyethylene terephthalate (PET) and polyvinyl chloride (PVC). These plastics were deployed in Northwestern Singapore waters for a period of 7 days. Amplicon sequencing of 28S rRNA gene was then conducted using the Nanopore MinION sequencing platform. Microorganisms such as phytoplankton, bacteria and fungi were detected on the plastics. Harmful phytoplankton genera such as *Levanderina* and *Alexandrium* were detected on most plastic types. *Alexandrium minutum* in particular, can produce saxitoxins which cause paralytic shellfish poisoning, this is particularly concerning as *Alexandrium minutum* blooms have previously been observed in neighboring waters. Further research into biofouling mechanisms and the factors influencing microorganism community composition is critical for developing strategies to monitor and manage plastic pollution to mitigate the spread of harmful algal blooms the potential harm to ecosystems and human health.

Keywords: marine plastic debris; plastisphere; 28S rRNA gene; phytoplankton diversity; harmful algal blooms

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Towards improving the application of environmental DNA metabarcoding in the Philippine ecosystems

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Abstract

The application of environmental DNA (eDNA) metabarcoding as a biodiversity monitoring tool is gradually becoming popular in the Philippines as noted by the increasing number of publication outputs from projects. On the other hand, the challenges associated with the use of this tool had never undergone thorough discussion amongst researchers. The genomic research in the Philippines should better advanced into metabarcoding using environmental samples, especially when budget constraints in maintaining field surveys or monitoring and lack of field marine taxonomists are compromising sustainability of efforts and reliability of data, respectively. This paper primarily evaluates peer-reviewed literature on eDNA metabarcoding which data was obtained from the Philippines setting. The trend of research topics, extent of data obtained, specific challenges encountered, employability of the data towards policy recommendations, and strategies for streamlining the application of the tool to become user-friendly or for its application to be easily socially accepted by various facets of environmental stakeholders are placed into focus for this review. The importance of local to international collaborations, establishment of local networks of researchers, and improvement of manpower are also highlighted. Finally, the applicability and availability of the tool to young generations of researchers are discussed in this paper.

Keywords: biomonitoring, eDNA, metabarcoding, Philippines

Genome-wide SNP analyses for stock delineation of commercially-harvested scallops, *Bractechlamys vexillum* in the Visayan Sea, Philippines

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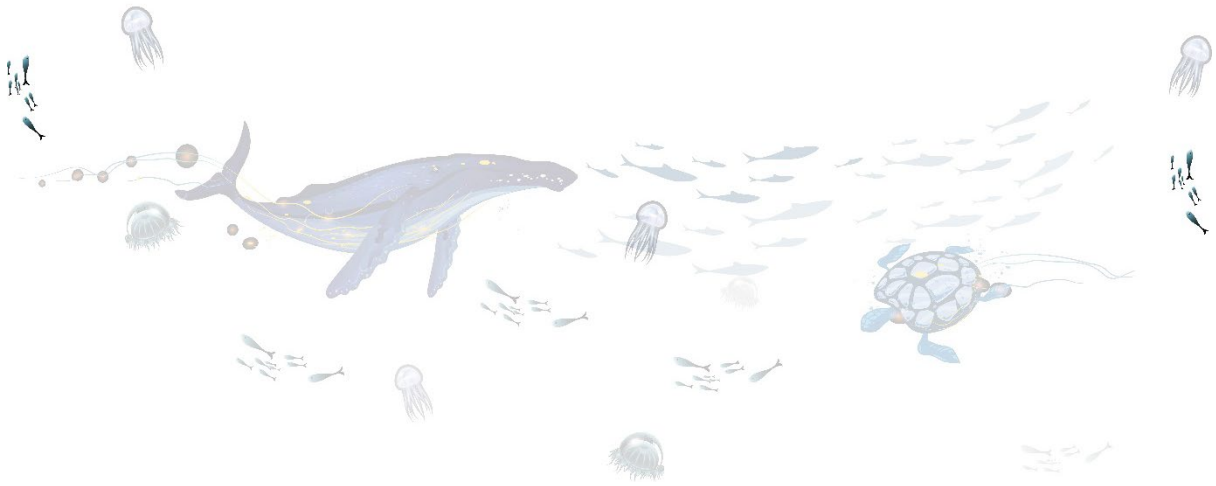
Abstract

Scallops are economically-important marine bivalves that are massively traded worldwide. In the Philippines, several scallops species are commercially harvested for both domestic and international markets. While scallops have been harvested and exported for decades, the fishery is “boom-and-bust” in nature with intermittent high and low export volumes through time. The sustainability of the fishery is becoming a concern, with local fisheries assessments exhibiting indications of overharvesting that could lead to stock depletion. This necessitates implementation of resource management schemes to ensure sustainability of wild stocks of this important fishery commodity. However, available information on their biology, ecology, and fishery are limited. This study utilized a genomic approach for stock assessment of scallop fisheries in the highly-productive Visayan Sea region in the Philippines, to guide resource management strategies. High-throughput genotyping-by-sequencing methods (RADseq) were used for stock delineation of the most commonly harvested scallops species, *Bractechlamys vexillum*. High-throughput sequencing of DNA extracted from 94 samples across 5 sampling sites generated raw data with 109,927 SNP loci. After applying filters to improve data quality, a final dataset of 3,189 loci was analyzed. Genetic variance among sites did not reveal genetic structure (F_{ST} = 0.00038; p>0.05) among the Visayan Sea populations. DAPC analyses revealed no distinct clustering by collection site. These results suggest population admixture within the Visayan Sea region. Insights on the population structure, diversity, and connectivity of *B. vexillum* population and its implications to stock delineation of scallops in the Visayan Sea region will be discussed.

Keywords: scallops, SNPs, population genomics, stock delineation

Sub-theme D: Emerging Ocean Science and Cross-cutting Issues

Session D3: Satellite and airborne remote sensing techniques for marine ecosystem monitoring and management



Programme

Venue: Jubilee B, 11th Floor
Date: 22 April 2024

Conveners:

Tatsuyuki Sagawa	Tottori University of Environmental Studies, Japan
Wirote Laongmanee	Faculty of Marine Technology, Burapha University, Thailand
Wenting Cao	Second Institute of Oceanography, Ministry of Natural Resources, China

Time	Presentation Titles	Speakers
Section 1		
10:30–10:45	Evaluating the potential of seaweed farming for eutrophication mitigation in South Sulawesi, Indonesia from remote sensing data	Hasriani Ayu Lestari, *Universitas Hasanuddin, Indonesia*
10:45–11:00	Geodatabase system from satellite to drone for monitoring and determining of coral reef, seagrass and mangrove conservation zones	Nurjannah Nurdin, *Hasanuddin University, Indonesia*
11:00–11:15	Using remote sensing for seagrass changes in coastal waters of Khanh Hoa, Vietnam	Phan Minh Thu, *VAST, Vietnam*
11:15–11:30	Detection of seaweed beds off Kottoi, Yamaguchi Prefecture, Japan using SPOT 6 and SPOT 7	Teruhisa Komatsu, *Japan Fisheries Resource Conservation Association, Japan*
11:30–11:45	Applications of unmanned aerial vehicles in intertidal reef monitoring: benefits and limitations	Thitiporn Khananuruxs, *Department of Marine and Coastal Resources, Thailand*
11:45–12:00	Deep learning for multi-label classification of coral conditions in the Indo-Pacific via underwater photogrammetry	Xinlei Shao, *The University of Tokyo, Japan*
12:00–12:15	Satellite derived bathymetry using Landsat-8 and Sentinel-2	Tatsuyuki Sagawa, *Tottori University of Environmental Studies, Japan*
Section 2		
13:30–13:45	Remote sensing estimation of dissolved organic carbon in a blue carbon mangrove estuary in Malaysian Borneo	Chance Sullivan, *Swinburne University of Technology, Malaysia*
13:45–14:00	Case studies of estimating seagrass blue carbon in selected sea areas in the NOWPAP region	Genki Terauchi, *Northwest Pacific Region Environmental Cooperation Center, Japan*
14:00–14:15	Truthing method for satellite remote sensing using sonar for blue carbon study	Ken-ichi Hayashizaki, *Kitasato University, Japan*

Time	Presentation Titles	Speakers
14:15–14:30	Comparison of seagrass mapping methods using different sonar images	Hajime Okawa, *Kitasato University, Japan*
14:30–14:45	Coastal blue carbon monitoring and the application of remote sensing techniques	Yining Chen, *Second Institute of Oceanography, China*
14:45–15:00	Carbon storage estimation of coastal muddy flat using remote sensing and field surveys	Wenting Cao, *Second Institute of Oceanography, China*
Section 3		
15:30–15:45	On the modeling coefficients of a photoacclimation model for phytoplankton in the global ocean	Dongmei Lian, *Xiamen University, China*
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16:30–16:45	Remote sensing observation and analysis of water clarity in tropical coastal waters in Sarawak, Malaysian Borneo	Jenny Cheng Yi Choo, *Swinburne University of Technology, Malaysia*
16:45–17:00	Integrated remote sensing and *in situ* Observations for Coastal Water Quality Monitoring	Moritz Mueller, *Swinburne University of Technology, Malaysia*

Evaluating the potential of seaweed farming for eutrophication mitigation in South Sulawesi, Indonesia from remote sensing data

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Abstract

Eutrophication of coastal waters is a growing problem around the world, and in particular in South Sulawesi, Indonesia. Phytoremediation is a potential eutrophication mitigation measure to support Sustainable Development Goal (SDG) 14, Life Below Water. South Sulawesi is a major seaweed producing area in Indonesia, however to estimate seaweed phytoremediation potential, reliable data on seaweed farming extent and production are lacking. Remote sensing can be used to identify and monitor marine natural resources at extensive spatial and temporal scales. This study integrated satellite imagery with data from field observations and key stakeholder interviews to analyse temporal changes in seaweed cultivation area and to estimate production volumes from 2015 to 2020 in three regencies along the south coast of South Sulawesi facing the Flores Sea. The main commodity cultivated was Eucheuma sp., reported as more reliable (but lower priced) compared to Kappaphycus alvarezzi. Cultivated area extent ranged from 11,680 to 13,199 ha (mean 12,444 ha), while production estimates ranged from 2,703,560 to 3,126,530 tonnes (mean 2,916,272 tonnes) wet weight. These figures show that seaweed farming has potential for phytoremediation. Furthermore, the method used could improve the efficiency, timeliness and accuracy of seaweed production data for management.

Keywords: Landsat-8, Phytoremediation, seaweed production, water quality, SDG-14

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Geodatabase system from satellite to drone for monitoring and determining of coral reef, seagrass and mangrove conservation zones

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Abstract

Management of marine living resources properly and wisely requires serious handling, especially in terms of collecting data and information on the condition of marine, coastal and small island ecosystems. Coral reefs, seagrass beds and mangroves are one of Indonesia's natural resources where they are found in almost every coastal region of Indonesia. The existence of these resources can generate foreign exchange for the country. Remote sensing technology, satellite to drone and GIS are a bridge to see the condition of coastal ecosystems, carry out spatial analysis based on geographic locations on the coast and sea, and monitor environmental changes that occur and in planning and formulating government policies. Systematic and time series data collection on coral reefs, sea grasses and mangroves, analysis and validation of raster and vector data is done first. Data storage in a geodatabase system using opensource applications is the main point so that all factual and dynamic data can be easily utilized by environmentalists, used by local governments as the main basis or reference in managing coastal and marine ecosystems, determining conservation areas and also as a basis for formulate policies for the welfare of coastal communities. Geospatial data and information in the Geodatabase system are rich in data sharing and become the main information to manage for sustainable of marine and coastal resources.

Keywords: geodatabase, satellite, drone, monitoring, coral reefs

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Using remote sensing for seagrass changes in coastal waters of Khanh Hoa, Vietnam

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Abstract

Utilizing remote sensing as a pivotal tool for monitoring seagrass variations in coastal waters has proven instrumental in providing a systematic and extensive observation of seagrass habitats. Employing Landsat 8 remote sensing image analysis techniques, this study investigates the contemporary status and alterations in seagrass beds within the coastal areas of Khanh Hoa province from 2013 to 2021. The assessment involves the analysis of water column correction methods, specifically Lyzenga's Depth Invariant Index (DII) method and Sagawa's Bottom Reflectance Index (BRI) method. The research reveals a notable shift in the extent of seagrass beds, reducing from 1207.17 hectares in 2013 to 1008.64 hectares in 2021. The application of the DII method demonstrates an accuracy of 81.4%, while the BRI method yields an accuracy of 80.1%. The observed change of 198.53 hectares in seagrass coverage during this period is attributed to potential influences from human activities, including aquaculture, fishing, and marine structure construction, alongside the impact of natural disasters. These findings underscore the efficacy of remote sensing in monitoring seagrass dynamics, offering valuable insights into the factors contributing to changes in the coastal seagrass ecosystems of Khanh Hoa province.

Keywords: seagrass, Landsat 8, DII, BRI, remote sensing

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Detection of seaweed beds off Kottoi, Yamaguchi Prefecture, Japan using SPOT 6 and SPOT 7

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Abstract

Seaweed beds are indispensable for sustainable development because they provide many ecological services which cannot be substituted with those of other coastal ecosystems to a human society. UN Decade of Ocean Science wants to mobilize a scientific community to contribute to realize sustainable coastal waters. In this line, we collaborate with Kottoi Branch of Yamaguchi Prefecture Fishery Cooperative. In Japan, a common fishery right area is set very near to the coast and exclusively managed by a fishery cooperative in front of the coast for sustainable coastal fishery. Snorkeling diver fishermen of Kottoi Branch catching abalones and turban shells have suffered from increase in sea urchin barren and decrease in seaweed forests due to predation of sea urchins on seaweeds because abalones and turban shells live in seaweed forests. They started to remove sea urchins from sea urchin barren in September 2021. They asked us to estimate an effect of sea urchin removal activity with an area of seaweed forests in a quantitative manner. Then we started to analyze satellite multi-band images of SPOT 6 taken on 6 May 2021 before the sea urchin removal and 7 on 4 May 2022 after the sea urchin removal with field surveys conducted on 5 December 2021 and 5 June 2022 to obtain ground truth data. QGIS 3.2 was used for image analysis. Action Cam (FDR-X3000, Sony) with one minute interval shooting mode set to quadrat frame was lowered from the boat to the sea bottom to shot a bottom substrate type. GPS (eTrex 32J, Garmin) recorded positions where the camera wea lowered. Substrate types are classified into seaweed beds and non-seaweed beds. Sea urchin barren and sand beds are visually lighter than seaweed beds. We used decision tree methods to classify the bottom types using blue-band radiance and depth invariant index (DII) of green and blue bands and assessed classification accuracy with ground truth data. Overall accuracies of the best combination of thresholds of blue-band radiance and DII on satellite images on 6 May 2021 and 7 May 2022 were 0.871 and 0.879, respectively. In average, an area covered with seaweed forests where sea urchins were removed was increased 23.1% from

2021 to 2022 while an area of control was decreased 5.2%. Our study shows sea urchin removal activities of local fishermen have positive effect to increase seaweed beds to encourage them to continue their activities.

Keywords: habitat mapping, seaweed forests, sea urchin barren, satellite remote sensing

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Applications of unmanned aerial vehicles in intertidal reef monitoring: benefits and limitations

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Abstract

Traditionally, reef monitoring has been carried out through on-ground surveys, which typically cover only a limited spatial area of the reef. However, recent advancements in unmanned aerial vehicles (UAVs) have opened up new possibilities for monitoring large-scale coastal ecosystems. These UAVs can capture high-resolution imagery and topographic data at a centimeter scale, a level of detail that was previously unattainable using conventional methods.

In this study, we are exploring the potential of multi-spectral imaging to assist resource managers and policy-makers in gaining a deeper understanding of how reefs respond to environmental stressors. This understanding will enable more informed decision-making regarding the long-term conservation and sustainable use of these vital ecosystems. Our study involves a comparison between UAV-based photographic data collection in intertidal reefs and traditional on-ground monitoring surveys. Additionally, we are assessing the utility of multi-spectral imaging for mapping and monitoring the status of coral reefs. We employed a UAVs to collect centimeter-resolution data from intertidal reefs, and simultaneously conducted on-ground line transect surveys to gather biotic data for comparative purposes. The UAVs surveys proved to be a reliable means of estimating coral reef area. The findings emphasize the advantages of employing cost-effective UAVs for monitoring intertidal areas. These benefits include rapid data collection, broad coverage of reef regions, the capability to identify prevalent canopy habitats, and the creation of geomorphic derivatives for better understanding biological variations. Nevertheless, there are limitations due to their restricted operation during low tide, weather conditions, and difficulties in distinguishing intricate substrate types within coral reefs.

Keywords: UAVs, coral reef survey, coral reef mapping

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Deep learning for multi-label classification of coral conditions in the Indo-Pacific via underwater photogrammetry

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Abstract

Coral reef ecosystems are crucial as they support diverse marine life and provide ecosystem services to humans. However, they are currently under threat from anthropogenic activities and climate change. Citizen science-based conservation activities are being conducted globally to protect and restore coral reefs. Regular monitoring of coral conditions is essential for understanding the status of coral and directing conservation actions. Automated classification using underwater images and deep learning has shown great potential in assisting ecologists and conservationists in tracking and identifying threatened and vulnerable coral colonies. However, this classification task is highly challenging due to the ecological diversity of coral stressors, the complexity of underwater imaging conditions, inaccurate annotations, and the use of outdated algorithms and datasets. In order to address these challenges in coral image classification and contribute to solving real-world problems, we conducted this study in collaboration with a non-profit organization in Koh Tao, Thailand, which has been engaged in continuous monitoring and coral conservation activities for 16 years. This study comprises three major components: (1) Construct a comprehensive, updated, and open-source dataset using underwater photogrammetry, containing over 20,000 high-resolution samples representing common stressors and Indo-Pacific coral conditions. (2) Compare and evaluate the performance of seven off-the-shelf representative deep learning architectures, including the recently emerging Vision Transformer architectures, for this multi-label classification task. The performance of 11 neural networks is quantitatively assessed using the F1 metric. (3) Introduce a new multi-label classification method for detecting coral conditions and extracting professional ecological information, utilizing the ensemble learning approach. This proposed method can accurately classify coral conditions into categories of healthy, compromised, dead, and rubble; it can also identify corresponding stressors such as competition, disease, predation, and physical damage. The classification results demonstrate that our approach, which integrates Swin-Transformer and EfficientNet through the ensemble learning strategy, has achieved state-of-the-art performance compared to other methods tested on the

dataset. These findings can support conservation activities and provide references for decision-making for reef managers and stakeholders.

Keywords: coral images, ecological monitoring, multi-label classification, deep learning, neural networks

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Satellite derived bathymetry using Landsat-8 and Sentinel-2

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Abstract

Remote sensing technology using optical satellite images has been studied to monitor coral reefs, seagrass beds and seaweed beds, which are habitats for marine life in coastal areas. However, these habitats are difficult to map from optical satellite images because they are underwater and are affected by light attenuation in the water. Water column correction has been proposed to remove the effect of light attenuation due to water depth as a method to accurately extract information on seafloor cover from satellite images. In water column correction, more accurate effects are expected by using water depth data. However, in practice, the problem is that highly accurate water depth data that can be used for water column correction does not necessarily exist. Therefore, here I introduce technology for extracting water depth information using Landsat-8 and Sentinel-2 satellites. Landsat-8 and Sentinel-2 satellites can acquire data covering the entire globe, and there is already sufficient archived data. The depth estimation model developed based on random forest machine learning can create water depth data using only satellite images for highly transparent sea areas, and is expected to contribute to improving the accuracy of coastal habitat mapping and monitoring.

Keywords: bathymetry, coastal habitats, Landsat-8, Sentinel-2, random forest

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Remote sensing estimation of dissolved organic carbon in a blue carbon mangrove estuary in Malaysian Borneo

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Abstract

Mangroves are an important blue carbon sink, helping to offset anthropogenic emissions by sequestering terrigenous, atmospheric, and marine carbon. Mangroves are also exporters of dissolved organic carbon (DOC) to the ocean carbon pool. Estimating DOC in the waters of mangrove estuaries can assist in DOC flux estimations, helping to close the knowledge gaps in mangrove carbon sequestration calculations and improve global carbon budget assessments. In this study, supervised machine learning analysis of remote sensing reflectance from Sentinel-2 imagery was performed to estimate DOC in the waters of a 66 km^2 mangrove estuary known as Kuching Wetlands National Park in Sarawak, Malaysian Borneo. The machine learning algorithm was trained and verified on in-situ measurements collected at sites throughout the estuary. For the training and verification data set, a relationship between absorption spectra of chromorphic dissolved organic matter (CDOM) and DOC of the in-situ samples was utilised to relate remote sensing reflectance to DOC concentration. The algorithm was able to produce estimates of water surface DOC in the mangrove estuary and show variations in DOC across the estuary at a resolution of 30 m. The use of publicly accessible data such as Sentinel-2 and open-source machine learning libraries enables low-cost, accessible solutions for analysis of blue carbon systems like mangroves at greater spatial and temporal resolutions than in-situ sampling can provide. This is particularly important in developing regions, where budgets for large scale analyses may be small or non-existent. The results of this study can be utilised by stakeholders looking to assess carbon stocks of the Kuching Wetlands National Park as part of larger carbon stock taking across Malaysia, Borneo, and even globally.

Keywords: blue carbon, dissolved organic carbon, mangroves, machine learning, remote sensing

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Case studies of estimating seagrass blue carbon in selected sea areas in the NOWPAP region

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Abstract

Seagrass is a group of flowering plants that form meadows in shallow coastal waters. They provide important ecological roles such as a habitat, nursery and feeding grounds for many marine organisms, contributing to biodiversity. Their photosynthetic activity converts CO_2 to organic matters and release O_2 in water. Blue carbon is carbon captured and stored by coastal and marine plant ecosystems. Seagrass produces not only organic matters but also refractory dissolved ones consisting of carbon and store carbon as roots and rhizomes below ground. Above-ground biomass accumulates in the sediments. Such carbon is sequestered from the atmosphere for long periods of time and serves as a sink for greenhouse gases, contributing to global warming deterrence. Thus, conservation of seagrass is important to mitigate effects of climate change and maintain marine biodiversity. The Northwest Pacific Region Environmental Cooperation Center is designated as the Special Monitoring and Environment Assessment Regional Activity Centre of the Northwest Pacific Action Plan (NOWPAP) of the United Nations Environmental Program. Established in 1994 by China, Japan, Korea, and Russia, NOWPAP aims to ensure the wise use, development and management of the coastal and marine environment so as to obtain the utmost long-term benefits for the human populations of the region, while protecting human health, ecological integrity and the region's sustainability for future generations". Conservation of seagrass habitats is acknowledged as a prioritized issues within the NOWPAP framework. In collaboration between NOWPAP and the UNESCO IOC Sub-Commission for the Western Pacific (IOC-WESTPAC) Ocean Remote Sensing Project, the Seagrass Mapper was developed as a cloud-based tool for mapping seagrass distribution, utilizing both satellite imagery and field-based information. These studies, conducted in selected sea areas across China, Japan, Korea, and Russia, aimed to estimate the blue carbon captured in seagrass ecosystems. The upcoming demonstration of the Seagrass Mapper and the subsequent presentation of case study results are poised to offer invaluable insights into the current status and significance of blue carbon within the region's seagrass ecosystems.

Keywords: seagrass, blue carbon, remote sensing, Seagrass Mapper, map seagrass

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Truthing method for satellite remote sensing using sonar for blue carbon study

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Abstract

Climate change is globally threatening human activity and welfare. Blue Carbon (BC) is expected to be an important natural-based solution for carbon sequestration. The main purpose is to establish a financial system, carbon offset by BC credit, but enhancing BC has another important aspect. For example, seagrass meadows and seaweed forests have diverse and important ecological roles called ecological services. Seagrass beds attract fishes and are nurseries of many marine organisms. Recovering and enhancing the BC ecosystem gives us co-benefits adding to carbon sequestration, such as increased biodiversity and productivity, like increased fish catch. Therefore, when the local communities share BC's co-benefits, actions for BC are bolstered by the local communities. It is necessary to elucidate the co-benefits of the target BC ecosystem in the BC study. Satellite remote sensing can cover a large area but needs ground-truthing. Hydroacoustic methods could be appropriate for ground-truthing in coastal areas. This presentation summarizes the properties of sonars, multi-beam echosounders, side scan sonars, and single-beam echosounders regarding bathymetry, seagrass/seaweed detection and mapping, and bottom classification. Among three types of sonar, we highlight side scan sonar for seaweed detection and measurement from our experience in the northern part of Japan. Due to fine resolution along the track, side scan sonar gives us precise bottom reflection images to identify sandy and rocky bottoms. A wide swath, even in shallow water, is the most favorable prospect of side scan sonar. We may get a clue to evaluate co-benefit in the BC ecosystem. WESTPAC regions contain subarctic, temperate, and tropic areas, which may contain varieties of coastal bottom topography and vegetation. A combination of satellite imaging, sonar exploration, and *in-situ* observation and collection of samples will give us informative results with the right choice of sonar type for BC study.

Keywords: seagrass, seaweed, side scan sonar, co-benefit, carbon credit

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Comparison of seagrass mapping methods using different sonar images

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Abstract

Seagrass beds play essential roles in coastal ecosystems. Mapping seagrass beds helps conserve them and estimate blue carbon in the area. Satellite remote sensing can cover a large area but needs ground-truthing. Hydroacoustic methods could be appropriate for ground-truthing of both occurrences of vegetation and satellite-derived bathymetry (SDB). A multi-beam echo sounder (MBES) and a towed side scan sonar (SSS) can collect wide-bottom images efficiently. MBES outputs point clouds, accurately revealing the water depth, but it requires skill and time for elaborate post-processing of noise removal. On the other hand, snippet from MBES and side scan images from MBES and towed SSS could be more easily obtained. Nevertheless, there are few reports about the accuracy of them. We evaluated the accuracy of mapping seagrass beds by snippet and side scan images from MBES and towed SSS, comparing with point cloud from MBES as a standard. We surveyed seagrass beds of *Zostera* sp. by MBES and towed SSS at Hakozaki beach in Otsuchi Bay, in Iwate prefecture, Japan. The field survey time of MBES and towed SSS were 58 and 21 minutes, respectively. In the seagrass beds, the side scan image detects strong reflections from the plants in the water column. But the snippet sees weak reflection from the seafloor, as plants mitigate the sound beam from the MBES. The areas of seagrass covered measured from point cloud, snippet, and side scan image recorded by MBES were 3073, 3099, and 2287 m^2, respectively. The area measured by towed SSS was 2541 m^2. As for the seagrass bed's positioning accuracy from snippet and side scan image from MBES and towed SSS were 84%, 74% and 63%, respectively. Snippet had accuracy almost comparable to the point cloud method for positioning and area measurement. The result was slightly overestimated because it did not detect the plant directly. Side scan image output from MBES underestimated the area of vegetation cover. The towed side scan image was the highest area measuring accuracy next to snippet but had low positioning accuracy. There is uncertainty about the positioning of the sonar itself with towing. On the other hand, this method was the shortest in survey time. Point clouds and snippet may be suitable as a reference to high-resolution sensing like drones. A side scan image from towed SSS is suitable for middle to low-resolution satellite remote sensing because of its efficiency.

Keywords: habitat mapping, blue carbon, multi-beam echo sounder, side scan sonar, snippet

Coastal blue carbon monitoring and the application of remote sensing techniques

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Abstract

Coastal blue carbon ecosystems, including as mangroves, coastal saltmarshes and seagrass meadows, sequester carbon and provide co-benefits such as coastal protection, as a solution to global climate change. The measurement of carbon pool changes is crucial for the accounting of blue carbon stocks. This presentation introduces the carbon sequestration measurement based on stock-difference method, combining direct field observation methods, such as high-resolution surface elevation table (SET) measurements and remote sensing techniques, such as airborne LiDAR surveys within coastal blue carbon ecosystems. It was revealed that vegetation zonation and succession could greatly affect the carbon sequestration of saltmarshes. The carbon stock was found to be 85.37 Mg C ha^{-1} for the exotic species, but 56.52 Mg C ha^{-1} for the native species. Within the study area, high-resolution remote sensing images illustrated that vegetation succession contributed an additional 4,858 Mg of organic carbon between 2017 and 2020 to the carbon pool. The comparison between SET and LiDAR surveys also showed a good consistency during typhoon seasons, indicating an accelerated carbon sequestration driven by typhoon events. It appeared that both high-resolution remote sensing images and LiDAR data could have potential applications in coastal blue carbon monitoring.

Keywords: carbon sequestration, coastal blue carbon, field observation, remote sensing

Carbon storage estimation of coastal muddy flat using remote sensing and field surveys

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Abstract

The carbon sequestration capacity of muddy flat has attracted significant attention due to their widespread distribution globally. However, the methods for estimating carbon storage in muddy flat areas are not well investigated. The study developed a framework for estimating carbon storage in muddy flat areas based on multiple remote sensing images and field survey data. Firstly, the spatial extent of muddy flat areas in Zhejiang Province, China in 2022 was quantified using time series Sentinel-1 and Landsat data. Secondly, the muddy flat areas were divided into multiple zones based on factors such as distance from tidal channels and relative elevation. Quadrat surveys were conducted in each zone to obtain actual carbon storage data. Furthermore, a model was established to correlate remote sensing parameters with measured carbon storage, enabling further estimation of the carbon storage in large-scale muddy flat areas.

Keywords: carbon storage, muddy flat, China, remote sensing

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On the modeling coefficients of a photoacclimation model for phytoplankton in the global ocean

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Abstract

Previous studies showing that photoacclimation plays a dominant role in phytoplankton dynamics based on the photoacclimation model. This model relies on two constants, which were determined by specific bin sizes and products from specific algorithms. However, it remains unclear whether this model is universally applicable across different bin sizes and algorithms for bio-optical products. Here we carried out sensitivity studies regarding this model on bin size and satellite products, where the results revealed that the matches between carbon-to-chlorophyll ratio (θ) of phytoplankton derived from the photoacclimation model (θModel) and θ obtained from satellite data (θSat) was initially poor in small randomly selected 2°×2° bins. However, as the bin size increased to 22°×22°, the matches improved significantly. Simultaneously, we found that the diffuse attenuation coefficient at 490 nm (Kd(490)) exerts the most influence on θModel. Different algorithms of Kd(490) led to variations in θModel of approximately 10–40%, particularly in the oligotrophic waters. These results suggest that the modeling coefficients of this photoacclimation model is not universally applicable, rather better be applied to the bin size and Kd(490) product when the model (along with model coefficients) was developed. It calls for efforts to develop more robust photoacclimation model regarding phytoplankton in the upper ocean.

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Spatio-temporal variability of sea surface temperature and Chl-*a* in the coastal waters of Sagami Bay

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Abstract

Chlorophyll-a (Chl-*a*), the primary pigment found in phytoplankton, serves as a proxy of biomass, water fertility, and productivity. Sea Surface Temperature (SST) is one physical water parameter which is also an indicator of marine ecosystem health. Coastal waters, known for high primary production and diverse marine life, are subject to increased fishing and human-induced impacts. Consequently, monitoring fluctuation in SST and Chl-*a* in these regions is critical. Sagami Bay is a coastal area located in Kanagawa, Japan, and known for high primary production, rich biodiversity, and importance for fisheries. In the realm of coastal research, particularly in areas like Sagami Bay, previous studies have provided valuable insights into the spatial and temporal variability of SST and Chl-*a* using remote sensing satellite data with low spatial resolution (>4 km). However, the relatively broad spatial resolution of this data often limits our ability to capture critical details necessary for understanding complex coastal dynamics. Recognizing this limitation, there is a growing emphasis on utilizing higher-resolution remote sensing data. The purpose of this study is to investigate spatial and temporal variability of SST and Chl-*a* in Sagami Bay using *in situ* and ocean color remote sensing satellite data. The specific objectives are (1) to investigate the spatio-temporal variability of SST and Chl-*a*, and (2) to investigate the relationship between SST and Chl-*a,* and their relationship with environmental parameters. The study uses *in situ* data (2016–2023) collected from Station M (35˚ 09’ 45” N, 139˚ 10’00” E) in Sagami Bay, 1-km resolution MODIS-Aqua (2002–2023), and 250-m resolution GCOM-C/SGLI (2018–2023) data. Preliminary results show clear spatial water mass variability of SST and Chl-*a* within Sagami Bay using GCOM-C/SGLI. The application of the Non-parametric Kendall-Theil Robust Line (KTRL) method to MODIS spatial monthly means indicates a significant decreasing trend in Chl-*a* ($p<0.05$). In contrast, SST shows a non-significant increasing time-series trend ($p>0.05$). Furthermore, an inverse correlation was observed between SST and Chl-*a* (ρ=-0.38), using Spearman’s correlation analysis. The significant decreasing trend of Chl-*a* for 21 years suggests a decline in phytoplankton productivity, which is vital for the marine food web and carbon sequestration. Although the trend analysis rise in SST was not significant, the inverse correlation with Chl-*a* suggests higher SST may impact phytoplankton distribution and biomass, subsequently affecting nutrient cycles, biodiversity, and the overall health of the marine ecosystem.

Keywords: remote sensing, chlorophyll-*a*, SST, Sagami Bay

Session D3: Satellite and airborne remote sensing techniques for marine ecosystem monitoring and management

Identifying red tides in the upper Gulf of Thailand using ocean color techniques and satellite imagery

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Abstract

In the upper Gulf of Thailand (uGoT), the red tide phenomenon triggered by green *Noctiluca scintillans*, a distinctive single-cell heterotrophic organism hosting green algae *Pedinomonas noctilucae*, frequently causes harmful effects. With its high density, this organism turns the water a deep milky green and has the potential to induce low dissolved oxygen conditions (hypoxia), resulting in substantial fish mortality. The harmful effects intensified during the 2023 southwest monsoon season due to an intense and prolonged bloom. Simultaneously, other red tide occurrences, such as *Ceratium furca* and diatoms, were also often reported in the uGoT. This research focuses on the development of techniques utilizing ocean color observations and satellite data to identify red tide water types and bloom locations in near-real time in order to mitigate the severe impact on fisheries, marine life, and human health. Ship observation during 2017–2019 and 2023 provided bio-optical data on uGoT seawater during green *Noctiluca* blooms and other red tide events. Seven types of bloom water, characterized by chlorophyll-a (chl-a) levels $\geq$10 mg m^{-3}, were classified based on *in situ* percentages of pigment-identified phytoplankton group composition and hyperspectral reflectance characteristics. Two distinct algorithms were developed based on this observation data: 1) local chl-a algorithms utilizing remote sensing reflectance (Rrs) in the blue-to-green band ratio and 2) red tide classification algorithms relying on the specific spectral characteristics in blue, green, and red wavelengths of red tide waters. These algorithms were applied to Level-2 Ocean Color data from the Moderate Resolution Imaging Spectroradiometer (MODIS) onboard Aqua at 1 km resolution and the Second-generation Global Imager (SGLI) onboard the Global Change Observation Mission-Climate (GCOM-C) at 250 m resolution, after satellite Rrs correction. The results of red tide classification on satellite images demonstrated that the developed algorithms effectively captured red tide events, encompassing green *Noctiluca*, dinoflagellates, and diatoms, as confirmed by red tide reports from local agencies. This presentation provides a comprehensive analysis of the algorithm developments, contributing significantly to the field of coastal red tide monitoring.

Keywords: green *Noctiluca*, red tide, ocean color algorithm, satellite, Gulf of Thailand

Session D3: Satellite and airborne remote sensing techniques for marine ecosystem monitoring and management

Seasonal phytoplankton abundance and massive fish kills monitoring in Jakarta Bay, Indonesia using Aqua-MODIS Satellite

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Abstract

Located in the north of Jakarta, the capital of Indonesia, Jakarta Bay is an essential bay that supports the communities surrounding it with various sectors, such as fisheries, marine tourism, transportation, trade, and more. However, this bay is also prone to severe heavy eutrophication due to elevated nutrient inputs originating from various activities of the more than 30 million residents living around the Jakarta mega-metropolitan city (JMC) and its hinterland areas called the JABODETABEK (Jakarta-Bogor-Depok-Tangerang-Bekasi). These activities load high nutrients into the bay via 13 rivers and canals, causing high phytoplankton blooms (HAB) and triggering several massive fish kills (MFK). The purpose of this study is to monitor the seasonal (Dec-Feb/DJF, Mar-Mar/MAM, Jun-Aug/JJA, and Sep-Nov/SON) eutrophication parameter, especially the phytoplankton abundance (ABUND) of Jakarta Bay using 8-daily Aqua MODIS data with a resolution of 4x4 km that is available on Giovanni web (https://giovanni.gsfc.nasa.gov/) from 2003 up to now. The study involved the development of an empirical estimation model of ABUND using field-collected ABUND data and remote sensing reflectance (Rrs) of Aqua MODIS data from 2008 to 2015. To monitor the HAB from 2003–2023, the study set up a criterion for the HAB condition. If the ABUND ≥108 cell/M^3 and covers more than a quarter (1/4) of Jakarta Bay's areas, then it is considered to be in HAB condition. The HAB was then mapped using this criterion. The study results indicate that MAM had the highest mean ABUND with 106.826x107 cells/M^3, followed by DJF with 61.494x107 cells/M^3, while the lowest was in JJA with 2.712x107 cells/M^3, but slightly increased again in SON with 3.138x107 cells/M^3. High ABUND values were found successively in DJF 2017, 2020, 2019, 2016, 2004, 2018, MAM 2004, 2010, and JJA 2016. Among those, the high HAB events of Apr 2004, Nov. 2007, and Nov 2015 triggered massive fish kills (MFK) due to dissolved oxygen (DO) depletion (≤2 mg/L) after HAB. However, some other big HAB blooms did not cause MFK. The study concluded that: (i) MFK associated with limited water movement (weak current) indicated by unusual calm conditions of sea surface or by the difference of the highest – (minus) the lowest tides of <0.5 m occurred 2–4 days after HAB; (ii) It is crucial to monitor and map the DO of the bottom layer in Jakarta Bay to predict the occurrence of MFK; (iii) Seasonal monitoring of HAB in this study is not sufficient to describe the HAB of Jakarta Bay. Therefore, monthly-based data analysis is necessary.

Keywords: monitoring, phytoplankton, abundance, massive fish kills, Jakarta Bay

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Session D3: Satellite and airborne remote sensing techniques for marine ecosystem monitoring and management

Remote sensing observation and analysis of water clarity in tropical coastal waters in Sarawak, Malaysian Borneo

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Abstract

Effective and rapid coastal monitoring and management efforts are critical to assess changes of water quality in response to the growing coastal population globally. In this study, we present a new regional remote sensing model for water clarity detection developed from the turbid coastal waters of Sarawak, Malaysian Borneo. The model was developed with the regression of in situ Kd(490) measurements and remote sensing reflectance values (Rrs(λ)) expressed in power function. The band ratio of Rrs(678)/Rrs(488) was best fitted to the turbid Sarawak coastal waters. Water clarity detection was described in the form of euphotic depth (Zed) via the inverse relationship with Kd(490) model values. The developed remote sensing model was applied onto MODIS(Aqua) time-series imageries, retrieved from year 2002 until 2023, to assess the spatial-temporal variability of water clarity in this region. Our analysis demonstrated that the Sarawak region recorded an averaged water clarity depth of 20 m, ranging from Lupar to Rajang coastal areas. Coefficient of variation (CV) values of 0.45% was detected along the Sematan coastal areas, which suggested potential hotspot of water clarity changes in this region. Analysis on coastal transects revealed that the water clarity showed gradual improvement from coastal regions extending to territorial and open ocean waters. Investigation on monsoon patterns indicated that the dry and wet seasons drive the increase and decrease of water clarity conditions respectively. This study presents the first observation of water clarity variability at high spatial and temporal extent within the Sarawak coastal areas. Findings from this study could provide valuable insights to enhance the coastal management strategies and practices in this region.

Keywords: Secchi disk, light availability, water transparency, primary production, eutrophication

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Session D3: Satellite and airborne remote sensing techniques for marine ecosystem monitoring and management

Integrated remote sensing and *in situ* Observations for Coastal Water Quality Monitoring

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Abstract

Blue Carbon ecosystems comprise of mangroves, seagrass meadows, and saltmarshes. Southeast Asia, which houses half of the global mangrove population, faces significant deforestation rates and sustainability conflicts exacerbated by climate change and economic growth pressures. Mangroves are vital for carbon sequestration but under-studied in the context of dissolved organic carbon (DOC) outwelling rates, particularly in Southeast Asia. The AquaWatch mission addresses this (and other coastal water quality topics) by combining in-situ sensing with remote Earth Observations. This involves deploying sensor-equipped buoys, collecting time-series data, and developing predictive models using machine learning to forecast water quality parameters, thereby facilitating better management of aquatic ecosystems. The presentation will introduce the international AquaWatch pilot site in the Kuching Wetlands National Park, Sarawak, Malaysia, and showcase first results collected since its installation in July 2023. Parameters to be discussed will include high-resolution measurements of physico-chemical parameters, CDOM /DOC, TSS and chl-a, among others. Additional coastal transects and FDOM analyses will be used to discuss the dynamics and potential sources and sinks of the dissolved organic matter in the Kuching Wetlands National Park.

Keywords: coastal water quality, remote sensing, datacube, mangroves

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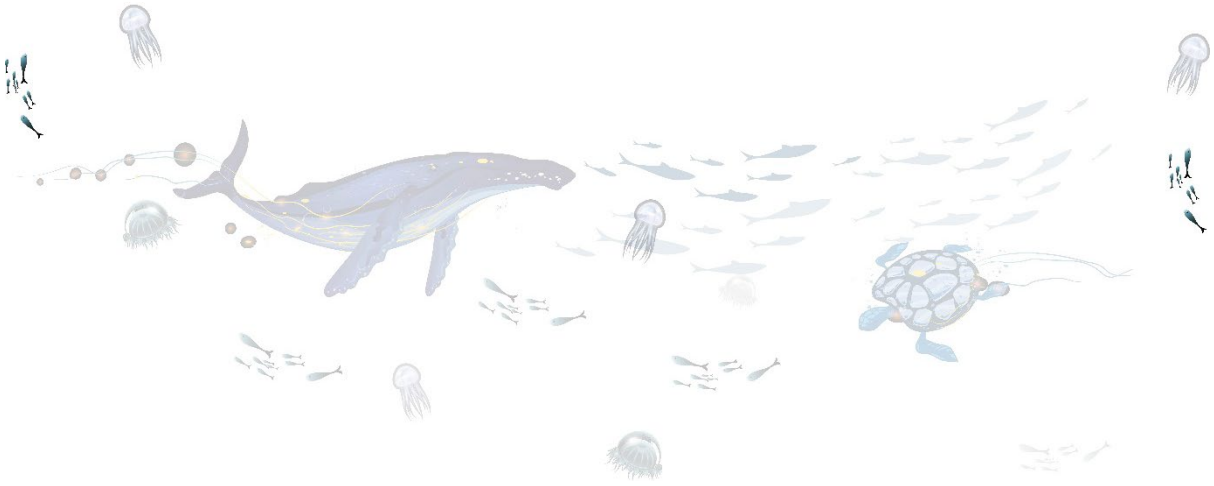
Sub-theme D: Emerging Ocean Science and Cross-cutting Issues

Session D4: Deep-sea exploration and research in the Western Pacific



Programme

Venue: Chelsea A, 5th Floor
Date: 23 April 2024

Conveners:

Intan Suci Nurhati	Research Center for Deep Sea, BRIN, Indonesia
Li Li	First Institute of Oceanography, Ministry of Natural Resources, China
Lisa Levin	Scripps Institution of Oceanography, UC San Diego, USA
Khaira Ismail	Faculty of Science and Marine Environment, Universiti Malaysia Terengganu, Malaysia
Augy Syahailatua	Research Center for Oceanography, BRIN, Indonesia

Time	Presentation Titles	Speakers
Section 1		
10:00–10:15	Discovery of a conic feature in Halmahera waters, Indonesia: traces of a late-stage hydrothermal activity	Gabriella Alodia, *Institut Teknologi Bandung, Indonesia*
10:15–10:30	Subsurface modifications of NH_4^+ at low-temperature, diffuse vents via combined observation and kinetic isotope effect integrated Michaelis-Menten model approach	Chawalit Charoenpong, *Chulalongkorn University, Bangkok, Thailand*
10:30–10:45	A potential source of Fe and other metals from the hydrothermal sediments in the southern Okinawa Trough	Li Li, *First Institute of Oceanography, China*
10:45–11:00	Perspectives from a developing nation: enhancing participation of Malaysia in regulating deep seabed mining	Khaira Ismail, *Universiti Malaysia Terengganu*
11:00–11:15	Improved deep-sea biodiversity assessments can inform conservation and sustainable management of deep-sea ecosystems: lessons learned from the Atlantic and applications to the Western Pacific	Morato Telmo, *University of the Azores, Portugal*
11:15–11:30	Fault identification at the Flores Sea using multibeam bathymetry and potential data	Gabriella Alodia, *Institut Teknologi Bandung, Indonesia*
11:30–11:45	Water mass transformation and seafloor sediment from Jala Citra-III Expedition in Flores Sea	Noor Cahyo D. Aryanto, *BRIN, Indonesia*
11:45–12:00	The distribution and behavior of Ga in Western Pacific Ocean	Zheng Bo Liu, *East China Normal University, China*

Discovery of a conic feature in Halmahera waters, Indonesia: traces of a late-stage hydrothermal activity

Gabriella Alodia[1], Nurhidayat[2], Dyan P. Sobarudin[2], Dian Adrianto[2], Angga Dwinovantyo[3], Steven Solikin[4], Mustafa Hanafi[5], Astyka Pamumpuni[6], Idham A. Kurniawan[7], Poerbandono[1], Chris M. Green[8] and Andrew M. McCaig[8]

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Abstract

An expedition to confirm the presence of underwater hazards was carried out in Halmahera waters, one of the forefront boundaries of the western Pacific, from August to September 2021. The expedition carried out a multibeam survey, surface-towed magnetic survey, and seafloor sampling. A ~615 m tall conic feature with traces of hydrothermal activity was discovered. The feature is bounded on the southeastern (SE) side by a series of normal faults at the peak, with possible dextral strike-slip faults traced west of the feature. The feature displays potential presence of volcanic rocks based on the observed contrasting magnetic anomaly signature of down to -100 nT, which in the magnetic equator corresponds to the presence of a highly magnetised material. Four 2.5-D magnetic models were built to test various scenarios on the subsurface structure of the feature, mainly focusing on the presence of volcanic rocks at different epochs and a possible presence of serpentinisation. X-ray diffraction (XRD) of the silt and clay sediments sampled confirms traces of late-stage hydrothermal activity, indicated by a high percentage of quartz (53.87%), followed by calcite (34.56%), kaolinite (6.54%), and illite minerals (5.04%). Non-carbonate materials are yet to be found in the sampled sand and gravel sediments, which mainly consist of shell and coral fragments. The discovery of the conic feature, now termed the Yudo Sagoro Hill, becomes pioneering information on the effort to understand the structure and activities on the seafloor of Halmahera waters.

Keywords: multibeam bathymetry, magnetic anomaly, x-ray diffraction (XRD), hydrothermal activity

Subsurface modifications of NH_4^+ at low-temperature, diffuse vents via combined observation and kinetic isotope effect integrated Michaelis-Menten model approach

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Abstract

Diffuse hydrothermal vents occur as the result of mixing between high-temperature vent fluids and ambient seawater, yielding low-temperature flows that allow microbial communities to thrive. Here we report the measurements of concentrations of different inorganic nitrogen pools and their nitrogen (N) and oxygen (O) isotope compositions taken from two diffuse vents at 9°50'N East Pacific Rise (EPR), *Crab Spa* and *Teddy Bear*. In comparison to the high-temperature, focused vents nearby, these diffuse vents exhibited depletion of nitrate (NO_3^-) and enrichment of ammonium (NH_4^+) attributable to microbial activities therein. Denitrification, dissimilatory nitrate reduction to ammonium (DNRA), and ammonia consumption are proposed to be the key N transformations at these sites. In addition to these natural sample measurements, we also report isotopic measurements from previously reported incubation experiments representing diffuse, low-temperature conditions (McNichol et al., 2016; 2018), in which varying environmental conditions (i.e., temperatures and electron donor) were used to investigate the microbial N transformation processes. The N isotopic composition of NH_4^+ ($\delta^{15}N_{NH4}$) both from the natural and incubation samples displayed an unexpectedly large degree of variation ranging more than 16‰ and 22‰, respectively. Simulations of the incubation experiments using a multi-process kinetic isotope effect integrated Michaelis-Menten model highlight a complex interplay between different N transformation reactions and notably ammonium consumption.

Keywords: ammonia, Crab Spa, Teddy Bear, Michaelis-Menten, dissimilatory nitrate reduction to ammonium (DNRA)

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A potential source of Fe and other metals from the hydrothermal sediments in the southern Okinawa Trough

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Abstract

Hydrothermal input is often considered as one of the major components contributing to the total marine elemental budget. However, the contribution of the elemental diffusive flow in sediments in vicinity of the hydrothermal vent is seldom studied. Short sediment cores were collected from an active hydrothermal field in the southern Okinawa Trough (OT) using a remotely operated vehicle (ROV). Vertical profiles of dissolved Fe, Mn, and other redox-sensitive metals (Mo, U, and V) in pore water were measured, as well as the metal contents and their speciation in sediments. The vertical dissolved profiles allowed calculation of diffusive benthic fluxes using PROFILE code. We detected high dissolved iron concentration (~140 μmol L-1) in surficial pore water at ROV10-1 (the station adjacent to the vent). In addition, we detect higher reactive fractions of Fe, Mo, U in sediments of ROV 10-1 than three other sediment cores. Geochemical processes in the area adjacent to hydrothermal vent were significantly different than other marine sediments and have led to significant upward benthic Fe flux (ca. 111 μmol m^{-2} day^{-1}). This calculated flux was in the high end of the ones found in coastal or reducing sediments, and much higher compared to the ones found in deep ocean sediments. Such upward benthic fluxes of Fe and other metals (Mn, Mo) from hydrothermal influenced sediments in the OT may be potentially important, yet not well recognized, metal sources to the waters of Northwest Pacific.

Keywords: Fe, trace metals, hydrothermal vent, early diagenesis, Okinawa Trough

Perspectives from a developing nation: enhancing participation of Malaysia in regulating deep seabed mining

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Abstract

Deep seabed mining has garnered increasing commercial interest over recent decades, particularly regarding deposits such as polymetallic nodules, polymetallic sulphides, and cobalt-rich ferromanganese crusts. These resources are known to exist on the continental margins that fall within national jurisdiction and on the international seabed that lies beyond the limits of national jurisdiction. To regulate access to these resources and design a suitable benefit-sharing mechanism, the International Seabed Authority was established, ensuring the effective protection of the marine environment from the harmful effects of mining activities. Malaysia's potential for deep seabed mining is determined by international maritime regimes, specifically the United Nations Convention on the Law of the Sea (UNCLOS). Malaysia ratified UNCLOS and signed Part XI concerning the Area of deep seabed mining in 1996 and 1994, respectively. Despite not having engaged in deep seabed mining activities, there is a growing need to explore this industry due to the increasing demand for strategic minerals such as rare earth elements (REEs) and the need for alternative sources of traditional land-based mineral resources. Before venturing into exploring deep seabed minerals, Malaysia must address several crucial issues, including policy and legal considerations, environmental impact, technological advancements, capital, and return on investment. A special committee comprising government agencies, universities, and experts has been convened to ensure a responsible and well-informed approach. The committee is responsible for discussing and proposing a deep seabed mining agenda for policymakers to consider. Through detailed deliberations and astute assessments, Malaysia's potential for deep seabed mineral exploration can be realised. In conclusion, while deep seabed mining offers significant potential for countries like Malaysia to explore and find alternative sources of strategic minerals, it is crucial to ensure that the exploration and exploitation of these resources are carried out responsibly and sustainably, with proper consideration given to legal, environmental, and economic factors. Through careful planning and consideration, Malaysia can realise the potential for deep seabed mineral exploration in a way that benefits both its economy and the global community.

Keywords: deep seabed mining, Malaysia, Southeast Asia, developing nation, ISA

Improved deep-sea biodiversity assessments can inform conservation and sustainable management of deep-sea ecosystems: lessons learned from the Atlantic and applications to the Western Pacific

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Abstract

The deep-sea is characterized by complex marine seafloors home to rich benthic habitats, where hydrothermal vents, coral gardens and sponge grounds are commonly observed. These benthic habitats are, however, exposed to anthropogenic pressures, which can put their long-term preservation at risk. Identifying areas of ecological relevance is currently of upmost importance to inform management measures that would ensure the protection of the natural heritage in commitment with a sustainable use of marine resources. Thanks to the cost-effective video platform Azor drift-cam and other ongoing collaborations, we have significantly increased our knowledge of the natural capital of the deep sea in the Azores. Over the past four years, almost 600 dives have been conducted at several seamounts, ridges and island slopes, resulting in over 550 hours of new deep-sea imagery, totaling approximately 400 kilometers of explored seafloor. We have found that the Azores is a hotspot of cold-water coral diversity in the NE Atlantic, with more than 180 species identified to date. We have discovered the largest assemblage of the very slowly growing black coral of the genus *Leiopathes* ever observed in the Atlantic, the densest octocoral garden of the bubble gum coral *Paragorgia johnsoni*, and large aggregations of the endemic hydrocoral *Errina dabney*, among others. Several of the areas explored meet the criteria to be considered VMEs due to the high structural complexity and functional importance of their benthic habitats, with high vulnerability to human activities and potentially slow recovery after disturbance. These improved assessments of the deep-sea biodiversity have enhanced our ability to develop systematic conservation planning approaches and inform the identification of priority areas for conservation. Indeed, these assessments have already informed the Regional Government of the Azores on the expansion of the existing network of Marine Protected Areas to achieve the 30% targets. We argue that cost-effective technologies along with well stablished frameworks can democratize deep-sea exploration, produce transparent, data-driven and science-based scenarios, and inform conservation and sustainable management of deep-sea ecosystems in the western pacific island countries and territories ocean.

Keywords: deep-sea exploration, cost-effective tools, deep-sea ecology, spatial ecology, systematic conservation planning, sustainable management

Fault identification at the Flores Sea using multibeam bathymetry and potential data

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Abstract

The Flores Sea is located at the back-arc basin of the Sunda Arc and the Banda Arc systems. These two arcs were formed due to the meeting of the Indo-Australian Plate with the Sunda Plate through a subduction process. The Banda Arc represents a transition from oceanic plate subduction to a continental plate collision event that produces a more complex deformation zone. The pressure formed from this transition event could give rise to the potential for the emergence of new fractures around the Flores Sea and Banda Sea, which could lead to the formation of new faults, other than the widely known Flores Back-Arc Thrust. This study was carried out to reveal the morphological structure of the Flores Sea seafloor using multiple techniques, such as analysis of the vertical gravity gradient (VGG) from a global free-air gravity model and in-situ marine surveys consisting of multibeam and magnetic anomaly surveys. The survey was carried out through the “Jalacitra 3-2023 Flores” expedition, initiated by the Indonesian Navy Hydro-Oceanographic Office (Pushidrosal). Several exposed faults, mainly dextral strike-slip faults, are identified in the multibeam bathymetry. These faults are consistent with the lineaments found in the global VGG data, striking NW-SE from the Selayar Islands, south of Sulawesi, to the Lesser Sunda Islands. Variability of magnetic anomaly in the area indicates unique pattern that might relate

to the regional tectonics in the area. This study attempts to correlate multiple seafloor data to better indicate undersea faults in the Flores Sea, as information of fault location and geometry is key for disaster risk reduction effort, undersea cable/pipeline route planning, and safety of navigation at sea.

Keywords: Flores sea, multibeam bathymetry, seafloor morphology, vertical gravity gradient, magnetic anomaly

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Water mass transformation and seafloor sediment from Jala Citra-III Expedition in Flores Sea

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Abstract

The Flores Sea functions as a crucial pathway for transporting water masses from the Pacific Ocean to the Indian Ocean. This region features unique topography and seafloor characteristics, notably the Flores Back Arc Thrust Fault. The aim of this study is to uncover the characteristics of water masses and turbulent mixing influenced by tides and bottom topography during Transitional Season I and its relation to distribution of seafloor sediment, which terrigenous mud, sand and several other lithofacies are recognized in the study area. The primary dataset consists of Conductivity, Temperature, and Depth (CTD) measurements, including five single casts and two yoyo measurements. The CTD measurement was conducted from 25 to 30 April 2023, representing the Transitional Season I (March to May) with depths ranging from 427 to 1309 m. In addition, two yoyo measurements were conducted in a period of 8.8 hours on station 2 and 22.7 hours on station 5 with hourly sampling frequency at the depths of 495 and 1309 m. The Optimized Thorpe Method (OTHORPE) is utilized to estimate turbulent kinetic energy dissipation rate (ε) and vertical eddy diffusivity (Kρ). The values of ε and Kρ provided represent averages across distinct stratification layers, including the Mixed Layer, Thermocline Layer, and Inner Layer. The results indicate heightened dissipation rates within the thermocline layer at all stations, ranging from ε $10^{-7.5}$ to $10^{-6.5}$ m^2 s^{-3}. Vertical diffusivity exhibits elevated levels in both the thermocline layer and deep layer, spanning the range of 10^{-4} to $10^{-2.5}$ m^2 s^{-1}. Additionally, noteworthy is the observation that changes in tidal height correlate with variations in Kρ values, demonstrating an increase as stratification diminishes.

Keywords: Indonesian Troughflow, turbulent mixing, tidal force, vertical mixing, seafloor sediment, Jala Citra-III, Flores Sea

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The distribution and behavior of Ga in Western Pacific Ocean

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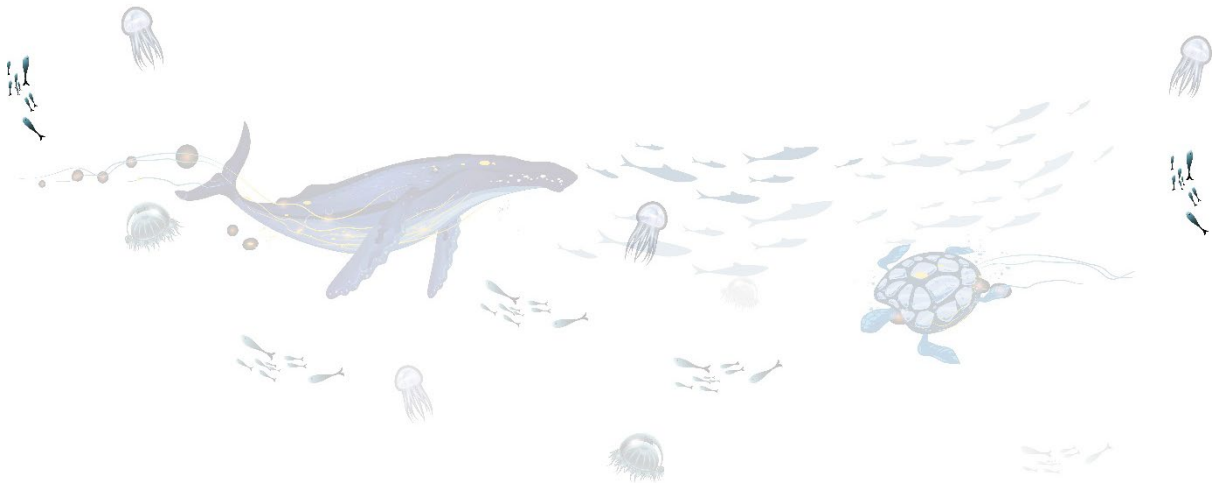
Abstract

Ga is a trace metal element with chemical properties similar to Al and Fe. In recent years, it has gained significant attention due to its unique residence time in the ocean. A new and accurate method using resin enrichment of Ga, combined with isotope dilution, was developed to determine its dissolved concentrations in natural waters. The procedural blank of the method is 0.42±0.18 pmol/kg (N=12, 1 SD) and the detection limit is 0.6 pmol/kg. The sampling methods of seawater have been explored, and the results show that Ga can be directly collected using a CTD sampler. The sampling and analysis of Ga are no longer a challenge. The Ga data in the region of 142°E, 2°S–20°N in the Western Pacific Ocean is reported for the first time. In the surface water of this section, there are significant differences in Ga concentrations among different ocean currents, which can serve as suitable tracers to distinguish SEC (South Equatorial Current), NECC (North Equatorial Counter Current), and NEC (North Equatorial Current). In the intermediate and deep waters, Ga shows a high correlation with salinity (R^2>0.8, p<0.01). Compared to Potential Temperature, Salinity, and Dissolved Oxygen, Ga exhibits a greater range of variations in the four water masses: NPIW (North Pacific Intermediate Water), AAIW (Antarctic Intermediate Water), UCDW (Upper Circumpolar Deep Water), and LCDW (Lower Circumpolar Deep Water). Ga can be a good tracer to distinguish intermediate and deep waters.

Keywords: Western Pacific Ocean, dissolved Ga, tracer, lower and upper circumpolar deep water

Sub-theme D: Emerging Ocean Science and Cross-cutting Issues

Session D5: Gas hydrates and methane fluxes in the Indo-Pacific region



Programme

Venue: Somerset B, 5th Floor
Date: 23 April 2024

Conveners:

Vyacheslav Lobanov	V.I.Il'ichev Pacific Oceanological Institute, Russia
Renat Shakirov	V.I.Il'ichev Pacific Oceanological Institute, Russia
Nengyou Wu	Qingdao Institute of Marine Geology, China

Time	Presentation Titles	Speakers
Section 1		
10:00–10:15	Methane distribution, production, and emission in the Western North Pacific	Gui-Ling Zhang, *Ocean University of China, China*
10:15–10:30	Preliminary results on gas hydrates distribution in South Makassar Strait, Indonesia	Feisal Dirgantara, *BRIN, Indonesia*
10:30–10:45	BSRs-derived thermal properties in the deepwater South Makassar Basin, Indonesia	Feisal Dirgantara, *BRIN, Indonesia*
10:45–11:00	Complex migration pattern of methane at the cold seep in the Middle Okinawa Trough	Ang Li, *Qingdao Institute of Marine Geology, China*
11:00–11:15	Fluid flux variations control the occurrence of active gas hydrate system in the northern slope of South China sea	Jin Jiapeng, *Pilot National Laboratory for Marine Science and Technology, China*
11:15–11:30	Methane distribution and sea-to-air methane flux in the Dongsha area of the South China Sea	Cuiling Xu, *Qingdao Institute of Marine Geology, China*
11:30–11:45	Spatiotemporal variability of the methane hydrates upper boundary stability zone in the Sea of Okhotsk	Evgeniya Petrova, *V.I.Il'ichev Pacific Oceanological Institute, Russia*
11:45–12:00	Evidence of relations of gas hydrates and oil-and-gas deposits in the seas off Sakhalin Island (Russia)	Yuri Telegin, *V.I.Il'ichev Pacific Oceanological Institute, Russia*
Section 2		
13:30–13:45	Cold seeps and heat flow: gas hydrate provinces offshore Sakhalin Island	Nadezhda Syrbu, *V.I.Il'ichev Pacific Oceanological Institute, Russia*
13:45–14:00	Dissolved methane transport	Nadezhda Syrbu, *V.I.Il'ichev Pacific Oceanological Institute, Russia*
14:00–14:15	Experimental and numerical investigation for the biogeochemical process of methane released from gas hydrate	Yizhao Wan, *Qingdao Institute of Marine Geology, China*

Time	Presentation Titles	Speakers
14:15–14:30	Molecular simulation of gas hydrate formation in marine sediments	Zhengcai Zhang, *Pilot National Laboratory for Marine Science and Technology, China*
14:30–14:45	Can we identify creep failure of marine hydrate-bearing sediment via geophysical techniques?	Yanlong Li, *Qingdao Institute of Marine Geology, China*
14:45–15:00	Fracture-filling gas hydrate and its geophysical responses on the host sediments	Gaowei Hu, *Qingdao Institute of Marine Geology, China*
15:00–15:15	Utilizing SWIR spectral channels in passive satellite remote sensing scanners for detecting methane plumes on the sea surface	Igor Stepochkin, *V.I.Il'ichev Pacific Oceanological Institute, Russian*
Section 3		
15:30–17:00	Meeting of the WESTPAC Working Group on Complex study of the gas-hydrates and methane fluxes in the Indo-Pacific region (CoSGas)	

Methane distribution, production, and emission in the Western North Pacific

Hao-Nan Wang[1, 2], Guan-Xiang Du[2], Shu-Xian Yu[2, 3], Hong-Hai Zhang[1, 2], Guo-Dong Song[1, 2], Su-Mei Liu[1, 2] Nan Zheng[4], Xiao-Hua Zhang[2, 3], Gui-Ling Zhang[1, 2, *]

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Abstract

Ocean is a source of atmospheric methane (CH_4), but there are still large uncertainties in the estimations of global oceanic CH_4 emission due to sparse data coverage. In this study, we investigated the spatial distribution and influencing factors of CH_4 in the Western North Pacific (WNP) during May–June 2021. High-resolution continuous underway measurements showed that surface CH_4 concentrations ranged from 2.09 to 3.92 nM, indicating an obvious spatial gradient with a gradual increase from the south to the north due to the influence of water mixing between Kuroshio and Oyashio. Surface water was oversaturated with respect to the atmospheric CH_4 with a mean saturation of 107.6±4.7% and the air-sea flux of CH_4 was estimated to be 0.49±0.89 μmol/m^2/d. High CH_4 fluxes occurred in the Kuroshio-Oyashio transition region due to high productivity and intensive air-sea interaction. Vertically, CH_4 concentrations in the water column ranged from 0.53 to 6.11 nM and almost decreased with depth. CH_4 maximums were observed around 45–300 m, which could be resulted from in situ production through multiple pathways and affected by advective transport and subduction of North Pacific Intermediate Water (NPIW). Incubation experiments with Methylphosphonate (MPn) enrichment and 16S rRNA gene sequencing showed that in subtropical region and Kuroshio-Oyashio transition region, *Vibrio* spp. might produce CH_4 by degrading methylphosphonate (MPn) and this process may be inhibited by inorganic phosphorus and regulated by iron stress. These results may provide evidence for explaining CH_4 oversaturation in the oxygenated surface water in the WNP.

Keywords: greenhouse gas, methane, air-sea flux Western North Pacific, methane production

Preliminary results on gas hydrates distribution in South Makassar Strait, Indonesia

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Abstract

The existence of gas hydrates in the deepwater basin off the Makassar Strait, Indonesia, is indicated by the presence of bottom-simulating reflectors (BSRs) and has been confirmed through past drilling activities. The strait, underlain by rifted thinned continental crust, has been open since the middle Eocene. While gas hydrate studies have focused on the Northern Makassar Basin, the southern region lacks equivalent investigation. This research employs vintage 2D reflection seismic data and well logs to interpret gas hydrate systems and associated free gas in the South Makassar Basin. Identified through the correlation of BSRs, seafloor topography, and structural features on reflection seismic profiles are six primary play types: buried anticline type, slope type, sediment waves type, buried carbonate mound type, basin margin type, and polygonal fault type. The distinctive characteristics of BSRs in this region can be summarized as follows: (1) predominantly positioned beneath topographic highs and basin depocenter, (2) typically displaying a series of high-amplitude dipping reflectors beneath BSRs, (3) the distribution of BSRs is not consistently continuous, and (4) the presence of blanking reflection above BSRs is variable. These observations suggest a preferential accumulation of gas hydrates beneath structural high topography and basin depocenter, possibly due to the upward and lateral migration of buoyancy-driven, gas-bearing fluids towards structural highs and corresponding topographic basins. Through the analysis of seismic attributes, hydrocarbon distribution is categorized into gas-hydrate compartments above BSRs and free gas compartments below BSRs. A first-order estimation of methane resources via petrophysical approach and Monte Carlo simulation suggests approximately 31 trillion cubic feet (Tcf).

Keywords: gas hydrates, free gas, bottom-simulating reflectors, play types, South Makassar Basin

BSRs-derived thermal properties in the deepwater South Makassar Basin, Indonesia

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Abstract

Situated between Borneo and Sulawesi Island, the widespread presence of bottom simulating reflectors (BSRs) in the deepwater basin off the Southern Makassar Basin strongly indicates the extensive existence of gas hydrates in the area. Despite the region's long petroleum exploration history, the understanding of thermal signatures in the basin remains enigmatic. By indirectly delineating the depth range where gas hydrates remain stable, BSRs can act as a proxy for deducing information related to thermal properties when direct measurements of bottom-hole temperature are scarce. The findings suggest that thermal properties derived from BSRs indicate a mean heat flow of 86 mW/m², a mean geothermal gradient of 73 °C/km, and a mean thermal conductivity of 1.19 $W \cdot m^{-1} \cdot K^{-1}$. In contrast, thermal properties reference obtained through direct measurement hint at average heat flow, geothermal gradients, and thermal conductivity values of 64 mW/m^2, 84 $^oC/km$, and 0.75 $W \cdot m^{-1} \cdot K^{-1}$, respectively. The variance between the drilling depth at which gas hydrates were penetrated in three exploration wells and the theoretical base of gas hydrate stability zone vary between a deviation of -5% to +5%. Discrepancies in thermal properties values and depth of gas hydrates are attributed to methodological disparities, uncertainties in theoretical assumptions, and geological factors such as buried volcanoes and localized fluid flow.

Keywords: heat flow, geothermal gradient, thermal conductivity, gas hydrates, South Makassar Basin

Complex migration pattern of methane at the cold seep in the Middle Okinawa Trough

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Abstract

Submarine methane seepages are are often promoted by the dissociation of gas hydrates, and play an important role in the global carbon cycle. There has been a hypothesis that the presence of lateral migration pathway for methane in the shallow subsurface can slow down the entry of methane into the ocean. But the evidence for the lateral migration of methane at seeping site is limited in nature. We present the results of mineralogical, isotopic, and dating analyses of a seep carbonate core obtained from seafloor drilling site D5 in the Middle Okinawa Trough. The dominant mineral of the carbonate core is aragonite and its average content is ~86.6%. The carbonate exhibits moderately depletion in ^{13}C ($\delta^{13}C$ values: -37.2‰ to -16.3‰ Vienna Pee Dee Belemnite; VPDB) and enrichment in ^{18}O ($\delta^{18}O$ values: 4.3‰ to 5.8‰ VPDB). These suggest that the precipitation of the seep carbonate was induced by the sulfate-driven anaerobic oxidation of methane (AOM) close to the seabed, resulting from the dissociation of gas hydrates. U–Th dating of the carbonate provides constraints on the time of active methane seepage. Lateral migration of two fluid-flow events probably occurred here because the upper and lower segments of the carbonate core are characterized by different $\delta^{13}C$ and $\delta^{18}O$ values and a coeval period of fast growth. The upward migration of methane released from gas hydrates could be redirected by the self-sealing of the overlying carbonate crust, leading to lateral migration and contributing to the expansion of authigenic carbonate at the flank of seabed mound Db4 during 6.2–4.6 ka. Our findings highlight the interaction between fluid flows and authigenic carbonates in the Okinawa Trough during Late Quaternary, which may have been previously overlooked.

Keywords: cold seep, authigenic carbonate, fluid migration, gas hydrate, Okinawa Trough

Fluid flux variations control the occurrence of active gas hydrate system in the northern slope of South China sea

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Abstract

Gas hydrates are widely distributed in the continental marginal environment, and cold seeps are related to the occurrences of gas hydrate and free gas in marine sediments. This study has found that a buried gas hydrate system characterized by high saturation with upward increase develops in the northern South China Sea, and high chloride concentration surrounding gas hydrate-bearing sediments indicates recently activity. High chloride concentration is an important indicator of cold seep systems, and similar characteristics were found at Sites W18 & 19 in gas hydrate drilling area of the Shenhu area, northern slope of the South China Sea. Recent gas hydrate occurrence can cause ion exclusion, resulting in elevated chloride concentrations in pore-water core, which indicating that the gas hydrate system in this area is recently active and has not yet reached steady state. Well log analysis shows that a highly saturation gas hydrate-bearing layer occur with a maximum saturation of over 60% and a thickness range of 18–28 m. A one-dimensional diffusion model is used to estimate the time when the gas hydrate formed based on the temperature, saturation, thickness, and porosity of gas hydrate-bearing layer obtained from well logging and core data. The results show that gas hydrates at sites SC-02 and W18 respectively formed 19–29 thousand and 26–28 thousand years ago (assuming a closed system). According to the previous simulation results, the buried active gas hydrate system is a stage before the cold seep system exposed to the seafloor. The cyclic evolution of gas hydrate and cold seep system is controlled by the variation of fluid flux. Abundant gas sources and fluid migration pathways in deep strata are the main geological controls on the buried active gas hydrate system. This study has important implications for understanding the formation and evolution of cold seep systems.

Keywords: gas hydrate, cold seep, fluid flux, formation time, chloride concentration

Methane distribution and sea-to-air methane flux in the Dongsha area of the South China Sea

Cuiling Xu[1, 2], Zhilei Sun[1, 2], Qing Li[1, 2], Xianrong Zhang[1, 2], and Nengyou Wu[1,2]

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Abstract

Sediments on continental slopes, which are rich in hydrates and organic matters, may release methane into the overlying seawater and even into the atmosphere. To evaluate the impact of sediment emissions on oceanic methane cycling and greenhouse gas emissions, this study assessed the distribution of methane in surface sediments and water columns and calculated the sea-to-air methane flux in the Dongsha area of the northern South China Sea. Results show that the methane concentrations exhibited large spatio-temporal changes. In May 2019, the methane concentrations and sea-to-air methane flux (4.1±3.7 μmol m^{-2} d^{-1}) were close to the background values, indicating that *in situ* aerobic methane production was a weak atmospheric methane source. In contrast, in September 2020, abnormally high methane concentrations up to 26.6 nM were detected in the upper slope with water depths of 600–950 m and in the eastern middle slope; the average sea-to-air methane flux increased to 11.3±7.9 μmol m^{-2} d^{-1}. The consistency of methane distribution throughout the water column and surface sediments, with a generally increasing trend with the increasing depth, indicates that in September 2020, sediment emissions were crucial methane sources in seawater and led to moderate emissions into the atmosphere. The heterogeneities of methane concentrations and sea-to-air methane fluxes were attributed to the uneven distribution of methane in the sediments and the seasonal variation in internal solitary waves. Our results demonstrate that methane released from the sediments, being perhaps affected by internal solitary waves induced sediments disturbance, substantially impacted the oceanic methane cycling in continental slopes. Thus, this study provides new insights into the methane budget of marginal basins.

Keywords: methane, sea-to-air methane flux, South China Sea, cold seep, continental slope

Spatiotemporal variability of the methane hydrates upper boundary stability zone in the Sea of Okhotsk

Renat Shakirov, Vladimir Luchin, Evgeniya Petrova, and Andrei Kholmogorov

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Abstract

In our study, we consider only the upper boundary of the stability zone of gas hydrates. All available data from deep-sea oceanological observations in Okhotsk Sea were used to calculate it (data: bottle data, CTD, drifting buoys of the Argo project, mechanical bathythermograph and bathythermograph). The resulting array of oceanological information includes 131 286 stations conducted from 1929 to 2020). The entire water area of Okhotsk Sea had generally been studied well. However, there are very few oceanological stations conducted in the cold season in the sea area. This is especially true for the vast shelf, which is covered with ice in winter. Therefore, there is practically no data in the northern and western parts of the sea from January to April. We calculated upper boundary of gas hydrates` stability zone using data on stability conditions of methane hydrate obtained in the paper (Dickens and Quinby-Hunt, 1994) for the "pure methane-seawater" system (100% CH_4; S=33.5%). Within the framework of the approach proposed, we revealed patterns of parameters distribution for the upper boundary of gas hydrates stability zone (water temperature, salinity and depth of the upper boundary). As shown the minimum water temperature and the minimum depth of the upper boundary (less than 1°C and 300–310 m) for Okhotsk Sea are at the Eastern slope of Sakhalin Island. The maximum water temperature and the maximum depth of the upper boundary of the gas hydrate stability zone (1.8–2.0°C and 340–350 m) are typical for the area adjacent to the Central and Northern straits of the Kuril Ridge. The results show that accumulations of gas hydrates in Okhotsk Sea are not threatened by thermal dissociation even if the climatic trend to global warming (1°C/100 years) lasts for the next 100 years. The results presented will be in demand both for planning expedition work in Sea Okhotsk, and studying the effect of gas hydrates and the consequences of their dissociation on the spread of benthic fauna. In addition, the position of the boundaries (upper and lower) and the length of the SSG are necessary conditions for modeling scenarios of the reaction of gas hydrates to changes in temperature at the seabed and assessing the possibility of methane release into the ecosystem. The results obtained are in good agreement with the data of expedition observations in Okhotsk Sea and previous studies (experimental observations and modeling) in other regions of the World Ocean.

Keywords: gas hydrates, methane, stability zone, water temperature, salinity

Evidence of relations of gas hydrates and oil-and-gas deposits in the seas off Sakhalin Island (Russia)

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Abstract

One of the main questions studying gas hydrates is the source of hydrate bearing gas. Carbon and hydrogen isotopic compositions of CH4 and molar ratios of CH4 to higher hydrocarbons (C1/C2+) helps to determine genesis of gas. However, considering the results of long-term international investigations in the far-eastern seas we noted that it could be not enough. To date we have found three gas hydrates areas in Sakhalin slope: a slope of western sector of the Deryugin Basin and the northwestern sector of the Kurile Basin (the Sea of Okhotsk) and northeastern slope of the Tatarsky Trough (the Sea of Japan). Considering data received in the complex expeditions, it has been hypothesized that oil and gas deposits on the Sakhalin shelf and gas hydrates on the Sakhalin slope belong to the same petroleum system. A number of evidence suggest it. The first evidence is fault tectonics in the areas of gas hydrates distribution. Gas hydrates and related gas seeps are controlled by the Western-Sakhalin fault system, the Eastern-Sakhalin fault system and the Hokkaido-Sakhalin fault system, which are pathways for deep-buried gas migration. The second evidence is gasgeochemical anomalies. Our findings indicate that high concentrations of CH4 in the upper part of sediments and near bottom water over shelf oil fields are similar with one in the upper part sediments and near bottom water over gas hydrates accumulations. The third evidence is a sedimentary cover thickness about 8 km on the oil and gas shelf and gas hydrates continental slope with common oil-gas generation zone. Although the carbon isotopic composition of methane and ethane from gas hydrates is a discussion point, it can be attributed to fourth evidence. C1 isotopic compositions ranging from -73‰ to -41‰ indicate or termogenic sourced methane or mixture of termogenic and microbial methane. C2 isotopic compositions almost in every cases indicate termogenic sourced ethane. Considering all the evidence in the complex, we concluded that gas hydrates on the Sakhalin slope and oil and gas deposits on the Sakhalin shelf belong to a single petroleum system.

The research was carried out on the state task of Il'ichev Pacific Oceanological Institute ("Study of climatically active substances, phenomena and processes in the Far Eastern seas and their coastal zones" № 122110700009-1).

Keywords: gas hydrates, methane, Sea of Okhotsk, Sea of Japan, oil and gas

Cold seeps and heat flow: gas hydrate provinces offshore Sakhalin Island

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Abstract

Gas hydrates were found in bottom sediments on the western slope of the Kuril Basin from the side of the Terpeniya Gulf (Okhotsk Sea) at 1020 m depths during expeditions in 2012 and 2013. How-ever, on the eastern slope of the Tatar Strait, gas hydrates were sampled at an unusually shallow 322 m depth. During our research, we identified gas hydrate provinces based on both bottom water and sediment temperature measurement data and heat flow, earthquake, cold seep and sea current data analyses. These provinces have similar hydrological regimes, providing suitable temperature conditions for the existence of gas hydrates, to those at a 322 m depth in the Tatar Strait (Japan Sea) and at 725 and 1020 m depths on the slope of the Kuril Basin (Okhotsk Sea). The influence of heat flow from below and cold water masses from above on the sediment provides temperature variability along the core horizons with the predominance of higher temperatures at the lower sediment horizons. Gas hydrates under these conditions are in a kind of thermal trap, which contributes, on the one hand, to their formation, on the other hand, to stable existence and accumulation. Gas hydrates of low depth (320m) in the Tatar Strait were formed and continue to exist in conditions similar to the gas hydrates of Okhotsk Sea due to the combined effects of heat flow and cold subarctic waters brought to this area from Okhotsk Sea. The general geological, geophysical, hydrological and seismic features of gas hydrates areas of Tatar Strait and East Sakhalin Island offshore are considered. It was determined that low-depth (320 m) gas hydrates in the Tatar Strait meet the similar geophysical, seismic and hydrological conditions as the gas hydrate of Okhotsk Sea (1000 m). Three provinces located in the South-West, South-East and North-East of the Sakhalin Island were distinguished: the Tatar, East Sakhalin and Deryuginskaya, respectively. These gas hydrate provinces are characterized by the massive presence of gas flares, which are an indicator of gas emissions. Similar hydrological regime providing necessary low temperature of the bottom water comparable to the Subarctic Okhotsk Sea water is the key factor in the formation and existence of the Tatar Strait gas hydrate province as an integral part of the Hokkaido-Sakhalin folded region.

This research was funded by a grant by the Russian Science Foundation, No. 23-77-10038.

Keywords: methane, gas hydrate, heat flow, cold seep, currents

Dissolved methane transport

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Abstract

The distribution of gas-geochemical fields in the sediment layer is controlled by a complex of geological and geophysical characteristics of the studied area. Released into the bottom water layer and distributed in the World Ocean, gas-geochemical fields' distribution is controlled by currents. The features of methane distribution in the area of jet baroclinic flows, mesoscale eddies and the main influencing factors are shown. Elevated concentrations of methane are carried under the lower boundary of the pycnocline by currents from its source, which makes it possible to determine areas of potential hydrocarbon deposits without the use of complex techniques. Seawater dissolved methane can also indicate areas of concentration of microbiological communities, including those that are the food base of commercial biological species. The results are also applicable for the implementation of research programs within the framework of the "climate agenda", as well as from the point of view of solving problems of rational nature management. It was found that in May–June, seawater dissolved methane comes from its sources located on the western Sakhalin shelf and in the deep-water zone near the axis of the Tatar Strait. At the beginning of the warm season, dissolved methane is transported northward by the West Sakhalin Current over the Eastern Shelf of the Tatar Strait in a layer under the seasonal pycnocline. In the anticyclonic eddy at 134°E in the deep part of the Japan Basin, a local methane maximum 5.2 nM/l was also detected under the pycnocline on the periphery of the eddy. Part of dissolved methane over the Ken Bao gas field (North Vietnam) can be transported to the South by the coastal Vietnamese current adapted to the conditions of the winter northeast monsoon. The great role of typhoon NARKI in the transportation of methane into the water column of the Phu Khan basin has been established. Under its influence, favorable hydrodynamic conditions were created for the transport of dissolved gases from oil, gas accumulations off the coast of Kalimantan and Palawan Islands to the Phu Khan sedimentary basin. The connection between the distribution of methane in water and the system of strait currents has been revealed. Elevated methane concentrations brought into the Bransfield Strait by the warm current from the Bellingshausen Sea have been established.

This research was funded by a grant Russian Science Foundation No. 23-77-10038.

Keywords: methane, transport, currents, eddies

Experimental and numerical investigation for the biogeochemical process of methane released from gas hydrate

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Abstract

Large quantities of methane are stored in natural gas hydrates within shallow marine sediments. With the onset of global warming, the released methane from these hydrates migrates and transfers through the sedimentary column, water column, and atmosphere. This process leads to seawater acidification and a reduction in oxygen content within marine waters, thereby significantly impacting marine ecology. A laboratory experiment is conducted to characterize the consumption of methane by microorganisms under both aerobic and anaerobic conditions. The study investigates how various marine environmental factors such as temperature, pressure, and methane transport flux influence both methane oxidation bacteria and the overall methane transformation process. Furthermore, a quantitative model is established to understand the extent of microbial methane consumption. Based on this model, a comprehensive numerical model is proposed that incorporates fluid flow dynamics along with dissolution, diffusion, and oxidation processes to track the fate of released methane from hydrate deposits within overlying sediments. It is determined that temperature plays a crucial role in controlling methanotrophic activity due to its significant impact on microbial growth rates. Additionally, pore pressure and velocity of migrating methane also have some effect on methanotrophic activity. However, their influence is comparatively lesser than that exerted by temperature variations. The numerical simulations can capture complex processes involved in sedimentary environments. It is observed that most of the consumed methane undergoes anaerobic oxidation while only under exceptional circumstances does aerobic oxidation occur when there is substantial seepage surpassing anaerobic zones. Finally, it can be concluded that almost all released methane from hydrate deposits is consumed by microorganisms residing within sediments without reaching into the water column.

Keywords: gas hydrate, aerobic/anaerobic oxidation, numerical and experimental simulation, sedimentary environments, methane release

Molecular simulation of gas hydrate formation in marine sediments

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Abstract

Natural gas hydrates widely exist on the seafloor of continental margins and are potential energy materials. The study of hydrate formation in sediments will help to solve practical problems in hydrate accumulation, development, and hydrate utilization, such as assessment of hydrate reformation in reserves and carbon dioxide seafloor storage in the form of hydrate. By using molecular dynamics simulation method, we conducted a series of studies to evaluate the impact of mineral surface properties and mineral slit size on the formation of methane hydrate. Our results indicate that hydrate forms either in the solution phase close to the solution/gas interface or in the solution phase close to the hydrophobic solid interface. When the other conditions are fixed, gas hydrate prefers the hydrophilic slit. However, along the increasing slit size, hydrate tends to firstly nucleate in the larger size slit. In addition, the pre-filling of the pores with methane can significantly accelerate hydrate formation, because the hydrophobic surface can help with methane dissolution in water, which can both promote the transportation of molecules between methane bubbles and enhance methane hydrate nucleation.

Keywords: hydrates formation, nucleation, molecular simulations, mineral pores

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Can we identify creep failure of marine hydrate-bearing sediment via geophysical techniques?

Yanlong Li and Nengyou Wu

Qingdao Institute of Marine Geology, China

Abstract

Marine natural gas hydrate (NGH) is a promising constitutive low-carbon energy resource, whereas NGH-production induced geoengineering concerns remain challenging. Advanced forecast of possible environmental risks is the fundamental for eco-friendly NGH exploitation. Reservoir creep deformation is an early symptom of the geoengineering risks. However, whether the creep deformation behaviors of the NGH-bearing strata is predictable remains controversial. In this study, a series of multi-step loading creep test are conducted for sandy gas hydrate bearing sediment (GHBS) samples, during which the ultrasonic responses are recorded simultaneously. The acoustic velocity, compression-to shear wave ratio, Poission's ratio, main frequency, and main frequency amplitude are used to characterize creep failures of the GHBS for the first time. Combining analyses of the creep behaviors and acoustic responses yield the following conclusions. Firstly, the creeping-derived long-term strength is 0.45~0.60 times of the triaxial-shearing-derived shear strength. Ignoring the creep effect might underestimate the scale and intensity of possible geoengineering risks during long-term NGH exploitation. Secondly, the acoustic velocity increases gently and then decreases continuously during creeping. Once the accelerated creep appears, the acoustic velocity plummets significantly, together with together with sudden decrease in the compression-to-shear velocity ratio, and fluctuations in the main frequency and its amplitude. Furthermore, the main frequency and its amplitude shall fluctuate abruptly prior to the emergence of the accelerated creep. Therefore, we anticipate that the combination of abnormal fluctuations of main frequency and its amplitude can be used as early-warning indicators for possible creep failure of the GHBS. The results might have great significance for in-situ detection and prediction for possible reservoir failure during long-term NGH exploitation.

Keywords: natural gas hydrate, hydrate-bearing sediment, creep test, acoustic response, reservoir failure monitoring, geophysical response

Fracture-filling gas hydrate and its geophysical responses on the host sediments

Gaowei Hu[1, 3], Zhun Zhang[1, 2], Yapeng Zhao[1, 3], Qingtao Bu[1, 3], Ang Li[1, 3], and Nengyou Wu[1, 3, *]

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[3] *Laboratory for Marine Mineral Resources, Laoshan Laboratory, Qingdao 266237, China*

Abstract

As a critical component of global methane hydrate reserves, fracture-filling hydrates is a significant focal point for hydrate exploration and carbon reservoir. However, the understanding of the formation mechanisms and its geophysical properties of fracture-filling hydrates in sediments remains limited due to the scarcity of investigative methods. In this work, the formation mechanisms of fracture-filling hydrates from both geological reservoir and micro-sedimentary perspectives were presented. It also delves into various aspects of field tests, including seismic and logging, as well as laboratory tests encompassing acoustics, permeability, thermal properties, resistivity, and mechanical properties. Finally, it outlines the challenges associated with the characteristics of fracture-filling hydrates reservoirs and their geophysical properties while proposing potential solutions. It emphasizes the urgency of identifying the formation patterns of fracture-filling hydrates and estimating their input for carbon reservoir. Collaborative geophysical characterization testing for fracture-filling hydrates is a crucial step in addressing this challenge. Fostering international cooperation for global data integration and sharing may provide a viable solution to advance our understanding.

Keywords: fracture-filling hydrate, formation mechanism, geophysical properties, challenges, prospects

Utilizing passive satellite remote sensing scanners for detecting methane plumes on the sea surface

I. E. Stepochkin[1] and A.V. Yatsuk[1]

V.I.Il'ichev Pacific Oceanological Institute, Far Eastern Branch, Russian Academy of Sciences, Vladivostok, Russia

Abstract

The detection of methane anomalies on the sea surface is significant for several reasons. Methane is the most abundant hydrocarbon in the Earth's atmosphere and a major greenhouse gas. Its concentration has dramatically increased in recent years due to number of natural and human-induced factors. The ability to detect and monitor methane concentrations has become an important issue for global climate research. Also, the energy industry can utilize remote sensing to identify leaks in pipelines, detect methane clathrates, and locate active gas seeps from underground oil or coal deposits. The distribution of methane fluxes at the “water-atmosphere” interface affects global climate processes. Furthermore, methane gas geochemical fields are used as indicators for forecasting and detecting hydrocarbon deposits, tracing fault zones, predicting seismic activity, and assessing the environment.

Currently existing satellite monitoring systems for greenhouse gasses, including methane, offer open data over the sea surface but possess a low spatial resolution (30-50 km). The main objective of this study is to develop a method for estimating methane concentrations in the near-surface layer of seawater using daily open SWIR (Shortwave Infrared) data obtained from medium-high spatial resolution passive satellite scanners (approximately 1 km). The study will involve the development and testing of a model to detect and estimate the intensity of methane plumes using data from passive remote sensing satellite scanners.

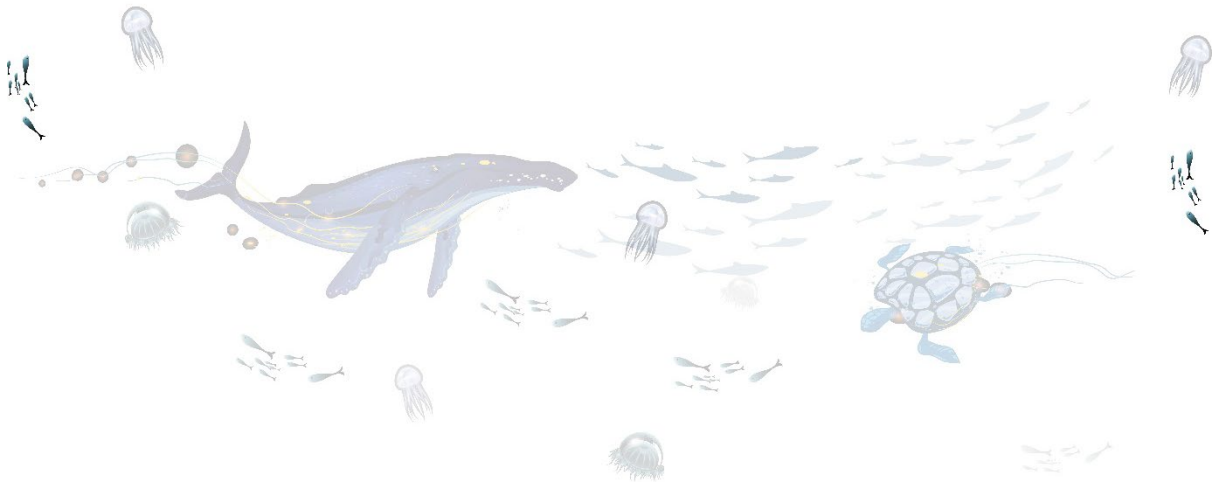
The results can be utilized for:
a) Deploying operational environmental monitoring systems for water areas.
b) Implementing the carbon landfill program.
c) Searching for hydrocarbon resource deposits.

Presented study was supported by the Russian state budget theme # 124022100078-7

Keywords: ocean optics, remote sensing, methane plume

Sub-theme D: Emerging Ocean Science and Cross-cutting Issues

Session D6: Sustainable financing of blue carbon



Programme

Venue: Chelsea B, 5th Floor
Date: 22 April 2024

Conveners:

Tomoko Takeda	The University of Tokyo, Japan
Pachoensuk Theeranukul	Innoqua, Inc., Japan
Saiko Katsunishi	Innoqua, Inc., Japan

Time	Presentation Titles	Speakers
Section 1		
10:30–10:50	Scientific support to conservation efforts of *Enhalus acoroides*	Tomoko Takeda, *The University of Tokyo, Japan*
10:50–11:10	Conservation of tape seagrass by elementary school children	Shinji Delage, *Nosoko Elementary School, Japan*
11:10–11:30	Seagrass gleaning fishery and its socioeconomic importance in two coastal communities in mindanao, Philippines	Aida D. Perpetua, *Mindanao State University at Naawan, The Philippines*
11:30–11:50	Assessing the economic impact of seagrass ecosystems to foster sustainable resource utilization in Northern Mindanao, Philippines	Mayenne Perpetua Balaba, *Mindanao State University at Naawan, The Philippines*
11:50–12:10	China's active exploration in international blue carbon standard research and collaboration	Liu Dahai, *First Institute of Oceanography, China*
12:10–12:30	Involve blue carbon of mangrove forest in ecosystem services in the Can Gio Man Biosphere, Vietnam	Phan Minh Thu, *VAST, Vietnam*

Scientific support to conservation efforts of *Enhalus acoroides*

Takeda, T.[1], Ohori, K.[2], and Ohori, N.[2]

[1] *Faculty of Science, the University of Tokyo, Tokyo, Japan*
[2] *Fukumimi Eco Tours, Okinawa, Japan*

Abstract

Seagrasses have been increasingly acknowledged to play a key role in sequestration of blue carbon. Ishigaki Island in Okinawa, Japan is the global northern limit for the habitat of *Enhalus acoroides*, or tape seagrass. Supported by a multistakeholder effort, children in Nosoko Elementary School are taking initiative to conserve the rapidly declining tape seagrass population. In one effort, children are trying to determine key growth indicators for tape seagrass by keeping them in a tank on land. Although protected from predators, the tape seagrass in the tank was observed to be diminishing in size and growing increasingly brown in color. To find out the cause of the difference between tape sea grass shoots in the tank and in the ocean, we analyzed physico-chemical parameters such as pH, temperature, light intensity, turbidity, and salinity to see if any marked difference could be observed. This presentation will discuss the results, the cost of conducting such observations, and next steps to be taken. We will also welcome inputs and discussion from the audience on financing citizen science for blue carbon.

Keywords: tape seagrass, *Enhalus acoroides*, blue carbon, pH, financing citizen science

Acknowledgements: The authors wish to thank the children of Nosoko Elementary School, Kazushige Tanahara, Jun-ichi Okuyama, Hajime Kayanne, Nori Fujita, Masaaki Kitajima, and Naoko Ebisawa for their technical and logistical support.

Conservation of tape seagrass by elementary school children

Araki, Y., Delage, S., Ishimoto, S., Mekaru, H., Nakai, H., Shindo, S., Takehara, M., Tanaka, R., and Toyooka, Y.

Nosoko Elementary School, Okinawa, Japan

Abstract

Seagrasses have been increasingly acknowledged to play a key role in sequestration of blue carbon. Ishigaki Island in Okinawa, Japan is the global northern limit for the habitat of *Enhalus acoroides*, or tape seagrass. In a citizen science initiative supported by a local non-profit organization, fifth and sixth graders in Nosoko Elementary School observed the tape seagrass habitat for over 15 years starting from 2008. Tape seagrass is the only known species of seagrass which pollinate above water by detaching their male flowers and letting them float until they reach the female flowers. Collectively through our continued observation, we found that their pollination is dependent upon the tidal levels at the full and new moons of June to September each year. This was presented as a poster in 2018. As the tape seagrass habitat of Ishigaki became gradually known to the public, we started raising awareness by creating signboards and educating our families and neighbors. At this point, we were able to start raising funds to support these efforts. However, in 2020, the population of tape sea grass suddenly and rapidly started decrease. Together with researchers in Ishigaki and Iriomote Islands, we observed the immediate cause to be overconsumption by *Chelonia mydas*, or green sea turtles. As of 2023, what was once a flourishing population of tape seagrass has become limited to several patches of short stubs. Several cages were put up around the remaining patches. We have designed a logo to raise awareness on our initiatives, and we hope to raise further funding to conserve the tape sea grass population on a wider scale.

Keywords: tape seagrass, *Enhalus acoroides*, child-led science, citizen science, blue carbon

Acknowledgements: The authors wish to thank Kazushige Tanahara, Kenji Ohori, Noriko Ohori, Tokio Marine Asset Management Co., Ltd., Innoqua, Inc., and Tomoko Takeda for their support to our efforts.

Session D6: Sustainable financing of blue carbon

Seagrass gleaning fishery and its socioeconomic importance in two coastal communities in mindanao, Philippines

Aida D. Perpetua[1,*], Mayenne P. Balaba[1], Zy D. Perpetua[2], Ruben F. Amparado[2], Wenceslao A. Coronado[1], Jessie G. Gorospe[1], and Sonnie A. Vedra[1]

[1] *School of Graduate Studies, Mindanao State University at Naawan 9023 Naawan, Misamis Oriental, The Philippines*
[2] *Department of Biological Sciences, College of Science and Mathematics, Mindanao State University – Iligan Institute of Technology, Tibanga, Iligan City, The Philippines*

Abstract

Gleaning fisheries play a vital role in the livelihood, food security, and cultural fabric of coastal communities in the Philippines, yet there is a significant gap in data concerning their socio-economic and ecological impact. This study aims to provide a detailed socio-economic profile centered around gleaning efforts, catch-per-unit effort (CPUE), and the contribution of gleaning to community sustenance, gleaning practices, and perceived environmental impacts. Using the Participatory Resource and Socio-Economic Assessment (PRSA) method, complemented by secondary data, the study highlights gleaning as a predominant income source for 61% of the coastal population, particularly among adults aged 21–50. The study shows a variance in gender participation between two regions: Laguindingan, Misamis Oriental with a higher male participation (59%), and Kauswagan, Lanao del Norte with a predominance of female gleaners (66%). The CPUE analysis uncovers that on average, male gleaners achieve higher yields (3.5 kg per gleaner per day) than females (2.16 kg per gleaner per day), with an overall daily income indicating the economic precarity of these populations. The annual financial gain from seagrass ecosystems is estimated at 42.65 tons, valued at PHP 1.9 million, translating to about PHP 1,875 per month for each gleaner, which is below the regional average. Although gleaning is indispensable for many, it presents risks to the delicate coastal ecosystems. The study posits that sustainable gleaning practices and thoughtful policy-making are required to safeguard both the economic interests of communities and the health of the marine environment. By implementing conservation policies that address the equilibrium between ecological preservation and economic needs, the study promotes strategies to sustain the viability of seagrass ecosystems and the well-being of dependent communities. This research contributes to the broader understanding necessary for the responsible management of marine resources and supports the development of policies aimed at enhancing the resilience of both human and coastal ecosystems.

Keywords: seagrass ecosystem, gleaning fisheries, socioeconomic importance, sustainable management

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Assessing the economic impact of seagrass ecosystems to foster sustainable resource utilization in Northern Mindanao, Philippines

Aida Dadole Perpetua[1], Mayenne Perpetua Balaba[1], Dan Moywela Arriesgado[1], Eliza D. Espinosa[2], Zy Dadole Perpetua[3], Ruben Amparado[3], and Nonillon M. Aspe[1]

[1] Institute of Fisheries and Research Development, Mindanao State University at Naawan, The Philippines
[2] Visayas State University, The Philippines
[3] Mindanao State University – Iligan Institute of Technology, The Philippines

Abstract

In Northern Mindanao, Philippines, the economic value of seagrass ecosystems has been understudied. This research aims to bridge that knowledge gap, providing data crucial for regional policy-making and the sustainable utilization of seagrass resources. Using participatory economic valuation, market pricing, benefits transfer, and the contingent valuation method (CVM)/willingness-to-pay (WTP) approach within the Total Economic Valuation framework, the study quantifies the goods and services of seagrass ecosystems. It finds that gleaning activities in Laguindingan and Kauswagan yield an annual net benefit of Php 2.3 million, while tourism generates annual revenues of Php 110,000 to Php 590,000. Biodiversity conservation provides indirect use values with net annual revenues between Php 610,000 to Php 680,000. Remarkably, the most substantial non-market benefits stem from carbon sequestration, valued at Php 7.2 million in Laguindingan and Php 5.4 million in Kauswagan, constituting 72.36 percent of the total net benefits across all sites. The net present value of benefits from these seagrass resources over a decade, discounted at 10 percent, is estimated at Php 7.4 million. These findings underscore the seagrass ecosystems' essential role in supporting the livelihoods of Filipino coastal communities. As such, it is imperative for local government bodies and relevant organizations to implement and uphold conservation and management strategies that ensure the resilience and long-term viability of seagrass resources, thereby securing the economic welfare of the communities that rely on them.

Keywords: economic valuation, seagrass ecosystem, sustainable management, biodiversity conservation, total economic valuation

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Session D6: Sustainable financing of blue carbon

China's active exploration in international blue carbon standard research and collaboration

Liu Dahai

First Institute of Oceanography (FIO), Ministry of Natural Resources (MNR), China

Abstract

The urgency of climate change poses a critical threat to both humanity and global interests, with carbon emissions emerging as a central focus in international political and economic competition. Despite substantial reductions in greenhouse gas emissions, the swift pace of global warming suggests a potential 1.5 degree Celsius increase within the next two decades. Taking proactive measures to control greenhouse gas emissions and implement carbon sequestration is crucial, and the window of opportunity to achieve this goal is closing rapidly. China, playing a pivotal role in climate change mitigation, has proactively established carbon neutrality goals. The aim is to peak carbon dioxide emissions by 2030 and achieve carbon neutrality by 2060. In the pursuit of these goals, the ocean assumes a crucial role in both mitigating and adapting to climate change, particularly in the context of the "dual-carbon" objectives. With vast carbon reserves, the ocean functions as a significant carbon sink, boasting a biological carbon sequestration capacity ten times that of forests and absorbing approximately 93% of Earth's greenhouse gases. The oceanic carbon sink holds immense potential, capable of storing carbon for thousands of years, surpassing land-based carbon storage by several orders of magnitude. China has laid a robust foundation in blue carbon, actively engaging in initiatives such as the "Belt and Road" and introducing the 21st Century Maritime Silk Road Blue Carbon Plan. Collaborating with partner countries in monitoring, standardization, and carbon sink research, China is contributing significantly to the global effort. Through multi-level international collaborations, China is promoting its blue carbon concepts, technologies, and practical approaches. A focal point is the international standardization of oceanic carbon sink classification and accounting. This includes thematic studies on mangrove carbon sinks, salt marsh carbon sinks, seagrass bed carbon sinks, and more, ensuring alignment with global standards. Simultaneously, through active participation in international cooperation organizations, China submits project proposals to advocate for the issuance of international standards for oceanic carbon sink classification and accounting. Building upon this research, initiatives are underway to promote pilot studies on marine carbon sink accounting transactions, regional demonstrations, and international cooperation. This includes the establishment of the China-West Pacific Blue Carbon Academy, creating an education and training platform with international influence. Through these comprehensive efforts, China is contributing significantly to the advancement of global initiatives addressing blue carbon, fostering shared understanding, and facilitating coordinated efforts in policy, standards, and methodologies.

Keywords: blue carbon; standardization; international cooperation

Involve blue carbon of mangrove forest in ecosystem services in the Can Gio Man Biosphere, Vietnam

Phan Minh Thu[1, *] and Nguyen-Truong Ngan[2, 3]

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[2] Faculty of Civil Engineering, Ho Chi Minh City University of Technology (HCMUT), 268 Ly Thuong Kiet Street, District 10, Ho Chi Minh City, Vietnam
[3] Vietnam National University Ho Chi Minh City, Linh Trung Ward, Thu Duc District, Ho Chi Minh City, Vietnam

Abstract

Coastal ecosystems are essential for providing a myriad of ecosystem services, yet their value is subject to dynamic changes influenced by anthropogenic impacts, natural processes, and socioeconomic development. The Can Gio Man-Biosphere, spanning an expansive 75,740 hectares with approximately half covered by mangrove forest, has been strategically established. However, Can Gio is currently undergoing development guided by three scenarios: Ecological economy, Marine urban economy, and Marine eco-urban economy. This study delves into the nuanced alterations in the value of ecosystem services within the Can Gio mangrove, attributing these changes to anthropogenic activities and economic development. The total economic value of ecosystem services is estimated to fall within the range of 8.61 to 9.98 thousand USD per hectare per year. Interestingly, local residents display a commendable awareness of the intrinsic value of mangroves, as evidenced by their willingness to contribute financially - approximately 22-25 USD per family per year - for conservation and mangrove protection efforts. From a blue carbon perspective, the aboveground biomass ranges from 24.3 to 118.8 Mg C/ha, whereas soil organic carbon contributes 1.37-3.98% and 150-360 Mg C/ha, with a carbon burial rate lower than 1 Mg C/ha/year. These findings underscore the complex interplay between human activities, economic dynamics, and the ecological resilience of coastal ecosystems, emphasizing the importance of sustainable management practices to preserve the invaluable services provided by the Can Gio mangrove.

Keywords: ecosystem services, blue carbon, mangrove forest, Can Gio, Vietnam

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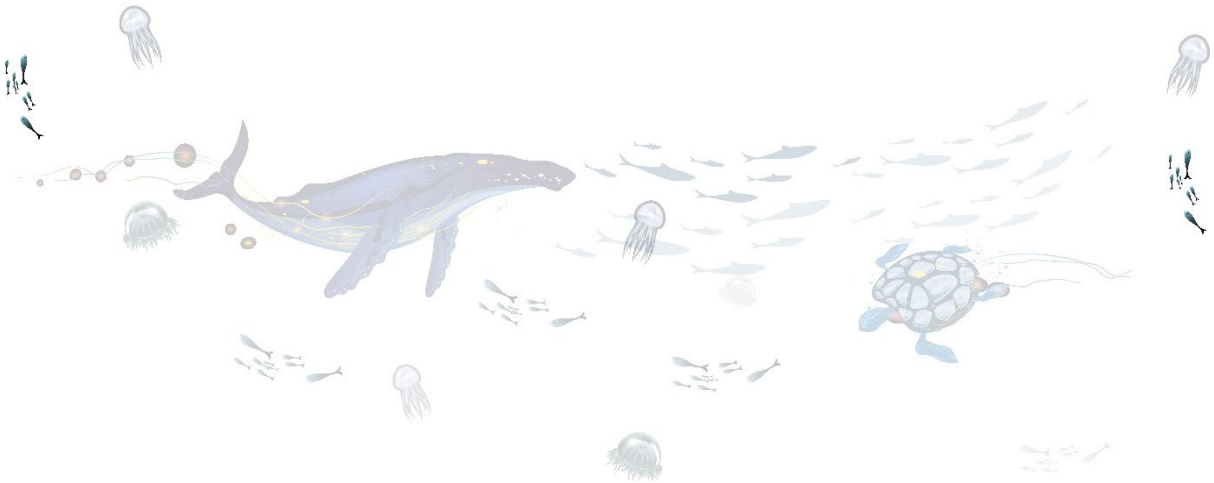
Special Forum

Special Forum:
Science for local-level environmental management, ecosystem conservation and sustainable use in the South China Sea and Gulf of Thailand



Programme

Venue: Mayfair A, 11th Floor
Dates: 22–24 April 2024

Conveners:

Anders Poulsen	Senior Project Manager, UNOPS
Vo Si Tuan	Regional Science Coordinator, UNOPS
Xiangbin Pei	China National Coordinator, UNOPS
Nguyen The Chinh	Vietnam National Coordinator, UNOPS

Time	Presentation Titles	Speakers
22 April 2024		
Session 1 – *Special Forum Opening*		**Chair / Facilitator: Vo Si Tuan**
10:30–11:00	*Special Forum Opening*	
11:00–11:30	Developing the first version of national seagrass blue carbon inventory and mitigation scenarios for Indonesia	Keynote: Novi Susetyo Adi, *Ministry of Marine Affairs and Fisheries, Indonesia*
11:30–12:00	Restoring fish stock and boosting sustainable blue economy towards fisheries refugia approach in the South China Sea region	Keynote: Somboon Siriraksophon, *UNEP/GEF Fisheries Refugia Project*
12:00–12:30	Science and collaboration of stakeholders for conservation of blue carbon ecosystems through carbon-neutral tourism	Keynote: Thamasak Yeemin, *Ramkhamhaeng University, Thailand*
Session 2 – *Mini session (MSP, ICM, MPA)*		**Chair / Facilitator: Nguyen Van Long**
11:00–11:15	The development of marine spatial planning in China and prospects for cooperation with WESTPAC countries	Hou Yuting, *First Institute of Oceanography (FIO), China*
11:15–11:30	Effective management of ecological conservation and sustainable development using innovative and integrated approach at Dapeng Bay, China	Huaming Luo, *Shenzhen Academy of Environmental Science, China*
11:30–11:45	Science for local-level management, ecosystem conservation, and sustainable use: the Tubbataha story	Angelique Garcellano, *Tubbataha Reefs Natural Park and World Heritage Site, The Philippines*
11:45–12:00	Establishment of the Thai Thuy coastal wetlands nature reserve in Thai Binh Province and the Tam Giang Cau Hai coastal wetlands nature reserve in Thua Thien Hue Province, Vietnam	Nguyen The Chinh, *Institute of Strategy and Policy on Natural Resources and Environment, Vietnam*
12:00–12:15	The study on social and economic impacts from marine protected area announcement	Sayan Thongsri, *Marine and Coastal Resources Research Institute, Thai Sea Watch Association, Thailand*

Time	Presentation Titles	Speakers
	and the utilization of the Kra Islands Area, Nakhon Si Thammarat, Thailand	
12:15–12:30	Nha Trang Bay, Vietnam: highly diverse coral reefs under severe threat	Vo Si Tuan, *Vietnam Academy of Science & Technology, Vietnam*
Session 3 (1) – *Mini-session (MSP, ICM, MPA)*		**Chair / Facilitator: Sy Vann Leng**
15:30–15:45	Building baseline data of coral reef ecosystem in Koh Mak, Thailand for monitoring on impacts from tourism	Nattawadee Phoocharoenpaiboon, *Department of Marine and Coastal Resources, Thailand*
15:45–16:00	Marine landscape mapping: a step towards effective ecosystem-based management for Malaysia Marine Parks	Khaira Ismail, *Universiti Malaysia Terengganu (UMT), Malaysia*
Session 3 (2) – *Mini-session (MSP, ICM, MPA)*		**Chair / Facilitator: Pei Xiangbin**
16:00–16:15	Implementation of action plan for the Pearl River Estuary pollution control and prevention	Yuming Zhang, *South China Institute of Environmental Sciences, China*
16:15–16:30	Whole chain control of plastic pollution in the Pearl River Estuary, China	Zhao Xiao, *South China Institute of Environmental Sciences, China*
16:30–16:45	The opportunity for microplastic consumption and excretion of black seahorse (*Hippocampus kuda*)	Pinantha Prowdang, *PSU Wittayanusorn Suratthani school, Thailand*
23 April 2024		
Session 4 – *Mini-session (Blue economy)*		**Chair / Facilitator: Nguyen The Chinh**
10:00–10:15	Economic valuation of mangroves in Ca Mau, Vietnam	Tran Thi Thu Ha, *Vietnamese Academy for Forest Sciences, Vietnam*
10:15–10:30	Coastal blue carbon management of Zhanjiang, Guangdong Province	Zhang Yuan, *Guangdong University of Technology, China*
10:30–10:45	Integrating blue carbon policies into marine spatial planning in the South China Sea	Shenghui Li, *Guangdong Ocean University, China*
10:45–11:00	Assessing the carbon sequestration potential from nipah palm (*Nypa frutican*) in the Surat Thani Mangrove (Ban Don Bay).	Thatarot Kongmaluan, *Prince of Songkla University, Surat Thani Campus, Thailand*
11:00–11:15	Achievements and challenges in sustainable development of marine farming in Quang Ninh Province, Vietnam	Nguyen Huu Dung, *Vietnam Seaculture Association, Vietnam*
11:15–11:30	From sustainable materials to green models in aquaculture and experiential tourism in Quang Ninh Province	Nguyen Thi Hai Binh, *Super Truong Phat Institute of Aquaculture Technology, Vietnam*
11:30–11:45	Framework of sustainable diving tourism system: an exploratory study in Nha Trang Bay Marine Protected Area	Tran Hai Linh Vo, *Thai Binh Duong University, Vietnam*

Time	Presentation Titles	Speakers
11:45–12:00	Managing sea walking tourism in Koh Lan and Koh Sak, Chonburi Province	Hathaichanok Nahuanil, *Department of Marine and Coastal Resources, Thailand*
Session 5 (1) – *Mini session (Blue economy)*		**Chair / Facilitator: Thamasak Yeemin**
13:00–13:15	Impact assessment of dolphin watching tourism on Indo-Pacific Humpback Dolphins (*Sousa Chinensis*) in Khanom Waters, Thailand	Nattarinee Kongnoon, *Prince of Songkla University, Surat Thani Campus, Thailand*
13:15–13:30	Over three decades of marriage of conservation and tourism in the municipality of Mabini, Batangas, Verde Island Passage: an author's reflection on best practices, weaknesses, lessons learned, and prospects	Romeo Trono, *UNEP/GEF SCS-SAP Project*
Session 5 (2) – *Panel on Blue economy*		**Chair / Facilitator: Anders Poulsen**
13:30–15:00	*Panel on Blue economy*	
Session 6 (1) – *Mini-session (Fisheries)*		**Chair / Facilitator: Somboon Siriraksophon**
15:30–15:45	From ocean to trade: impacts of fish exportation on the food security of coastal communities	Celis Anna, *University of the Philippines Los Baños, The Philippines*
15:45–16:00	Mapping the overlapped area of fishing and coast dolphin in the middle Gulf of Southern Thailand from Fishermen's Experiences	Supharoek Sasi, *Prince of Songkla University, Surat Thani Campus, Thailand*
16:00–16:15	Science-based establishment of fisheries refugia: a case study in Vietnam	Van Long Nguyen, *Vietnam Academy of Science and Technology (VAST), Vietnam*
16:15–16:30	Best practice of the establishment of marine Fisheries Refugia: Cambodia's Case	Syvann Leng, *Department of Fisheries Conservation, Fisheries Administration of the, Cambodia*
Session 6 (2) – *Mini session (Co-management)*		**Chair / Facilitator: Suharsono**
16:30–16:45	Sustainable management of mangrove forests in Cambodia: national best practices	Sopheak Thav, *Royal University of Agriculture, Cambodia*
16:45–17:00	Mangrove co-management at Shankou, Guangxi	Zhang Hongke, *Guangxi Shankou Mangrove National Nature Reserve, China*
24 April 2024		
Session 7 – *Min-session (Co-management)*		**Chair / Facilitator: Marie Antonette Menez**
10:00–10:15	Outcome from Belitung coral reef demonstration site, Indonesia	Suharsono, *Asosiasi Koral, Kerang dan Karang Indonesia, Indonesia*
10:15–10:30	Demonstration of community-based management of seagrass habitats in Trikora Beach, East Bintan, Riau Archipelago Province, Indonesia	Tri Edi Kuriandewa, *Yayasan Lamun Indonesia (Indonesian Seagrass Foundation), Indonesia*

Time	Presentation Titles	Speakers
10:30–10:45	Joint hands with local communities in fisheries co-management: success and lessons learned from Binh Dinh province, Vietnam	Tran Van Vinh, *Sub- Department of Fisheries, Binh Dinh Provine, Vietnam*
10:45–11:00	Capacity building coastal community toward sustainability marine protected area in East Belitong	Ibnu Izhar Isdatahari, *IPB University (CCMRS IPB), Indonesia*
11:00–11:15	Scaling up sea cucumber stock restoration through community-based culture production and reserve management	Marie Antonette Menez, *University of the Philippines Diliman, Quezon City, The Philippines*
11:15–11:30	Sustenance and more: the diverse role of intertidal gleaning in the livelihood of women in coastal communities	Nur Afiqah Dharwisyah Mohd Amin David, *Universiti Malaya, Malaysia*
11:30–11:45	Determining indicators of mangrove forest abundance through cooperation between government agencies and the communities in the middle Gulf of Southern Thailand.	Suwat Jutapruet, *Prince of Songkla University, Surat Thani Campus, Thailand*
Session 8 – *Mini session (Restoration)*		**Chair / Facilitator: Fan Hangqing**
13:00–13:15	Rehabilitation of Yintan beach by Nature-based solutions and supporting artificial measures and regulation reform in Beihai, China	Zhao Baozhen, *Guangxi Department of Ecology and Environment, China*
13:15–13:30	Nature-based solutions and watershed approaches to ecological restore the Haikou Bay and city	Yuan Zhao, *Hainan Department of Ecology and Environment Haikou Bureau of Ecology and Environment, China*
13:30–13:45	Watershed treatment and coastal wetland restoration at Maoweihai, Guangxi	Naiwen Zhang, *South China Institute of Environmental Sciences, China*
13:45–14:00	Mangrove wetland restoration can promote the protection of waterbirds	Chen Qing, *Shenzhen Mangrove Wetlands Conservation Foundation, China*
14:00–14:15	Conversion of aged shrimp ponds to mangrove ecological farm - mangrove restoration practice in Guangxi, China	Fan Hangqing, *Guangxi Academy of Marine Sciences (Guangxi Mangrove Research Center), China*
14:15–14:30	The role of herbivory in coral restoration success: a field study in the Bidong Archipelago, Malaysia	Aisyah Wan, *Heriot-Watt University, Malaysia*
14:30–15:00	Break for preparation of roundtable of local representatives	
Session 9		
15:00–17:00	*Roundtable of local representatives*	Chair / Facilitator: Vo Si Tuan
18:00–20:00	*Networking (venue to be announced)*	Chair / Facilitator: Rey Molina

Developing the first version of national seagrass blue carbon inventory and mitigation scenarios for Indonesia

Novi Susetyo Adi, Muhammad Yusuf, Fegi Nurhabni, Barnard Purba, and Marselius Talahatu

Directorate of Coastal Area and Small Islands Utilization, Ministry of Marine Affairs and Fisheries, Indonesia

Abstract

As the largest archipelagic country in the world located at the center of world biodiversity, namely the Coral Triangle, Indonesia has abundant coastal resources, including seagrass, whose area is in the top 5 in the world. However, like other coastal ecosystems, degradation continues to occur for Indonesian seagrass ecosystem, both due to development of coastal areas, increased turbidity due to land conversion and pollution. As a country that has ratified the UNFCCC, Indonesia is also encouraged to conduct emission inventory on wetland as stated on the IPCC's 2014 Wetland Supplement. Ministry of Marine Affairs and Fisheries of Indonesia (MMAF) was mandated by Indonesia's National Focal Point to the UNFCCC, which is Ministry of Environment and Forestry, to coordinate climate change policy on blue carbon or ocean sector. To achieve this mandate, we used the combination of data activities derived from seagrass degradation rate and activities impacting the loss of seagrass and IPCC's Tier 1 emission factor for seagrass. The first step of this work was to simulate seagrass carbon emission up to 2030 based on the current rate of seagrass degradation. We used our first version of seagrass national map and overlaid it with activities impacting seagrass degradation and loss as outlined in the IPCC's 2014 Wetland Supplement obtained from marine spatial use permits available at MMAF. Next, we devised the first mitigation scenario of seagrass emission baseline by reducing emission from the baseline and expressed it as areas that need to be protected from marine spatial uses by regulating marine spatial permit. Finally, we devised the second mitigation scenario by adding the reduction of the emission baseline using limited seagrass restoration scenario. With all of these steps we have managed to develop seagrass blue carbon inventory and mitigation scenarios where the emission reduction from regulation marine spatial permit is higher the emission reduction from seagrass restoration or rehabilitation. This pioneering work on seagrass blue carbon inventory has further both technical and policy consequences. From the technical perspective, we need to refine our seagrass national map with more ground validation and to provide time-series of seagrass maps. Next, we need to refine seagrass restoration technique which currently still shows low survival rates. In regard to policy measure, we need to prepare the regulation on marine spatial planning which considers the presence of blue carbon ecosystems, including seagrass, so the conservation measure can be implemented on marine spatial use.

Keywords: seagrass blue carbon, IPCC's 2014 wetland supplement, seagrass carbon inventory and itimgation, marine spatial planning

Restoring fish stock and boosting sustainable blue economy towards fisheries *refugia* approach in the South China Sea Region

Somboon Siriraksophon

UNEP/GEF Fisheries Refugia Project

Abstract

With financial support from the GEF, implemented by UNEP and executed regionally by SEAFDE, the project entitled "Establishment and Operation of a Regional System of Fisheries *Refugia* in the SCS and GoT" was operated from 2016 to 2022. The fisheries *Refugia* is a novel fisheries resource management approach to the identification and designation of priority areas in which to integrate fisheries and habitat management in the context of maintaining fish stock and critical habitats as satisfying the fishing community, social needs now and in the future. In implementation, the project built an excellent platform for building partnerships, enhancing communication and engagement of stakeholders, finding local and scientific-based knowledge, and putting in place an effective integration of fisheries and habitat management, including strengthening the management of the transboundary fish stock towards subregional cooperation among relevant states. Through capacity building, public awareness, communication, and mainstreaming at national and regional levels, the communities in the *Refugia* sites came from about 100 multi-stakeholder groups from various institutions, not only fisheries and environment agencies but also the tourism department, public organizations, navy, coastguards, NGOs, civil society organizations, academia, research institutes, local government at provincial and state levels, fishing community, private sectors have shown their interest and efforts towards enhancing the integration of habitat and biodiversity conservation into fishery management and practices for the economically important aquatic species. A total of 1.05 million hectares of 13 *Refugia* sites were accepted by the stakeholders and endorsed by governments covering 11 critical economic species, namely blue swimming crab, short mackerel, juvenile groupers, spiny lobster, black tiger prawn, penaeid shrimp, squid, siganids, one-stripe fusilier, and redbelly yellowtail fusilier. The provincial order/notification was approved and issued at each *Refugia* site to support the sustainable management and implementation of fisheries *Refugia* at country levels. 13 fisheries management plans, agreed upon by communities and endorsed by the central government, were implemented at local community levels. In addition, six countries amended their fisheries law/ legislation by including the fisheries *Refugia* concept in the context to support the long-term implementation of fisheries *Refugia*. The beneficiaries of establishing 13 *Refugia* are direct fishing communities in the coastal area of the sites that cover about 49,000 fisherfolks. About 4,670 fishing

vessels in the *Refugia* sites are affected and controlled by the local governments or municipalities. In addition, the 13 *Refugia* are connected to critical habitats covering 102,626 ha of coral reefs, 2,385 ha of seagrass, and 31,480 ha of mangrove, which must be protected.

Keywords: fisheries refugia, South China Sea region, important aquatic species., fishing communities

Special Forum: Science for local-level environmental management, ecosystem conservation and sustainable use in the South China Sea and Gulf of Thailand

Science and collaboration of stakeholders for conservation of blue carbon ecosystems through carbon-neutral tourism

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Abstract

Degradation of marine and coastal resources has been recognized because of anthropogenic and climate impacts which are driving ecological changes and resulting in a climate change crisis. Tourism development at the global scale is emphasizing sustainable tourism and moving toward Sustainable Development Goals (SDGs). The concepts of low carbon and carbon neutrality in the marine tourism sector have been significantly enhanced. The scientific knowledge, the potential of marine tourism operators, and the availability of marine tourism standards, which are applied as a tool for the tourism business operation, are urgently required. For carbon-neutral marine tourism, the tourism operators used the carbon-neutral marine tourism guideline by applying four steps of implementation, i.e., measuring the carbon footprint of marine tourism activities, reducing carbon emissions through appropriate measures, promoting carbon offsetting of marine tourism activities and enhancing public relations concerning carbon neutral tourism. Thailand's carbon-neutral marine tourism standards were also developed in connection with international standards. The standard criteria focus on effective sustainable management, social and economic benefits to the local community, benefits to cultural heritage and environment, biodiversity, ecosystems, and landscape conservation, and offsetting for achieving carbon neutrality. The nature-based solutions (NBS) can play a major role as a systemic approach and an important component of the carbon-neutral tourism operation. In marine and coastal ecosystems, NBS can contribute to environmental health, climate change mitigation and adaptation, and a sustainable blue economy. At the global scale, the climate change impacts are increasing and the reduction of GHG emissions and offsetting are essential. NBS can be applied for offsetting i.e., the conservation and restoration activities of blue carbon ecosystems, particularly mangroves, seagrass beds, coral reef-associated macroalgal communities, and sediment trapped in the marine ecosystems. Marine tourism, particularly snorkeling and SCUBA diving activities, are recognized as having some greenhouse gas

emissions that contribute to global climate change. Cooperation of relevant stakeholders in joint responsibility and business companies operating environmentally friendly businesses are urgently needed. Tourism operators in collaboration with local agencies and communities have an important role in educating the public about carbon-neutral marine tourism and minimizing tourist impacts on the environment. Local tourism business operators can play a significant role in conservation of restored marine ecosystems and enhancing capacity building for carbon-neutral marine tourism.

Keywords: blue carbon, ecosystem management, restoration, tourism

The development of Marine Spatial Planning in China and prospects for cooperation with WESTPAC countries

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Abstract

Marine Spatial Planning (MSP) is a process of analyzing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic and social objectives. Nearly 70 countries worldwide have implemented or are implementing a total of 140 MSP programs at the national, regional or local level now. MSP has been globally accepted as a fundamental tool for management of the ocean. China's MSP practice has been going on for more than 40 years, experiencing an evolution from Marine Functional Zoning to Territorial Spatial Planning and Coastal Zone Special Planning, achieving both economic and environmental results, and at the same time still facing a number of challenges including land-sea coordination, which is receiving increasing attention in the development of ocean management, both in domestic politics and academic circles. This report will introduce the evolvement of China's MSP system and related projects, discuss China’s experience on marine and coastal management, and present suggestions for cooperation with WESTPAC countries in terms of technical cooperation in MSP and ICZM, project cooperation related to planning and regional development, platform cooperation for scientific research, and also regular personnel cooperation.

Keywords: Marine Spatial Planning, coastal zone, cooperation, land-sea coordination

Special Forum: Science for local-level environmental management, ecosystem conservation and sustainable use in the South China Sea and Gulf of Thailand

Effective management of ecological conservation and sustainable development using innovative and integrated approach at Dapeng Bay, China

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Abstract

Dapeng Bay is shared by Hong Kong and Shenzhen. It is located in the economic core area of the Guangdong-Hong Kong-Macao Greater Bay Area, covering 174 square kilometers with 31 beaches and 60% natural coastline. For a long time, the prevention of coastal water pollution, the protection and restoration of important ecosystems, and the improvement of a seaside resort have been made in Dapeng Bay. After years of efforts, some remarkable results has achieved at Dapeng Bay, that is, water quality of the coastal area is excellent, various important marine ecosystems such as coral reefs and seaweed beds exist in the bay, and eco-tourism revenue has increased rapidly. The ecological construction of Dapeng Bay can provide the world with valuable experience for the sustainable development of a marine economy and ecology. First, establishing comprehensive marine ecosystem conservation mechanisms with land and sea integration. From river basins to sea areas, the system of total discharge control of land based pollution was set up to improve the water quality of the river and bay. The whole chain governance mechanism for marine plastic litter including recycling economy was developed with involvement of multi-department and public and NGO. In addition, A UAV intelligent monitoring system was created at Dapeng Bay, which can carry out a full coastal coverage surveillance by the tool of remote control. Second, establishing a model of community involvement, public awareness and education for coastal habitat conservation and restoration. The first national marine ranching demonstration area taking coral conservation as the center was created at the bay. The first coral conservation center was built by collaborating with universities. Furthermore, 11 ecological conservation organizations for the bay were set up. 2.5 square kilometers of coral areas have been conserved effectively. Third, promoting eco-tourism development with the concept of “Integration of ecology, tourism and economy” in Dapeng Bay. The actions included improving the quality of the beach, building a coastal public eco-path, holding marine sports events, establishing marine theme parks, which has enabled it to receive more than 30 million tourists annually. The eco-tourism revenue of Dapeng New District reached 7.09 billion RMB yuan in 2022, and the coastal habitat conservation and sustainable development model has formed in Dapeng Bay.

Keywords: intelligent supervision, coral conservation, eco-tourism, sustainable development

Science for local-level management, ecosystem conservation, and sustainable use: the Tubbataha story

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Tubbataha Reefs Natural Park and World Heritage Site, The Philippines

Abstract

The Tubbataha Reefs Natural Park is located in the Philippines' Sulu Sea, within the Coral Triangle, global center of marine biodiversity. The 97,030-ha marine park is a no-take zone, allowing only tourism and research. However, access is limited by weather constraints for most of the year. Tubbataha hosts over 370 coral species, 700 fish species, the largest known seabird assemblage in the Philippines, and diverse marine megafauna. Its unique ecological features, coupled with isolation and conservation status, position it as a significant marine diversity hotspot. The limited human influence and reduced exposure to anthropogenic stressors contribute to the preservation of its unique and undisturbed habitats. Under the protective mandate of Republic Act 10067 (Tubbataha Act of 2009), the park is managed by a multi-sectoral body, ensuring representation across various sectors. The management of Tubbataha involves regular monitoring of fish, benthic organisms, seabirds, sea turtles, sharks, and gastropods, and other taxa (when funds are available) with population assessments serving as indicators for the efficacy of conservation measures. A focus on management effectiveness evaluations, engaging stakeholders, including local community representatives, is integral to assessing the park's condition and refining conservation approaches. Tubbataha's role extends beyond conservation, serving as a dynamic research environment for studies of marine ecology and as a reference site for investigating climate change impacts. The delicate balance between conservation imperatives and sustainable practices is underscored by local governance guided by scientific understanding. This approach aligns with the park's commitment to maintaining ecological integrity while facilitating sustainable use within the bounds of its protected status.

Keywords: Local-level management, conservation, science

Establishment of the Thai Thuy Coastal Wetlands Nature Reserve in Thai Binh Province and the Tam Giang Cau Hai Coastal Wetlands Nature Reserve in Thua Thien Hue Province, Vietnam

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Abstract

The Thai Thuy Coastal Wetlands Nature Reserve in Thai Binh Province and the Tam Giang Cau Hai Coastal Wetlands Nature Reserve in Thua Thien Hue Province of Vietnam are the first two coastal wetlands nature reserves established in the South. These two reserves share the common feature of high biodiversity value, including migratory bird species from other countries that visit seasonally. The Thai Thuy Coastal Wetlands Nature Reserve covers a total area of 6,560 ha. The linking habitat outside the embankment area is 6,540 ha. This area has a good area of mangrove forests, a rich ecosystem that acts as a buffer between the mainland and the sea, with mangroves playing a critical role in protecting the coastal area. The Tam Giang - Cau Hai Coastal Wetlands Nature Reserve spans an area of 69,684 ha, making it a large wetland area compared to other Southeast Asian mangrove swamps. It is an area of high biodiversity, especially in shrimp and fish species, waterfowl, and mangrove ecosystems. The process of establishing the Thai Thuy and Tam Giang Cau Hai coastal wetlands nature reserves faced numerous challenges due to conflicts of interest between economic development, local livelihoods, and conservation. Achieving consensus from local authorities at various levels, from commune to district and province, and especially from the people living near the reserves, required a process of assessment, analysis, research, and suitable planning between conservation and development. After thorough preparation and with the support of UNDP and technical guidance from MONRE, these two provincial-level wetland reserves were established, opening opportunities for the establishment of further provincial-level coastal wetlands nature reserves in Vietnam.

Keywords: nature reserve; coastal wetlands; linking habitats

Special Forum: Science for local-level environmental management, ecosystem conservation and sustainable use in the South China Sea and Gulf of Thailand

The study on social and economic impacts from marine protected area announcement and the utilization of the Kra Islands area, Nakhon Si Thammarat, Thailand

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Abstract

Kra Islands area is the first Marine Protected Area (MPA) in Thailand and was announced by Ministerial Regulation in May 2021, followed Section 20 of Marine and Coastal Resources Management Promotion Act B.E. 2558 (2015). The research team including Department of Marine and Coastal Resources (DMCR) would like to understand the impacts both socially and economically from the MPA announcement and how the area is utilized. A mixed method research was used. The samples of the study selected using a purposive sampling were from a network of coastal communities and stakeholders in 6 coastal districts in Nakhon Si Thammarat Province, totaling 311 people. The research instruments were a questionnaire and an interview. The statistics used to analyze quantitative data were percentage, mean, and standard deviation. Qualitative data was analyzed using content analysis. The results of the study found that 1) Kra Islands are utilized as shelter areas for boats from waves and wind, source of income from fishing in the outer areas, and fishing tourism 2) The overall mean score of the social impacts was moderate, except for integration of local community organizations was low. This is because of the distance of 63 kilometers from the coast. 3) The overall mean score of the economic impacts was moderate because only certain groups can utilize the protected area. The economic impacts at low mean score included employment, dept decreasing, and creating new careers in the community. In addition, the samples' satisfaction on the utilization was moderate. However, most of them agree with the MPA announcement because it leads to the abundance of marine and coastal resources and better ecosystem service. Some suggestions were 1) the announcement should be strictly controlled to ensure the protection of resource abundance; 2) mooring buoys should be provided in the shelter areas to prevent anchoring in coral areas; 3) fishing tourism activities should be promoted to be a source of income for the community; 4) utilization zones should be clearly identified; and 5) the information of the Kra Islands area should be included in education system to ensure the sense of resource ownership to the next generation.

Keywords: utilization, social impacts, economic impacts, Kra Islands, Marine Protected Area

Special Forum: Science for local-level environmental management, ecosystem conservation and sustainable use in the South China Sea and Gulf of Thailand

Nha Trang Bay, Vietnam: highly diverse coral reefs under severe threats

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Abstract

Nha Trang Bay is located in the western South China Sea near the eastern-most point of the Vietnam mainland. Coral reefs on the submersed bank and fringing the islands occupy an area nearly 800ha. Extensive surveys over past decades have recorded more than 350 species of reef corals, 773 species of reef fishes, 106 species of mollusks, 69 species of crustaceans and 27 species of echinoderms Detailed site observations in 2002 indicated high diversity of reef features, with 198-341 (286±12 in average) species of corals, fishes, macrobenthos and seaweeds at each of 18 studied sites. For reef corals, *alpha* diversity was 139 in average and 190 in maximum. More recent research has found that this bay forms a western part of a Mini-Coral Triangle within the South China Sea. Rapid economic development beginning in the years before 2000 has contributed to reef degradation and a perceived loss of diversity. Data collected from a number of surveys during 2002 – 2022 exhibited serious decline of coral cover, fish species richness and density by time. A review of the literature and analysis of these updated data indicated that degradation occurred firstly on remote reefs, subsequently on nearshore reefs, and from outside to within the core zone of the Nha Trang Bay MPA. This is a consequence, in approximate chronology, of the cumulative impacts of illegal fishing on remote reefs, nutrient enrichment due to river run-off and aquaculture, sedimentation from coastal and island development, outbreaks of crown of thorns starfish (COTs), and coral bleaching. Some reefs were also damaged by tropical typhoons. In November 2022, the authority of Khanh Hoa province approved an overall plan for Nha Trang Bay restoration aiming to mitigate impacts and rehabilitate marine habitats. However, challenges remain, particularly on mechanism for coordination among related stakeholders, functions of the MPA management board, and policy for private sector engagement. Additional concerns include identifying the best approach for ecological restoration, specifically a lack of “donor reefs” and investment for sea ranching of reef resources. In terms of coral reef resilience, further researches on reef recovery under different levels of anthropogenic impacts and MPA re-zoning for effective conservation are proposed.

Keywords: biodiversity, reef degradation; threats; coordination; restoration

Building baseline data of coral reef ecosystem in Koh Mak, Thailand for monitoring on impacts from tourism

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Abstract

Koh Mak, Trat Province, is one of the important tourist attractions because of their abundant and diverse coral reef. However, there are negative impacts from tourism including deterioration of natural resources and coral reef ecosystem. To monitor environmental changes that might happen from tourism activities, baseline data on resources in coastal coral reefs is required. This study applied three different methods: (1) line intercept transact method; (2) fish visual census technique; and (3) invertebrate belt-transect method. The three sampling sites of Koh Mak area were Koh Phee, Suan Yai Bay, and Tanid Bay. The results showed that Poritidae coral is the most abundance and percentages of area covered by living coral were varies by sites: 83% for Koh Phee, 25.6% for Suan Yai Bay, and 24.87% for Tanid Bay. The organisms that found most at all three sites were (a) Eightband butterflyfish (*Chaetodon octofasciatus*), (b) Copperband butterflyfish (*Chelmon rostratus*), (c) Brown banded grouper (*Cephalopholis boenack*), (d) Longfin grouper (*Epinephelus quoyanus*), (e) Porcupine sea urchin (*Diadema setosum*), and (f) Scaly giant clam (*Tridacna squamosa*). In terms of relative abundance, the top three species were Porcupine sea urchin varied from 89.9% to 59.1%, followed by Scaly giant clam varied from 28.4% to 2.1%, and Eightband butterflyfish varied from 9.7% to 7.2%. In summary, coral reef ecology of Koh Mak is currently in abundant stage and the result of the study are used as baseline information for monitoring impacts from tourism in the future including issuing regulations to conserve the abundance of resources.

Keywords: coral reefs, Koh Mak, relative abundance, baseline information, tourism

Special Forum: Science for local-level environmental management, ecosystem conservation and sustainable use in the South China Sea and Gulf of Thailand

Marine landscape mapping: a step towards effective ecosystem-based management for Malaysia Marine Parks

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Abstract

The Marine Parks of Malaysia represent the designated national Marine Protected Areas (MPA) gazetted as part of the Marine Park Malaysia Establishment Order 1994. A collaborative project has been established, leveraging the joint efforts between government agencies and universities in Malaysia to facilitate and contribute towards the effective implementation of Ecosystem-based Management (EBM) in Malaysian marine parks. The primary objective of this initiative is to propose a novel framework rooted in the usage of marine landscape mapping techniques to identify zonation for Marine Spatial Planning. The proposed framework involves the identification of ecologically significant zones through multibeam bathymetry and backscatter data, followed by the generation of a marine landscape map using an objective automated technique. The framework encompasses data contribution, classification using the marine landscape approach, and integration of benthic classes. Through the integration of data, survey planning, and standardized classification, this framework provides a practical avenue for the Malaysian Government and relevant agencies to enhance marine park management aligned with EBM principles. To evaluate ecological relevance, species indicator analysis is subsequently employed, which determines the presence of indicator species and, thus, the ecological significance of identified zones. This research establishes a blueprint for fostering sustainable marine ecosystem management, combining scientific rigour with operational applicability for preserving marine biodiversity and resource utilization. By adopting this framework, the Malaysian Government and relevant agencies can effectively manage marine parks and promote the principles of EBM.

Keywords: habitat mapping, seafloor mapping, marine landscape mapping, EBM, MPA

Special Forum: Science for local-level environmental management, ecosystem conservation and sustainable use in the South China Sea and Gulf of Thailand

Implementation of action plan for the Pearl River Estuary pollution control and prevention

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Abstract

The Pearl River Delta is one of the most populated regions in China with relatively high level of economic growth. The adjacent waters of the Pearl River Estuary (PRE) receive pollution input from both the Pearl River Delta and the upper-middle reaches of Pearl River, and the environmental pollution pressure is maintained at a relatively high level. In February 2022, the Ministry of Ecology and Environment and six other ministries issued an "Action Plan for the Comprehensive Management of Key sea areas", which listed the adjacent waters of the PRE as one of the three sea areas under national priority management. In accordance with the requirements of the country, the People's Government of Guangdong Province issued and implemented the "Implementation Plan for the Comprehensive Management of the Adjacent Waters of the PRE", aiming to achieve the water quality target of the adjacent waters of the PRE by 2025 set by the country. Systematic implementation of ten actions, including improving the water quality of rivers flowing into the coastal areas, inspecting the direct discharge outlets entering the sea, pollution control and prevention of coastal cities, pollution control and prevention of coastal agriculture and rural areas, improvement of aquaculture environment, pollution prevention and control of ship ports, marine ecological protection and restoration, etc. It has achieved initial results, the flux of total nitrogen carried by rivers into the sea has decreased, the water quality in the adjacent waters of the PRE has improved, and the ecological function of key bays in coastal cities has restored.

Keywords: Pearl River Estuary, comprehensive management, land and sea overall planning, total nitrogen pollution Control

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Whole chain control of plastic pollution in the Pearl River Estuary, China

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Abstract

The key of marine litter management is the prevention and control of plastic pollution. Since 2020, China has unveiled a plan on controlling plastic pollution over the next five years, aiming to effectively curb white pollution by 2025. The details measures include cutting the production and use of plastics, developing alternatives for plastics, and substantially reducing the amount of plastic waste in landfills and environmental leakage during 2021–2025.The Pearl River Estuary (PRE) is the core sea area of the Guangdong-Hong Kong-Macao Greater Bay Area, where China has set out a construction plan with timetable and tasks, aim to build an international leading livable as well as business and tourism friendly bay area by 2035. In PRE, the whole-chain control system of plastic pollution was comprehensively improved and the whole-life cycle management of plastic waste was implemented. The key sectors such as retail, e-commerce, and express delivery, are expected to drastically cut the unreasonable use of disposable plastics. It will promote the use of alternatives to plastic, such as bamboo, wood, paper, and degradable plastics. It will also ramp up research on degradable-plastic technologies and encourage the orderly development of related industries. in PRE, some specific studies were done including: 1) Analyzed the distribution and sources of plastic pollution. 2) Studied the generation and treatment of plastic pollution. 3) Identified the main problems for plastic pollution control. 4) Proposed short-term and Long-term measures for strengthening the whole chain control of plastic pollution in PRE. The short-term measures included: 1) Cleaning up the stock, carry out special initiative of plastic waste in estuaries and coastal waters. 2) Curbing the increase, organize the responsible departments to block the plastic waste into the sea. 3) Different measures for different plastic waste categories, strengthen the recycling and resource utilization of plastic waste. The long-term measures included: 1) systematic planning, promote the source reduction of land-based plastic waste. 2) multi-party governance, promote the area cooperation of Guangdong, Hong Kong and Macao for plastic waste pollution prevention and control. 3) clear responsibilities, promote the coordination level of various departments to carry out plastic waste management. 4) Explore and carry out tracking analysis and risk assessment of plastic pollution.

Keywords: marine litter, plastic pollution, Pearl River Estuary, whole chain control

Special Forum: Science for local-level environmental management, ecosystem conservation and sustainable use in the South China Sea and Gulf of Thailand

The opportunity for microplastic consumption and excretion of black seahorse (*Hippocampus kuda*)

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Abstract

The problem of plastic waste has become a significant international issue in the current era. Globally, approximately 368 million metric tons of plastic are produced, with about 76% of plastic waste ending up in the oceans. Plastics undergo degradation or fragmentation into microplastics, leading to marine pollution that adversely affects the environment and enters the food chain. Seahorses belonging to CITES Appendix II are afforded protection. Presently, their status is heavily threatened due to natural changes. This has sparked researchers' interest in the opportunity for microplastic consumption through the eating behavior of seahorses (*Hippocampus kuda*) to provide information for risk reduction planning in seahorse aquaculture to minimize microplastic contamination. The ultimate goal is to achieve the least possible microplastic contamination or even create a system free from microplastics for the conservation of seahorses. The experiment aims to enhance understanding of the transmission process of microplastics through the digestive system, considering the timing and travel of microplastics within the digestive tract. Aligning with feeding behavior patterns, this knowledge will be applied to other aquatic species affected by microplastic ingestion. The procedure involves preparing differently colored microplastics, mixing them with the seahorse's diet, and establishing a feeding schedule. Quantities of ingested microplastics per meal are recorded, along with feeding and excretion times. Subsequently, the collected fecal samples are examined for microplastic content, and Microsoft Excel is utilized for data analysis. This foundational data is crucial for ongoing monitoring efforts, including seahorse aquaculture practices aimed at effective conservation in the future.

Keywords: seahorses, microplastics, eating behavior, consumption

Special Forum: Science for local-level environmental management, ecosystem conservation and sustainable use in the South China Sea and Gulf of Thailand

Economic valuation of mangroves in Ca Mau, Vietnam

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Abstract

Mangroves play an important role for many communities, especially coastal communities. They provide food, clean water, raw materials and fuel for people and economic activities. In many localities, mangroves act as green live barriers, protecting people and environment from the negative impacts of natural disasters. Moreover, these ecosystems provide nutrition and are home of hundred species of animals and plants, including rare, precious, and endangered species. Recognizing the irreplaceable role of mangroves, Vietnamese government has deployed a wide range of strategies, policies and activities to conserve and develop mangroves. However, in many localities, mangroves have been significantly degraded and narrowed due to various causes, in which, improperly and insufficiently integrating the economic value of mangroves into the regional and local policies making process is considered as the key driver. The study "*Economic valuation of mangroves in Ca Mau, Vietnam*" was conducted by the Institute of Strategy, Policy for Natural Resources and Environment (ISPONRE) with technical and financial support of the Dragon Capital Group. The overall objective of the study was to estimate the economic values of the important goods and services provided by Ca Mau mangroves, providing inputs for local policy development, especially for those related to management and use of mangrove ecosystems. The study focused on the valuation of mangroves' use values (including direct use values and indirect use values). The results were summarized as follows: (1) Timber and firewood: VND 63.5 billion per year, (2) Aquatic resources: VND 335.1 billion per year, (3) Aquaculture support: VND 598.4 billion per year, (4) Coastal protection: VND 552.2 billion per year, (5) Carbon storage and sequestration: VND 103.9 billion per year and (6) Landscape beauty: VND 90.7 billion per year. It can be seen from the study results that Ca Mau mangroves have great contributions to the people, environment and economy of Ca Mau province and of the entire key economic region of the Mekong Delta. The total economic value of Ca Mau mangroves in 2019 was up to VND 1,743.7 billion per year, of which, direct use value was VND 1,087.6 billion (accounting for 62.4%) and in-direct value was VND 656.1 billion (accounting for 37.6%). Maps were also developed by for better tracking of mangrove ecosystem values by administrative unit at district level.

Keywords: mangroves, mangrove ecosystem services, economic valuation, Ca Mau

Coastal blue carbon management of Zhanjiang, Guangdong Province

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Abstract

Coastal blue carbon ecosystems possess significant carbon sequestration potential. Enhancing the carbon sequestration capacity of these ecosystems is a crucial approach to achieving China's goals of carbon peaking and carbon neutrality while promoting high-quality development. Zhanjiang City, located in Guangdong Province, China, boasts a coastline stretching 1,243.7 kilometers and encompasses three key blue carbon ecosystems: mangroves, seagrass beds, and coastal salt marshes. The mangrove area in Zhanjiang accounts for 25% of China's total mangrove area, making it the region with the highest mangrove coverage nationwide. Moreover, Zhanjiang serves as a vital production and processing base for aquatic products in Guangdong Province and the entire country, offering a natural advantage for the development of coastal blue carbon. Building upon these advantages, Zhanjiang has introduced the concept of becoming a "Mangrove City" and successfully completed China's inaugural blue carbon trading project in 2021. To promote the conservation of mangrove carbon sinks and foster market cultivation in Zhanjiang, this study conducted a comprehensive assessment of carbon stocks and carbon sequestration across mangroves, salt marshes, seagrass beds, and aquaculture from 2022 to 2023. Based on the findings, policy recommendations were put forward to guide the conservation and development of coastal blue carbon in Zhanjiang. The study revealed that the total carbon stock of coastal blue carbon in Zhanjiang amounts to 1,295,662.40 Mg C, with mangroves accounting for the largest proportion at 80.11%. The total carbon sequestration capacity of Zhanjiang reaches 79,840.41 Mg C yr^{-1}, with aquaculture and mangroves exhibiting the highest carbon sequestration capacities, accounting for 53.10% and 32.10%, respectively. The study proposed several actions, including the establishment of a data intelligence platform for coastal blue carbon, the creation of a standardized blue carbon trading market, and the promotion of carbon inclusion projects. These initiatives lay the groundwork for the development of a robust carbon trading market.

Keywords: blue carbon ecosystems, mangroves, seagrass beds, coastal salt marshes, carbon sink accounting

Special Forum: Science for local-level environmental management, ecosystem conservation and sustainable use in the South China Sea and Gulf of Thailand

Integrating blue carbon policies into marine spatial planning in the South China Sea

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Abstract

As the global community grapples with the complex challenges of climate change and the degradation of marine ecosystems, there is an increasing recognition of the need for integrated and innovative approaches to address these issues. As a nature-based solution, blue carbon is crucial for addressing climate change and realizing carbon neutrality. The South China Sea has great potential to serve as a blue carbon ecosystem to mitigate climate change, restore marine biodiversity and enhance coastal resilience. Several surrounding countries of the South China Sea issued national or sub-national blue carbon policies to promote blue carbon protection and development. However, there has been limited consideration, both academically and practically, regarding the integration of these policies with marine spatial planning (MSP). This study investigates the potential integration of blue carbon policies into MSP within the intricate context of the South China Sea region. By conducting qualitative document analysis and comparative analysis, this study explores the synergies, challenges and implications associated with merging these frameworks at local, national and regional levels. Based on the existing literature, policy documents and case studies, this study examines how blue carbon policies and MSP can collectively contribute to making rooms for preserving marine biodiversity and enhancing ecosystem services. Preliminary findings suggest that integrating blue carbon into MSP holds promise for enhancing carbon sequestration and contributing to climate change mitigation in the South China Sea region. Additionally, this paper critically examines challenges such as conflicting stakeholder interests, inadequate institutional frameworks and geopolitical tensions. It underscores the necessity for collaborative governance, stakeholder engagement and international cooperation to navigate these complexities effectively. Furthermore, the study delves into the socioeconomic implications, emphasizing potential co-benefits such as improved marine protected areas management, enhanced blue carbon policies and standards, and increased climate resilience in coastal communities. The research provides best practices and contributes policy insights for marine planners, researchers, and practitioners seeking sustainable approaches to marine resource management and climate action in the South China Sea.

Keywords: blue carbon; marine spatial planning; climate change; South China Sea

Assessing the carbon sequestration potential from Nipah Palm (*Nypa frutican*) in the Surat Thani mangrove (Ban Don Bay).

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Abstract

Thailand is currently experiencing the effects of climate change, particularly the impacts of global warming. This is due to the release of greenhouse gases from natural processes and various human activities, including burning fossil fuels, industrial expansion, waste management, and deforestation. Consequently, carbon dioxide accumulates in the atmosphere. To mitigate the impacts of climate change, carbon dioxide absorption and storage in wood has been identified as a viable process. Surat Thani's mangrove forests serve as habitats for diverse plant and animal species, including Nipah Palm (*Nypa fruticans*). This monocotyledon, commonly found in mangrove forests throughout Southeast Asia, is a salt-tolerant palm essential for coastal protection and a valuable resource for local communities. The plant provides food, such as fruits and palm sugar, and materials for construction and traditional crafts. Additionally, it contributes to local economies by supporting ecotourism activities. This research aims to investigate the carbon sequestration potential of Nipah Palm and compare it with other solitary leafy plants. The findings indicate that Nipah Palm has a lower carbon sequestration capacity compared to palms and sugar palms. Overall, the study highlights the significance of Nipah Palm in carbon sequestration and emphasizes the need for conservation and sustainable management strategies to preserve its carbon-storing capabilities. The findings provide valuable insights for mangrove restoration and climate change mitigation efforts in Thailand and other Southeast Asian regions. It is hoped that the information obtained from this research will be beneficial for conservation efforts and raising awareness of the value of Nipah Palm in the mangrove forests of Surat Thani province, specifically in the Ban Don Bay, for future sustainability.

Keywords: carbon sequestration, Nipah palm, mangrove, Bandon Bay, Surat Thani

Special Forum: Science for local-level environmental management, ecosystem conservation and sustainable use in the South China Sea and Gulf of Thailand

Achievements and challenges in sustainable development of marine farming in Quang Ninh Province, Vietnam

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Abstract

Quang Ninh is a coastal province in the Northeast region of Vietnam, having Ha Long Bay - a world heritage and natural wonder; has a synchronous transport system infrastructure, being a multi-modal transport gateway connecting with China, Northeast Asia and ASEAN; has great fisheries potential with a wide sea area and thousands of islands. In the decade 2011–2020, the province has successfully completed the legal framework and policies for developing the fisheries industry; focus on developing marine economic zones, especially industrial marine farming; encourage the private sector to invest in the application of advanced marine science and technology, with many new farming subjects and new farming methods. By promulgating a local technical regulation on floating materials in aquaculture, in the 3 years 2021–2023, foam buoys will be completely eliminated, replaced with HDPE and other environmentally friendly materials. There have been many new production models, with 154 OCOP aquatic products (accounting for 43.2% of the total OCOP products of the agricultural sector). However, Quang Ninh is facing with great challenges, such as: technical barriers of seafood importing countries; near-shore marine farming space is shrinking due to industrial activities, urbanization and tourism; marine ecosystems are at risk of decline and depletion; lack of high-quality human resources, especially skilled and trained workers, while the unskilled workforce is increasingly aging; climate changes increase and the risk of environmental pollution increases. With close cooperation with the Vietnam Seaculture Association (VSA), the province is completing the Program for sustainable development of fisheries to 2030, with a vision to 2050. By 2030, fisheries will account for 57.8% of the agricultural sector's GRDP; average seafood production value grows by 5.8%/year; aquatic output increased by 10%/year, of which aquaculture increased by of 15.6%/year; seafood export increases 1.5 times compared to 2022. Quang Ninh will accelerate the dual transformation (Greening and Digitization) of the fisheries industry, integrating sea farming activities with tourism and other marine economic sectors, promoting the PPP investment in natural sea ranching activities combined with conservation and developing aquatic resources, preserving endemic marine ecosystems, rationally planning the use of multi-purpose marine space associated with preserving and developing cultural values of marine communities, bringing Quang Ninh a model for sustainable marine farming development in Vietnam.

Keywords: Quang Ninh province, marine culture, sustainable development

From sustainable materials to green models in aquaculture and experiential tourism in Quang Ninh Province

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Abstract

Contributing to converting and putting into use more than 1,000,000 HDPE buoys, STP group has contributed to replacing 1/6 of cracked and floating foam buoys in Quang Ninh (6,153,987 buoys). The foam buoys amount accounts for 70% of this province's ocean plastic waste. Raising oyster by using foam buoy lines is popular in Quang Ninh province, where the plastic waste discharged into the sea is up to hundreds of kg per year. The biggest amount discharged by a household can be up to 552.8 kg/year. This does not only cause heavy environmental pollution, but also cause loss of aesthetics to Quang Ninh's tourism industry. As a province that is potential in both aquaculture and tourism, with the World Heritage site of Ha Long Bay and the Asean heritage site of Bai Tu Long Bay, Quang Ninh needs appropriate models to maximize these potentials. HDPE buoys & cages are identified as the optimal material for aquaculture. They own outstanding durability and extremely low ocean plastic emissions compared to other materials. In particular, HDPE microparticles have little effect on the maturation process of aquatic species. STP group has researched and launched HDPE buoys & cages products made from high quality imported virgin plastic to ensure durability (from 30–50 years) and the "green" nature of the product. In 2020, STP sponsored materials and conducted testing, providing HDPE material durability test indexes for Quang Ninh Provincial Fisheries Department pilot plan. As a result, local standard No. 08 (QCDP08) on materials used to manufacture floating buoys in Quang Ninh aquaculture was born. STP is also the first unit to launch HDPE buoys for oyster farming, and is exited in its propaganda work to all communes, districts and towns of the province, contributing to increasing fishermen's awareness of using HDPE green material in aquaculture. In 2022, STP launched the first marine farm with an infrastructure system made of 100% HDPE material. This is a typical green model combining aquaculture and tourism in Quang Ninh that attracted leaders, visitors to visit and study. STP Farm is currently a sustainable green investment trend for economic jobs associated with the sea.

Keywords: HDPE material, aquaculture, tourism, Quang Ninh

Framework of sustainable diving tourism system: an exploratory study in Nha Trang Bay Marine Protected Area

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Abstract

With its diverse biological characteristics, Nha Trang Bay has become a homeland for recreational scuba diving. Furthermore, it has received great conservation attention from the Vietnamese government. The primary means of sustainable management are policies issued by government agencies, with direct oversight by the Nha Trang Bay Management Department. Since the establishment of the Hon Mun Marine Protected Area in 1999, which is now the core zone of the Nha Trang Bay Marine Protected Area (NTB MPA), these policies have been continuously issued to respond to practical operations. According to the framework for a sustainable diving tourism system, to ensure practicality in planning and feasibility in implementation, policies from the host community should be consulted by the diving industry. This interaction has been limited in the past, thus this study aims to gather in-depth opinions from diving businesses to contribute to the effectiveness of these policies. After conducting in-depth interviews with 15 individuals from tour operators in Nha Trang City, the results demonstrate the high applicability of the sustainable diving system framework in the Nha Trang Bay Marine Protected Area. Additionally, the study contributes the perspectives of the diving industry to current diving tourism-related policies, as well as the potential for future collaboration to address existing issues. The study also proposes the Inclusion of an additional element and the FSDTS model from a theoretical standpoint.

Keywords: diving tourism, Marine Protected Area (MPA), sustainable tourism.

Managing sea walking tourism in Koh Lan and Koh Sak, Chonburi Province

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Abstract

Sea walking is an underwater activity that is like scuba diving, but the difference is that sea walkers do not require to accomplish training. Sea walkers can breathe underwater using air from surface through air compressor onboard via a hose connecting to underwater breathing apparatus, worn on their heads. This is aimed to allow tourists to see reef fish and corals; therefore, operating points are in the area near coral reefs leading to encroachment of coral reef area and removing coral to clear space for tourists to walk easily. Negative impacts from sea walking tourism are (a) losing coral reef area permanently from removing coral as clearing path for sea walkers, (b) scattering of sediment from stepping on seafloor making sediment to cover on corals and unable to recover, (c) damaging corals by directly stepping and anchoring on them, (d) damaging ecosystem by allowing tourists to feed fish, and (e) polluting coral reef area by releasing discharge from vessels and dumping garbage in the sea. In May 2021, Department of Marine and Coastal Resources therefore has established measures, criteria, methods, and conditions for operating sea walking tourism activities to protect marine resources from negative impacts of the tourism. Operators are not allowed to operate sea walking tourism in coral reef area of Koh Lan and Kok Sak, Cholburi Province. However, this do not apply to operators permitted by Pattaya City Mayor and local government organization, with approval on the area and measure to reduce environmental impacts from Environmental Protection Supervision and Monitoring Committee of Cholburi Province and Director-General of Department of Marine and Coastal Resources (DMCR), including complying with other related laws. The licensed operators must set boundary buoys surrounding the activity area, any activities that cause changes to underwater conditions from the current situation are prohibited, feeding aquatic animals are also prohibited. If any licensed operators cause damage to the coral reef, they are responsible for those damage, or to restore the damaged corals to the healthy condition, under supervision of DMCR officers. Punishment for non-compliance are imprisonment not exceeding one year, or fine not exceeding one hundred thousand baht, or both. This regulation is effective for a period of three years.

Keywords: sea walkers, management, Koh Lan, Koh Sak, tourism operators

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Impact assessment of dolphin watching tourism on Indo-Pacific Humpback Dolphins (*Sousa Chinensis*) in Khanom waters, Thailand

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Abstract

Dolphin-watching is a key attractive tourism in Khanom District, Nakhon Si Thammarat Province, where the spotlight is on the Indo-Pacific humpback dolphin (*Sousa Chinensis*), drawing the attention of the largest boat-watching communities in Khanom. Tourists actively seek dolphin encounters during boat rides, allowing for intimate interactions with these unique pink humpback dolphins, affectionately known as 'pink dolphins,' due to their distinctive coloration. Despite previous research documenting the impact of dolphin tourism on behavior, such insights are lacking for this specific dolphin species and in Thailand study. Our study delves into the effects of tour boat behavior on Indo-Pacific humpback dolphins in Khanom over twice per month (November 2023–March 2024). Using Markov chain models, we evaluate the influence of tour boats on dolphin behavioral transition probabilities in both control and impact scenarios. The impact of tour boat interactions is quantified by comparing transition probabilities between control and impact chains. Markov chain analysis unveils that, in the presence of tour boats, dolphins are less inclined to engage in socializing and more prone to initiate travel behaviors. These behavioral shifts pose significant risks to the dolphins, potentially leading to population-level impacts. To ensure the well-being of dolphins and foster sustainable tourism, strict adherence to dolphin viewing regulations by tour boat operators is imperative.

Keyword: Indo-Pacific humpback dolphin, behavior, dolphin watching, Khanom District, sustainable tourism

Special Forum: Science for local-level environmental management, ecosystem conservation and sustainable use in the South China Sea and Gulf of Thailand

Over three decades of marriage of conservation and tourism in the municipality of Mabini, Batangas, Verde Island Passage: an author's reflection on best practices, weaknesses, lessons learned, and prospects

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Abstract

The coastal municipality of Mabini in Batangas, strategically located at the western tip of the Verde Island Passage, boasts a unique position as the bullseye of "The Center of the Center of Marine Shorefish Biodiversity" globally (Carpenter, K.E., Springer, V.G. The center of the center of marine shore fish biodiversity: the Philippine Islands. Environ Biol Fish 72, 467–480 (2005). https://doi.org/10.1007/s10641-004-3154-4). Over the past three decades, Mabini has been a focal point for conservation endeavors, driven by its remarkable biodiversity and tourism allure. Substantial financial investments, amounting to hundreds of thousands of dollars, have been allocated to numerous projects, with millions of pesos generated through local sustainable financing mechanisms. This paper endeavors to disseminate insights, best practices, weaknesses, and lessons learned from historical projects and local initiatives in Mabini. Additionally, it will outline future prospects based on the municipality's current plans. The information presented is drawn from the author's extensive involvement in project conceptualization, fundraising, planning, implementation, and monitoring since 1998. The author's roles have spanned various capacities, including serving as the Country Executive Director for WWF Philippines from 1996 to 2003, Country Director for Conservation International from 2003 to 2012, Independent Consultant for UNOPS overseeing the Implementation of the South China Sea Strategic Action Program from 2020 to the present, and a member of the Advisory Board (Biodiversity) of Metro Pacific Investments Foundation since 2021. The accumulated experience of three decades of conservation initiatives in Mabini provides a rich repository of information on successes, failures, best practices, and lessons that can significantly benefit conservation efforts in other biodiversity-rich sites grappling with intensive tourism development. Factors such as local political dynamics, science-informed management, effective partnerships, support from NGOs and external donors, incentive mechanisms, rigorous and sustained enforcement, sustainable financing strategies, and alignment with national commitments to regional and international initiatives all play pivotal roles in influencing outcomes. The paper underscores the potential mutual benefits of aligning conservation with tourism, emphasizing that meticulous planning, robust baselining, engagement of diverse stakeholders, effective implementation, joint initiative monitoring, and commitment to sustainability are indispensable for ensuring enduring success.

Keywords: conservation and tourism, lessons learned, Mabini, Verde Island Passage.

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From ocean to trade: impacts of fish exportation on the food security of coastal communities

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Abstract

Coastal communities depend on fishing activities for their well-being, in particular for their food security and livelihoods. This vital dependence is threatened by environmental change, globalization, and inequitable management. The relationship between fishing yields and food security is often conceptualized as a linear one: increasing fish stocks would directly benefit local consumers by an increase in availability. However, productivity is just one of the many environmental and social factors can shape food systems. The relative contribution of ecological, fishery, and socio-economic factors on the food and nutrition security of coastal communities remains poorly explored. Using mixed methods including a series of semi-structured and household interviews, fishery surveys, and censuses undertaken in five districts of Palawan in the Philippines, we assess the linkages between fishing yields, distribution patterns, fish consumption, and food security, measured as an estimated prevalence of inadequate energy, protein, and micronutrient intakes. In particular, we demonstrate that: i) a higher fish consumption is associated with a higher food and nutritional security, ii) fish consumption is decorrelated from local yield levels (catch per unit effort), and iii) fish consumption and food security are driven by exportations: while increasing revenues are beneficial to fish consumption, decreasing local availability and increasing prices are detrimental to access. We also discuss different factors driving the food security of coastal communities including livelihood strategies and the relative contribution of coral-reef and pelagic fish species. These results are important as the crucial role blue foods in global food systems is increasingly recognized. The fact that increasing fishing productivity is not a standalone solution to increase local food security should also be pushed forward, as the global coverage in marine protected areas and other area-based conservation tools is increasing, sometimes with little attention paid to local contexts. We anticipate these results to push further research and decision-making on marine conservation and fisheries management to better include food and nutrition considerations.

Keywords: equity, food systems, marine conservation, nutrition, small-scale fisheries

Mapping the overlapped area of fishing and coast dolphin in the middle Gulf of Southern Thailand from fishermen's experiences

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Abstract

Fishing activities and dolphin sightings often overlap in the Middle Gulf of Southern Thailand, raising concerns about potential interactions and impacts on dolphin populations. This study aims to map the overlapped areas of fishing and dolphin occurrence based on the knowledge and experiences of local fishermen. Fishermen were interviewed using semi-structured questionnaires to gather information on fishing locations, gears, and target species. Additionally, they were asked to report sightings of dolphins and provide details on their location, frequency, and group size. The collected data was analyzed using a Geographic Information System (GIS) to generate maps showing the spatial distribution of fishing activities and dolphin sightings. The results identified several areas of overlap between fishing and dolphin occurrence (Ban Thong Aow bay, Nang Kam bay, Tha Rai Island, Ta-let bay, Thong-Nian bay, Thong-Nod bay, and Khwaeng-Phao bay), suggesting potential risks of entanglement and bycatch. These findings highlight the importance of considering fishermen's experiences in conservation efforts and the need for further studies to assess the impacts of fishing activities on dolphin populations in the Middle Gulf of Southern Thailand.

Keywords: bycatch, fishing gear, entanglement, marine mammals, fishing area

Special Forum: Science for local-level environmental management, ecosystem conservation and sustainable use in the South China Sea and Gulf of Thailand

Science-based establishment of fisheries refugia: a case study in Vietnam

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Abstract

Fishery refugia has been proposed by UNEP and FAO and is considered an important tool for conservation and sustainable fisheries in many countries around the world through the management of important sites in certain critical stages of the life cycles of target species and their associated habitats. The key criteria based on the selection and establishment of fishery refugia proposed by UNEP are spawning and nursery grounds (high density of eggs and larvae), presence of marine habitats, and management potential with involvement of local communities, whereas some other criteria such as species richness and quantitative of habitats and target resources and population connectivity are not considered. In this study, we analyzed available data from 26 key locations in the coastal waters of South Vietnam. The data are categorized in 5 levels (very low, low, medium, high, and very high) of 5 criteria, including 1) Representative of key marine habitats (numbers of habitats and area); 2) Plankton and settled seeds (density of fish eggs and larvae, density of larvae of mollusks and crustaceans, numbers of target species of seeds and catch of juveniles, numbers of spawning/nursery grounds of target species); 3) Target resources (species richness and catch of target species); 4) Potential of population connectivity among key marine habitats of some target reef fish species (numbers of target species linked between MPAs and coastal lagoons and estuaries, densities of commercial and juveniles of linked target species, genetic linkages); and 5) Management potential. The results from cluster analyses indicate that the establishment of fisheries refugia should be prioritized for 9 locations of marine protected areas (MPA) and estuaries or lagoons with very high (Thu Bon estuaries, Nha Trang Bay MPA and Phu Quoc National Park) to high potential (Con Co MPA, Tam Giang-Cau Hai lagoon, Cu Lao Cham and Ly Son MPAs, Quy Nhon Bay, Nui Chua National Park) in the immediate period. The 8 other locations (Cua Tung & Cua Viet estuaries, Hai Van-Son Cha proposed MPAs, De Gi, Thi Nai and Nha Phu lagoons, Hon Cau MPA and Con Dao National Park) with medium potentials should be received for intermediate or long-term consideration.

Keywords: criteria, fisheries refugia, target resources, coastal habitats.

Special Forum: Science for local-level environmental management, ecosystem conservation and sustainable use in the South China Sea and Gulf of Thailand

Best practice of the establishment of marine fisheries refugia: Cambodia's case

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Abstract

Fisheries refugia is a management approach to ensure sustainable fishing, restore marine habitat and fisheries ecology, and reduce climate change impact. Its concept is applied for Southeast Asia's countries in term of long-term marine fisheries resources uses and the enhancement of people's livelihood depending on the resources. Cambodia has started practicing this initiate since 2004 supported by SEAFDEC/UNEP/GEF. Participatory coordination through stakeholder consultation meetings and workshops at national and sub-national levels to develop official refugia sites in the coastal areas, are key in the refugia development process. This are based on six principles including identification of potential areas for management, conservation and development of resources; compilation and analysis of scientific data on fisheries resources, habitats, ecosystem, economics, socio-economics, culture and threats; mapping and demarcating boundaries of proposed refugia sites; stakeholder consultations with relevant institutions, local authorities, fisheries communities and other stakeholders; draft proclamation and consultations at all level; and final proclamation submitted and endorsed by MAFF. To date, three fisheries refugia sites were established and endorsed by the Royal Government of Cambodia, including the Blue Swimming Crab refugia in Kep established in 2018, and the Short Mackerel refugia in Koh Kong and the Blood Cockle refugia in Preah Sihanouk established later in 2019 and 2020, respectively. Several key management measures are applied within the fisheries refugia, including fishing method; restricted gears; prohibited gears; vessel; seasonal closures during critical periods of fish life cycles; seasonal restrictions; and limited access and use of rights-based approaches in small-scale fisheries. Consequently, it was reported that fish stock has increased, some endangered species recovered, and fish catch has also improved. Such positive results have attracted policy makers and raised awareness about the significant concept of the fisheries refugia. Furthermore, the result of the fisheries refugia development has made changing the national fisheries sector policies. Its concept has been integrated into important policies, namely the National Plan of Action for Combating IUU (Illegal, Unreported and Unregulated) Fishing; Final draft of 10-year Strategic Plan for Fisheries Conservation; Marine Management Plan; and the draft New Law on Fisheries.

Keywords: fisheries refugia, marine sustainable fishing, marine fisheries ecology, management

Special Forum: Science for local-level environmental management, ecosystem conservation and sustainable use in the South China Sea and Gulf of Thailand

Sustainable management of mangrove forests in Cambodia: national best practices

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Abstract

Mangrove forests are among the most vital and diverse ecosystems found along the coastlines of Cambodia. These unique habitats not only provide numerous ecological benefits but also contribute significantly to the socio-economic well-being of local communities and the nation as a whole. However, mangrove forests in Cambodia are facing a number of challenges, including: deforestation (mangrove forests have been cleared for a variety of purposes, including shrimp farming, agriculture, and coastal development), pollution (mangrove forests are also threatened by pollution from agricultural runoff, industrial waste, and sewage), climate change (climate change is expected to increase the frequency and intensity of extreme weather events, such as storms and floods, which could further damage mangrove forests). Despite these challenges, there are a number of best practices that can be used to sustainably manage mangrove forests in Cambodia. Cambodia's Community Fisheries Management Policy (CFiMP) and Conservation and Restoration Initiatives for Mangrove Ecosystems are two noteworthy national best practices highlighted in this report. Both practices empower local communities to manage fisheries resources and conserve mangrove ecosystems through participatory decision-making, capacity building, collaboration, and sustainable management practices. CFiMP faces challenges such as resource limitations, limited government support, and enforcement difficulties. Its success hinges on effective implementation, enforcement, and ensuring sustainability against challenges like corruption and climate change. The Conservation and Restoration Initiatives for Mangrove Ecosystems also faces challenges such as resource scarcity, insufficient government support, limited enforcement, community awareness and participation, and ensuring sustainability against threats like climate change and overexploitation. Both practices underscore the importance of community involvement, collaboration, and sustainable management for their success. However, challenges remain in terms of resource scarcity, government support, enforcement, community engagement, and mitigating threats like climate change and overexploitation. Addressing these challenges is crucial for effective implementation, ensuring sustainability, and securing the long-term success of these national best practices in Cambodia.

Keywords: biodiversity, CFiMP; conservation; coordination; restoration

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Mangrove co-management at Shankou, Guangxi

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Abstract

Guangxi Shankou Mangrove National Nature Reserve is located in the north-east of Beibu Gulf. Covering 836 ha of mangrove forest (data in 2019), the reserve is home to 10 true mangrove species and 7 semi-mangrove species. The reserve joined the UNESCO Man and the Biosphere (MAB) Programme network of protected areas in 2000. In 2002, it was listed in the Ramsar Convention on Wetlands as internationally important wetland. Challenges include human interference, pests and species invasion, as well as conflicts between mangrove protection and livelihood development. To address these challenges, a number of actions were taken. First, the reserve keeps strengthening cross-sectoral cooperation with local prosecutor's office and public security bureau, and sets up public interest litigation Mechanism as well as Mangrove Police Office, which helps reduce anthropogenic mangrove destruction. Second, intelligent technology was introduced to construct a monitoring system with full area coverage. This, together with adequate staff and equipment, enabling grid-based, visualized and effective supervision. Third, the reserve discovered and enhanced a historical tradition of villagers' self-organization on mangrove management, and build a management network based on communities, management institution and local government departments. Meanwhile, the reserve helped improve villagers' income through ecotourism and eco-agriculture. Fourth, the reserve conducted regular mangrove ecosystem monitoring, annual monitoring was carried out since 2006. Long-term partnerships with several research institutions and a special Committee of Expert Advisers were established. Last but not least, the reserve conducted several projects of mangrove replantation and nature-based restoration, under financial support from central and local government. In 2023, the reserve has replanted 113 ha and restored 112ha of mangroves, cleared 108.7 ha of *Spartina alterniflora* Loisel. As the results, mangrove area increased from 730 hectares when the establishment of the nature reserve in 1990 to 836 hectares in 2019, part of the reserve observed good natural recovery of mangrove forest and biodiversity improvement. Income of local communities also improved remarkably. Some lessons learnt were highlighted from the effort. First, cross-sectoral cooperation backed by advanced technology helps strengthen the vigor of supervision, effectively punishing and preventing illegal activities destructive to mangrove ecosystem. Second, respect and rational utilization of local tradition and suitable ways of sustainable development play an important role in mangrove management. Third, long-term and regular monitoring and continual scientific support effectively contributes to mangrove protection.

Keywords: Shankou mangrove; cross-sectoral cooperation; community co-management; long-term monitoring

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Outcome from Belitung coral reef demonstration site, Indonesia

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Abstract

Coral reefs are a typical ecosystem of tropical areas. This ecosystem has an important ecological, social-economic, and aesthetic role. The extent of Indonesia's coral reefs is around 2.5 million hectares and tends to decrease in line with coastal development. In 2006–2008, the Selat Nasik Sub District, Belitung Regency, was designated as a 'demo site' for coral reef management through the SCS (South China Sea) Project. During this period, several components were implemented, namely: 1) Project Management, 2) Community Awareness and Education, 3) Monitoring, Controlling, and Surveillance, 4) Data and Information, 5) Alternative Livelihoods, and 6) Legislation and Management Plans. Collaborative management and community-based approaches were used in program implementation. Evaluation was carried out by looking at achievements before and after the project. The results show that at the project's end, components of data and information, and alternative livelihoods provide a positive and sustainable impact. Monitoring of coral reefs and related ecosystems was continued through the COREMAP-CTI program until 2019. Livelihood activities have triggered various micro-medium enterprises (UKM) by utilizing appropriate technology based on local resources. Micro enterprises are developing well to date and have received an award from President Soesilo Bambang Yudoyono's administration. Another activity in terms of problem-solving faced by fishermen was giving fish drying with nanotechnology in Petaling and Gersik villages by Karya Muda Belitung Foundation (a local NGO). This tool is beneficial for the community, especially during the rainy season, and improves the quality of salted fish. The success of the Selat Nasik demonstration site is inseparable from the community's active role, the local government's involvement, and the existence of assistance in triggering activities that can improve the local resource-based economy. SCS activities in Selat Nasik Sub District proved to be the trigger for other similar activities. It is important to carry out similar projects in the future because they will trigger the emergence of follow-up programs.

Keywords: coral reef management, SCS project, Belitung Regency, Indonesia

Demonstration of community-based management of seagrass habitats in Trikora Beach, East Bintan, Riau Archipelago Province, Indonesia

Tri Edi Kuriandewa

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Abstract

The project was one of the demonstration projects developed under the framework of the UNEP/GEF project entitled “Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand”. It was implemented from 2007 to 2010. The demo-site is located in the eastern coast of Bintan Island. It was chosen for having rich of seagrass meadows mostly around the Eastern Coast of Bintan Island Riau Archipelago Province. However, this area experienced environment degradation due to marine pollution and impact of rapid development in the coastal areas. The goal of the project is to establish a demonstration plot to show the proper way to protect, manage, and utilize seagrass resources in a rational, integrated and sustainable way. This project is recorded as the first project in Indonesia dealing specifically with seagrass management. The expected outcomes of the project are: (i) management of the area improved; (ii) awareness and support for the importance of seagrass habitat improved; and (iii) environmental sustainability of local economy increased. Institutional arrangements have been established through the formation of EBCOMBO (East Bintan Collaborative Management Body). It was established as consultative and advisory forum of the stakeholders in solving the environmental and relevant issues in the East Coast of Bintan. Three Management Plans have been adopted at the fifth meeting of EBCOMBO namely: (i) East Bintan Coastal Resources Management Plan (ii) East Bintan Coastal Area and Zoning Plan; (iii) Sustainable Tourisms Spatial Plan. These outputs were suggested as a reference in managing the East Coast of Bintan with sustainable manner. The political support by Local Government was manifested through Head of District Decree No 267/VI/2010 to declare that all of the seagrass areas in the eastern coast of Bintan Island (±2.600 ha) was designated as conservation area and dugong as ‘flagship animal’ of Bintan district. Five hectares of seagrass sanctuaries or no take zone areas were determined in four coastal villages. These seagrass sanctuaries were authorized through a Village Decree and considered to be the first seagrass sanctuaries in Indonesia. Various awareness campaign activities were established through training, focus group discussion, social media such as radio-broadcast, internet, newspaper, distribution of posters, flyers, banners, booklets, billboards, stickers, T-shirts, caps, writing competition and other merchandizes relating with seagrass conservation. Alternative income generation training has been promoted, such as handy craft, sewing, backyard farming to improve the skills and knowledge of gender groups.

Keyword: South China Sea, East Bintan, seagrass conservation, demosite, community based

Joint hands with local communities in fisheries co-management: success and lessons learned from Binh Dinh province, Vietnam

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Abstract

Binh Dinh Province is characterized by high marine biodiversity, providing potentials in capture fisheries, marine trades and tourism. Many small islands shielding the coast, providing habitats for aquatic species, endemic species and protected species, such as lobster, sea turtle, dolphin. Fisheries sector of the province has faced some risks and challenges, including: over-exploitation, destructing fishing practices, conflicts in resources use, environmental pollutions, high poverty and low awareness of coastal stakeholders in environmental protection. A series of interventions have been conducted in last years by the ISP Project such as: adoption of Inter-Sectoral Spatial Planning for coastal areas, promoted fisheries co-management, prevention of environmental pollutions. The project involved all concerned sectors at provincial, district, commune, and community levels; identified hotspots and solutions taking into account present and future needs; prepared an action framework to guide sustainable coastal management; and approved the framework by Province People Committee. The fisheries co-management achievements included: Engaged local fishing communities to sustainably manage coastal resources with support from government's MCS.; Co-management established over 100 km of coastlines of Binh Dinh involving over 2,200 fishing households; Allocated fishing rights to local community to enhance their ownership; Build management capacity for local communities; Developed legal framework for fisheries co-management; Decisions to establish 12 fisheries co-management groups; Signing agreements with local governments; Training in monitoring, surveillance, and control; Carry out regular monitoring, surveillance, and control activities; Additional livelihoods development; Eco-tourism; Upgraded public infrastructure to facilitate voluntary shift to other occupations (reduced over 1,000 fishing boats in Binh Dinh).

Some lessons learned composed of: (1) No universal model, needs to adapt to the specific geographical location, natural conditions, fisheries resources, socio-economic, cultural, legal and traditional practices of local communities, and needs and aspirations of coastal communities. (2) It requires coordination and strong commitment of fishers' organization and local management agencies to prepare and implement the co-management plan. (3) Discussed and consulted in the community, shared the decision-making right and responsibility for sustainable management of the resources. (4) Fisheries Co-management teams be allocated with legal rights to sustainably manage and use coastal waters on the basis of ecosystem and biodiversity protection resources. (5) Developed rules, regulations, and legal bases for

co-management on the basis of consultation with local communities. After they have been approved, all concerned parties must comply with. (6) Improved livelihoods and enhanced local incomes; develop and maintain sustainable self cost-recovery financing mechanisms for co-management team through contributions from membership fees.

Keywords: joint hands with local communities; fisheries co-management

Special Forum: Science for local-level environmental management, ecosystem conservation and sustainable use in the South China Sea and Gulf of Thailand

Capacity building coastal community toward sustainable marine protected area in East Belitong

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Abstract

In western Indonesia, the condition of coral reefs is poor. This condition, among other things, is due to changes in natural resource and exploitation activities. At first, exploitation activities in the western region were very intense, namely to meet the high demand for fishery products. This condition was influenced by human activities such as coral mining, cyanide fishing for ornamental fish, and trawling (destructive fishing). This disturbance also occurs in conservation areas, making it a challenge for coral reef management in this location. The establishment of a marine conservation area in East Belitong is a form of regional support for the management of conservation areas to preserve the coral reef ecosystem. Developing a community-based management strategy is important to support the implementation of optimal conservation area management in preserving coral reef ecosystems so that coastal communities can use them sustainability. This research aims to examine the factors that influence coral reef damage and the role of the community in managing the East Belitong marine conservation area. The research results show that the threat of damage to coral reefs was cause by a lack of coastal community knowledge and awareness in coastal resources utilization. To maintain the sustainability of the coral reef ecosystem, the recommended strategy is strengthening community capacity and providing alternative livelihoods for the community through ecotourism activities that can improve the community's economy.

Keywords: MPA, coral reef, coastal community, sustainable, capacity building

Special Forum: Science for local-level environmental management, ecosystem conservation and sustainable use in the South China Sea and Gulf of Thailand

Scaling up sea cucumber stock restoration through community-based culture production and reserve management

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Abstract

The sea cucumber fishery in the Philippines is largely artisanal and multi-species. Because of the high market demand, ease in collection and the lack of management, sea cucumber stocks are overexploited. Restoration of the high value species *Holothuria scabra* through restocking and sea ranching have been piloted in various localities in the country. Ecological and social benefits have been demonstrated but the economic viability as a substantial source of supplemental livelihood has yet to be realized. Increased sea cucumber production of cultured and wild stock is essential to realize greater benefits to the small household fishers. To address this need, a pilot sea cucumber reserve in the contiguous nearshore area along three villages was established through the partnership among the local government unit (LGU), a research institution, an NGO and fisher organizations. Within the reserve, community-based culture production sites were established to scale-up culture production of *H. scabra*. The LGU legislated the implementation of the minimum size limit and permit system to manage the multi-species fishery within the reserve. Members of existing people's organization in three villages were trained in ocean nursery culture of hatchery-produced sea cucumber juveniles to release size, then stocking in their communal grow-out areas. They were granted limited preferential use rights and designated as enforcers and co-managers of the reserve. In return, aside from regular guarding, they co-designed and conducted information dissemination activities to raise awareness of the ecological and socio-economic benefits of the reserve and encourage compliance to collection and permit regulations. This builds on local knowledge of their nearshore resources and their importance to domestic food security. Qualitative assessment across social, ecological, and economic dimensions was conducted with respect to: the effectivity of governance, active participation of fisher organizations, support from the community, establishment of spawning populations and improved landed catch size. Findings indicate very high interest to continue stock restoration and implementation of the sea cucumber reserve. Capacity development for culture and fishery management, financial and technical support of partners, and empowerment of local communities to make decisions related to implementation are essential for stock restoration towards sustainable utilization of nearshore invertebrate fishery resources.

Keywords: sea cucumber, stock restoration, fishery management, socio-ecological system

Special Forum: Science for local-level environmental management, ecosystem conservation and sustainable use in the South China Sea and Gulf of Thailand

Sustenance and more: the diverse role of intertidal gleaning in the livelihood of women in coastal communities

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Abstract

Coastal resources play a vital role in the well-being and livelihoods of people in coastal communities globally, with diverse uses and values that vary among individuals and across different periods. Equitable management of these resources necessitates an understanding of how people value ecosystems under varying circumstances. Intertidal gleaning, a type of small-scale fishery in the seagrass meadows and mangroves of Perigi Acheh village in the Sungai Johor estuary is conventionally portrayed as primarily focused on food security. This study explores the values of gleaning, emphasizing its non-material significance, including aesthetic, recreational, cultural, and social dimensions. Through an ethnographic case study in the Perigi Acheh village, we uncovered a myriad of instrumental and relational values that women and other gleaners attribute to this practice. Contrary to the oversimplified notion of gleaning as solely a means for sustenance, our findings underscore the diverse priorities gleaners place on activities such as socializing and connecting with the intertidal gleaning habitats. This emphasizes the importance of moving beyond simplistic understandings, signifying the evaluation of intangible values when assessing coastal ecosystem services. By recognizing the non-material roles of gleaning, we can offer more accurate portrayals of coastal livelihoods, promoting equitable management in these areas.

Keywords: intertidal gleaning, small-scale fisheries (SSF), gender, non-material values, Johor

Special Forum: Science for local-level environmental management, ecosystem conservation and sustainable use in the South China Sea and Gulf of Thailand

Determining indicators of mangrove forest abundance through cooperation between government agencies and the communities in the Middle Gulf of Southern Thailand

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Abstract

Baan Don Bay, Surat Thani Mangrove forests are ecosystems with high biodiversity and play an important role in coastal ecosystems and community economies in the middle gulf of southern Thailand. Therefore, it is important to assess the health of mangrove forests for sustainable management of natural resources and the environment. Sustainable mangrove forest health indicators should cover the following key components of mangrove ecosystems: 1) Structure and composition of plant, animal, and microbial species 2) Ecological processes such as nutrient cycling, water quality control, and carbon storage 3) Benefits that mangrove forests provide to communities such as food, habitat, and tourism. Collaboration between government agencies and communities is important for the development of sustainable mangrove forest health indicators. Communities are a valuable source of information about the condition of mangrove forests in Baan Don Bay area. Government agencies should provide education and understanding to communities about mangrove forest health indicators to ensure effective community participation in the indicator development process. The following are the steps for developing sustainable mangrove forest health indicators through collaboration between government agencies and communities: 1) Conduct a comprehensive study of the mangrove forest in the area by collecting data from various sources such as academic data, field survey data, and community data. 2) Involve communities in the indicator development process by allowing them to participate in discussions, provide suggestions, and co-develop indicators that are appropriate for the condition of the mangrove forest in the area. 3) Evaluate the suitability of the indicators by experts in mangrove ecology. The results show that the occurrence of the Asian small-clawed otter (*Aonyx cinereus*), smooth-coated otter (*Lutrogale perspicillata*), marsh clam (*Polymesoda proxima*), horn shell (*Cerithidea obtusa*), mangrove crab (*Sesarma mederi*), nipah palm (*Nypa fruticans*), *Sonneratia caseolaris*, and *Sonneratia alba* are bioindicators of mangrove abundance. The development of sustainable mangrove forest health indicators through collaboration between government agencies and communities will help to ensure that mangrove forest resources are managed effectively and sustainably, providing maximum benefits to communities and the nation.

Keywords: mangrove, diversity, indicator, communities, Ban Don Bay, Thailand

Rehabilitation of Yintan beach by nature-based solutions and supporting artificial measures and regulation reform in Beihai, China

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Abstract

In recent years, Beihai has given priority to ecological and green development towards a sustainable and beautiful bay. the Fengjiajiang River Rehabilitation was selected as top ten typical cases of ecological restoration and the typical case of natural-based solution. The Beihai Coastal Wetland was listed as a wetland of international importance. The key objectives were achieved at the bay, for instance, the proportion of the sea water with good-quality keeps at 100%, and the regional biodiversity increase. The Yintan Tourist Resort was upgraded to "National-level tourist resort" in 2023. A number of actions were taken in the past years. Firstly, strengthened long-term policy reform. Coastal Beach Protection Ordinance of Beihai City and Mangrove Forests Protection Ordinance of Beihai City (Draft) were published to establish the responsibility distinction system of ecological environment management on the bay and watershed in Beihai. Secondly, strengthened pollution control. Carried out comprehensive environmental remediation of the Fengjiajiang and Nankangjiang rivers by improvingthe domestic sewage treatment; Established a maritime environmental sanitation system to clean up marine litter. As a result, the environmental quality of nearshore waters has been improving continuously. Thirdly, implemented the Nature-based solution restoration on mangrove wetland protection, nearly 40 acres mangrove forests planted in total and over 2000 acres of mangrove forests restored. Clear away 10 acres of Spartina alterniflora loisel, which improves the quality and stability of the ecosystem. Fourthly, improved the quality of the beach environment. 3.3 kilometers beach shoreline were recovered to form 167,200 square meters beach areas, and 40,400 square meters of dykes and reclamation were returned to the sea. constructed public facilities along the coast to forge "Ten Miles coastal beach of Yintan" for further enhancement of the public's sense of happiness enjoying the sea landscape to promote tourism development.

Keywords: policy reform, nature-based solution, beautiful-bay, tourism development

Special Forum: Science for local-level environmental management, ecosystem conservation and sustainable use in the South China Sea and Gulf of Thailand

Nature-based solutions and watershed approaches for ecological restoration of the Haikou Bay and city

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Abstract

Haikou Bay lies in the city center of Haikou, Hainan Province. Under the impact of human development activities, it once faced such issues as the emptiness of inferior quality water into the sea, serious corrosion in some parts of the coast, degeneration of the ecological functions and obstructed seaside spaces. To cope with outstanding ecological and environmental issues, Haikou City, Hainan, started the protection and construction of an amazing bay in Haikou Bay, and after years of meticulous works, Haikou Bay has achieved triple successes in ecology, economy and society and become a scenic bay featuring “coconut fragrance, ocean scenery and beautiful Haikou”. The actions taken include: (1) Control pollution to clean the sea by strengthening comprehensive prevention and rectification of oceanic pollution. Rectified black and stinky rivers, implemented “basin rectification + one river one method”, improved water quality flowing into the ocean, raised the water quality above Class V for ocean-going rivers, completed estuary rectification in the bay area, established maritime environment cleaning system, realized regular rectification of floating rubbish on the beach, removed 100% of the waste and maintained excellent water quality in the offshore areas; (2) Improve ocean environment by ecological methods to paint a beautiful maritime landscape. Following the principle of “natural recovery + human remedy”, restored 4.6 kilometers of coastlines, planted 2,590 square meters of mangroves, invested 576,000,000 yuan in the rectification and restoration of Wuyuan wetland and turned a stinky river into a national wetland park; (3) Harmonize people’s access to the sea to build a bay suitable for living and tourism. Upholding the concept of “nature, coexistence and future”, optimized the functional businesses and public spaces in the core area of the bay, improved the tropical ocean resources of Hainan University, established “post stations + service facilities” and built “Yundong Library” and other sites. Coordinated 13.1 kilometers of public scenery spaces along the west coast, built the “business card” of the convention and exhibition section, the “green belt” of ecological beach section, the “citizen resort” of holiday beach section and the “leisure paradise” of yachting marina section, opened the public access to the bay and effectively boosted Haikou’s culture.

Keywords: beautiful bay, control pollution to clean the sea, improve ocean environment by ecological methods, harmonize people’s access to the sea

Special Forum: Science for local-level environmental management, ecosystem conservation and sustainable use in the South China Sea and Gulf of Thailand

Watershed treatment and coastal wetland restoration at Maoweihai, Guangxi

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Abstract

Maoweihai is a semi-closed bay in Beibu Gulf, part of Guangxi zhuang autonomous region, at the top of Qinzhou Bay. It is one of the demonstration sites of SCS SAP project in China. There are about 2371ha of mangroves and coastal salt marsh wetland distributed in Maoweihai. In recent years, the total amount of pollutants flowing into Maoweihai is continually increasing which brings a negative impact on Maoweihai wetland habitat. In addition, wetland protection face degradation. To solve problems above, Guangxi Department of Ecology and Environment developed the Maoweihai integrated environmental management plan in December 2022 and Guangxi government also takes many measures about pollutant control and prevention and ecological protection and restoration. Local government continually improves mangrove wetland protection regulations and strengthen the cooperation among departments to enhance the ability of mangrove wetland inspection and law enforcement. Measures about mangrove re-plantation and wetland restoration have been continually taken, and illegal mariculture have been cleaned up inside nature reserve. Major river valley comprehensive treatment has implemented and measures of controlling the total amount of pollutants flowing into Maoweihai have been taken. The government also actively develop ecological mariculture projects. The efforts achieved some successes. First, mangrove wetland resources are effectively protected, most of the wetland are included into nature reserve or ecological red line. Since 2019, more than 490.37ha mangrove are re-planted or restored in Maoweihai. Second, marine environment has continued to improve, seawater quality and major pollutant concentrations have reached the target set by the government. Third, the awareness about coastal wetland protection of government and public are significantly raised. A number of lesions learnt are also indicated. First, the comprehensive treatment about pollution treatment and ecological restoration could promote the all-round protection and restoration of coastal wetlands, including improve the environmental quality of coastal wetland and protect the wetland habitat and biodiversity. Second, the institutional system reform effectively contributes to wetland ecological protection and restoration.

Keywords: Maoweihai, comprehensive treatment, coastal wetland restoration, land-based pollution

Mangrove wetland restoration can promote the protection of waterbirds

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Abstract

Mangrove ecosystems provide important ecosystem services, including shoreline protection, climate change mitigation and adaptation, coastal biodiversity supporting, etc... Globally, mangrove extent has decreased markedly. Efforts to restore mangrove ecosystem and enhance biodiversity are increasing. Leizhou Peninsula holds 9000 ha of mangrove forest. And it is listed as the largest wintering site for a critical endangered species, the spoon billed sandpiper (*Calidris pygmaea*). Around 30 individuals were recorded each year from 2015 to 2023. The invasion of Smooth cordgrass (*Spartina alterniflora*) has substantially reduced the habitat available for waterbirds and threatens the mangrove forests as well. We applied NbS to restore mangrove wetland through eradicating invasive saltmarsh *Spartina alterniflora*, restoring bare tidal flats, and long-lasting maintenance by local communities. An evaluation reveals that almost all waterbirds, except gulls, avoided areas where *S. alterniflora* was present. Once S. alterniflora was eradicated, the species richness and species-level diversity of shorebirds and waterbirds did not differ significantly from those of the bare tidal flats. Food resources densities for spoon billed sandpiper were higher within 1 km of the seawall than further offshore. This may relate to the mangrove forests growing near the seawall providing released minerals, nutrients, bacterial production, and diatoms for the benthic community in the adjacent mudflats. Our efforts demonstrate that careful consideration of alternative management strategies when restoring and managing mangrove wetland can boost broad biodiversity conservation.

Keywords: wetland restoration, waterbirds, biodiversity, Leizhou peninsula

Special Forum: Science for local-level environmental management, ecosystem conservation and sustainable use in the South China Sea and Gulf of Thailand

Conversion of Aged shrimp ponds to mangrove ecological farm - mangrove restoration practice in Guangxi, China

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Abstract

The destruction of mangroves for the construction of shrimp ponds has been a primary reason for the rapid decline of mangroves in South China Sea. In China, such ponds cover approximately 24,000 hectares, which is equivalent to 88.56% of the total mangrove area in the country. These ponds represent a crucial potential space for future mangrove restoration efforts. In the process of transforming shrimp ponds back into mangrove forests, the focus should not be solely on vegetation restoration. Instead, there should be an emphasis on sustainable utilization and the development of “Conversion of Aged Shrimp Ponds to Mangrove Ecological Farm (MEF)” that balance ecological preservation with the livelihoods of local communities. Starting from 2017, we conducted field experiments in Beihai, Guangxi. The total area of the experimental wetlands was 2.33 hectares, of which 30.05% has successfully been restored as mangrove forests. The remaining water areas have been used for the artificial breeding and cultivation of 12 economically valuable species, which have helped protect 9 species of wild fish and significantly improved the coastal landscape. Compared to traditional shrimp ponds, the success rate of shrimp farming in our (MEF) has increased by 1.16 times. Additionally, there has been a 53.09% reduction in total nitrogen emissions and a 24.89% reduction in total phosphorus emissions. The ecological economic value has increased by 26.56 times, making it a distinctive educational hub for China’s coastal blue carbon economy. The development and production of "Mangrove Ice Wine" incorporating elements of traditional Chinese medicine is currently underway.

Keywords: mangrove restoration, ecofarming, mangrove sustainable utilization, ecological farm, returning ponds to mangroves

The role of herbivory in coral restoration success: a field study in the Bidong Archipelago, Malaysia

Aisyah Wan

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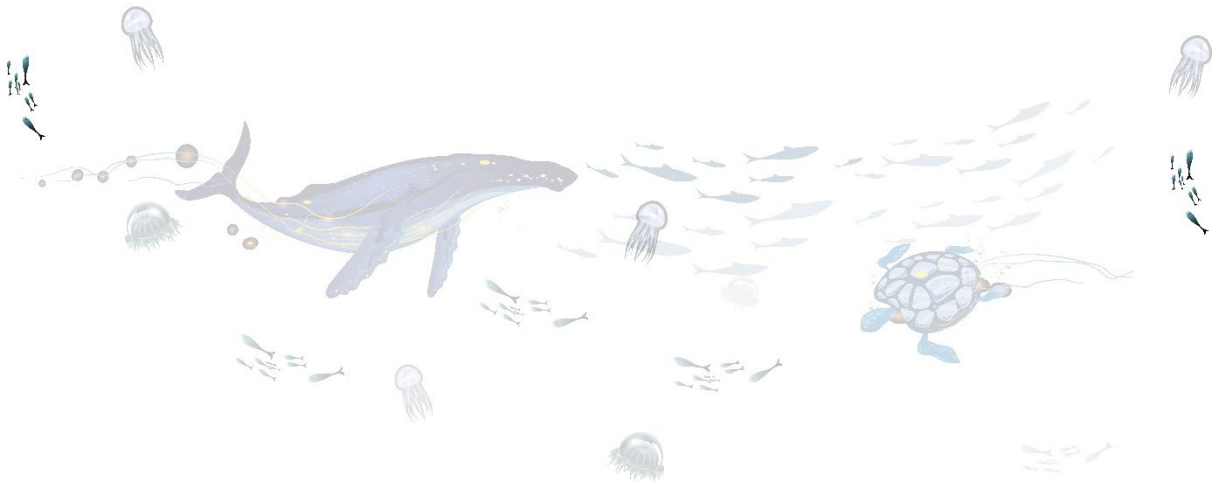
Abstract

In recent decades, coral restoration projects have grown in popularity as a means to address the ecological decline of coral reefs. Restoration efforts generally focus on restoring populations of reef-building corals, but often neglect the role of the wider ecosystem. There is also a gap in the scientific literature concerning the relationship between coral reef ecology and restoration, especially regarding herbivory. The aim of this study was to determine how ecological context influences the success of coral restoration projects, achieved by characterising coral and fish communities at two sites on peninsular Malaysia's east coast. Live coral cover, especially of corals with branching morphologies, is important in supporting structural complexity and fish diversity within the reef. A herbivore-exclusion experiment on *Acropora vermiculata* fragments (open>partially closed>closed cages) was constructed to investigate the impact of reduced herbivory on coral-algal competition over 74 days. Exposed fragment tiles showed significantly less algal growth, allowing coral more capacity for growth. The control of algal colonisation relies on a diverse community of reef fish, therefore, selecting a site with functional diversity is important to the success of coral reef restoraion projects. It is critical for restoration practices to focus on improving ecosystem function as a measurement of success in order to address ecological decline. Further studies should extend the length of monitoring, incorporating the response of the fish community, for a more comprehensive understanding of the interactions between restoration and ecology. Additionally, restoration must be used as part of a wider plan including protection and fisheries management to see maximal benefits.

Keywords: coral restoration, reef ecology, herbivory

Poster Presentations



Poster Session

Venue: Paladium Hall (10th Floor)
Dates: 22–25 April 2024

ID	Presentation Titles	Presenters
Sub-theme A Ocean Processes and Climate Change		
Session A2: Western Pacific Marginal Seas: Physics, biogeochemistry and ecosystem		
A2-01	Initial steps to build a predicting upwelling model in the South Vietnam under climate change conditions	To Duy Thai, *Vietnam Academy of Science and Technology, Vietnam*
A2-02	Spatiotemporal characteristics and volume transport of Lagrangian eddies in the Northwest Pacific	Jianyu Hu, *Xiamen University, China*
A2-03	Spatio-temporal dynamics of seawater physicochemical characteristics in the Bohol Sea, Philippines	Jherome L. Co, *University of the Philippines Diliman, The Philippines*
A2-04	Long and continuous time series observations in the key location of the East Sea (Japan Sea)	Seungsoo Kim, *Seoul National University, Republic of Korea*
A2-05	Drivers of N2O distribution and atmospheric emissions from a southern hemisphere Fjord-like deep coastal inlet: Macquarie Harbour Tasmania	Maxey Johnathan Daniel, *Swinburne University of Technology, Malaysia*
A2-06	Fluxes and distributions of trace elements in the East Sea (Japan Sea)	Guebuem Kim, *Seoul National University, Republic of Korea*
A2-07	Significant benthic inputs of dissolved amino acids in the marginal seas of the northwestern Pacific Ocean	Hyekyung Park, *Seoul National University, Republic of Korea*
A2-08	Numerical study on the circulation in the Gulf of Thailand and its seasonal water exchange with the South China Sea	Changshui Xia, *First Institute of Oceanography, China*
A2-09	Summer high primary productivity zone in the central North Pacific Subtropical Gyre	Luping Song, *Xiamen University, China*
A2-10	Hydrophysical processes and chlorophyll concentration in the Peter the Great Gulf (Sea of Japan)	Vadim Navrotskiy, *Far Eastern Branch, Russian Academy of Sciences, Russia*
Session A3: Advance the understanding of marine heatwaves and their impacts		
A3-01	Marine heatwave in the Oyashio region in 2022 and dissolved oxygen changes	Yoshimi Kawai, *Japan Agency for Marine–Earth Science and Technology, Japan*
A3-02	Changes in the dominant modes of MHW in the Gulf of Thailand	Parichat Wetchayont, *Srinakharinwirot University, Thailand*

ID	Presentation Titles	Presenters
Session A4: Ocean environmental and climate changes in the past: High and low latitude connections in the Asian Continental Margins		
A4-01	Impact of evolving anthropogenic Pb emissions on sedimentary systems in Asia: A comparative study in the Yellow Sea and Gulf of Thailand	Bin Wu, *First Institute of Oceanography, China*
A4-02	Spatial variability of surface sediments in the Malacca Strait and its implications for sedimentary environments	Lina Ai, *First Institute of Oceanography, China*
A4-03	Time lag and cumulative effects of extreme climate on coastal vegetation in China	Tong Dong, *First Institute of Oceanography, China*
Session A5: Sediment source-to-sink processes responding to rapid climate change		
A5-01	Chemical composition of aerosols collected in Bangkok and Chonburi, Thailand: a comparative study between a megacity and a coastal city	Suwapat khotchabang, *Chulalongkorn University, Thailand*
A5-02	Dissolved organic matter distribution in the Gulf of Thailand	Kulsarun Prajongmul, *Chulalongkorn University, Thailand*
A5-03	Reconstructing chemical weathering intensity of Taiwan since the last glaciation: Geochemical records in the Penghu Submarine Canyon of the northeastern South China Sea	Wei Xie, *Tongji University, China*
A5-04	Organic carbon burial rates in the lower Gulf of Thailand	Supamas Jansri, *Chulalongkorn University, Thailand*
A5-05	Organic carbon content in the sediment core from Bangpakong River mouth, Thailand	Pisit Suksawad, *Chulalongkorn University, Thailand*
A5-06	Geochemistry of core sediments in the nearshore area of the Bay of Bengal, Bangladesh	H. M. Zakir Hossain, *Jashore University of Science and Technology, Bangladesh*
A5-07	A review of the effects of turbidity and anthropogenic pollution on seagrass carbon sequestration in urban areas	Yuxin Liang, *Universiti Sains Malaysia, Malaysia*
A5-08	Concentrations of nitrate and other nutrients in groundwater and surface river water in Rayong Province, Thailand	Chirapa Tanya, *Chulalongkorn University, Thailand*
A5-09	Source and fate of organic matter in Bandon Bay, Thailand as evidenced by carbon and nitrogen contents and stable isotope composition	Narainrit Chinfak, *East China Normal University, China*

ID	Presentation Titles	Presenters
Session A6: Climate variability in the Indo-Pacific Maritime Continent (IPMC): Understanding impacts on atmosphere-ocean dynamics		
A6-01	Seasonal variations in the food habits of *Sardinella lemuru* in response to climate-induced plankton dynamics: implications for fisheries management and food security in Prigi waters, Indonesia	Yanida Azhari Julianinda, *Universitas Brawijaya, Indonesia*
A6-02	Climate comfort level analysis and projection for tourism in the Toba Caldera Geopark	Marzuki Sinambela, *Indonesia State College of Meteorology Climatology and Geophysics (STMKG), Indonesia*
A6-04	Tidal flood study in the coastal area of the Surabaya city in 2021 based on sea level analysis	Ahmad Fadlan, *STMKG, Indonesia*

Sub-theme B Marine Biodiversity, Seafood Safety and Security		
Session B1: Biogeography and dispersal of marine life in the Western Pacific		
B1-01	Gamete development of gorgonian, *Dichotella gemmacea* and diversity of gorgonians in Thailand	Konrawat Janhom, *Chulalongkorn University, Thailand*
B1-02	Distinguish the variations of Indo-Pacific multi-decadal climate variability on spatiotemporal distribution of yellowfin tuna population	Kuo-Wei Lan, *Department of Environmental Biology and Fisheries Science, NTOU*
B1-03	Abundance, distribution, and diversity of Tuna larvae (Family Scombridae) in the Philippine waters	Laureana T. *Nepomuceno, Bureau of Fisheries and Aquatic Resources, The Philippines*
B1-04	Tissue culture and development of multiple shoots in Thai seagrasses, specifically *Enhalus acoroides* (L.F.) Royle	Pattama Tongkok, *Kasetsart University, Thailand*
B1-05	The effects of fertilization on the Growth of *Enhalus acoroide*s (L.F.) Royle in plantlet culture	Attawut Khantavong*, Kasetsart University, Thailand*
B1-06	Sediment characteristics in the upper intertidal seagrass beds in the Andaman Sea coast of Thailand	Yaowaluk Monthum, *Kasetsart University, Thailand*
B1-07	Dynamics of green *Noctiluca scintillans* bloom at Bangsean beach, Chonburi province, Thailand from July to September 2023	Chayanee Kiemvatchara, *Burapha University, Thailand*
B1-08	Carbon-Nitrogen content variation and allelopathic disruption of Renieramycin M-Producing sponge *Xestospongia* sp. in the Gulf of Thailand	Gad Elsayed Mohamed Salem, *Chulalongkorn University, Thailand*
B1-09	Zooplankton composition at estuarine front of tidal influenced Kuala Terengganu estuary, Terengganu	Thaarshini Paramasivan, *Universiti Malaysia Terengganu, Malaysia*

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B1-10	Early life dynamics of *Sardinella gibbosa* in central Philippines	Alexanra Bagarinao-Regalado, *The University of Tokyo, Japan*
Session B2: Systematics, taxonomy, and phylogenetics of marine life in the Western Pacific		
B2-01	Species diversity of marine organisms and their relationship with echinoderms along Samaesarn Island and adjacent areas, Chonburi, Thailand	Arom Mucharin, *National Science Museum, Thailand*
B2-02	*Coscinodicus* in Viet Nam: diversity and phylogeny	Huynh Thi Ngoc Duyen, *Vietnam Academy of Science and Technology, Vietnam*
B2-03	Antibacterial activities screening on Nudibranch-associated bacteria from northeast of Bali, Indonesia	Fadillaisyia Riandani Putri, *Marine Education and Research Organisation (MERO) Foundation, Indonesia*
B2-04	Biomass and benthic microalgae communities in mudflats that affected and unaffected by coastal erosion in Ban Laem, Phetchaburi, Thailand	Karantharat Huangnak, *Chulalongkorn University, Thailand*
B2-05	Community structure of macrobenthos in Ban Laem Estuary, Thailand: comparison between mudflats affected and unaffected by coastal erosion	Natchanon Wongyai, *Chulalongkorn University, Thailand*
B2-06	The diversity of marine mollusks on underwater rock piles from the South Andaman Sea, Thailand	Ratchaneewarn Sumitrakij, *National Science Museum, Thailand*
B2-07	Phylogeny and thecal plate morphology of an undescribed species of *Scrippsiella* from Central Luzon, Philippines	Samantha Patricia C. Esteban, *Central Luzon State University, The Philippines*
B2-08	Some new records and species of Vietnamese marine macroalgae	Nguyen Thi Xuan Thuy, *Vietnam Academy of Science and Technology, Vietnam*
B2-09	Genetic diversity assessment of *Calappa bilineata* from coastal area in Ranong, Thailand	Vararin Vongpanich, *Department of Marine and Coastal Resources, Bangkok, Thailand*
B2-10	Genus *Halophila* is under the perspective of ITS secondary structure	Nguyen Nhat Nhu Thuy, *Vietnam Academy of Science and Technology, Vietnam*
Session B3: Vulnerability of the coral reef ecosystem towards extreme environmental fluctuations		
B3-01	Coral-killing sponges in Nusa Dua, Bali	Dwi Haryanti, *Diponegoro University, Indonesia*
B3-02	Coral spawning in the closed system aquarium using biosphere transfer technology might be possible to increase the coral reefs	Theeranukul Pachoensuk, *Innoqua Inc., Japan*

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B3-03	Into the skeleton: a permanent sink of microplastic in reef-building corals	Suppakarn Jandang, *Kyushu University, Kasuga, Japan*
Session B4: Coral reef resilience to climate change and human impacts		
B4-01	Water quality at Tubbataha reefs: a comparison between the different areas	Lara Sotto, *University of the Philippines, Diliman, Quezon City, The Philippines*
B4-02	Differential impacts of size and species selective fishing on reef fish populations across a gradient of market demand	Tanmay Wagh, *Dakshin Foundation, India*
B4-03	Study on small marine debris in corals (*Turbinaria sp.*) at Koh Ya, Trang Province	Thikomporn Wongtawatchai, *Department of Marine and Coastal Resources, Thailand*
B4-04	Coral reef resilience in the lower Gulf of Thailand: ecological and social assessments	Panisara Jitkaew, *Prince of Songkhla University, Thailand*
B4-05	Influence of environmental factors on juvenile coral density at Mu Ko Chumphon, the western Gulf of Thailand	Sittiporn Pengsaku, *Ramkhamhaeng University, Thailand*
B4-06	Composition and abundance of juvenile corals on underwater pinnacles in Surat Thani Province, the Gulf of Thailand	Makamas Sutthacheep, *Ramkhamhaeng University, Thailand*
B4-07	Diversity and density of juvenile corals in Mu Ko Similan, the Andaman Sea, Thailand	Wanlaya Klinthong, *Ramkhamhaeng University, Thailand*
B4-08	Size-frequency distribution and mortality rate of juvenile corals on a shallow reef flat in Chumphon Province, the Gulf of Thailand	Charernmee Chamchoy, *Ramkhamhaeng University, Thailand*
B4-09	Initial reports on artificial hybridization of *Tridacna gigas* and *T. derasa*	Gabriella Juliane Maala, *University of the Philippines, The Philippines*
Session B5: Fisheries, biodiversity and dynamics of mangroves' aquatic ecosystem		
B5-01	Rhizophora diversity's hallmark, Neil Island, the Andaman Sea	K Sivakumar, *Annamalai University, India*
B5-02	Population structure of commercial Opossum Shrimp *Mesopodopsis orientalis* (Tattersall, 1908) in mangrove of Phetchaburi Province, Thailand	Boonyaporn Prajai, *Chulalongkorn University, Thailand*
B5-03	Assessing shellfish diversity of aquatic habitats of the Sundarbans mangrove ecosystem of Bangladesh	Md. Nazmus Sakib, *Sher-e-Bangla Agricultural University (SAU), Bangladesh*
B5-04	Application of eDNA metabarcoding in the assessment of fish biodiversity in Philippine mangroves: prospects, challenges, and opportunities	Camila Frances P. Naputo, *University of the Philippines Diliman, The Philippines*

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B5-05	Diversity of molluscs in the mangrove forest reserves of Peninsular Malaysia	Brian Chew Bo En, *UCSI University KL Campus, Malaysia*
B5-06	Stuck in the mud: using a metabarcoding approach to capture biodiversity patterns in mangroves and seagrass	Emma Isabelle Rossouw, *Stellenbosh University, South Africa*
Session B6: Conservation of marine endangered species		
B6-01	Carrying capacity of seagrass habitats as dugong feed in Thailand	Tipamat Upanoi, *Department of Marine and Coastal Resources, Thailand*
B6-02	Study of the distribution and density of dugongs in Trang province by aerial survey	Piyarat Khumraksa, *Department of Marine and Coastal Resources, Thailand*
B6-03	Age class of stranded marine mammal in the upper Gulf of Thailand, 2018–2022	Luxkana Munkhetkit, *Department of Marine and Coastal Resources, Thailand*
B6-04	Coral conservation and restoration towards sustainable ecosystem at Pulau Bidong, Terengganu, East Coast of Peninsular Malaysia	Zainudin Bachok, *Universiti Malaysia Terengganu, Malaysia*
B6-05	Measurement of glucocorticoid activity in a rescued striped dolphin (*Stenella coeruleoalba*) in Phuket, Thailand	Patcharaporn Kaewmong, *Department of Marine and Coastal Resources, Thailand*
B6-06	The study of comparation of heavy metal level in stranded marine endangered species along the Thai coast	Usawadee Detsri, *Department of Marine and Coastal Resources, Thailand*
B6-07	First report of *Cyamus boopis* from a humpback whale (*Megaptera novaeangliae*) in the coastal East China Sea	Xiaowan Ma, *Fourth Institute of Oceanography, China*
B6-08	Assessing Billfish abundance and investigating fishers' perceptions in the context of Billfish conservation: a study in Kuantan, Pahang, Malaysia	Mohamed Juliana, *International Islamic University Malaysia, Malaysia*

Sub-theme C Ocean and Human Health		
Session C1: Marine chemical Contaminants of Emerging Concern (CEC)		
C1-01	Pharmaceuticals in urbanized riverine and estuarine waters of Hong Kong	Qiong Luo, *City University of Hong Kong, China*
C1-02	Pharmaceutical pollution in the world's estuaries: a review	Demilade T. Adedipe, *City University of Hong Kong, China*

ID	Presentation Titles	Presenters
C1-03	Groundwater quality in Pag-asa Island, West Philippine Sea	Valerie D. Culis, *University of the Philippines Diliman, The Philippines*
C1-04	Contamination status, bioaccumulation profiles, and human health risk assessment of polychlorinated biphenyls (PCBs) in shark species from Indonesia	Dede Falahudin, *National Research and Innovation Agency, Indonesia*
C1-05	Organic extraction method for determination of UV stabilizers in plastics	Xinghuo Wang, *East China Normal University, China*
C1-06	Biomagnification of mercury in marine organisms from Rayong Bay, Thailand	Suriyapong Kumsopar, *Chulalongkorn University, Thailand*
C1-07	Eutrophication status in estuaries of Ba Ria - Vung Tau, Vietnam	Phan Minh Thu, *Vietnam Academy of Science and Technology, Vietnam*
C1-08	Can waste shells be used in the removal of contaminants of concerns in wastewater?	Egbedi Brakemi, *South East Technological University, Ireland*
C1-09	Ecological risk assessment of heavy metal pollutants and total petroleum hydrocarbons in sediments off north of the Yellow River estuary, China	Yongzhi Wang, *First Institute of Oceanography, China*
C1-10	Spatial distribution, sources and ecological risk of polycyclic aromatic hydrocarbons (PAHs) in the sediment of Peter the Great Bay (the Sea of Japan/East Sea)	Tatiana Chizhova, *Far Eastern Branch, Russian Academy of Sciences, Russia*
C1-11	Mussel watch: POPs in the Russian section of the Northeast Pacific ecosystems	Vasiliy Tsygankov, *Far Eastern Federal University, Russia*
Session C2: Source, transport, fate, impacts and mitigation strategies of marine plastics and microplastics		
C2-01	Small island waste management by using UAV images on Balang Lompo Island, Pangkep district, South Sulawesi, Indonesia	Syazwi Quthbi Al- Azizi, *Bandung Institute of Technology, Indonesia*
C2-02	Analyzing the coupled relationship between the distribution of marine microplastics in the Northwestern Pacific Ocean and global climate	Jungang Lu, *East China Normal University, China*
C2-03	Juvenile fish ingest microplastics? Juvenile fish microplastics story in the South China Sea	Xinyu Bu, *East China Normal University, China*
C2-04	Changes and transport of microplastics in the riverbed of the mainstream below the Three Gorges Dam of the Yangtze River	Changxing Zong, *East China Normal University, China*
C2-05	Characteristics and sources of microplastic fibers in the Yangtze River Basin, China	Li Qingqing, *East China Normal University, China*
C2-06	Understanding sources, transport, and accumulation of small microplastics (<1 mm) in beach sediments of western Philippines using Nile Red staining and image-based machine learning	Jan Danielle P. Bonita, *University of the Philippines Diliman, The Philippines*

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C2-07	Relation between surface hardness and elasticity to Carbonyl Indexes of plastic products and environmental Plastic debris	Emiko Fujita, *Chiba Institute of Technology, Japan*
C2-08	Development of semi-automatic analytical methods for fine microplastics larger than 1 μm in surface water by Raman Imaging Microscopy	Yutaka Kameda, *Chiba Institute of Technology, Japan*
C2-09	The studying of the distribution of floating debris released from river mouths in the inner Gulf of Thailand by numerical model	Chaninat Prichameth, *Chulalongkorn University, Thailand*
C2-10	The first multi-compartment analysis of microplastics in the Karnafully river, Bangladesh	Md. Jaker Hossain, *East China Normal University, China*
C2-11	Microplastics in two marine sponges from Rayong Bay	Akaracha Tongrod, *Chulalongkorn University, Thailand*
C2-12	Occurrences of microplastics larger than 20 microns in surface waters of the Philippines	Yuka Motohashi, *Chiba Institute of Technology, Japan*
C2-13	Patterns of plastic occurrence during the pre- and post-super Typhoon Rai (Odette) event in Olango Island Wildlife Sanctuary (OIWS), Philippines	Apple AJ Langcamon, *University of San Carlos, The Philippines*
C2-14	Plastic Waste Analysis and Brand Audit (WABA) in mangrove ecosystems as an approach to support the enforcement of Extended Producer Responsibility (EPR) policy	Evelyn B. Taboada, *SouthEast Asia Marine Plastics (SEAMaP) Project*
C2-15	Stony corals as a biological sink for microplastics: a case study in Hong Kong	Ken Chue-Ho Yuen, *The Hong Kong Polytechnic University, China*
C2-16	Plastic size does matter: combined effects of microplastics and the toxic dinoflagellate *Alexandrium tamarense* on the edible green-lipped mussel *Perna viridis*	Elizaldy Acebu Maboloc, *The Hong Kong Polytechnic University, China*
C2-17	International coastal cleanup scientific report: items and monthly variations of river, beach, and underwater litters in the northeast coast of Bali	Kharisma Halisah, *Indonesian Marine Education and Research Organization (MERO Foundation), Indonesia*
C2-18	Macroplastics deposited in the coastal mangrove areas in Olango Island, Cebu	Francis Dave C. Siacor, *University of San Carlos, The Philippines*
C2-19	Circulation and transport patterns in the Nha Trang Bay	Thinh Nguyen-Duc, *Vietnam Academy of Science and Technology, Vietnam*
C2-20	Abundance and composition of microplastics in sediment from Bangpakong River, Thailand	Noppasorn Horthiwong, *Chulalongkorn University, Bangkok, Thailand*

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C2-21	Occurrence of microplastics larger than 20 microns in sediments of Tokyo Bay	Eiji Fukazawa, *Chiba Institute of Technology, Japan*
C2-22	Occurrences of microplastics larger than 20 microns in surface waters at Tokyo Bay	Gaksuhi Fujimura, *Chiba Institute of Technology, Japan*
C2-23	Simulation of floating macro plastic debris particles in Karimunjawa National Park Water	Ivonne M. Radjawane, *Bandung Institute of Technology, Indonesia*
C2-24	Effect of monsoon on microplastic bioavailability and ingestion by zooplankton in tropical coastal waters of Sabah	Teruaki Yoshida, *Universiti Malaysia Sabah, Japan*
C2-25	Microplastics in water and *Acetes* shrimps in Chao Phraya Estuary, Thailand	Massakorn Pimsarn, *Chulalongkorn University, Thailand*
C2-26	A study on the abundance of microplastics on beaches in Southeast Sarawak, Malaysia	Clarence Tay, *Swinburne University of Technology, Malaysia*
C2-27	Comparative analysis of microplastic abundance in sea surface water and tap water across three states in Malaysia	Changi Wong, *Swinburne University of Technology, Malaysia*
C2-28	Vertical distribution of microplastic larger than 20 microns in Tokyo Bay waters	Yutaro Numazawa, *Chiba Institute of Technology, Japan*
C2-29	Unveiling the presence of global-scale microplastics greater than 20 μm in oceans: a study with volunteer ships	Emiko Fujita, *Chiba Institute of Technology, Japan*
C2-30	Investigations of Microplastics in Surface Water at Rivers, Lakes and Bays using a Novel Automated Microplastic Sample Preparation System	Yutaka Kameda, *Chiba Institute of Technology, Japan*
C2-31	Development of a semi-automatic software to identify microplastics from imaging data by Micro-Fourier-transform infrared spectroscopy	Yutaka Kameda, *Chiba Institute of Technology, Japan*
C2-32	Development of a portable and affordable sampling device for microplastics in water samples	Yutaka Kameda, *Chiba Institute of Technology, Japan*
C2-33	Polyethylene terephthalate (PET) bottles along the Coastline of Capayas Island, Palawan, Philippines: Evidence of Transboundary Plastic Pollution?	Kim Ryan S. Mantuhac, *Mindanao State University-Iligan Institute of Technology, The Philippines*
C2-34	Quantity and physical characteristics of microplastics in beach sand along the coast of Mueang and Chana district, Songkhla province, Thailand	Siriporn Borrirukwisitsak, *Silpakorn University, Thailand*
Session C3: Deoxygenation in the Western Pacific: Implications for coastal and open ocean ecosystems		
C3-01	Seasonal variation and spatial extent of deoxygenation in Bolinao, northwestern Philippines	Raffi R. Isah, *University of the Philippines, The Philippines*

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Session C4: Ocean acidification and its impacts on marine ecosystems		
C4-01	Low-pH seawater observed along Thailand coast in the northern Strait of Malacca	Chalermrat Sangmanee, *Department of Marine and Coastal Resources, Thailand*
C4-02	Biogeochemical properties of shallow-water CO2 seeps in the Himeshima and Showa Iwojima Islands, Japan	Masahiko Fujii, *The University of Tokyo, Japan*
C4-03	Carbonate chemistry baseline information on Philippine coral reefs	Raffi R. Isah, *University of the Philippines, The Philippines*
Session C5: Mitigation and management of harmful algal blooms		
C5-01	The IOC Harmful Algal Information System	Eileen Bresnan, *Marine Directorate of the Scottish Government, United Kingdom*
C5-02	Phylogeny and ultrastructure of a new non-toxigenic *Amphidoma* species isolated from the Western Pacific	Koyo Kuwata, *University of Tokyo, Japan*
C5-03	Morphology and phylogeny of kareniacean dinoflagellates from the eastern coast of Hokkaido, Japan	Koyo Kuwata, *University of Tokyo, Japan*
Session C6: Marine toxins and seafood safety		
C6-01	Economic loss of white spot syndrome virus disease in whiteleg shrimp (*Litopenaeus vannamei*) farming business	Sonia Putri Maulidya, *Universitas Brawijaya, Indonesia*
C6-02	Light-regulated microalgae metabolite retinal transport and transformation through the food chain effectively inhibited the growth and disturbed the liver-gut axis of marine medaka (*Oryzias melastigma*)	Haisu Liu, *Jinan University, China*
C6-03	Plant growth promoting bacteria associated with edible sea grapes *Caulerpa lentillifera* (J. Agardh 1837)	Bui Thi Ngoc Trieu, *Institute of Oceanography, Vietnam*
C6-04	Investigate lipid and protein oxidation in herring (*Sardinella gibbosa*) by sodium acetate during preservative time.	Thi Thiet Doan, *Institute of Oceanography, Vietnam*
C6-05	Light-induced algae retinal stress can deform fish spines	Lei Cui, *Jinan University, China*
C6-06	Seasonal changes of tetrodotoxin and its analogue composition in *Takifugu niphobles* pufferfish caught in Korean Waters	Bong ki Park, *Chung-Ang University, Republic of Korea*
C6-07	Temporal monitoring of pinnatoxins in shellfish collected from the Korean Peninsula	Chan-Young Kim, *Jeju National University, Republic of Korea*
C6-08	Rapid monitoring of Cyclic Imines in marine organisms using LC-MRM-MS platform	D.S. Dissanayake, *Jeju National University, Republic of Korea*

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C6-09	Mass spectral matching-based detection for pteriatoxin isomers in marine organisms	Hye Won Kim, *Chungnam National University, Republic of Korea*
C6-10	Dietary exposure assessment of azaspiracids (AZAs) in imported shellfish using maximum likelihood estimation from left-censored data	Hyojin Kwon, *Chung-Ang University, Republic of Korea*
C6-11	Maximum likelihood estimation of brevetoxin (BTX) in imported shellfish in Korea	Hyojin Kwon, *Chung-Ang University, Republic of Korea*
C6-12	Simultaneous surveillance of pectenotoxins (PTXs) in imported shellfish and their dietary exposure assessment	Changsun Choi, *Chung-Ang University, Republic of Korea*
C6-13	UHPLC-MS/MS detection and dietary exposure assessment of YTX and in imported shellfish in South Korea	Changsun Choi, *Chung-Ang University, Republic of Korea*
C6-14	TTX screening of *Atergatis floridus* (Linnaeus, 1767) and *Atergatis integerrimus* (Lamarck, 1818) collected from Jeju Coast using a competitive ELISA	Jong-Seop Shin, *Jeju National University, Republic of Korea*
C6-15	Semi-quantitative non-targeted screening of novel marine toxins using LC/MRM-MS	Nari Seo, *Chungnam National University, Republic of Korea*
C6-16	Quantification of tetrodotoxin (TTX) and its analogue in boxfish *Ostracion immaculatum* Temminck & Schlegel, 1850 from Jeju Island, Korea	Nobuhisa Kajino, *Jeju National University, Republic of Korea*
C6-17	Investigation of extraction efficiency and matrix effect in Palytoxin quantification using LC/MRM-MS	R.P.G.S.K. Amarasiri, *Jeju National University, Republic of Korea*
C6-18	Investigation of contamination levels of CI toxins in imported shellfish products available in South Korea	Young-Sang Kim, *Jeju National University, Republic of Korea*
Session C7: Harmful jellyfish in the Southeast Asian region: Networking across the oceans		
C7-01	New records of two box jellyfish in the eastern Gulf of Thailand	Isara Arsiranant, *Department of Marine and Coastal Resources, Thailand*
C7-02	Should we worry about box jellyfish sting to the face?	Muhamad Na'im Bin Ab Razak, *Hospital Lahad Datu, Malaysia*
C7-03	First documented case of jellyfish sting with Irukandji like syndrome in Sabah coastal water	Muhamad Na'im Bin Ab Razak, *Hospital Lahad Datu, Malaysia*
Sub-theme D Emerging Ocean Science and Cross-cutting Issues		
Session D1: Ocean observing technology and systems in the Indo-Pacific: major advances and challenges		
D1-01	Field observation of rip currents at Kata Noi Beach, Phuket, Thailand	Suriya Kumnaundao, *Kasetsart University, Thailand*

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D1-02	Advancing *in-situ* measurements for enhanced understanding of the Gulf of Thailand's environmental dynamics	Tanuspong Pokavanich, *Kasetsart University, Thailand*
D1-03	Zonal structure of tropical Pacific surface salinity anomalies affects the eastern and central Pacific El Niños differently	Cong Guan, *Chinese Academy of Sciences, China*
D1-04	Satellite observed multisource internal tide radiation and interference in the Banda Sea	Peiwen Zhang, *Institute of Oceanology Chinese Academy of Sciences, China*
Session D2: Ocean observing technology and systems in the Indo-Pacific: Major advances and challenges		
D2-01	Exploring the biodiversity at Koh He, Phuket, using eDNA technique together with metagenomics analysis	Vararin Vongpanich, *Department of Marine and Coastal Resources, Thailand*
D2-02	Effects of artificial light at night on gene expression in the coral, *Acropora digitifera*	Kelly Rome A. Publico, *University of the Philippines Diliman, The Philippines*
D2-03	Evaluating three environmental DNA (eDNA) sampling methods to observe small pelagic fish community compositions	Xueding Wang, *The University of Tokyo, Japan*
Session D3: Satellite and airborne remote sensing techniques for marine ecosystem monitoring and management		
D3-01	Long-term variations in phytoplankton production measured by satellite ocean remote sensing data in the Northwest Pacific	Seunghyun Son, *NOAA/NESDIS Center for Satellite Applications and Research (STAR), USA*
D3-02	Development of neural network models for distributions of plastics patches in the ocean by Sentinel-2 high-resolution data	Yutaka Kameda, *Chiba Institute of Technology, Japan*
D3-03	Working time of acoustic survey methods for the truthing of optic remote sensing	Hajime Okawa, *Kitasato University, Japan*
Session D5: Deep-sea exploration and research in the Western Pacific		
D5-01	Methane seepage caused by gas hydrate dissociation in the middle Okinawa Trough since the Last Glacial Maximum	Ang Li, *Qingdao Institute of Marine Geology, China*
D5-02	Gas hydrates and natural gas discharge in the Sea of Okhotsk	Renat Shakirov, *V.I.Il'ichev Pacific Oceanological Institute, Russia*
Session D6: Sustainable financing of blue carbon		
D6-01	The impact of density on biomass: a study of changes in blue carbon in the seagrass ecosystems of Thailand	Tipamat Upanoi, *Department of Marine and Coastal Resources, Thailand*

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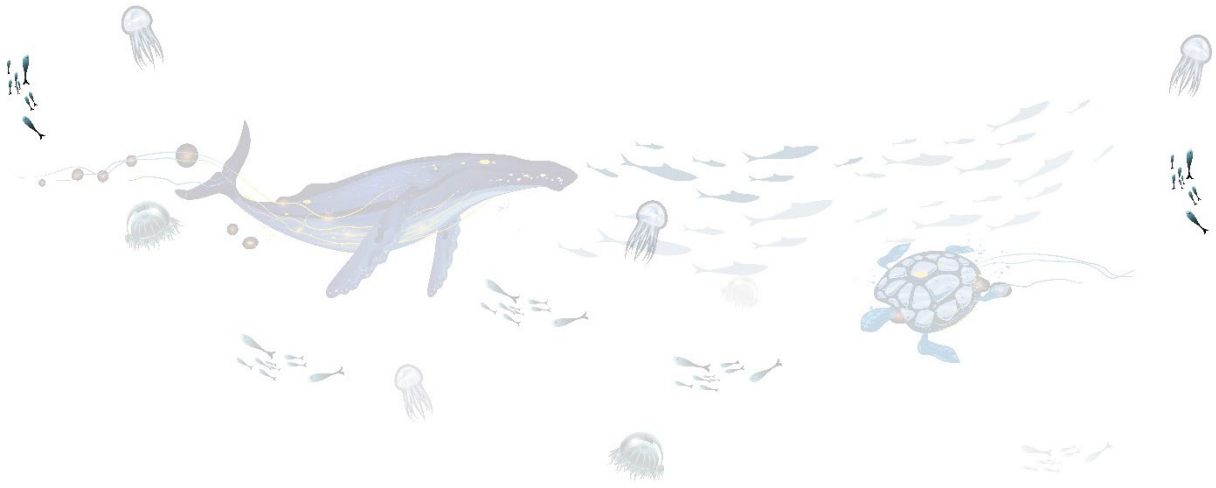
Special Forum Science for local-level environmental management, ecosystem conservation and sustainable use in the South China Sea and Gulf of Thailand		
SF-01	Marine protected areas contribute to sustainable socio-economic development	Nguyen Van Vu, *The Management Board of the Cu Lao Cham Marine Protected Area, Vietnam*
SF-02	Reef coral decline and adaptive solutions for coral reef conservation in Nui Chua National Park, Vietnam	Thai Minh Quang, *Vietnam Academy of Science & Technology, Vietnam*
SF-03	The study on social and economic impacts from marine protected area announcement and the utilization of the Losin Island, Pattani, Thailand	Aekkarak Faiboon, *Prince of Songkla University, Thailand*
SF-04	Achievements in sea turtle conservation in Con Dao waters, Vietnam	Nguyen Khac Pho, *Con Dao National Park, Vietnam*
SF-05	Basic cognition, methods, and implementation route of marine detailed planning from the perspective of territorial spatial planning	Wenxiu Xing, *First Institute of Oceanography, China*
SF-06	Promotion of blue economy in Trat Province, Thailand	Laddawan Sangsawang, *Department of Marine and Coastal Resources, Thailand*
SF-07	A conceptual framework for blue economy resilience to build sustainable and adaptive capacity	Han Zhang, *Ocean College, Zhejiang University, China*
SF-08	Eutrophication reduced carbon sequestration in tropical seagrass beds	Zhijian Jiang, *Chinese Academy of Sciences,, China*
SF-09	Hydrogen-producing capability of green microalgae found in Sarawak, Malaysia	Jonathan Lee Wen Han, *Swinburne University of Technology Sarawak, Malaysia*
SF-10	Reef caretaker: coral rehabilitation as part of participatory management of marine parks in Lang Tengah Island, Malaysia	Azrin Asyikin Mohd Shukor, Marine Conservation and Research Organization (PULIHARA), Malaysia

Sub-theme A:
Ocean Processes and Climate Change

Session A2:
Western Pacific Marginal Seas: Physics, biogeochemistry and ecosystem



Initial steps to build a predicting upwelling model in the South Vietnam under climate change conditions

To Duy Thai[1], Bui Hong Long[2], and Marine Herrmann[3]

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Abstract

One of the big challenges in predicting upwelling is that the causes, mechanisms, formation, and development of upwelling in the coastal areas of the Bien Dong (South China Sea) and Vietnam still have many unresolved issues related to the interactive processes between the atmosphere and the ocean. Analyses of the influence and interaction of meteorological systems from the Western Pacific and Indian Ocean regions on the upwelling phenomenon remain uncertain. Forecasting upwelling in coastal areas not only has high scientific significance but also practical importance. To develop a rigorous quantitative method for upwelling forecasting models, it is necessary to evaluate the ability to predict upwelling and to better understand its variability under the influence of different climatic conditions. In this study, we initially built a high-resolution 3D hydrodynamic model (~1 km nearshore, linearly increasing to 4.5 km offshore, and consisting of 50 layers of a "vanishing quasi-sigma" coordinate system) to forecast this phenomenon under the following scenarios: (1) normal conditions; (2) daily climatological averages of boundary conditions from atmospheric forcings; (3) daily climatological averages of total rainfall in the entire region; and (4) daily climatological averages of total river water discharge from major rivers in the study area. Initial results show that during the period 2009–2018, upwelling did not develop for scenario 2 because atmospheric forcing parameters were consistently stable and did not change every year. The impact of rainfall and river discharge is insignificant in strong upwelling areas where the main influence is from the wind; however, the role of precipitation is determined in areas where upwelling is weak and dominated by ocean circulation and intrinsic ocean variability. This study represents an important step toward developing a model to predict upwelling variability under climate change.

Keywords: 3D hydrodynamic model, climatological averages, coastal upwelling, South Vietnam

Spatiotemporal characteristics and volume transport of Lagrangian eddies in the Northwest Pacific

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Abstract

Mesoscale eddies play a crucial role in the transport of mass, heat, salt and nutrients, exerting significant influence on ocean circulation patterns, biogeochemical processes and the global climate system. Based on Lagrangian-Averaged Vorticity Deviation (LAVD) method, this study applies 27 years (1993–2019) of geostrophic current velocity data to detect Rotationally Coherent Lagrangian Vortices (RCLVs) in the Northwest Pacific (NWP; 10°N–30°N, 115°E–155°E), with the spatiotemporal characteristics of Eulerian Sea Surface Height Eddies (SSH eddies) and RCLVs being compared. A higher number of SSH eddies and RCLVs can be observed in spring and winter, and their inter-annual variations are similar. SSH eddies show higher generation number and larger radius in the Subtropical Countercurrent region, while RCLVs occur more favorably in the ocean basin. The propagation speed distributions of both eddy types are nearly identical and decrease with in-creasing latitude. Due to the material coherent transport maintained by RCLVs within a finite time interval, the coherent cores of RCLVs are considerably smaller in scale as compared to those of SSH eddies. The average zonal transports induced by SSH eddies and RCLVs are estimated to be −0.82 Sv and −0.51 Sv (1 Sv = 106 m3/s), respectively. For non-overlapping SSH eddies with RCLVs, approximately 80% of the water within the eddy leaks out during the eddy's lifespan. In the case of overlapping SSH eddies, the ratio of coherent water inside the eddy decreases with increasing radius, and the leakage rate is around 58%. Finally, an examination of 36 shedding RCLVs events from the Kuroshio near the Luzon Strait, which induce an average zonal transport of −0.14 Sv, reveals that 54% of the water within the shedding RCLVs originates from the Kuroshio.

Keywords: mesoscale eddies, Lagrangian methods, spatiotemporal characteristics, coherent transport, Northwest Pacific

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Spatio-temporal dynamics of seawater physicochemical characteristics in the Bohol Sea, Philippines

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Abstract

The Bohol Sea, also known as the Mindanao Sea, is one of the internal seas located within the Philippine archipelago. It is bounded by several island provinces to the north and Mindanao Island to the south. It is connected to the Sulu Sea to the west and the Pacific Ocean to the east through the Dipolog Strait and Surigao Strait, respectively. Its basin topography, the influence of the Asian monsoon system, and river discharge from islands result in double estuarine-type circulation and oceanographic features such as jets, eddies, and upwelling that influence surface productivity, hence pelagic fisheries. The Bohol Sea is one of the major fishing grounds in the country that provide food and livelihood to coastal communities. However, there have been limited studies linking these oceanographic features to physical and chemical properties in the water column that help sustain productivity. Furthermore, there is a scarcity of baseline information on water quality and carbonate chemistry that will serve as a basis for determining future trends in changes due to global (ocean warming and acidification) and local (eutrophication) stressors. To address these gaps, a multi-disciplinary research expedition was conducted in October 2021 that involved extensive vertical profiling of physical parameters (temperature, salinity) and water sampling along five longitudinal transects covering 25 stations in the Bohol Sea. The distribution of spatial stations was selected to capture the different oceanographic features identified in the Bohol Sea and understand how seawater nutrients, chlorophyll a, dissolved oxygen, and carbonate chemistry parameters (pH, total alkalinity, pCO_2, aragonite saturation) vary with these features. Aside from contributing to the limited baseline information on essential ocean variables, these parameters may help describe the distribution patterns and presence of key biological organisms at the sites, the variabilities in offshore and nearshore observations, and the possible temporal change in parameters recorded from a prior expedition in 2007. The Bohol Sea has been considered one of the priority areas for conservation due to its vulnerability to human threats, natural disasters, and climate change. The information presented in this study will be valuable not only in understanding the physicochemical drivers of pelagic fisheries but also in determining appropriate management actions for anthropogenic stressors.

Keywords: Bohol Sea, water quality, carbonate chemistry, productivity

Long and continuous time series observations in the key location of the East Sea (Japan Sea)

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Abstract

The East Sea (Sea of Japan), one of the Western Pacific Marginal Seas, is known as a region where the impacts of most rapid global warming are evident, making it a valuable area for observing future changes in the oceans. A subsurface mooring named EC1, was first deployed in the Ulleung Interplain Gap (UIG) at a depth of 2,300 meters, between Dokdo and Ulleungdo in the East Sea. This location is crucial for quantifying the temporal variability of deep exchange between the Ulleung Basin and Japan Basin, as it is the sole deep pathway for seawater exchange at depths below 1,500 m. Observations at EC1 was supplemented with the deployment of four other moorings at 810, 1,010, 1,305 and 1,910 m depths, collecting multi-mooring time series data of temperature, salinity, and currents for approximately one year. Subsequent retrievals and redeployments, spanning 27 years and comprising 26 legs (Leg01-Leg26), continued the data collection up to now. Key observation depths during mooring periods were around 400, 1,400, and 2,200 m (excluding Leg01), where Recording Current Meters (RCMs) and Aquadopp current-meters equipped with temperature and pressure sensors were deployed. Additional instruments were added during retrievals and redeployments to expand the scope of observations. Starting from 2017, dissolved oxygen sensors were added at depths of 1,400 m and 2,250 m, and sediment traps were attached to the mooring. This study utilizes the long-term continuous time series data archived from EC1 to examine temperature and current variability at different depths. Particularly, anomalies in temperature were observed at the 400 m depth during the observation period compared to their climatology and mesoscale circulation. Corrections for depth errors caused by mooring drifts and currents at the target depth were made using pressure sensors on the moored instruments. The data collected by the moorings at EC1 have undergone quality control and are publicly available through SEANOE and OceanSITES up to Leg23. This research analyzed past temperature and current variations, and it is anticipated that future studies will contribute to predicting changes in the future ocean using the EC1 mooring data.

Keywords: East Sea (Japan Sea), EC1, subsurface mooring, long-time series, continuous time-series

Session A2: Western Pacific Marginal Seas: Physics, biogeochemistry and ecosystem

Drivers of N_2O distribution and atmospheric emissions from a southern hemisphere Fjord-like deep coastal inlet: Macquarie Harbour Tasmania

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Abstract

Fjord-like deep coastal inlets are hotspots of biogeochemical cycling due to steep physicochemical gradients. The spatiotemporal distribution of N_2O within many of these systems is poorly described, especially in the southern hemisphere. The goal of this study was to describe the spatiotemporal distribution of N_2O within a southern hemisphere fjord-like estuary, describe the main environmental drivers of this distribution, the sea-to-air flux of N_2O, and the main drivers of N_2O production.

Cruises were undertaken in Macquarie Harbour, Tasmania to capture N_2O concentrations and water column physiochemical profiles in austral winter (July 2022), spring (October 2022), summer (February 2023), and autumn (April 2023). N_2O samples were collected at one depth at system end members, and at 5 depths at 4 stations within the harbour.

Results indicate that N_2O is consistently supersaturated (reaching 170% saturation) below the system's freshwater lens where the oxygen concentrations are generally poorest. In the surface lens, levels of N_2O saturation vary with estimated river flow and with proximity to the system's main freshwater endmember. The linear relationship between oxygen saturation and N_2O saturation indicates that nitrification is the process generating N_2O in the system. When river flow was high (July and October 2022), surface water N_2O was undersaturated (as low as 70%) throughout most of the harbour. When river flow was low (February and April 2023) N_2O was observed to be supersaturated at most stations. Calculated sea-to-air fluxes of N_2O indicated that the system is both a source of N_2O to the atmosphere as well as a sink depending on location and season implying that the proportion of the harbour's surface functioning as a source or sink of N_2O to the atmosphere also varies with season. We propose that it is river flow across the harbour surface that captures N_2O diffusing up from subhalocline depths and transports it out of the system in the surface plume. In a changing climate, Western Tasmania is expected to receive higher winter rainfall and

lower summer rainfall which may augment the source and sink dynamics of this system by enhancing the summer / autumn efflux of N_2O to the atmosphere.

This study is the first to report observation of N_2O distribution and surface N_2O fluxes from this system thus helps to provide context for how other fjord-like estuaries operate with regard to freshwater inputs, dissolved oxygen, and N_2O dynamics.

Keywords: marine nitrous oxide, deoxygenation, Fjord-like estuaries, greenhouse gas emissions, Macquarie Harbour

Fluxes and distributions of trace elements in the East Sea (Japan Sea)

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Abstract

The distributions of trace elements (Fe, Mn, Co, Cu, Cd, and Ni) were measured in the entire East Sea (22 stations, n = 276, 0–3400 m). In general, the distribution patterns of these trace elements were similar to those in the major oceans. However, relatively higher concentrations of trace elements, except for Ni, were observed in the surface layer due to pronounced external inputs (atmospheric deposition and/or continental shelf input). In addition, we observed unusually high concentrations of Fe and Mn in the bottom layer of the Ulleung Basin, owing to large benthic inputs. Thus, the East Sea is characterized by the efficient scavenging processes of trace elements related to high sinking fluxes of particles under the significant boundary input conditions (atmospheric deposition, continental shelf input, and benthic input). In addition, we further evaluated the atmospheric inputs of anthropogenic iron (Fe) to the East Sea. We observed that about 45% of the water-soluble Fe in aerosols collected over the East Sea is anthropogenic, which originates mainly from heavy fuel oil combustion, based on various chemical tracers (Al, K, V, Ni, Pb, and ^{210}Pb). It is striking that a tiny quantity of oil, less than 1% of the aerosols in mass, can constitute the majority of water-soluble Fe in aerosols due to its high Fe solubility. Then, we revealed that a quarter of the dissolved Fe in the East Sea is anthropogenic using a ^{210}Pb-based scavenging model. Since this sea is almost fully enclosed (200–3000 m) and located at the forefront of the Asian human footprint, our results provide a new insight that the marine Fe cycle may be already perturbed by human activities in large areas of the global ocean.

Keywords: trace element, anthropogenic Iron, manganese, Ulleung Basin, East Sea

Significant benthic inputs of dissolved amino acids in the marginal seas of the northwestern Pacific Ocean

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Abstract

To investigate the distributions, sources, and cycling of total dissolved amino acid (TDAA) in the northwestern Pacific marginal seas, we measured TDAA in both seawater and sediment porewater of the East Sea (Japan Sea) and in the seawater of the Yellow Sea and the East China Sea. In the deep ocean of the East Sea, TDAA originates mainly from sediment porewater as well as the euphotic zone while dissolved organic carbon (DOC) originates mainly from the euphotic zone. The large contribution of TDAA benthic flux and its shorter residence time in the benthic boundary layer (BBL) (1.3±0.9 years) resulted in steep TDAA increases in the BBL, although DOC concentrations remained relatively uniform throughout the entire deep ocean. AA-derived indices also show enhanced bioavailability of dissolved organic matter (DOM) in the BBL, suggesting significant benthic inputs of bioavailable DOM. In the continental shelf waters of the Yellow Sea and the East China Sea, L-amino acid (L-AA) originates mainly from phytoplankton production, showing the highest concentrations in spring. However, D-amino acid (D-AA) originates mainly from sediments, based on the ^{228}Ra tracer. In this shelf region, the TDAA benthic flux (~ 3.5 Gmol y^{-1}) was 2-fold higher than its flux from the Changjiang River discharge, comparable with the contribution of phytoplankton production. AA-derived indices show higher DOM bioavailability in spring and summer relative to autumn and winter. Our results underscore the significance of TDAA benthic inputs in fueling deep-sea microbial activity as well as in controlling DOM composition and bioavailability in the shelf waters.

Keywords: amino acid, benthic input, dissolved organic matter, marginal seas

Numerical study on the circulation in the Gulf of Thailand and its seasonal water exchange with the South China Sea

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Abstract

Gulf of Thailand (GOT) is a semi-closed basin connected to the Southern South China Sea (SSCS). Circulations in the GOT are mainly influenced by seasonal monsoon and its interaction with SSCS. The first circulation pattern in the GOT was proposed by the Hydrographic Department of the Royal Thai Navy in 1961. GOT has two eddies through the year that are located at the upper and lower gulf, with the lower gulf eddy being an anticyclonic eddy at most times. Yanagi et al., 1998, Diagnostic numerical calculation using the observed water temperature, salinity and wind data during NAGA cruises from October 1959 to August 1960. He found that the wind-driven current dominated and the circulations were nearly barotropic in the Gulf of Thailand throughout the year; the clockwise circulation developed at the central part of the Gulf of Thailand both in the northeast and southwest monsoons. Using the CROCO model we studied the circulation in the Gulf of Thailand and its seasonal water exchange with the South China Sea. The results show that:

(1) The center of the GoT basin is occupied by anticyclonic circulation in the upper layer except in autumn, the direction of coastal currents varies seasonally.

(2) The GOT vertical flow in winter/summer is stronger than that in spring/autumn. During summer, the coastal upwelling at the bottom of East Coast of Peninsula Malaysia is very strong

(3) Net flow in winter and spring, is from GoT into SSCS, while in summer and autumn from SSCS into GoT. The net flow of the upper (0-30m) and lower (below 30m) layers have similar values and opposite flow directions during most of the year

Keywords: circulation, Gulf of Thailand, water exchange, South China Sea

Summer high primary productivity zone in the central North Pacific Subtropical Gyre

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Abstract

Numerous studies have documented phytoplankton blooms in the central region (16-25°N) of the North Pacific Subtropical Gyre (NPSG) during summer (June-August). However, due to its remoteness, field measurements of primary productivity (PP) in NPSG are very limited, and its spatial extensiveness remains unclear. Here we employed a phytoplankton absorption (a_{ph})-centered model (AbPM) along with satellite data from 1998 to 2020 to estimate summer PP variations in NPSG. Results revealed a prominent high-PP zone in the central NPSG (16-25°N) with a PP of 557 mg C m^{-2} d^{-1}, surpassing the background level of 455 mg C m^{-2} d^{-1}. This notable high-PP zone, across the east-west regions of the gyre (120°E-140°W), includes the eastern part covering the Hawaii Ocean Time-series stations (HOT, around 22°45'N, 158°W). Differences were observed between the eastern and western parts of the high-PP zone though, with the eastern section, represented by HOT, exhibiting a higher summer PP value (6-112 mg C m^{-2} d^{-1}) compared to the western region (BOX 1, a selected 5*5 matrix centered at 22°N, 145°E). Nitrogen fixation data suggested that the high-PP zone's formation may be linked to increased summer N_2 fixation rates due to iron deposition from East Asian dust storms, supporting the observed higher productivity of ~20% (90 mg C m^{-2} d^{-1}) in the high-PP zone.

Key words: North Pacific Subtropical Gyre, primary productivity, phytoplankton absorption, N_2 fixation rates

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Hydrophysical processes and chlorophyll concentration in the Peter the Great Gulf (Sea of Japan)

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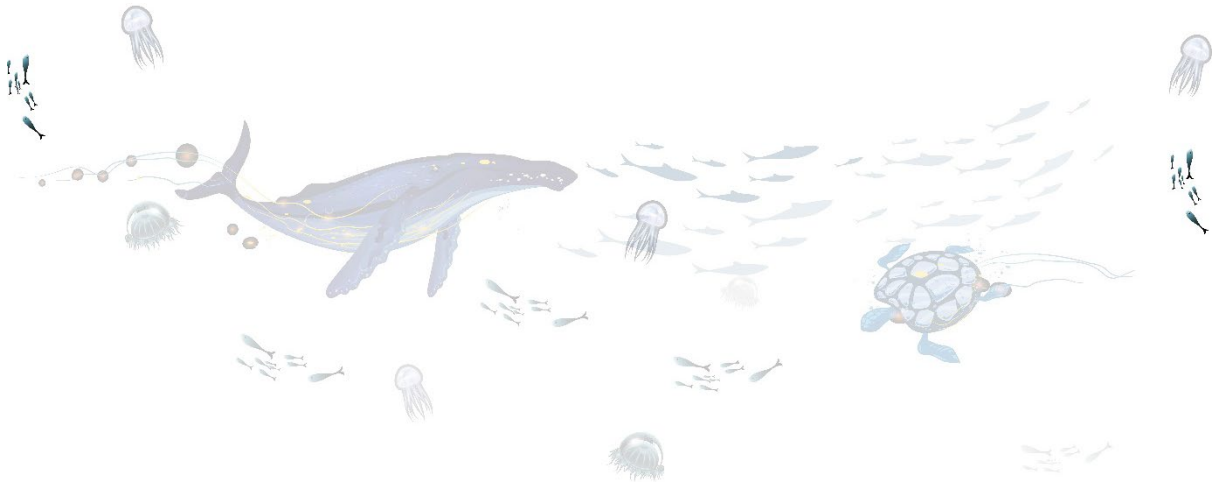
Abstract

Results of daily satellite snapshots of chlorophyll-a concentration (CHL) in the Peter the Great Gulf area were analyzed for the period of 10 years. Grouping of the snapshots is performed subject to prevailing one of the four factors affecting chlorophyll concentration: shore proximity, current, eddies, convection. Seasonal tendency, revealed in chlorophyll spatial distributions, is considered in relation to seasonal changes of role of different physical mechanisms in the delivery of necessary nutrients for primary production into the photic layer. In most cases the pictures are formed by simultaneous action of several factors, but by frequency and CHL magnitude, the prevailing factor in the considered area was shore proximity. To explain the observed seasonal differences in chlorophyll distributions and their interrelations with physical processes, results of experiments in the near-shore region with depths of 20–40 m were used. In the satellite data maximum values of CHL in the near-shore region are not observed in the periods of maximum runoff from land, but they are observed in the periods of strong thermocline and maximum intensity of internal waves (IW) in the near-bottom layer. IW breaking leads to sharp amplification of mixing and bottom sediments resuspension. Internal waves are generated by interaction of tides, eddies, and currents over the continental slope with changeable steepness and curvature, and they carry energy of these large-scale motions to shores. Eddies of different scales, tidal currents, with additional input of local horizontal turbulence of different origin, are the main mechanisms of the near-shore waters ventilation and chlorophyll and phytoplankton redistribution over the area. Effect of upwelling along the shelf boundary, which most frequently appears in papers as the main object in study of shelf productivity, in our conditions reveals itself only indirectly against the background of other factors in absentia of seasonal thermocline.

Keywords: satellites, chlorophyll, shelf, continental slope, near-shore region

Sub-theme A:
Ocean Processes and Climate Change

Session A3:
Advance the understanding of marine heatwaves and their impacts



Marine heatwave in the Oyashio region in 2022 and dissolved oxygen changes

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Abstract

The Oyashio region east of northern Japan have experienced marine heatwaves (MHWs) frequently since 2010, and sea surface temperature in the summer of 2022 was the highest in the satellite-observation era as of 2022. This study examined the impact of the MHW in 2022 on dissolved oxygen (DO) analyzing observations of a research vessel and two biogeochemical Argo floats. Warm, saline water from the Kuroshio Current intruded into around 42°N in July. DO anomaly from climatology above about 200 m depth had negative correlations with temperature anomaly. On the other hand, DO concentration tended to increase when temperature was high below this depth. On the density coordinate, DO and temperature anomalies had a strong negative correlation when potential density (σ_θ) was less than approximately 27.0 kg m^{-3}. Hence, subsurface DO anomaly can be predicted from temperature and salinity observations using this relationship. DO anomaly can be divided into components that are related with isopycnal mixing and density-surface heaving. This decomposition reveals that the dynamical process, which means that the intrusion of the Kuroshio water that is lighter than the Oyashio water pushed down density surfaces, caused oxygenation. Meanwhile, isopycnal mixing tended to mitigate the increase of DO concentration since DO concentration is smaller in the south than the north on an isopycnal surface of σ_θ<27.0 kg m^{-3}. This study clarified that the MHW caused deoxygenation near the surface through the decrease of gas solubility, while conversely DO concentration increased in the subsurface layer.

Keywords: oxygenation, marine heatwave, Oyashio, BGC Argo float, isopycnal mixing

Changes in the dominant modes of MHW in the Gulf of Thailand

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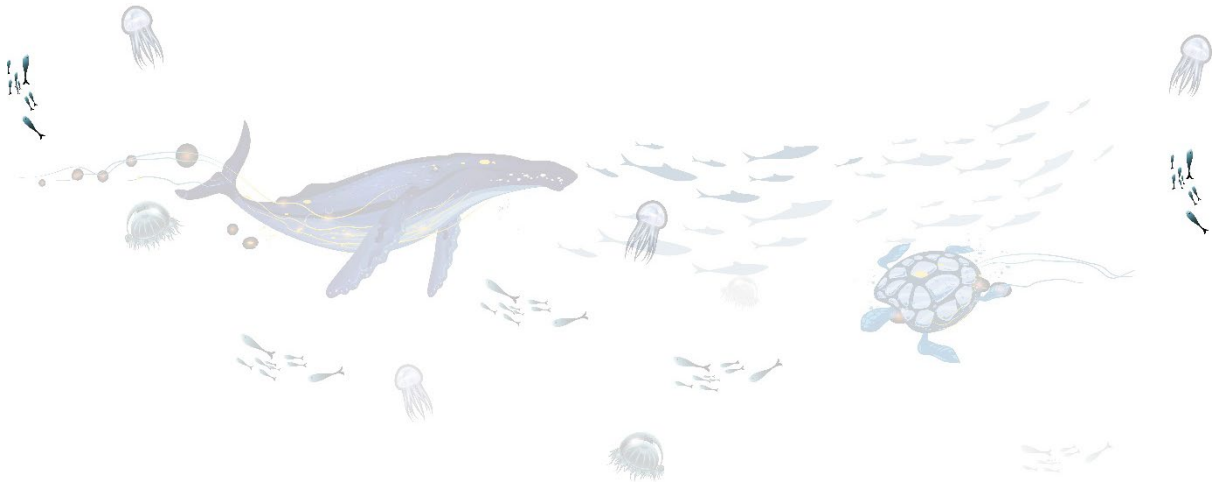
Abstract

A marine heatwave (MHW) is a warming event of abnormally high sea surface temperatures (SSTs) than the 90th percentile of the long-term historical SSTs (Hobday et al., 2016). Over the last century, marine heatwaves have become more numerous and have a longer lifespan, demonstrating a clear long-term trend, as a result of absorbing more than 90% of the extra heat marine heatwave caused by (Oliver et al., 2018; Smale et al., 2019; Oliver et al., 2020). Climatology of the annual total days, frequency, and cumulative intensity of MHWs over the GOT from 1982 to 2021 are shown in this study. Moreover, the calculation of the empirical orthogonal functions (EOFs) and principal components (PCs) of marine heatwave intensity (MHWI) in the Gulf of Thailand from 1982 to 2021 is revisited in this study. The first EOF and PC of marine heatwave (MHW) have proven to be a useful metric of sea surface temperature (SST) variation in the Gulf of Thailand. We discover that the period of persistent marine heatwaves that began in the 2010s may cause a fundamental change in the first EOF and PC of MHWI. The results also indicate that there is a need for better monitoring and investigation of MHWs in the GOT. For future works, it is very important to investigate the mechanisms and impact of MHW in the GOT. This will help to improve our understanding of the risks posed by MHWs and to develop strategies for mitigating their impacts.

Keywords: MHW, EOF, OSTIA, GOT, climate change

Sub-theme A:
Ocean Processes and Climate Change

Session A4:
Ocean environmental and climate changes in the past:
High and low latitude connections in the Asian Continental Margins



Session A4: Ocean environmental and climate changes in the past: High and low latitude connections in the Asian Continental Margins

Impact of evolving anthropogenic Pb emissions on sedimentary systems in Asia: A comparative study in the Yellow Sea and Gulf of Thailand

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Abstract

Anthropogenic emissions from coal-petroleum-based energy consumption have greatly altered the concentration and isotopic composition of lead (Pb) in the global oceans since the mid-20th century. China and SE Asia countries are among two of the most rapidly expanding and emerging economies with contrasting magnitudes of anthropogenic Pb emissions in recent decades, leading to totally different patterns of Pb distributions in the Western Pacific and neighboring seas compared with North America and Europe. To capture large-scale features of the sources and pathways of Pb, a systematic investigation of the sedimentary Pb and Pb isotopes in the Yellow Sea (YS) and Gulf of Thailand (GOT) was performed. Pb contamination was observed in the two regions with quite distinct sources and input pathways. We found that sediment Pb in the YS was heavily impacted by coal-petroleum combustion sources, which explained ~58% of the total Pb. The influences of increasing Pb emissions from coal consumption in the 2000s were more significant because Pb isotopic ratios in the YS show more affinity to those in the coal. Comparatively, Pb isotopic evidence, however, showed that lithogenic sources from mining activities, combined with anthropogenic origins such as coal combustion, contribute to Pb contamination in the GOT, with a minor role from fossil fuel consumption. Furthermore, coastal input from gold mining, dumping and atmospheric deposition were the possible pathways for elevated Pb in the YS seafloor, while river transport was the prevailing route in the GOT. In short, the stark patterns of anthropogenic disturbance in China and SE Asia demonstrate distinct impacts on Pb contamination in the YS and GOT. Although there are signs of contamination mitigation from reduced emissions, Pb contamination across Asia should be closely observed in the long term as human activities and natural processes continue to release Pb into the marine environment.

Keywords: Pb isotopes; anthropogenic disturbance; energy consumption; Yellow Sea; SE Asia

Session A4: Ocean environmental and climate changes in the past: High and low latitude connections in the Asian Continental Margins

Spatial variability of surface sediments in the Malacca Strait and its implications for sedimentary environments

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Abstract

The Malacca Strait is not only a part of shelf deposition but also a crucial conduit connecting the continental shelf to the deep ocean. Here, we present the grain size characteristics of sediments in the Malacca Strait and regional hydrographic data obtained from global models to delineate its depositional configurations and further identify its sedimentary environments. The results reveal that the residual sediments are concentrated in the central region of the strait, whereas the modern terrigenous sediments are distributed along the coast of Malaysia and the broad northern region of the strait. The central region of MS, Province I, has the coarsest sediments with moderate sorting, indicating a residual sedimentary environment where the sands are residual paleo-river deposits. There are poorly sorted silty sands in Province II, which display finer mean grain size than that of Province I. It suggests a reworked sedimentary environment with variations of sediment sources between the southern and northern regions. It is a palimpsest of the paleo-deltaic deposits in the southern region, which have been intensely altered by modern high-energy hydrodynamic conditions. In terms of the northern part of Province II, it has modern reworked deposits shaped by wave, tide, and monsoon currents. The finer sediments, which correspond to the distribution of higher silt content, are supplied by the surrounding land in Province III indicating a modern environment primarily influenced by seasonally varying sedimentary dynamics, such as monsoon currents, well-developed eddies, and water masses. We thus propose that the depositional configurations in the Malacca Strait are confined by depositional dynamic environments, which restrict modern terrigenous sediments distributed along the coast and scarcely transported into the central region of the strait which exposes residual deposits. This study highlights the importance of both modern and relict sediments in the strait and our findings are important to better understanding modern strait sedimentary systems with high tidal-current-energy.

Keywords: surface sediment, grain size, depositional characteristics, sedimentary environment, Malacca Strait

Time lag and cumulative effects of extreme climate on coastal vegetation in China

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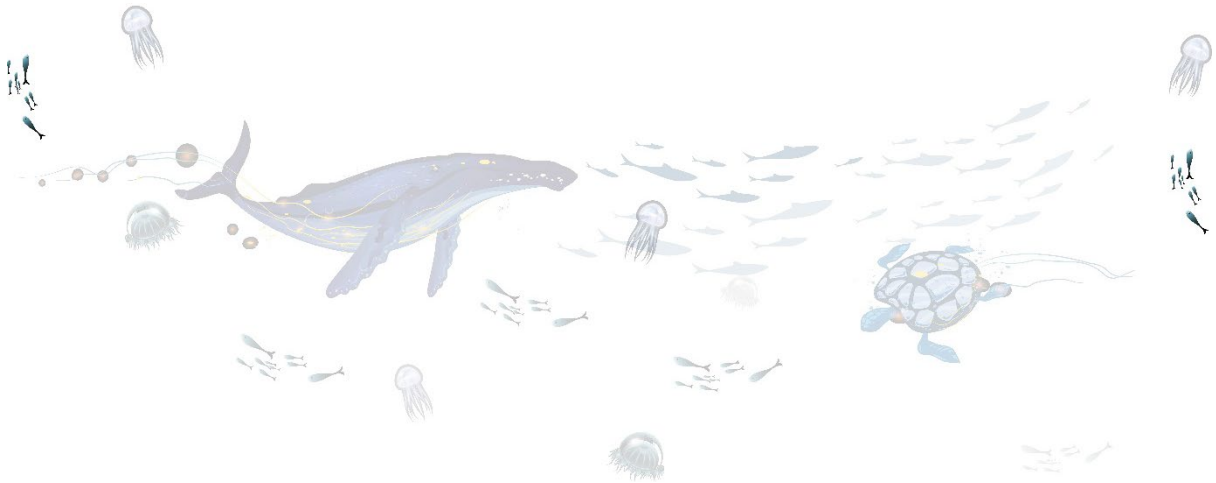
Abstract

Rapid global changes are altering regional hydrothermal conditions, especially in ecologically vulnerable regions such as coastal areas of China. Identifying and quantifying the response of extreme climates to vegetation growth and the time lag-accumulation relationship still require further exploration. We characterize the vegetation growth status by solar-induced chlorophyll fluorescence (SIF), analyzed the vegetation dynamic in coastal areas of China from 2000 to 2019, also explored the spatiotemporal pattern of vegetation, and assessed the response of vegetation to extreme climate in term of time lag-accumulation by combines gradual analysis and abrupt analysis. The results showed that (1) Coastal areas of China were sensitive to global climate change, with extreme high temperatures and extreme precipitation increasing from 2000 to 2019, and the warming in high latitudes was greater than in low latitudes, while the increase in precipitation was concentrated in the southern regions, which are already water-rich. (2) The vegetation in coastal areas of China improved significantly, with gradual analysis showed that the vegetation improvement area accounts for 94.12% of the study area, and the abrupt analysis showed that the majority (69.78%) of the vegetation change types were "monotonic increase", with 11.77% showing "increase with negative break" and 9.48% "increases to decreases." (3) Significant lag-accumulation relationships were observed between vegetation and extreme climate in coastal areas of China, and the time-accumulation effects was stronger than time-lag effects. The accumulation time of extreme temperatures was typically less than one month, and the accumulation time of extreme precipitation was 2-3 months. These findings contribute to filling gaps in understanding the time lag-accumulation effects of extreme climates on vegetation in sensitive coastal regions. It provides a foundational basis for predicting the growth trend of coastal vegetation, environmental changes and ecosystem evolution, which is essential for a comprehensive assessment of coastal ecological security.

Keywords: Lag-accumulation effects, extreme climate, gradual and abrupt analysis, coastal vegetation

Sub-theme A:
Ocean Processes and Climate Change

Session A5:
Sediment source-to-sink processes responding to rapid climate change



Chemical composition of aerosols collected in Bangkok and Chonburi, Thailand: a comparative study between a megacity and a coastal city

Suwapat khotchabang, Sujaree Bureekul, and Patama Singhruck

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Abstract

The research investigated the chemical composition of aerosols collected at the Anyamanee Building, Chulalongkorn University, Bangkok during the northeast monsoon season (November 15, 2021, to January 31, 2022) and compared with the influences of marine effect aerosol samples collected at Ang Sila Marine Animal Research Station (ASL) (December 20-26, 2021) Chonburi. Aerosols with diameters ≤ 2.5 microns ($PM_{2.5}$) and between 2.5 - 10 microns ($PM_{2.5-10}$) were collected and analyzed for mercury (Hg) and trace metals including cadmium (Cd), manganese (Mn), lead (Pb), and zinc (Zn). The results showed an increasing trend of total metals in $PM_{2.5}$ from November to January, with Pb>Zn>Cd>Mn, averaging concentrations of 0.22, 0.20, 0.03, and 0.01 μg/m^3, respectively. For $PM_{2.5-10,}$ no increase in total metal concentration was observed, with Zn>Pb>Cd and Mn, averaging at 0.26, 0.23, 0.03, and 0.03 μg/m^3, respectively. Hg had the lowest concentration (average of 0.18 ng/m^3 and 0.23 ng/m^3). Water-soluble inorganic ions (WSIIs) were also analyzed, $PM_{2.5-10}$ contained more WSIIs than $PM_{2.5}$, showing an increase in January. In $PM_{2.5}$, NO_3^-> Cl^- >SO_4^{2-} (Anion) concentrations were 1.80, 0.51, and 0.40 μg/m^3, respectively, and NH_4^+>K^+>Ca^{2+}>Na^+>Mg^{2+} (Cation) concentrations were 3.08, 1.57, 1.56, 0.61, and 0.33 μg/m^3, respectively. In $PM_{2.5-10}$, concentrations were 26.60, 12.59, and 0.45 μg/m^3 for NO_3^-, SO_4^{2-}, and Cl^- (Anion), respectively, and 5.49, 5.21, 2.53, 1.88, and 0.51 μg/m^3 for Ca^{2+}, NH_4^+, K^+, Na^+, and Mg^{2+} (Cation), respectively. Hybrid Single-Particle Lagrangian Integrated Trajectories (HYSPLIT) indicated a predominant wind from the northeast direction, gradually shifting to the southeast in January.Comparison with ASL samples revealed higher total metal concentrations in Bangkok, especially for Zn and Hg. Zn concentrations in $PM_{2.5}$ and $PM_{2.5-10}$ were 1.72 and 1.33 times higher, and Hg concentrations were 14.4 and 1.3 times higher, respectively. Some WSIIs concentrations in ASLwere higher, such as NO_3^- and NH_4^+. Enrichment factors (EF) greater than 10 (EF>10) for mercury and trace metals suggested deposition from sources other than natural deposits, except for Mn (EF<10).

Keywords: $PM_{2.5}$, $PM_{2.5-10}$, trace metals, water-soluble inorganic ions (WSIIs), Northeast monsoon

Dissolved organic matter distribution in the Gulf of Thailand

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Abstract

Dissolved organic matter (DOM) refers to a complex mixture of organic compounds that are dissolved in the water column of marine environments. DOM consists of a diverse array of molecules, originating from different sources within and outside of the ocean. DOM serves an important role in nutrient cycling, light attenuation, ocean color, and food sources for marine microbes. This study analyzed dissolved organic carbon (DOC), dissolved organic nitrogen (DON) and dissolved organic phosphorus (DOP) using high-temperature catalytic oxidation (HTCO) and persulfate oxidation. Water samples were collected by depth from the 72 stations in the Gulf of Thailand in October 2018. The results showed that the concentration of DOC, DON, and DOP ranged from 14 to 1,083 μM, 0.12 to 43.94 μM, and below detection to 0.39 μM, respectively. On average, these concentrations were 280±162 μM, 9.31±5.36 μM, and 0.10±0.08 μM, respectively. Most high values were found near the coast, indicating riverine source that brings terrigenous DOM into the study area. Furthermore, in some highly productive stations, we could also observe peaks of DOM as well.

Keywords: Dissolved organic carbon (DOC), Dissolved organic nitrogen (DON), Dissolved organic phosphorus (DOP), persulfate oxidation, high-temperature catalytic oxidation (HTCO)

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Reconstructing chemical weathering intensity of Taiwan since the last glaciation: Geochemical records in the Penghu Submarine Canyon of the northeastern South China Sea

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Abstract

The chemical weathering process plays a major control in sediment transport and is regulated by complicated factors including climate, tectonics, and lithology in different timescales. However, the interaction of chemical weathering with environmental conditions remains controversial. To better understand how chemical weathering responds to East Asian monsoon and sea level fluctuations since the last glaciation in Taiwan, a high-resolution X-ray fluorescence core scanning study was conducted on Core MD18-3570 located in Penghu Canyon in the north-eastern part of the South China Sea. We reconstruct the chemical weathering intensity history of Taiwan since 57 kyr BP using high-resolution major elements results. Based on differences in elements' mobility during the weathering process, K/Ti and Al/Ti ratios are applied to be weathering indicators. At glacial-interglacial timescale, K/Ti and Al/Ti decrease since the last glaciation and reach minimum value during LGM, then increase again to a relatively high level in Holocene, indicating the chemical weathering was higher during glaciation than interglaciation, which is due to larger shelf exposure and less physical erosion controlled by sea level and rainfall change. At the millennium scale, the chemical weathering intensity greatly correlated with stalagmite oxygen isotope in Dongge/Hulu Cave. The K/Ti and Al/Ti ratios can record rapid climate changes in the last glaciation (Heinrich events, Bølling–Allerød, and Younger Dryas), which suggests rainfall variation can determine chemical weathering intensity on a millennium scale. Therefore, the intensity of chemical weathering in Taiwan since the last glaciation was controlled by sea level fluctuation and monsoon rainfall.

Keywords: geochemistry, chemical weathering, East Asian monsoon, last glaciation, Penghu canyon

Organic carbon burial rates in the lower Gulf of Thailand

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Abstract

The Gulf of Thailand is a semi-enclosed body of water surrounded by land from four countries and has many rivers flowing into it. It is economically important in terms of fisheries and serves as an area for carbon sink. This study evaluates the quantification of organic carbon burial in the lower Gulf of Thailand (lower GoT). Samples were collected from the lower GoT using a box core, providing a core sample with a length of 65 centimeters. Most of the sediment from this core was made up of silt. The analysis for organic carbon (OC) was done by the Walkley-Black titration method to quantify readily oxidizable organic carbon (ROOC). The ROOC content was determined to average 0.88 ± 0.08% by weight of dry sediment. The sediment accumulation rate was assessed using the Pb-210 radiometric dating method, resulting in a 0.45 cm/year rate. The calculated accumulation rate of ROOC ranged from 0.04 to 0.09 g C /cm^2.yr. It is notable that this work used ROOC as a proxy for OC and this will serve as a conservative minimum number for OC stock in the calculation of OC burial rate.

Keywords: readily oxidizable organic carbon (ROOC), Pb-210 dating, Accumulation rate, Walkley-Black titration, Sediment accumulation rate

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Organic carbon content in the sediment core from Bangpakong River mouth, Thailand

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Abstract

Continental shelf sediments store large amounts of organic carbon, thereby representing one of the primary areas of research for carbon storage. Here, we investigated the organic carbon content in a sediment core collected near the Bangpakong River mouth in 2020. A gravity corer was used to obtain the core sample with the total length of 80 centimeters. The sediment from this core was made up mainly of clayey silt. The ages of sediments as determined using Pb-210 radiometric dating were from 1916 to 2016. We analyzed the amount of sedimentary organic carbon in the Walkley-Black titration method. Hence, this fraction of organic carbon was deemed as the readily oxidizable organic carbon (ROOC). Throughout the length of the sediment core, the ROOC was 2.43 ± 0.13 % dry weight. The calculated burial rate for ROOC in the sediments for the whole core (from 1916 to 2016) was 0.730±0.320 gC/cm^2.yr which is at least five times less than the values from core taken around Yangtze River mouth (3.50–5.58 gC/cm^2.yr). This difference might stem from the differing deposition regime or the fact that our values were based on ROOC instead of total organic carbon.

Keywords: estuary, carbon burial rate, readily oxidizable organic carbon (ROOC), Walkley-Black titration

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Geochemistry of core sediments in the nearshore area of the Bay of Bengal, Bangladesh

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Abstract

The geochemical composition of core sediments collected from the Bay of Bengal coast, Bangladesh was examined to infer provenance, chemical weathering, and tectonic setting. The sediment samples contained high SiO_2 (84-90 wt.%) and low Al_2O_3 (4-8 wt.%) and displayed a strong negative correlation (r = -0.99) indicating that SiO_2 is mainly controlled by the quartz content rather than aluminosilicates. Al_2O_3 shows a marked positive correlation with Fe_2O_3T (r = 0.97), MgO (r = 0.94), and K_2O (r = 0.80), indicating the association of these oxides with ferro-magnesium minerals and phyllosilicates. Additionally, Al_2O_3 displays strong positive correlations with Ni (r = 0.91), Rb (r = 0.88), V (r = 0.88), Ga (r = 0.87), and Ba (r = 0.56), representing the association of these elements with clay minerals. Rubidium is strongly correlated with Ba (r = 0.97) and Sr (r = 0.97), reflecting the association of these elements probably allied with feldspar minerals. The positive correlation of Zr with Hf (r = 0.99), HREE (r = 0.92), and Yb (r = 0.79) implies that these elements are mostly allied with heavy minerals. Geochemically, the sediments are classified as sub-litharenites to litharenites, and shale, and are compositionally low mature to immature. The Chemical Index of Alteration (CIA, ~70 to 80) and Plagioclase Index of Alteration (PIA, ~70 to 93) indicate that the source area experienced in moderate to higher degrees of chemical weathering. The weathering pattern in the core sediments might be influenced by the strength of the South Asian monsoon climate. However, provenance discriminant diagrams and elemental ratios show that the sediments were largely derived from felsic source rocks. The Index of Compositional Variability (ICV) values of the sediments differ from 0.79 to 1.18, which indicates immature to moderate maturity. Tectonic setting diagrams of the sediments demonstrate a transitional scenario between active continental margin and passive margin environments.

Keywords: geochemistry, provenance, chemical weathering, tectonic setting, Bay of Bengal

A review of the effects of turbidity and anthropogenic pollution on seagrass carbon sequestration in urban areas

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Abstract

Seagrass ecosystems are an important component of the coastal environment and provide a variety of ecosystem services. It has become known in recent years for its important role in sequestering carbon and mitigating climate change. However, seagrass ecosystems in coastal urban areas face multiple pressures. Coastal development increases runoff and sedimentation, leading to increased turbidity and light restrictions. Anthropogenic pollution, arising from urban activities, introduces an array of contaminants into coastal waters enriching nutrients. These have an impact on seagrass growth and carbon sequestration. Here, we review existing research on carbon storage in seagrass meadows to determine the effects of turbidity and anthropogenic pollution on the carbon storage capacity of different seagrass species. We demonstrate that carbon storage in not all seagrass habitats is reduced by the effects of turbidity and anthropogenic activities. Trends and disparities in seagrass responses to turbidity and pollution vary in diverse urbanized coastal settings. Therefore, local seagrass species, turbidity, and nutrient availability should be considered in conservation and management strategies aimed at maximizing sediment carbon content.

Keywords: urban area, seagrass, carbon sequestration, anthropogenic pollution, turbidity

Concentrations of nitrate and other nutrients in groundwater and surface river water in Rayong Province, Thailand

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Abstract

Rayong is situated along the eastern side of the Gulf of Thailand and it has been facing diverse anthropogenic pressures. Furthermore, the rapid development of Eastern Economic Corridor (EEC) in Rayong Province may lead to an increasing demand for groundwater resources. One particular concern about groundwater usage for drinking water supply is the high groundwater nitrate above than standard value. This can affect human health and lead to various environmental problems, especially eutrophication or subsequent deoxygenation. This research aimed at investigating and comparing concentrations of nitrate and other nutrients in groundwater and rivers in Rayong. Our study areas were divided into 2 watersheds: Rayong and Prasae watersheds. Groundwater samples were collected from 25 and 17 wells in Rayong and Prasae watersheds, respectively. These groundwater samples include those from unconsolidated sedimentary aquifers and granite aquifers. For river water samples, 23 sites from Rayong River and 20 sites from Prasae River were sampled in July and August 2023. Nutrients including nitrate, nitrite, ammonium, phosphate, and silicate were measured by colorimetry. The nutrient concentrations for both groundwater and river water in Rayong and Prasae watershed were different. Groundwater nitrate ranged from 0.08 to 11.39 mg/L in Rayong and 0.16 to 2.55 mg/L in Prasae, while nitrate in Rayong and Prasae Rivers were 0.23- 8.44 mg/L and 0.18- 12.10 mg/L, respectively. Rayong groundwater has higher concentrations for all nutrients than Rayong River except for nitrite. Meanwhile, Prasae groundwater was generally low in nutrient composition. The difference in nutrients between two watersheds was likely due to several factors such as land use and hydrogeological regimes. Overall, the water quality in Rayong province found in this current study was still within the water quality standard of Thailand and probably pose minimal impact to the adjacent coastal ecosystem. To this end, groundwater nitrate in this study is, unlike in prior reports, lower than the WHO threshold for drinking water. Whether this low nitrate in groundwater samples was a one-off event or due to improvement in groundwater quality is up for debate. It is imperative to conduct additional studies to determine the potential sources of nitrate, the effect of land use change and nitrate concentration in the submarine groundwater discharge to ensure the healthy coastal ecosystem in

Rayong. Moreover, climate change may impact future precipitation events and in turns affect groundwater nitrate in the area.

Keywords: water quality, Rayong watershed, Prasae watershed, The Gulf of Thailand, Eastern Economic Corridor (EEC)

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Source and fate of organic matter in Bandon Bay, Thailand as evidenced by carbon and nitrogen contents and stable isotope composition

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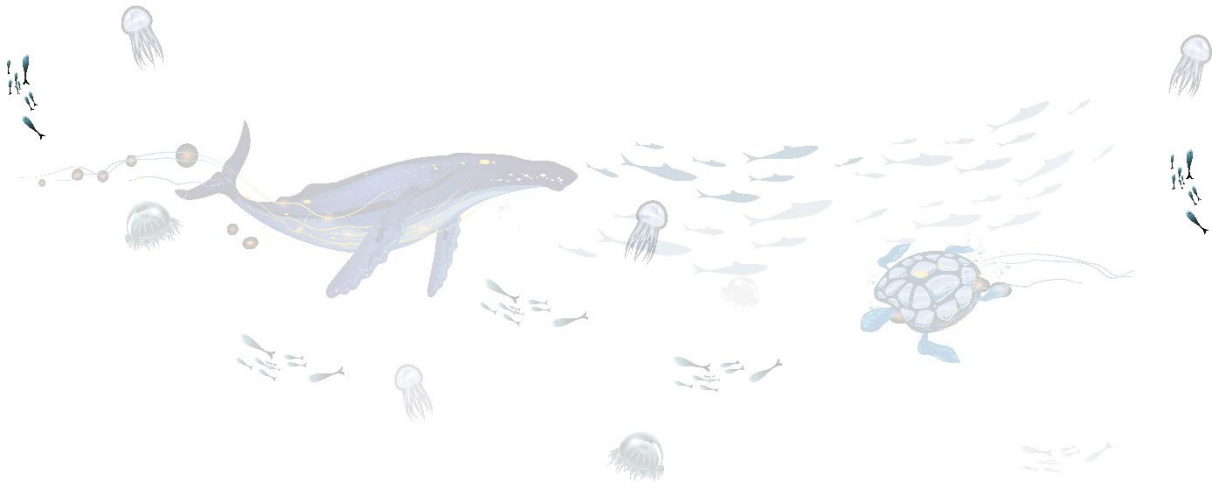
Abstract

Bandon Bay is Thailand's productive area for mariculture of many economically important shellfish species, including oysters and green mussels. High primary productivity in this shallow bay leads to organic matter (OM) production in the water column and its export to underlying sediments and adjacent areas. However, understanding of the source and fate of OM in Bandon Bay is still scarce. To address this knowledge gap, we investigated organic carbon (OC) and total nitrogen (TN) elemental contents, C:N elemental ratio, and stable carbon ($\delta^{13}C$) and nitrogen isotopic ($\delta^{15}N$) compositions in surface sediments, sediment cores, and suspended particulate matter (SPM) collected from Bandon Bay and surrounding river systems during the wet season in 2019. Conservative behaviors of $\delta^{13}C$ in the bay indicated a major contribution of terrigenous sources to the pool of sediment organic matter. In addition, river-associated high $\delta^{15}N$ input contribution during low tide with evidence of freshwater phytoplankton input to the bay. The degree of mixing was further quantified using a four-end-member carbon-isotope mixing model showing approximately 80% of sediment organic matter to be of terrestrial origin (land soils and freshwater phytoplankton) most likely brought to the bay via Tapi-Phumduang River. Furthermore, tidal cycles, and prevailing circulation in the bay cause mixing of OM in the bay with OM from the Gulf of Thailand. All these processes work together to bring about dispersal, dilution, and transformation of OM in Bandon Bay, which maintain high organic content in the sediment and supply nutrients essential for shellfish production in Bandon Bay.

Keywords: organic matter, sediments, suspended particulate matter, C:N ratio, stable isotopes

Sub-theme A:
Ocean Processes and Climate Change

Session A6:
Climate variability in the Indo-Pacific Maritime Continent (IPMC): Understanding impacts on atmosphere-ocean dynamics



Session A6: Climate variability in the Indo-Pacific Maritime Continent (IPMC): Understanding impacts on atmosphere-ocean dynamics

Seasonal variations in the food habits of *Sardinella lemuru* in response to climate-induced plankton dynamics: implications for fisheries management and food security in Prigi waters, Indonesia

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Abstract

Climate change has become increasingly evident over the last 150 years, indicated by increasing sea surface temperatures. It has an impact on the organisms that live in it, one of which is *Sardinella lemuru*. As a pelagic fish, *S.lemuru* depends on plankton availability as its food source. The availability of plankton in the water varies based on space and time scales. Climate change can trigger changes in the composition of plankton in waters. Limited information on the effect of seasonality on the food habits of *S.lemuru* prompted this study. So, this study aims to analyze the food habits of *S.lemuru* in different monsoon seasons. Plankton content of *S,lemuru* was collected within two seasons: Transitional Season I (March 2017) and Transitional Season II (November 2019). The t-test results showed a temperature difference between transitional seasons I and II, followed by differences in the composition of *S. lemuru* stomach contents. In transitional season I, the composition of *S. lemuru*'s stomach contents consisted of 76.27% zooplankton and 23.730 phytoplankton. Meanwhile, in the second transitional season, it consisted of 51.51 phytoplankton and 48.49 zooplankton. Based on the Ivlev method, it is known that the main food choices of *S. lemuru* in Prigi waters are Coscinodiscus (F) and Oncaea (Z) for both seasons. The results of this study can provide essential information in determining the right season in the management of *S.lemuru* fisheries for food security.

Keywords: pelagic fish, feeding habits, monsoon, plankton, climate change

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Session A6: Climate variability in the Indo-Pacific Maritime Continent (IPMC): Understanding impacts on atmosphere-ocean dynamics

Climate comfort level analysis and projection for tourism in the Toba Caldera Geopark

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Abstract

The climate of the Toba Caldera Geopark, North Sumatra, Indonesia, is unique. It is flanked by two bodies of water, the Strait of Malacca and the Indian Ocean, and traversed by the Bukit-Baran Mountain range, which runs from north to south. The local weather, seasons and climate are influenced by global, regional and local atmospheric conditions. Lake Toba as a natural tourism destination is vulnerable to climate change. Weather and climate characteristics become one of the important factors determining tourism interests. Climate conditions and predictions of future climate change must be taken into account when developing tourism. Weather and climate information is an important factor in travel decisions. Presenting climate variability data in tourism climate studies provides information for tourism professionals. This information helps to determine when and where conditions are optimum, pleasant, tolerable or unpleasant. The climate index approach is one-way researchers determine the diversity of climatic components for tourism. The index has been developed to help tourists and tourism managers evaluate climate suitability for tourism. This study aims to analyze the temporal and spatial patterns of the state of tourist comfort in the Toba Caldera Geopark using the Tourism Climate Index (TCI) and Holiday Climate Index (HCI) methods, and to predict the best time and place to travel to the Toba Caldera Geopark area based on the predicted state of tourist comfort in the period 2031–2050. The result of the research shows that the distribution pattern of the level of tourist comfort for the period 2031–2050 is "bimodal-shoulder-peak", where the level of comfort is dominated by the comfortable category. The highest comfort level for TCI and HCI is found in December. Comfort was lowest in June and July. HCI means that the best time for visiting the park are the months of April/May/October/December. According to the TCI method, the recommended sites are Simanindo-Batu Hoda and Hutatinggi-Sidihoni.

Keywords: temporal pattern, spatial pattern, TCI, HCI, Geopark, Toba Caldera

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Session A6: Climate variability in the Indo-Pacific Maritime Continent (IPMC): Understanding impacts on atmosphere-ocean dynamics

Tidal flood study in the coastal area of the Surabaya city in 2021 based on sea level analysis

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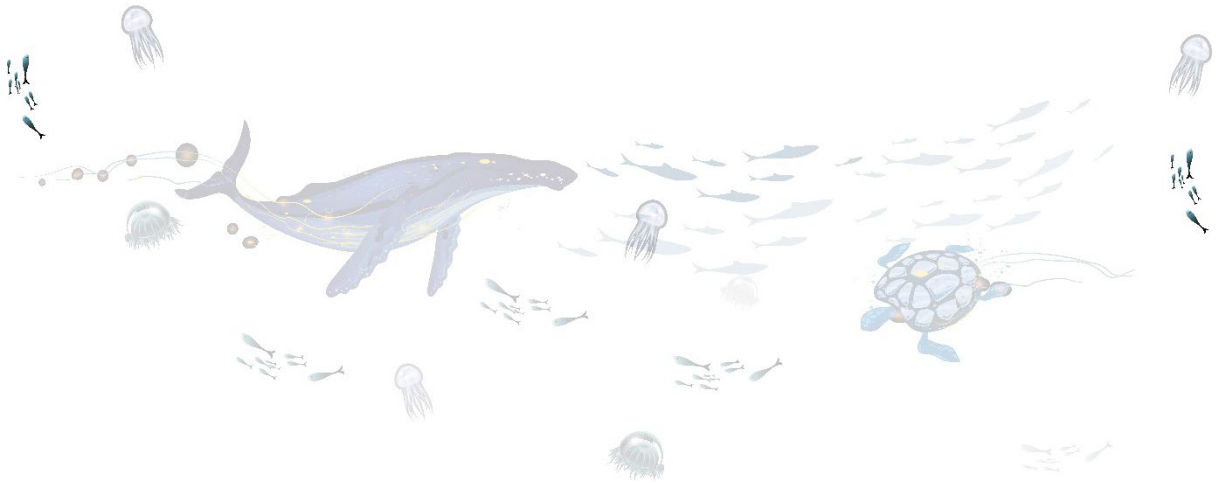
Abstract

Most of Surabaya city is a coastal area with low topographic characteristics. It is vulnerable to tidal flooding. In 2021, it was recorded that tidal floods often occurred in the coastal areas of the city of Surabaya, especially starting in May, June, November, and December. Some of them are caused by lunar eclipses and tides that occur in these months. This study aims to determine the variability of sea level in Surabaya coastal area during 2021, especially when tidal flooding occurs. Sea level analysis using tidal observation data from the Surabaya tidal station (7.19996944 N, 112.74058611 E). The hourly average sea level model during 2021 is used to determine the dynamics of sea level variability in the Surabaya waters. The method used is the time series method and the analysis of changes in sea level to determine the cause of tidal flooding in the coastal areas of the city of Surabaya. Based on the results of the analysis of the hourly average sea level variability during 2021, it is known that the sea level in the coastal areas of the city of Surabaya has variations. In general, sea level will increase from May to July and from November to January. The sea level generally decreases from February to April and August to October. This indirectly causes tidal flooding in the months with the highest average sea level. Tidal analysis also shows a difference where in cases of tidal flooding, the maximum tide shows a higher value. The results of the analysis show that not only astronomical phenomena trigger an increase in sea level which causes tidal flooding, but seasonal patterns and other weather phenomena can also have an impact on increasing sea level in the coastal areas of Surabaya.

Keyword: tidal flood, sea level, tide, Surabaya

Sub-theme B: Marine Biodiversity, Seafood Safety and Security

Session B1: Biogeography and dispersal of marine life in the Western Pacific



Gamete development of gorgonian, *Dichotella gemmacea* and diversity of gorgonians in Thailand

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Abstract

Gorgonian is one of the marine invertebrates that is abundant and has an important role in marine ecosystem. However, the populations of gorgonian have been decreasing from Thai waters. In this study, the gamete development and spawning periods of *Dichotella gemmacea*, the most abundant gorgonian at Laem Pu Chao, Sattahip district, Chon Buri province, Thailand were investigated. The results showed that *Dichotella gemmacea* had the highest density (0.32 colony/m^2) in this area. In addition, *Dichotella gemmacea* produced gametes during the whole study period. The high numbers of gametes in polyps were between 20.15±2.83 cells/polyp to 45.91±5.44 cells/polyp. The large diameters of gametes were 246.85±86.05 µm to 258.53±78.94 µm. Temperatures between 29.5 to 31.0^oC could be a factor influencing gamete development. Historical studies of this gorgonian showed that *Dichotella gemmacea* was gonochoric and all stages of oocyte or spermatid can be found at the same time in a polyp. Moreover, the results from histology studies showed that *Dichotella gemmacea* was a broadcasting spawner because none of the planula larvae were detected in any polyps during the period of the study.

Keywords: gorgonians, diversity, Thailand

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Distinguish the variations of Indo-Pacific multi-decadal climate variability on spatiotemporal distribution of yellowfin tuna population

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Abstract

Spatial variations in tuna population and abundance are strongly linked to large-scale climate fluctuations, such as the Pacific decadal oscillation (PDO) and Atlantic multidecadal oscillation (AMO). However, the mechanisms underlying the association of climate indices with yellowfin tuna (YFT) abundance and habitat preference remain unclear. We analyzed long-term longline fishery data for YFT and oceanic climate variability index data for 1971–2018. The standardized catch per unit effort (CPUE) of Indo-Pacific Ocean YFT was higher during negative AMO and positive PDO phases. In tropical Pacific Ocean, the trend of YFT habitat preference exhibited seesaw patterns because of the distinct environmental factors influenced by the PDO phase. The PDO changed the environmental parameters throughout the tropical Indian Ocean such that the habitat preference of YFT remained consistent throughout. However, the variations in habitat suitability did not correspond to the distribution or standardized CPUE of YFT throughout the Pacific Ocean during AMO events. Moreover, the changes in habitat suitability had a positive periodicity of 8–16 years with AMO in the Indian Ocean, but revealed opposite trends with the distribution or standardized CPUE of YFT. Our results provide sufficient information to distinguish the variations between PDO phase changing and YFT standardized CPUE/ habitat preference. Furthermore, the AMO phase shift period 60–100 years longer than that of the PDO (20–30 years), and models employing time series of fishery and environmental data must be extended the time period of our study to make the AMO match the fishery data more complete.

Keywords: Pacific decadal oscillation, Atlantic multidecadal oscillation, Yellowfin tuna, Indo-Pacific Ocean

Abundance, distribution, and diversity of Tuna larvae (Family Scombridae) in the Philippine waters

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Abstract

The Philippines is a significant producer of tuna globally but has experienced a decline in tuna production in recent years. Thus, efforts to explore and assess new fishing grounds were conducted by the Bureau of Fisheries and Aquatic Resources (BFAR) through M/V DA-BFAR. Assessment of the spawning and nursery grounds of tunas in the country's EEZ was also undertaken to properly manage and conserve tuna stocks. The said assessment commenced in 2006 and is continuing up to the present. All the data from 2006–2018 were compiled, including the data from collaborative studies with the University of the Philippines-Marine Science Institute and Southeast Asian Fisheries Development Center to create an overall profile of Scombridae's abundance and distribution of larvae in Philippine waters. The study results showed that family Scombridae is most abundant in the Philippine waters along Batanes-Polillo and areas off Eastern Luzon. Species diversity in Philippine waters was considerably high, with about six to eight dominant species. The most dominant species was *Thunnus albacares*, followed by *Thunnus obesus*, *Auxis* spp., *Katsuwonus pelamis*, unidentified Scombrid larvae, *Rastrelliger* spp., *Thunnus alalunga*, and *Thunnus tonggol*. The Scombridae species are diverse in the West Philippine Sea and Batanes-Polillo waters but not in Davao Oriental-Surigao waters.

Keywords: Scombridae larvae, abundance, distribution, Philippine waters

Tissue culture and development of multiple shoots in Thai seagrasses, specifically *Enhalus acoroides* (L.F.) Royle

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Abstract

Enhalus acoroides (L.f.) Royle is the largest seagrass species distributed in the coastal area of Thailand, playing a crucial role in the country's coastal ecosystems. This research focused on studying the morphological and anatomical development of *E. acoroides* after shoot multiplication using plant tissue culture techniques. *E. acoroides* seedlings were cultivated in a multiple shoot medium (KU medium) under a 16-hour photoperiod for 8 months. The morphological development stages of the explant were observed every two days using a stereo microscope. Anatomical development stages were collected, fixed in a Weak Chrom-Acetic acid solution, and processed into permanent slides using the paraffin method. Thin sections (10–15 µm) were stained with 1% Safranin and 0.5% Fast Green before mounting with permount solution and observed under a light compound microscope. The study revealed the emergence of new shoot initials from the lateral meristem on the 4th day of culture, developing from both apical and lateral meristems. Clearly formed shoots were visible by the 16th day of culture. After 8 months of culture, an average of 232.00±20.74 shoots were induced per explant. These findings provide valuable insights for guiding future in vitro seagrass propagation efforts.

Keywords: anatomy, aquatic plant, morphological development, propagation, tropical seagrass

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The effects of fertilization on the Growth of *Enhalus acoroides* (L.F.) Royle in plantlet culture

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Abstract

Enhalus acoroides (L.f.) Royle, the largest seagrass species in Thailand, plays a crucial role in coastal ecosystems and has a remarkably carbon sequestration capacity. The aim of this study was to determine an effective fertilization to promote the growth of *E. acoroides* plantlets in a controlled culture system. Eight-week-old plantlets were transferred to sandy trays and cultured in 28 psu seawater with concentrations of 1/16, 1/8, 1/4, 1/2, and 1 of Murashige and Skoog (MS) and Haugland nutrient solution (HL) media. The total leaf length of *E. acoroides* was measured weekly for four weeks, and the maximum quantum yield (Fv/Fm) was measured at the end of the experiment to measure photosynthetic efficiency. The plantlets cultivated in 1/16 HL showed the highest relative growth rate in the second week. Although there was no significant difference in the relative growth rate between 1/16 HL and the control group at the end of the experiment, the maximum quantum yield was highest in the plantlets cultivated in 1/16 HL. This result suggests that 1/16 HL may be a suitable medium for the long-term culture of *E. acoroides* plantlets.

Keywords: seagrass, aquatic plant, photosynthesis, nutrient solution

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Sediment characteristics in the upper intertidal seagrass beds in the Andaman Sea coast of Thailand

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Abstract

Sediments characteristics are vital factors impacting the growth and distribution of seagrasses. Bottom sediments, serving as the seagrass substrate, play a crucial role in stabilization, preventing displacement by strong currents and waves. Furthermore, seagrass sediment serves ecologically important functions such as nutrient absorption, organic material entrapment, and provide space for many marine benthic organisms. The objective of this research was to investigate grain size composition and organic matter content in the sediments among three dominant seagrass species; *Halophila ovalis, Thalassia hemprichii* and *Enhalus acoroides*, compared to bare area in Andaman coast of Thailand. We collected 223 samples in monospecific patches along transect lines in the upper intertidal zone in Krabi and Trang Province. Silt-clay content was highly significant difference between seagrass species and bare areas ($F=4.802$, $p=0.002$). *Enhalus acoroides* sediments had the highest silt-clay content at 15.3±12.1%, followed by bare areas (13.7±16.2%), *Halophila ovalis* (7±2.2%), and *Thalassia hemprichii* (4.7±3.1%). Organic matter content showed a highly significant different among seagrass species ($F=16.34$, $p<0.001$) with the highest percentage in *Enhalus acoroides* sediment (1.18±0.5%). Interestingly, while there were no significant differences in the respective organic matter contents, *Enhalus acoroides* thrives across various silt-clay sediment compositions surpassing other species. The sediments associated with *Enhalus acoroides* showed a higher accumulation of organic matter within patches compared to others, suggesting its potential as an effective carbon storage plant, addressing blue carbon concerns.

Keywords: *Enhalus acoroides*, grain size, organic matter, silt clay, carbon storage

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Dynamics of green *Noctiluca scintillans* bloom at Bangsean beach, Chonburi province, Thailand from July to September 2023

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Abstract

Green *Noctiluca scintillans* (GNS) is a dinoflagellate phytoplankton that causes the red tide phenomenon in the upper Gulf of Thailand especially along the eastern boundary which has become more frequent in recent years. This study examines the bloom dynamics of *Noctiluca scintillans* found at Bangsaen Beach, Chonburi Province in Thailand between 27th July and 20th September 2023. The objective is to understand dynamics associated with plankton bloom and its relationship with physical and chemical seawater quality. Throughout the study period, seawater samples were collected on the coast spanning approximately 4.5 km centered at Bangsaen Beach and area nearly 2 km offshore. A 21-micrometer net was used to filter 10 liters of seawater for plankton samples to investigate plankton abundance and diversity at the genus level under a microscope at the laboratory. To preserve the cells, 5% formaldehyde was used. Moreover, physicochemical parameters of seawater, including temperature, salinity, pH, dissolved oxygen of the samples were measured. Additional water samples were collected to analyze concentration of nutrients during the bloom of *Noctiluca scintillans* in the laboratory. As the observed GNS bloom occurred over a long period, the results revealed several important and thorough findings. From the end of July to the end of September, there were a series of 2 *Noctiluca scintillans* blooms. Throughout the bloom period, densities of GNS ranged between 190–4,355,000 cells/liter, with high cell densities firstly found offshore (6.45×10^4 cells/liter). The high cell-density water moves nearshore appearing to the north of Bangsaen Beach and gradually moving southward. Competition of GNS and *Perdinium* sp. was observed to the north of Bangsaen Beach during the initial bloom stage, while the predominant group is *Chaetoceros* sp at Bangsaen Beach and to its south. The GNS cell density ranged between 2.55–435.50 $\times 10^4$ cells/liter during the observing period with the highest cell density in mid-August. At the end of the GNS bloom period in late August, a group of diatoms, *Chaetoceros* sp., was found. Water quality during the bloom has a significant positive correlation with phosphorus concentration. During the observing period, salinity ranged 20–22 ppt, and pH levels ranged 4.5–6, dissolved oxygen ranged 0.07–12.07 mg/L. This GNS bloom resulted in the death of 14 tons of marine animals likely due to oxygen depletion.

Keywords: *Noctiluca scintillans,* phytoplankton, Bangsaen Beach, red tide

Carbon-Nitrogen content variation and allelopathic disruption of Renieramycin M-Producing sponge *Xestospongia* sp. in the Gulf of Thailand

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Abstract

The existence of allelopathy in marine sponges is common, but there remains a scarcity of information regarding the specific allelopathic properties of sponge extracts. In this study, variations of nutritional values of *Xestospongia* sp. were investigated. The nutritional components of *Xestospongia*'s predatory defense were not distributed unevenly. The edge, inner, and outer sections of *Xestospongia* sp. did not significantly differ in their carbon-nitrogen contents or renieramycin M concentrations. Carbon–nitrogen contents in every area of *Xestospongia* coexisting with *Porites* were not different from those of *Xestospongia* coexisting with *Palythoa*. However, different proportions of *Xestospongia*, with the highest concentration of renieramycin M at the edge area, coexisting with *Porites* were higher than that proportion of *Xestospongia* coexisting with *Palythoa*, despite the concentrations of renieramycin M not being differently distributed throughout the body and among individuals of *Xestospongia.* Additionally, *Xestospongia* coexisting with *Porites* had a greater average renieramycin M concentration at its edge than *Xestospongia* coexisting with *Palythoa*. Renieramycin M did not cause bleaching or necrosis of coral nubbins in the laboratory, and it did not affect coexisting organisms (*Porites lutea* and *Palythoa caesia*). However, renieramycin M inhibited the settlement of acorn barnacle (*Semibalanus balanoides*) while not affecting pelecypods. Renieramycin M tested as an antimicrobial agent, but it did not inhibit aerobic bacteria growth under all conditions when it was tested for its antimicrobial effect. This study provides evidence that renieramycin M found in Xestospongia was uniform; however, it can possess strong inhibitory activities against some marine organisms.

Keywords: *Xestospongia* sp., Renieramycin M, allelopathy, Gulf of Thailand, bioactive compounds, coral

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Zooplankton composition at estuarine front of tidal influenced Kuala Terengganu estuary, Terengganu

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Abstract

The spatial pattern of zooplankton community was studied during southwest monsoon season at the estuarine front of Kuala Terengganu estuary. Zooplanktons were collected at three main regions of the estuary that were plume, front and shelf during May and August 2022, where comparison of zooplankton composition and diversity and relationship of environmental factors were done. Frontal zone of the estuarine front yield's greater density of zooplankton during high tide with tide height greater than 1.5 m in both surface and mid waters. High incoming tidal waters and convergence with incoming riverine water influence high zooplankton composition at the frontal zone during the formation of tidal fronts. Contrastly, low zooplankton abundance was recorded at frontal zone during ebb tide than adjacent plume and shelf waters during both months. The average density of zooplankton recorded in the month of May and August 2022 was 6184 inds. m^{-3} and 9415.566 inds. m^{-3}, respectively. In both sampling events, copepod group yield higher abundance which was 81.6 % and 90.1%, respectively. The dominant genera recorded for the month of May, 2022 were *Oithona* sp*.*, *Paracalanus* sp., and *Microsetella* sp., and significant shift to *Oncaea* sp., *Microsetella* sp., and *Paracalanus* sp*.* was recorded for the month of August, 2022. The findings from this study contributes in the baseline understanding of the dynamics of the estuarine plume fronts in shaping the zooplankton community.

Keywords: frontal, southwest monsoon, copepod

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Early life dynamics of *Sardinella gibbosa* in central Philippines

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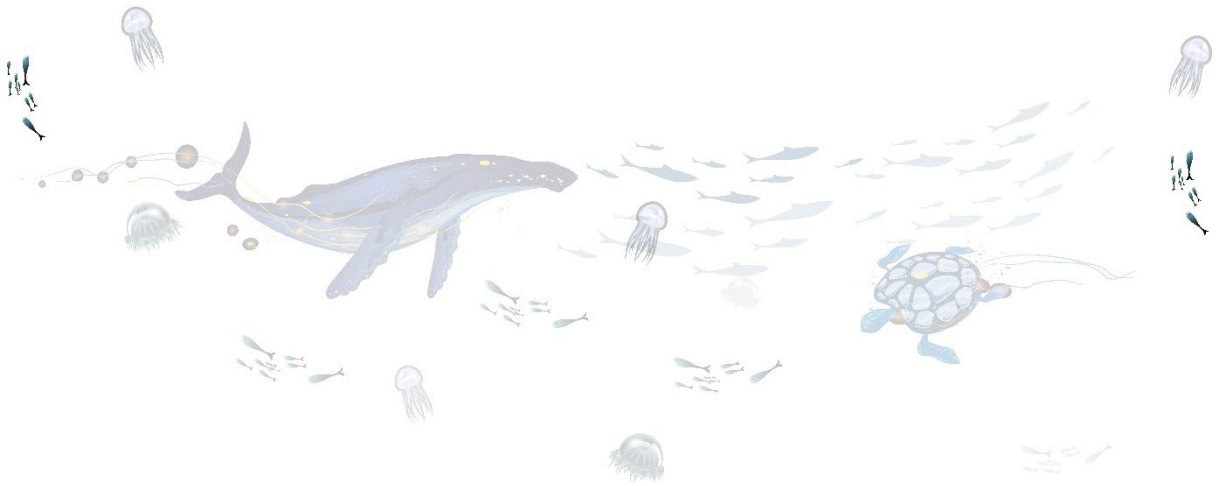
Abstract

The abundance of sardine population has been strongly linked to recruitment strength which is mainly influenced by various factors affecting the early life stages. Understanding these factors is essential if we are to manage the sardine resources effectively. Sardines is one of the major fishery resources in the Philippines, with *Sardinella gibbosa* comprising the bulk of the catches in various major sardine fishing ground such as the Visayan Sea. Otolith microstructure of *S. gibbosa* were analyzed to examine their early life growth from a 5-yr period (2016–2021). Mean growth rate of individuals ranges from 0.26–0.74 mm day^{-1}. Repeated measures ANOVA indicated that growth varied significantly within season, between seasons in a year, and among years. Cohorts hatched during the northeast monsoon months (dry and cold) display significant variability in growth compared to those hatched during the southwest monsoon months (wet). Moreover, growth greatly varied during strong/weak El Niño/La Niña years compared to neutral/moderate ENSO years. These differences in early life growth appear to be influenced by environmental and climatic conditions. GAM analysis showed that food, proxied by *chl a*, and sea surface temperature significantly affected growth but only explained 28.5% of the total variability.

Keywords: otolith, fish early life, recruitment, Sardines

Sub-theme B: Marine Biodiversity, Seafood Safety and Security

Session B2: Systematics, taxonomy, and phylogenetics of marine life in the Western Pacific



Species diversity of marine organisms and their relationship with echinoderms along Samaesarn Island and adjacent areas, Chonburi, Thailand

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Abstract

Echinoderms and the marine organisms that are associated with echinoderms were collected from coral areas in the daytime and nighttime by SCUBA diving during 26–29 October 2021, 7–10 December 2021, and 11–13 May 2022. Twenty-two study sites were used for collection.

The host echinoderms found were classified into 9 species, including 2 species of Crinoidea, 2 species of Asteroidea, 4 species of Echinoidea, and 1 species of Holothuroidea. Thirty-four species of associated marine organisms were found, including 4 species of Polychaeta (Annelida), 4 species of Myzostomida (Annelida), 1 species of ribbon worm (Nemertea), 10 species of Crustacea (Arthropoda), 8 species of Ophiuroidea (Echinodermata), 2 species of Gastropoda (Mollusca), 1 species of Bivalvia (Mollusca), 1 species of Syngnathidae (Chordata), and 3 species of Pomacentridae (Chordata). The greatest relationship type between echinoderms and marine organisms was Commensalism (+, 0). A minority of species were Parasitic (+, -).

The species of echinoderms that had the closest relations to other marine organisms were *Diadema setosum, Dichrometra palmata*, and *Stephanometra indica*, respectively, while the marine organism that had the closest associations to echinoderms was *Zebrida adamsii,* which was found to be acting as a parasite (+, -) upon the echinoderm species *Diadema setosum*, *Salmacis sphaeroides,* and *Toxopneustes pileolus*.

Keywords: Echinodermata, Associated marine organisms, Species diversity, Commensalism, Parasitism

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Coscinodicus in Viet Nam: diversity and phylogeny

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Abstract

Centric diatom species of *Coscinodiscus* are commonly found and often contribute a significant proportion of the primary productivity of the marine ecosystem. Early work in Viet Nam coastal waters reported a long list of 32 taxa. However, this checklist is subject to be revised due to various issues including synonymous species, wrong identification, and most of all poorly described species with relatively similar features of the frustule. The present study used samples collected over decades along the coast of Viet Nam attempting to revise the species checklist based on morphological features using light and scanning electron microscopy and molecular analyses of the *rbc*L marker. Each species was presented with a short description and illustrations and where possible with molecular data. This checklist provided reliable information on the species identification of the genus *Coscinodiscus* in Vietnamese waters.

Keywords: *Coscinodiscus*, diversity, phylogeny, Vietnamese waters

Session B2: Systematics, taxonomy, and phylogenetics of marine life in the Western Pacific

Antibacterial activities screening on Nudibranch-associated bacteria from northeast of Bali, Indonesia

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Abstract

Marine invertebrates, especially nudibranchs, are well known as exotic organisms and have been recognized to produce bioactive compounds. The problematic sustainability of natural product research was driving the research towards the associated microbes. In the attempt to find new antibacterial candidates, we screened nudibranch associated bacteria for their bioactivities. In total, we isolated 6 of the specific nudibranchs, namely *Ceratosoma trilobatum, Phyllidia picta, Hypselodoris maridadilus, Mexichromis trilineata,* and *Mexichromis multituberculata*. The study reported for the first time that seven strains of the bacteria associated with nudibranch from Northeast of Bali have promising activities to inhibit the Multi-Drug Resistance (MDR) growth. The candidates of bacteria were identified using 16S-rRNA gene and carried out by chelex method. Nonetheless, further research for detailed characterization of potential compounds is indispensable.

Keywords: Antibacterial, Nudibranch, Bacteria, Identification, Indonesia

Biomass and benthic microalgae communities in mudflats that affected and unaffected by coastal erosion in Ban Laem, Phetchaburi, Thailand

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Abstract

Coastal erosion is a serious problem that caused loss of coastal area in Thailand. Phetchaburi is a province that has experienced a substantial coastal erosion on both mudflat and sandy beaches, resulting in loss of shore and affect the ecosystem in that area, including the benthic microalgae that serve as important primary producers in intertidal areas. However, knowledge of benthic microalgae diversity and density in mudflat in Thailand is still very little. This study aims to compare biomass and composition of microphytobenthos in eroded and non-eroded intertidal mudflats at Ban Leam estuary, Phetchaburi, Thailand. Microphytobenthos samples were collected in dry and wet season during May and August 2023 by using 5x5 centimeters quadrat method. Chlorophyll *a* as microalgae biomass from eroded mudflat is much higher than that of non-eroded mudflat. Benthic microalgae found in both seasons were Cyanobacteria and Pennate diatom. *Surirella* sp. was found as the dominant species on the eroded mudflats, while unidentified single cell cyanobacteria dominated on non-eroded mudflat. This study reveals the importance of benthic microalgae as primary producer of benthic communities in intertidal mudflat.

Keywords: Benthic microalgae, Biodiversity, Coastal erosion, Mudflat, Estuary

Community structure of macrobenthos in Ban Laem Estuary, Thailand: comparison between mudflats affected and unaffected by coastal erosion

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Abstract

Mudflat is an area where fine sediment accumulates by river transportation and mixing with saltwater sediments at the river mouth. These areas serve as a crucial habitat for diverse organisms, especially macrobenthos. Now a day, many mudflats are facing coastal erosion, which may lead to habitat loss and low macrobenthos. However, information of macrobenthos community in mudflat and eroded area are still limited. This study aims to investigate the density and diversity of macrobenthos in the mudflat affected by erosion (AM) and compared to the community in unaffected mudflat (UM) at Ban Laem District, Phetchaburi Province, Thailand. The samples were collected in May and August 2023 using the Quadrat sampling method. The results indicate that mudflat affected by erosion exhibit higher diversity and density of macrobenthos compared to unaffected mudflat. The AM was dominated by Cerithidae gastropod and Nephtyidae polychaetes. In contrast, UM was dominated by Veneridae bivalves and Sternaspidae polychaetes. This study contributes to a better understanding of the macrobenthos community in mudflat ecosystem.

Keywords: Macrobenthos, Biodiversity, Mudflat, Coastal erosion, Estuary

The diversity of marine mollusks on underwater rock piles from the South Andaman Sea, Thailand

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Abstract

The researchers in this study surveyed the diversity of marine mollusks in the Andaman Sea underwater rock piles, Thailand, between 2022 and 2023, in the areas of Krabi, Trang, and Satun provinces, at 12 stations. The survey results yielded a total of 33 families of marine mollusks with 84 species, including 24 families of gastropods with 67 species, and 9 families of bivalves with 17 species. The most common gastropod family is the Chromodorididae and the most common bivalve family is Pteriidae.

Keywords: Marine mollusks, Underwater rock piles, Sea slugs

Session B2: Systematics, taxonomy, and phylogenetics of marine life in the Western Pacific

Phylogeny and thecal plate morphology of an undescribed species of *Scrippsiella* from Central Luzon, Philippines

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Abstract

Algal blooms formed by the marine armored dinoflagellate *Scrippsiella* has been reported from countries worldwide. During the May 2022 fish kill in aquaculture sites of Obando, Bulacan, Central Luzon, Philippines, cells of unidentified *Scrippsiella* species were isolated. Two culture strains (GBBUL04 and GBSEBUL07) were established to examine its cellular and thecal plate morphology under light microscopy and SEM. Thecal plate morphology was consistent with other *Scrippsiella* species which is composed of Po, x, 4', 3a, 7'', 6c, 5s, 5''', 2''''. Compared to the length of the epitheca and hypotheca of *S. masanensis* which were equal, the isolate has a relatively shorter epitheca with an overall cell length of 20.9 µm which was considered small among *Scrippsiella* species. The three intercalary plates differ in size were 2a is distinctively asymmetrical and pentagonal in shape. Pores were observed all over the cell, specifically, in the boundaries of 1''' and 4''' plates. The nucleus was longitudinally elongated which occupies both the epitheca and hypotheca at the center of the cell. Cysts were smooth compared to the common spinous cysts among species in the genus. Phylogenetic analysis based on LSU rDNA, which include four Malaysian sequences and two Philippine sequences, identified four *Scrippsiella* species (*S.* cf *erinaceus,* S. cf *acuminata, S.* cf *spinifera* and *S. masanensis)* and showed the separation of GBBUL04 strain from known *Scrippsiella* species. Based on the distinct morphological characters and taxonomic position of the Philippine isolate suggests that it is a new species to be described under the *Scrippsiella* genus.

Keywords: Biodiversity, red tide, fisheries, phytoplankton, milkfish farming

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Some new records and species of Vietnamese marine macroalgae

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Abstract

With a coastline of approximately 3,260 km, Viet Nam is one of the Southeast Asian countries that has a high species diversity of seaweed. Recent studies have documented 878 species of marine macroalgae belonging to Rhodophyta (439), Chlorophyta (196), Ochrophyta (156), and Cyanobacteria (87) from Vietnamese waters. During the last decade, the combination of molecular markers and morphological observations has been effectively used in amending misidentified species as well as refining new and cryptic species. In the year 2023, two new records *Grateloupia yangjiangensiss* and *G. yinggehaiensis,* and a new species *Phyllymenia nhatrangensis* are identified based on the comparative morphology and phylogenetic analysis of *rbc*L and/or LSU sequences. This contributed to the checklist of Vietnamese marine algae into a new list of 881 species.

Keywords: *Phyllymenia, Grateloupia*, new records, new species, Viet Nam

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Genetic diversity assessment of *Calappa bilineata* from coastal area in Ranong, Thailand

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Abstract

Calappa bilineata is one of seven species of the box crab that were recorded in Thailand. However, no molecular information of this species from Thailand is available. Therefore, this project aimed to evaluate genetic diversity of 40 samples of *C. bilineata* collected along coastal area in Ranong using microsatellite markers. Ten polymorphic loci were identified providing 29 alleles with a mean number of 2.9 alleles per locus and average major allele frequency was 0.778. The averages of the expected (He) and observed (Ho) heterozygosity were 0.295 and 0.285, respectively. The average value of polymorphic information content (PIC) was 0.253 with one SSR locus showing highly informative. Significant linkage disequilibrium (LD) was observed between one pair of loci and a significant deviation from Hardy-Weinberg equilibrium (HWE) ($P < 0.05$) was detected at four loci. The average Inbreeding coefficient (IC) of *C. bilineata* was 0.027. Even though, *C. bilineata* population in coastal area in Ranong has a low level of genetic diversity indicating of inbreeding situation, but no level of inbreeding depression was exhibited in the population. Further study including additional sample and marker loci is recommended to obtain better understanding to genetic status of this species. However, preliminary results of this study will be useful for sustainable conservation and utilization of *C. bilineata* in Thailand.

Keywords: *Calappa bilineata*, microsatellite marker, conservation, genetic diversity

Session B2: Systematics, taxonomy, and phylogenetics of marine life in the Western Pacific

Genus *Halophila* is under the perspective of ITS secondary structure

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Abstract

The seagrass genus *Halophila* Thouars is one of the most complex taxonomic challenges due to leaf morphological traits that overlap among species. Earlier classifications were mostly based on morphological traits. In the last decade, plastid and nuclear sequences were used to reveal the genetic relationships among members of this genus. However, some taxonomic problems involved hybridization between *H. ovalis*, *H. ovalis* Red Sea type, *H. major*, *H. major* SL type, *H. nipponica* and *H. minor*. To resolve phylogenetic relationships of these cryptic species, the current study, 43 ITS2 sequences of 21 *Halophila* taxa were predicted their secondary structures and recorded all existing substitutions, CBCs, and hemi-CBCs (hCBCs). Alignments and analyses were based on this structural information, leading to the following results: (1) The predicted ITS2 secondary structures of four examined ITS2 sequences folded into four helices, (2) ITS2 secondary structures of *H. major* varied to those of *Halophila* spp. on Helix I while *H. major* SL type and H. *ovalis* sub sp. *bullosa* differed from others on Helix III, (3) *H. nipponica* had two hCBCs while *H. minor* had one hCBC in Helix III; (4) *H. ovalis* had no substitutions from the *Halophila* consensus secondary structure. To achieve this aim more reliably there is a need for the application of modern genomic approaches in combination with traditional ones.

Keywords: *Halophila*, ITS, secondary structure, phylogeny

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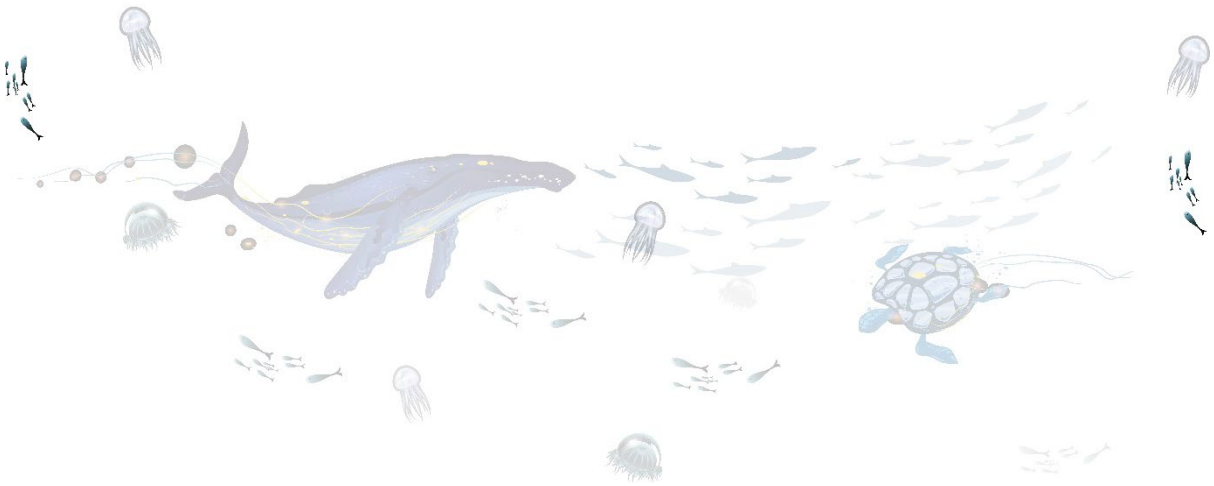
Sub-theme B: Marine Biodiversity, Seafood Safety and Security

Session B3: Vulnerability of the coral reef ecosystem towards extreme environmental fluctuations



Session B3: Vulnerability of the coral reef ecosystem towards extreme environmental fluctuations.

Coral-killing sponges in Nusa Dua, Bali

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Abstract

Nusa Dua in Bali, Indonesia is a popular tourist area, facing Indian ocean with high waves activity and fringing coral reef ecosystem. The area was severely affected by bleaching in 2016, and post-bleaching restoration was carried out by local managers. Anthropogenic pressure might affect coastal environment such as from untreated waste water and high nutrient input, therefore interfering with reef restoration effort. Our preliminary research showed that there were coral competitions with algae and ascidians in the shallow water of Nusa Dua (<1m) as well as the fast-growing encrusting sponges and soft corals (>3 m). This research aims to investigate the types and abundance of coral killing-sponges (CKS) in Nusa Dua post mass mortality, in this case, coral bleaching 2016. Samuh beach was selected as monitoring site, with 3 sub-sites each at the depth of 5–7 m and 10–12 m. We conduct a survey using underwater photo transect (50x50 cm) to estimate coral and sponge coverage. Encrusting sponges in contact with corals are photographed and sponge samples were kept in DNA shield for molecular analysis using CO1 or 28S gene, and in 70% ethanol for spicule observation. Molecular analysis and spicule observation shows that there are at least 2 types of encrusting coral killing sponges *Mycale* sp. and *Haliclona scotii*, as well as 1 type of sponges that is space-competing with corals (*Lamelodysidea herbacea*), but not directly kills them. All of these sponges are substrate generalist and were found in live substrate such as coral as well as sand and ead coral algae (DCA). We found that there was more coverage of hard corals in the shallow (up to 28%) than deeper water (up to 14%). *Mycale* sp were mostly found in shallow (5m) while *L. herbacea* CKS in the deeper water (10 m). *H. scotia* was found in small number covering massive corals. High percentage of DCA in all sites means less space for coral settlement. Morphology identification alone cannot confirm the species of CKS. Some Dysidea species do not produce spicule, therefore spicule identification cannot be count on. On the other side, molecular identification has limitation (depend on the database). Recommendation for sponge monitoring, in addition to corals would be important for further management. Competition with fast-growing soft coral should be further studied.

Keywords: coral reef, sponge, competition, post-bleaching

Session B3: Vulnerability of the coral reef ecosystem towards extreme environmental fluctuations.

Coral spawning in the closed system aquarium using biosphere transfer technology might be possible to increase the coral reefs

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Abstract

Climate change is one of anthropogenic activities which has destroyed the diversity and abundance of coral reefs. However, coral reefs have slightly increased compared to mortality. Sexual reproduction is the one that can improve this situation. Coral spawning is an important sexual reproduction which mostly occurs once a year. Many environmental factors affect this phenomenon, such as, seasonal temperature, water quality, and day light period. It is really difficult to make this phenomenon happen in temperate zones, including Tokyo, Japan. Biosphere transfer technology is the unique technology from Innoqua Inc. that combines knowledge of the aquarists and technology, such as, AI analysis and IoT monitoring. This technology controls a wide range of parameters, including water quality (dissolved concentration of many elements), water temperature, water flow, lighting environment, and relationships among organisms including microorganisms, in order to model and reproduce arbitrary water environments in aquariums. *Acropora* and *Montipora spp*. were grown in the suitable environment in an aquarium tank for more than 2 years. In Japan, many corals spawn in the summer season around May to June when the temperature is warm around the new and full moon. For growing the oocyte and spawning experiment, the water temperature, water quality and day light period was set up following the environment from Sesoko island, Okinawa. *Acropora digitifera* can produce eggs in the artificial environment. For this experiment, we used coral that had been raised in our managed aquarium and had been confirmed to be holding eggs as of August. After that, another species, *Montipora digitata*, succeeded in confirming the spawning in February during the winter season. This information suggests that the biosphere transfer technology can survive, grow and reproduce for some species of coral in the completely closed system which is the first in Japan. Current biosphere transfer technology is limited in the parameters it can control, even for water quality, and it is difficult to say that it can reproduce a 100 percent environment same as nature. In addition, it is not possible to reproduce some parameters in the ecosystem, such as seasonal variations in the amount and diversity of bacteria species in the environment. Moreover, the understanding of the nature that is necessary to reproduce the environment is not yet sufficient. However, this technique has the possibility of leading to the new protocol that can conduct the various kinds of research, for example, gametogenesis, larva recruitment, and coral restoration.

Keyword: coral spawning, coral reef, core technology, biodiversity

Session B3: Vulnerability of the coral reef ecosystem towards extreme environmental fluctuations.

Into the skeleton: a permanent sink of microplastic in reef-building corals

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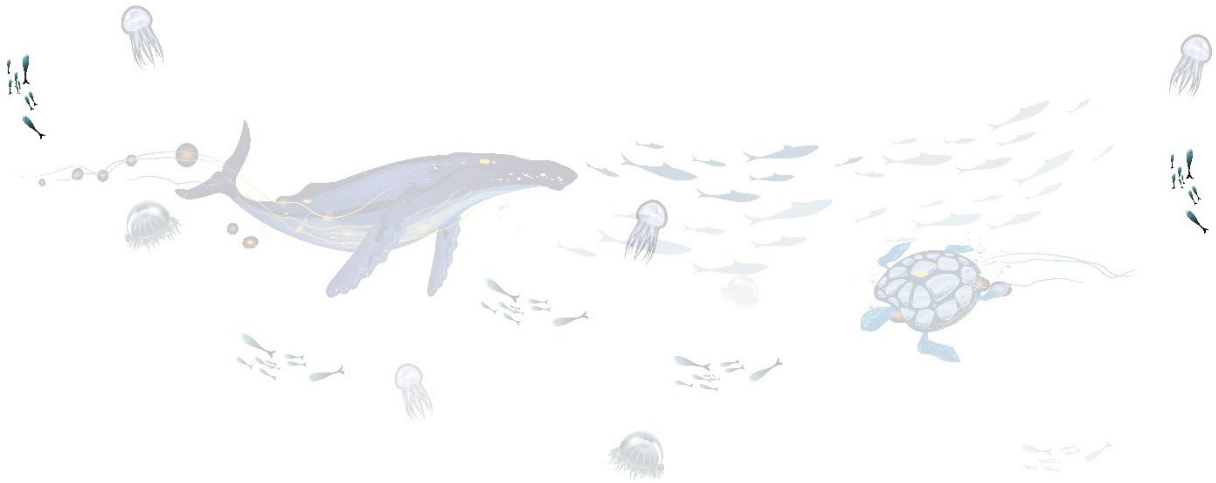
Abstract

The presence of marine microplastic (MPs) has reached a critical level, as it has the potential to negatively impact ocean ecosystems. The biologically mediated pathway is believed to be a mechanism for MPs accumulation in the environment; however, it depends on the organism species and their behavior. Reef-building coral has been observed to actively interact with MPs particles, acting as a passive suspension feeder, consuming various food sources, including plastic particles. However, the number of MPs present in coral, especially in Southeast Asia, remains largely unexplored. Here, we examined the adhesion and accumulation of MPs in four coral species from Si Chang Island (upper Gulf of Thailand): *Lobophyllia* sp., *Platygyra* sp., *Pocillopora* cf. *damicornis,* and *Porites lutea*. We have detected MPs in all coral layers, including surface, tissue, and skeleton. We identified several polymer types in corals, including Polyamide (nylon: 21.1%), Polyacetylene (12.8%), Polyethylene (11.78%), and Polyethylene terephthalate (9.09%), respectively. The predominant morphological types of MPs were fragments (71.17%) and fibers (27.01%). Size ranges predominated between >100–200 µm. Our research reveals significant variations in the total accumulation of MPs among the different coral species ($p < 0.05$). *P*. cf. *damicornis* and *P*. *lutea* had higher MPs accumulation in their skeleton, whereas *Lobophyllia* sp. and *Platygyra* sp. exhibit a greater adhesion on their surfaces. Although MPs particles adhering to surface layers and/or being incorporated into coral tissue are considered temporary sinks, they can cause tissue overgrowth and become permanently trapped in the coral skeleton. Overall, these findings indicated that the unique morphological, feeding strategies and MPs removal capabilities could affect the number of MPs present in different coral species. Hence, conducting comprehensive studies on a broader range of coral species and their uptake is imperative for accurately assessing the potential role of reef-building corals as permanent sinks for MPs.

Keywords: Gulf of Thailand, corals, coral reefs, microplastics, incorporation, adhesion

Sub-theme B: Marine Biodiversity, Seafood Safety and Security

Session B4:
Coral reef resilience to climate change and human impacts



Water quality at Tubbataha reefs: a comparison between the different areas

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Abstract

Water quality data including inorganic nutrients (nitrate, nitrite, phosphate, ammonium and silica), chlorophyll-a, total alkalinity, and colored dissolved organic matter were taken during two research expeditions (October 2019 and May 2021) at the Tubbataha Reef Natural Park (TRNP). The Tubbataha Reefs Natural Park is a 97,030-hectare marine protected area isolated in the middle of the Sulu Sea, under the province of Palawan, Philippines. The uninhabited reefs are composed of two coral atolls, the North and South Atoll, and a smaller reef structure called the Jessie Beazley Reef. In general, nutrient and chlorophyll-a levels were relatively higher inside the lagoons versus outside and at the North Atoll versus the South Atoll. Nutrient levels inside lagoons are usually higher due to restricted water flow and accumulation of organic substances. The highest nutrient and CDOM levels were observed near the vicinity of Bird Islet likely due to the increased organic matter input from bird feces in the area.

Keywords: inorganic nutrients, water quality, coral reefs, algoons, organic matter

Differential impacts of size and species selective fishing on reef fish populations across a gradient of market demand

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Abstract

Overfishing is one of the most pervasive and chronic stressors facing coral reefs globally. The high-value and rising demand for reef-based seafood has dramatically increased reef fisheries, especially in previously underexploited tropical islands. However, despite the numerous efforts highlighting the impact of fishing, little is known about how the selective removal of certain species and sizes affects reef fish communities. In this study, we aim to understand how highly selective fishing influences reef fish communities in a data-deficient, emergent commercial reef fishery in Andaman and Nicobar Islands, India. The islands have a relatively nascent history (~30 years) of commercial harvests, primarily catering to markets in South Asia. Our goal is to understand how size and species selective fisheries drive abundance, biomass and size-class distributions in reef fish communities along a gradient of market demand. To study this, we will use data from three reef fish surveys inside and outside the Mahatma Gandhi Marine National Park (MGMNP), a no-take MPA in the Andaman Islands, India over five years. Further, we will classify fish based on the level of demand (external, local and not-consumed) using market surveys and fish trait data (trophic levels, fishing vulnerabilities, price) extracted from FishBase. Based on this data, we will analyse the changes in fish abundance and biomass across size classes for species in each demand category. Cumulatively, this will include data from 24 sites and a total of 114 50m X 5m underwater belt transects. Preliminary analysis reveals that the differences in mean abundance between protected and non-protected areas are highest for species with high export value followed by those consumed locally. There are no differences in the abundances of species that are typically not consumed. However, these differences vary across different size classes for each demand category. To further validate these findings, we will use Generalised Linear Mixed Models (GLMM) with site as a random effect and coral cover, year of survey, fishing pressure and demand category as fixed effects. We expect this study to reveal the consequences of selective harvest on fish stocks and highlight the need to incorporate market-based strategies in contemporary fisheries management.

Keywords: Reef Fisheries, Export Markets, Selective Harvest, Reef Fishery, Market-Based Management

Study on small marine debris in corals (*Turbinaria* sp.) at Koh Ya, Trang Province

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Abstract

Study on small marine debris in *Turbinaria* sp. at Koh Ya in Trang province. The objective in this study is to identify small marine debris trapped in *coral,* including the form of marine litter. Collecting samples from polyps of coral along the eastern and western sides during the northeast monsoon period (March 2022) and southwest monsoon (July 2022). The most commonly found form is fiber and sheet respectively. The colors of small marine debris found are a total of eight colors. The most common colors are black, followed by blue and red. When considering the seasonal aspect, it is found that the average small marine debris during the northeast monsoon on the east coast is average of 3.6±2.7 pieces per 25 polyps, and the western side had an average of 5.0±2.4 pieces per 25 polyps. In the southwest monsoon, the eastern side had an average of 3.4±2.3 pieces per 25 polyps, and the western side had an average of 4.8±2.4 pieces per 25 polyps. The average number of small marine debris on both the western and eastern sides of the island was not significantly different ($p > 0.05$). This study was unable to determine the type of small marine debris. The researcher will confirm type by Fourier-transform infrared (FT-IR) spectroscopy.

Keywords: smal marine debris, *Turbinaria* sp., coral

Coral reef resilience in the lower Gulf of Thailand: ecological and social assessments

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Abstract

Coral reef ecosystems are threatened by global and local anthropogenic stressors, in particular, sedimentation, sewage, pollution, etc., influencing long-term environmental change. According to different reef utilization of each local area, we evaluated coral reef resilience based on social and ecological considerations. Reef data were collected from 7 study sites along the lower Gulf of Thailand: Nu Island, Maew Island and Kham Island in Songkhla Province; Lao Pi Island and Lao Pi Pinnacle in Pattani Province; Ka Rang Lao Pinnacle and Brou Wae Pinnacle in Narathiwat Province. Social science data were collected from all stakeholders in each area using methods of observation, participation, structure, and semi-structured interviews. The factors for resilience score were modified from the standard method by Obura, D.O. and Grimsdith, G. (2009). The lowest resilience index was found at Nu Island, followed by medium-low at Maew Island and Kham Island. A notable issue on Kham Island, Songkhla presented low resilience score influenced by coral bleaching, fragment, disease, and reef competitors, which may imply climate change effect. Nu Island and Maew Island were mostly influenced by chronic factors related to coastal development and tourism activities. Whereas coral reefs in Pattani and Narathiwat Provinces showed medium-high to high resilience, however we recorded variety of fishing activities, including destructive and ghost fishing gear. We highlighted local issues that can be evidence for sustain implementation of resilience-based management.

Keywords: Reef Utilization, Human Impact, Local Relevant Indicator, Resilience-Based Management

Influence of environmental factors on juvenile coral density at Mu Ko Chumphon, the western Gulf of Thailand

Sittiporn Pengsakun, Wichin Suebpala, Charernmee Chamchoy, Wanlaya Klinthong, Thamasak Yeemin, Makamas Sutthacheep, Phatthira Karnpakob, and Laongdow Jungrak

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Abstract

As global temperature continues to rise, climate change impacts, particularly increasing sea surface temperature, become more severe, synergizing with anthropogenic impacts to increase the magnitude of disturbances on coral reefs. Furthermore, unsuitable conditions can also slow down the natural recovery of coral reefs after the disturbances. The recovery potential of coral reefs particularly the recruitment of corals and environmental factors governing recruitment are important factors influencing the dynamics and structures of coral reef ecosystems. However, in Thailand, little is known about how environmental factors influence juvenile corals. Thus, this study aims to examine the relationships between environmental factors influencing juvenile coral density at Mu Ko Chumphon in the Western Gulf of Thailand. Coverages of live corals, algae, sediment, densities of juvenile corals (≤5 cm in diameter), and sea urchin (*Diadema setosum*) were investigated by SCUBA diving along a permanent belt transect. The results show that juvenile corals varied spatially. The highest density of juvenile corals was observed at Ko Ngam Yai (3.73 ind.m^{-2}), followed by Ko Ngam Noi (2.63 ind.m^{-2}) while the lowest one was observed at Ko Rang Kachiu (0.44 ind.m^{-2}). The density of juvenile corals was significantly influenced by environmental factors (algae, sea urchin, sediment, live corals). Juvenile corals were negatively related to the coverages of sediment ($r = -0.787$, $p<0.01$) and live corals ($r = -0.504$, $p<0.01$). On the other hand, a positive relationship was found between juvenile corals and coverage of algae ($r = 0.892$, $p<0.01$) and the density of sea urchin (*D. setosum*) ($r = 0.794$, $p<0.01$). The findings of this study increase the understanding of the influence of environmental factors on juvenile corals, supporting coral reef management which focuses on controlling environmental factors to facilitate natural recovery and resilience of coral reefs in Thailand.

Keywords: grazer, Gulf Of Thailand, juvenile coral, recovery, sediment

Composition and abundance of juvenile corals on underwater pinnacles in Surat Thani Province, the Gulf of Thailand

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Abstract

Underwater pinnacles in the tropical region are important marine habitats that provide similar functions and services as coral reefs. The structure of the underwater pinnacle influences the diversity and composition of reef-associated organisms. The composition and abundance of juvenile corals are generally influenced by planktonic larval duration, physical and chemical properties of seawater, availability and location of substrates and competition with other species. Juvenile corals are important for sustaining coral reef ecosystems and ensuring their resilience. The purpose of this study was to explore the composition and abundance of juvenile corals on natural substrates of 35 underwater pinnacles in Surat Thani Province, the Gulf of Thailand. At each study site, quadrats (16x16 cm^2 for each) were randomly placed on available substrates using SCUBA diving and the number of visible juvenile corals (less than or equal to 5 cm in diameter) was counted and identified. The results showed that the highest density of juvenile corals was found at Hin Chumphon (20.21±6.97 juveniles /m^2), followed by Hin Kong Sai Dang (15.69±5.41 juveniles /m^2), Hin Wong (12.66±4.35 juveniles/m^2), while the lowest one was observed at Hin Ko Rap (0.38±0.05 juveniles/m^2). The dominant juvenile corals were *Porites*, *Favites*, *Dipsastraea*, *Pavova*, *Pocillopora*, and *Platygyra*. High species richness was observed in some locations e.g., Hin Chumphon, Hin Bai, Hin Kong Sai Dang, Hin Khao, Hin Phiwi. These findings provide baseline information that is necessary for understanding the critical role of juvenile corals in managing coral recovery after overcoming environmental stresses and supporting the resilience of coral communities on underwater pinnacles in the future.

Keywords: resilience, climate change, coral, recruitment, Gulf of Thailand

Diversity and density of juvenile corals in Mu Ko Similan, the Andaman Sea, Thailand

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Abstract

Coral recruitment plays a crucial role in supporting the resilience of coral reefs. It serves as a vital contributor to genetic diversity and facilitates coral recovery following disturbances, thereby safeguarding the overall health and adaptability of coral reefs. This study aims to assess the diversity and density of juvenile corals on settlement plates at study sites in Mu Ko Similan, the Andaman Sea, Thailand, covering four areas: East of Eden, West of Eden, Ao Numchai, and Ao Faiwab. The findings reveal that Ao Numchai had the highest diversity of coral recruits (H'=1.49), followed by West of Eden (H'=1.33) and East of Eden (H'=1.10), while Ao Faiwab exhibited the lowest diversity (H'=0.43). In terms of densities, Ao Numchai also had the highest one, with 20.99 colonies/m², followed by West of Eden and East of Eden with 17.28 and 7.52 colonies/m², respectively. Ao Faiwab had the lowest density of coral recruits (1.23 colonies/m²). The taxonomic composition of coral recruits was dominated by *Pocillopora*, with a total density of 18.99 colonies/m². The recruits of *Acropora, Pavona, Pocillopora*, and *Porites* were commonly found in all study sites, except Ao Faiwab. On the other hand, *Montipora* was only found in the Ao Faiwab. This study highlights the recruitment patterns and potential for coral reef recovery in Mu Ko Similan, providing crucial information used to shape policies for effective management, restoration, and promoting the natural recovery of coral reefs.

Keywords: Coral Recruitment, Recovery, Management, Mu Ko Similan, Andaman Sea

Size-frequency distribution and mortality rate of juvenile corals on a shallow reef flat in Chumphon Province, the Gulf of Thailand

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Abstract

Coral population ecology is commonly based on measurements of recruitment and the size-specific survivorship, growth, fecundity and mortality of colonies. Recruitment of corals is an important process for the recovery of coral populations after natural and anthropogenic disturbances. Size-frequency distributions and mortality of juvenile corals reveal important characteristics of populations responses to environmental conditions. Consequently, this knowledge can be used to assess coral populations under local environmental stresses, recovery, and resilience in response to anthropogenic and climate impacts. This study aimed to examine community structure, colony size structure, and mortality rate of juvenile corals on a shallow reef flat at Ko Ngam Yai, Mu Chumphon National Park, Chumphon Province, the Western Gulf of Thailand. At the study site, coral communities were recorded using permanent quadrats (2×2 m^2) on shallow reef flats, between 0.5–1.0 m in depth. Juvenile corals (≤5 cm in diameter) were monitored by successive photographic surveys and then they were identified to genus level. The diameter of each juvenile coral was measured. The results showed that the average density of juvenile corals was 5.3±0.64 juveniles/m^2. The juvenile corals on the shallow reef flat ranged in size from 0.6 to 4.7 cm. The size-frequency distribution showed a higher abundance of small colonies (<2 cm.). The mortality rates of juvenile corals ranged from 84–92%, with juvenile corals less than 3.5 cm in size having a high mortality rate. This study highlights the importance of size-frequency distribution and mortality rate of juvenile corals on the shallow reef flat in the Western Gulf of Thailand for further coral reef management applications. Our findings also provide data of small coral colonies which are high potential resources for active coral restoration projects to enhance coral recovery following severe disturbances, particularly coral bleaching events in the Gulf of Thailand.

Keywords: Juvenile Coral, Reef Flat, Resilience, Gulf of Thailand

Diversification of gamete recognition proteins in giant clam species

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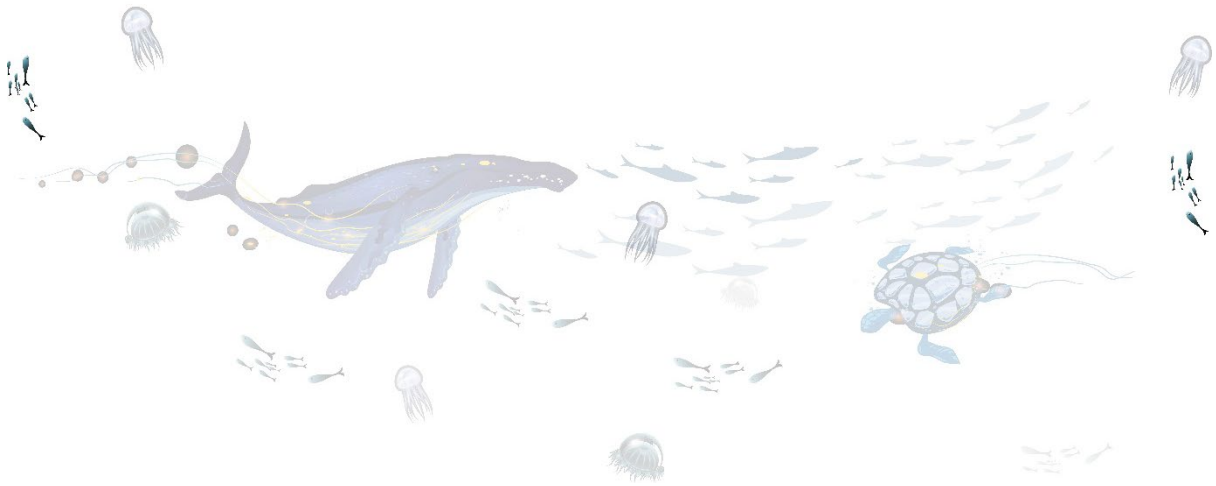
Abstract

Giant clams (subfamily Tridacninae) are the largest living bivalves. Like corals, they exhibit obligate photosymbiosis with *Symbiodiniaceae* and contribute to the functioning of reef ecosystems. Giant clams, however, are in danger of extinction due to overharvesting, habitat loss, and climate change. To support giant clam conservation, novel intervention approaches, such as interspecific hybridization, are being considered to enhance the growth and resilience of giant clams. However, the underlying molecular mechanisms and determinants of interspecific hybridization success within this subfamily have yet to be explored. Gamete compatibility is a critical factor in producing viable offspring, and interspecific hybridization is likely influenced by molecular diversification of gamete recognition proteins (GRPs). Here, we performed phylogenetic analysis and sequence comparison among putative GRPs identified from transcriptome data of giant clam species. These findings reveal differences in gamete recognition proteins within the tridacnine lineage and provide insights into potential hybridization success among giant clam species.

Keywords: giant clam, gamete recognition proteins, transcriptome, phylogenetics

Sub-theme B: Marine Biodiversity, Seafood Safety and Security

Session B5: Fisheries, biodiversity and dynamics of mangroves' aquatic ecosystem



Rhizophora diversity's hallmark, Neil Island, the Andaman Sea

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Abstract

Mangroves are trees that are found in the intertidal, brackish, and saline waters of the tropic and subtropic regions. Mangroves act as frontiers that protect the coastal land against the destruction of ocean waves, tsunamis and storms. Mangroves also provide habitat for various aquatic life forms and function and play an important role as a significant carbon sink in coastal environments. Andaman and Nicobar Islands, which account for 25% of the country's coastline, are endowed with about one fifth of the country's extensive and diverse mangroves and as far as density and growth are concerned, the mangroves in the Andaman and Nicobar Islands are probably the best in our country. Anchored in transition zones throughout the coasts of these islands, these forests deliver a wide range of pecuniary benefits. Neil island is one of the pristine islands found in the Andaman and Nicobar group of islands. The mangroves of Neil Island are diverse, especially the Rhizophora species. The genus Rhizophora is a dominant constituent of global mangroves and is represented by six species in the Indo- West Pacific (IWP). Of these, three are well known IWP mangrove species viz. Rhizophora apiculata, Rhizophora mucronata and Rhizophora stylosa, two are natural hybrids viz. Rhizophora × annamalayana (=hybrid between R. apiculata and R. mucronata) and Rhizophora× lamarckii (=hydrid between R. apiculata and R. stylosa), and one species (Rhizophora samoensis) extends into both IWP and Atlantic East Pacific regions. Ragavan et al. (2015) have reported a new hybrid entity, Rhizophora × mohanii, a hybrid between R. mucronata and R. stylosa, from Neil Island. The co-existence of all the known species of Rhizophora and their putative hybrids in Neil Island makes it a unique site for studying the phylogenetics and evolutionary significance of the genus Rhizophora. Further, an effort has been made to barcode all the representative Rhizophora species found in the Neil island.

Keywords: Rhizophora, Neil island, DNA barcoding, hybrids

Population structure of commercial Opossum Shrimp *Mesopodopsis orientalis* (Tattersall, 1908) in mangrove of Phetchaburi Province, Thailand

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Abstract

Mesopodopsis orientalis (Tattersall, 1908) is a shrimp-like crustacean that serves as a commercial fishery in many countries. Ecologically, it acts as an important link between primary producers and higher consumers. However, the population structure of *M. orientalis* remains unexplored. This study aims to investigates the population dynamics and ecological attributes of *M. orientalis* (Tattersall, 1908) within the mangrove area of Phetchaburi Province. Samples were collected monthly from April 2021 – March 2022 by using a 100 µm plankton net equipped with a flow meter along with the measurement of water quality. Abundance of *M. orientalis* was observed year-round with the range of 1,190 to 316,953 ind./100 m^3 and averaging of 96,396 ± 99,085 ind./100m^3. Even though, *M. orientalis* presented in a broad salinity range (4.90 to 28.75 psu), its peak abundance coincided with the dry season. An examination of the year-round sex ratio reveals an imbalance, with 80 females per 100 males, indicating a male-biased population. We found juvenile and ovigerous females with different stages of embryo every month, suggesting that *M. orientalis* has continuous breeding activity throughout the year. Brood size of this species ranged from 10 to 22 eggs and the number of eggs was positive significantly correlated with female body length ($p < 0.01$). Our findings provide crucial insights for understanding the population dynamic of *M. orientalis*, which will be useful for management efforts and sustaining this economic species.

Keywords: Mysid, Population, Mangrove, Commercial Fisheries

Assessing shellfish diversity of aquatic habitats of the Sundarbans mangrove ecosystem of Bangladesh

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Abstract

Mangrove habitats are the most productive and biologically important ecosystems in the world. The waters surrounding the mangroves provide ample sources for diverse species of fish and shellfish. They act as a vital breeding and nursing grounds for fish and invertebrates such as oysters, shrimp, and crabs due to the accumulation of heavy organic matter. The Sundarbans is the single largest continuous mangrove forest in the world, located in the delta of the Ganges, Brahmaputra and Meghna rivers on the Bay of Bengal. This forest tract including the Indian part covers an area of 10,000 sq. km. About 62% of the Sundarbans is located in the south-west coast of Bangladesh. The present study aims to assess the diversity of shellfish (i.e. crustaceans and molluscs) of Sundarbans of Bangladesh through building a morphological and molecular profile (i.e. DNA barcoding). Shellfish samples are being collected from 2022 until now from local fishermen who harvest fish from the tidal rivers, creeks, canals, estuaries and coasts at different locations in the Sundarbans and also from the fish landing sites inside or adjacent to the Sundarbans. The collected samples are first identified by examining morphometric characteristics and then DNA barcoding is accomplished by sequencing of mtDNA COI and/or 16S rRNA gene region. Until now, 21 species of crab from 12 genera and 9 families, 21 species of shrimp from 9 genera and 5 families, and 31 species of mollusk from 28 genera and 23 families have been morphologically identified. DNA barcoding of the collected samples is being conducted in the lab. After completion of the study, the developed DNA barcode library of the shellfish will contribute to the sustainable conservation of the aquatic fauna of Sundarbans.

Keywords: crab, shrimp, mollusc, mangrove, Sundarbans

Application of eDNA metabarcoding in the assessment of fish biodiversity in Philippine mangroves: prospects, challenges, and opportunities

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Abstract

Conventional fish biodiversity assessments (e.g., visual census, trap nets, etc.) in mangroves are challenging as these are time-consuming, labor-intensive, and expensive. The emergence and the increasing popularity of environmental DNA (eDNA) metabarcoding technique has the potential to circumvent these challenges. In most ecosystems, the eDNA technique is considered fast, non-intrusive, and relatively less expensive. However, mangroves present different challenges because of its inherent turbidity along with difficulty in access. Such environmental complexity may reduce the accuracy of biodiversity results from eDNA method. In this study, we applied the eDNA metabarcoding method (using 12S genetic markers from water samples) to document and assess fish biodiversity in mangroves from two marine biogeographic regions in the Philippines: Oriental Mindoro in the West Philippine Sea and Sorsogon in the Northern Philippine Sea. Our results yielded 177 unique operational taxonomic units (OTUs). Out of these OTUs, 60% were identified at species level although 10% were not identified. We detected 95 unique fish species from 63 families. Both sites were dominated by species from the *Gobiidae* family. Only nine species were commonly detected in both sites. Thirty-six species were found in the Philippine's list of economically important aquatic organisms while two species were classified as Vulnerable in IUCN's Red List of Threatened Species (the native *Epinephelus fuscoguttatus* and the exotic *Acanthopagrus sivicolus*). More species were detected in Sorsogon probably because the sampling sites covered diverse ecosystems within a seascape of coral reefs, seagrasses, and mangroves. In contrast, less species were detected in Oriental Mindoro probably because the sampling points were limited to the coastal fringes. Our results serve as baseline fish biodiversity data and the first obtained using this method in the country. However, we observed some limitations: (1) the low eDNA reads can be attributed to less efficient on-site filtration due to turbid seawaters common in Philippine mangroves; (2) there could be possible contamination as we detected species outside their resident range; and (3) the absence of a comprehensive reference database specific to Philippine aquatic

organisms could limit the accuracy of species detection. Despite these limitations, we were able to demonstrate the viability of this technique at the least in doing rapid fish biodiversity assessments, and more importantly its potential to contribute to biodiversity conservation in Philippine mangroves.

Keywords: mangroves, biodiversity, fish, eDNA, metabarcoding

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Diversity of molluscs in the mangrove forest reserves of Peninsular Malaysia

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Abstract

Following the global trend, Malaysia has experienced a significant loss of mangroves over the last few decades. Although the loss rate has been slowed down in recent years, mangrove ecosystems are still vulnerable to unprecedented anthropogenic impacts such as coastal development, pollution, and climate change. While many financial and technical supports are given to mangrove conservation and restoration by government, private sector and non-governmental organisations, the priorities always focus on the commercially important groups such as fish and mangrove vegetation. In contrast, the benthic macrofauna such as molluscs are always neglected even though they constitute a significant component in mangrove ecosystems in terms of abundance and diversity. In fact, the molluscs play a substantial role in trophodynamics and nutrient cycling which in turn sustain the healthy mangrove ecosystem via direct and indirect interactions. This study aims to elucidate the present mollusc diversity status in the mangrove forest reserves of Peninsular Malaysia. The molluscs were collected from various locations in the mangrove forest reserves along the Klang Straits during spring low tide between December 2022 and November 2023. The molluscs were identified to species level using morphological and molecular methods. The preliminary results reveal a discrepancy in the list of mollusc species between the present and previous studies in the same area. A total of 30 taxa were identified in the present study versus 48 taxa in the previous studies. Among these, there were only ten species confirmed to be similar at the species level in both present and previous studies. Fifteen species identified in the present study were previously not reported while 18 species reported previously were not sampled in the present study. Morphometric measurements and sequencing of more targeted genes will be carried out for the potential new record species to ease the current taxonomic uncertainties and to establish a reliable checklist of mangrove molluscs in Peninsular Malaysia. The baseline data is crucial for environmental monitoring and detection of biodiversity loss.

Keywords: Biodiversity, DNA barcoding, gastropods, benthic macrofauna, mangroves

Sub-theme B: Marine Biodiversity, Seafood Safety and Security

Session B6: Conservation of marine endangered species

Carrying capacity of seagrass habitats as dugong feed in Thailand

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Abstract

Dugong (Dugong dugon) are herbivorous mammals and have ancestors with elephants. Dugong live in the sea along the coastline of the Indian and Western Pacific Oceans. They often live in shallow water bays or straits to shelter winds and storms. 273 dugongs were found in Thailand, resulted from direct survey both field trip and interview in 2022. of these, 242 dugongs were found in the Andaman Sea while, 31 dugongs were found on the Gulf of Thailand. Dugongs feed mainly on seagrass and seaweed. Except Ruppia maritima, they feed on all seagrass species reported in Thai waters and more prefer to eat Halophila ovaris than other seagrasses. Dugongs feed all daytime. During low-tide, they feed in the deep and come to shallow places during high-tide. Dugongs that live in natural habitats eat 4% of their body weight and migrate according to food sources within a radius of 6 kilometers. The largest herd of 188 dugongs in Thailand is found in at Libong Island and Muk Island, Trang Province, which is considered the largest seagrass beds in Thailand. The rest of dugongs is live in other 12 seagrass habitats. These include 1) Sriboya Islands -- Nang Bay, 2) Phang-nga Bay -- Phuket 3) Bang Ben -- Pratong Islands, 4) Lidi Islands, 5) Ban Don Bay, 6) Kung Kraben Bay, 7) Pae Bay -- Prasae estuarine, 8) Kud Island and adjascent islands, 9) Sattahip Bay and adjascent islands, 10) ThungKa--Sawi Bay, 11) Pattani Bay and 12) Talet Bay -- Samui and Pha-nga Islands. The migration of dugongs is related to seagrass habitat, which is the dugong's staple food. If there is an incident that causes the seagrass beds to disappear. It might lead to declining in population of dugong in that area.

In 2022, There were 16,573 hectares of seagrass beds report in Thai waters which average percentage of seagrasses was 31%, approximately. The maximum carrying capacity of seagrass beds as a food source of dugong is estimated from 2 approaches; 1) the changing a total biomass of seagrass from recovery rate and daily eating loss of dugong and 2) the dugong food production with total biomass of seagrass divided by the food needs of dugong per day. The same assumption of when each dugong feed on around 30 kg wet weight (67% moisture) and only 6 seagrass species of dugong food preference; Cymodocea rotundata, C. serrulate, Halophila ovaris, H. major, Halodule pinifolia, and H. uninervis were selected as dugong feed, were applied in to both approaches. Based on the results of this study, the capacity of 1 ha of seagrass as dugong feed support was 3.8 dugong/day from the changing a total mass of seagrass approach and 4.8 dugong/day from the dugong food production approach. In the seagrass beds of 16,573 ha (16% coverage are dugong

feed species or 2,816 ha), the carrying capacity of seagrass feed can accommodate 10,713 dugongs /day and 13,585 dugongs/day estimated from biomass changing rate approach and food production, respectively. Although, food is limitation factor for dugong population. The maximum carrying capacity of amount of dugong estimated from both approaches are higher than existing amount of dugong at every seagrass beds zone. This shows that seagrass beds as dugong feed is still sufficient for the current dugong population. However, the reason that why the dugong population is not reach the maximum carrying capacity probably because of some seagrass species, especially food species, are highly seasonal changing. Some seagrass might degrade lead to loss of habitat connectivity. Furthermore, dugong populations might be controlled by other factors, such as the environment, health problems and human threats.

Keywords: dugong feed, seagrass, carrying capacity

Session B6: Conservation of marine endangered species

Study of the distribution and density of dugongs in Trang province by aerial survey

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Abstract

There were approximately 282 dugongs were found along the Thai coasts. The largest population of dugong, being up to 70 percent of the total dugong population in Thailand, live along the coast of Trang Province. The largest seagrass area in Thailand is in Trang Province that approximately 54.4 km.^{2} of seagrass bed, making this area as the crucial ecotourism attraction and one of the marine protected areas in Thailand. The dugong survey on the coast of Trang Province aims to study the distribution and estimate the population of dugongs. The small fixed-wing aircraft and unmanned aerial vehicles (Drone) had been used for the aerial survey in the coast of Trang Province, including Koh Libong, Koh Mook, Laem Yong Lam, Pak Meng, Ban Pak Khlong, and Laem Sai between 2014–2023. The result showed that the highest density of dugongs (> 1 dugong per km^2) were in Laem Juhoi, Koh Libong follow by Ao Kham, Koh Muk and Laem Yong Lam (0.5-1 dugong per km^2). The density of dugongs in each area analysis will be applied to plan the conservative management of dugongs and their habitats more appropriately. However, the technology should be applied to further survey the distribution of dugongs and the status of seagrass beds, including the threats from human activities study to prevent impacts that may affect dugongs and their habitat.

Keywords: dugong, Trang province, aerial survey, distribution, density.

Age class of stranded marine mammal in the upper Gulf of Thailand, 2018–2022

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Abstract

The study of the Age class of Marine mammals stranding in The Upper Gulf of Thailand during 2018–2022. A total of 225 marine mammals stranded were found. These included the baleen whales (Mysticetes, 2.67%) and toothed whales (Odontocetes, 97.33%) groups. Two species of baleen whales were identified 5 Bryde's whales and 1 Minke whale. The study found that 5 Bryde's whales in The Upper Gulf of Thailand have an age range from juvenile to adult with an average length of 10.28 meters (8.30–11.30 meters). And one adult Minke whale, measuring 5.27 meters, was also recorded. Four species of toothed whales were observed Indo-Pacific humpback dolphin, Indo-Pacific bottlenose dolphin, Irrawaddy dolphin, and Finless porpoise. Among the toothed whales, the majority were Finless porpoises with 147 individuals in the calf to adult age range, averaging 1.14 meters (0.5–1.5 meters). Irrawaddy dolphins found 68 individuals in the calf to adult age range, average length of 1.86 meters (0.9–2.60 meters), Indo-Pacific bottlenose dolphins found 3 individuals in the juvenile to adult age range average length of 2.23 meters (2.04–2.22 meters), and one Indo-Pacific humpback dolphin with a length of 2.62 meters in the adult age range. The study indicates that The Upper Gulf of Thailand serves as a habitat for all age classes of baleen whales and toothed whales.

Keywords: age class, marine mammal, The Gulf of Thailand

Coral conservation and restoration towards sustainable ecosystem at Pulau Bidong, Terengganu, East Coast of Peninsular Malaysia

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Abstract

The project aims to develop a community-based coral reef conservation program by involving various stakeholders such as the local reef-dependent community, researchers, private companies and reef managers. The project started in July 2020 in Pantai Pasir Cina, which was severely damaged by tropical storm Pabuk in January 2019. The population of live corals in Pantai Pasir Cina decreased from an average of 60% to less than 10% after the catastrophic storm. The loss of habitat also led to a decline in the biodiversity of marine organisms. A total of 200 one-meter-long pile constructions made of a combination of L-shaped stainless steel and PVC were installed. Corals were then transplanted by attaching selected fragments of different species to the cement on the top of the PVC-R/pedestals using epoxy resin. The transplanted coral colonies were measured in terms of length and color health code. The increase in length shows a positive result as the corals are growing. The discoloration of the corals (pale color) shows that the corals are losing symbiotic algae and are under stress. However, a darker color when compared to the Coral Health Chart indicates a healthier coral as it contains more symbiotic algae that give the coral its color. The citizen scientist program was implemented to engage local stakeholders in efforts to protect and conserve the coral reef ecosystem. The guide was created with the goal of assisting different levels of society in the coral reef restoration program. It includes general aspects of coral reef biology and ecology, coral reef restoration design and planning, coral condition monitoring and information on the laws and management of coral reefs in Malaysian marine parks. Mass spawning of transplanted corals was observed in September 2023 indicates the success of restoration activities.

Keywords: coral, conservation, restoration, Pulau Bidong, spawning, Malaysia

Measurement of glucocorticoid activity in a rescued striped dolphin (*Stenella coeruleoalba*) in Phuket, Thailand

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Abstract

Introduction: The striped dolphin (*Stenella coeruleoalba*) is currently listed as a species of least concern on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species in 2018, but is a protected species in Thailand. Considering the hazards presented by both natural phenomena and human actions, Thailand has implemented detailed protocols for the proper retrieval and management of endangered stranded marine mammals. One site where animals are rescued and rehabilitated is the Phuket Marine Biological Center (PMBC), Thailand, which provides excellent medical care aimed at enhancing the overall health and well-being of the animal. Stranded animals, such as striped dolphins, are likely stressed due to injuries or discomfort. This can cause a response characterized by increased secretion of glucocorticoid hormones such as cortisol, the primary hormone used to assess stress in animals, and is used to monitor activities that could potentially lead to increased stress. The goal of this study was to quantify serum cortisol during rehabilitation at PMBC of a striped dolphin that was found stranded in Phang Nga.

Materials and methods: The male was 10–15 years of age, with a weight of 54 kg and length of 2.1 m. The dolphin engaged in physical therapy sessions every 2 hours and was treated with antibiotics and laser therapy for 46 days under continuous 24-hour monitoring. Blood samples were obtained from the fluke vein every morning to assess hematology, blood chemistry, and cortisol concentrations.

Results and discussion: Serum cortisol was high (23–31 ng/ml) in the 3 days after rescue, but then decreased to <5 ng/ml for the next month. Concentrations increased again (9.8 ± 1.0 ng/ml) in the last 2 weeks before death due to septicemia. Thus, serum cortisol monitoring can be a useful tool for evaluating stress and health status in rescued dolphins and potentially other marine mammals after a stranding event, with increased concentrations indicating potential distress.

Keywords: striped dolphin, stress, Cortisol, rehabilitation, management

Session B6: Conservation of marine endangered species

The study of comparation of heavy metal level in stranded marine endangered species along the Thai coast

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Abstract

Heavy metal ions are the most harmful water pollutants that are carcinogenic in nature and adversely affect DNA, proteins, and lipids by producing free radicals that lead to severe health and environmental problems. The accumulation of 8 heavy metals including Arsenic (As), Cadmium (Cd), Copper (Cu), Iron (Fe), Lead (Pb), Mercury (Hg) Selenium (Se), and Zinc (Zn) were studied in stranded marine endangered species including 39 sea turtles, 40 cetaceans, and 21 dugongs along the Thai coasts. The organ samples were analyzed including muscle, liver, and kidney. The result showed that arsenic was mostly accumulated in sea turtle muscle, cetacean kidney, and dugong liver. Cadmium and mercury accumulation were in kidney. In the liver, copper, iron, zinc was found high accumulation. The highest level of selenium was found in sea turtles, dugong liver and cetacean kidney. Lead accumulated mostly in dugong liver. However, the results of this study are only preliminary data to determine the accumulation situation of heavy metals of marine endangered species in Thai coasts and contribute to a greater understanding of heavy metal impacts in the Thai coasts

Keywords: heavy metal, sea turtle, cetacean, dugong, Thai coasts

First report of *Cyamus boopis* from a humpback whale (*Megaptera novaeangliae*) in the coastal East China Sea

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Abstract

Cyamus boopis is an amphipod crustacean that obligately parasitizes the body surface of the humpback whale, *Megaptera novaeangliae*. The life cycle of *C. boopis* does not include a swimming stage, and the crustacean spends its entire life on the body of *M. novaeangliae*. On November 15, 2017, a male humpback whale was found stranded on the coast of the cape of Yuan Tuo, Qidong, Nantong, JiangSu Province, China. Parasites were collected from the carcass of this whale and identified by morphological techniques and molecular analysis. A total of 15 *C. boopis* specimens were collected, and eight females and seven males were morphologically identified. A phylogenetic tree of cytochrome c oxidase subunit 1 revealed that the collected specimens clustered together with previously reported *C. boopis* sequences from the Northern Hemisphere. This is the first report of *C. boopis* in a humpback whale from the East China Sea and supplements data from humpback whales found off the coast of China. In addition, our data provide supplementary data on the migration paths of humpback whales.

Keywords: *Megaptera novaeangliae*, *Cyamus boopis*, Cyamidae, whale lice, East China Sea

Session B6: Conservation of marine endangered species

Assessing Billfish abundance and investigating fishers' perceptions in the context of Billfish conservation: a study in Kuantan, Pahang, Malaysia

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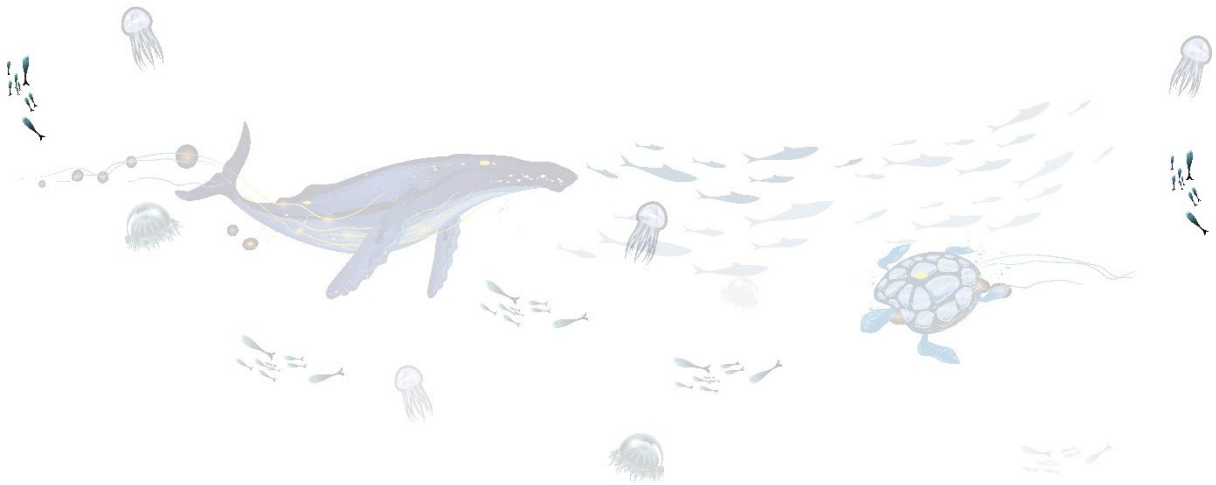
Abstract

Billfish are predatory and migrate with a distinct long mouth known as a 'bill'. Besides economic value, billfish are essential to the function of the marine ecosystem. However, it is reported that the billfish catch in Pahang, has been declining since 2014 as the recent conservation status change as a vulnerable species by the International Union for Conservation of Nature (IUCN). Billfishes from Family Istiphoridae (Nelson, 1984) are very popular among recreational fishers and contributed approximately RM 18 million to local economic activities in a single competition. The conservation endeavours aimed at billfish are crucial not just for preserving coveted game fish species in Pahang's recreational fisheries but also for contributing to the well-being of local communities. Assessing billfish abundance, local fishers' knowledge and attitudes is important in determining the successful conservation of billfish. Therefore, this study was developed to determine the billfish abundance as bycatch and the fishers' knowledge and attitudes toward billfish conservation and investigate the in Pahang, Malaysia. A total of 170 billfish samples were collected between March and December 2021, wherein morphometric measurements of length and round weight were undertaken. Subsequently, the stomach content of these samples was analysed to ascertain their dietary composition. Then, a face-to-face survey employing a questionnaire was administered to 140 Malaysian fishers. Based on the findings, the majority of billfish exhibited sizes within the range of juvenile to early adult stages while 566 prey items were identified to the lowest possible taxa. The study showed that most respondents have good knowledge and reported themselves as having positive attitudes towards billfish conservation. Besides, research into fishers' knowledge and attitudes can offer important insights into effectively designing regulations accepted by most fishers for the governance of sustainable fisheries in Malaysia, especially in recreational fisheries.

Keywords: billfish, fishers, perception, bycatch, conservation

Sub-theme C:
Ocean and Human Health

Session C1:
Marine chemical Contaminants of Emerging Concern (CEC)



Pharmaceuticals in urbanized riverine and estuarine waters of Hong Kong

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Abstract

Pharmaceutical pollution is of global concern due to the widespread presence of pharmaceuticals and their potential environmental risks. Rivers and estuaries, serving as receiving bodies of contaminated waters, play a critical role in regulating the discharges of contaminants from the terrestrial environment to the marine environment. The rivers and estuaries with highly populated and urbanized catchments, attract more attention to pharmaceutical pollution. To address this issue, six rivers and estuaries from highly urbanized districts of Hong Kong, including Kai Tak River, Shing Mun River, Lam Tsuen River, Tung Mun River, Kam Tin River, Shan Pui River were selected, a diverse array of pharmaceuticals, i.e., antibiotics, analgesics, anti-epileptics, antidepressants, antifungals, antihistamines, β-blockers, diuretics, non-steroidal anti-inflammatory drugs, opioid pain medication, and stimulants were examined in water samples of these rivers and estuaries during the dry and wet seasons, incorporating with an efficient and cost-effective analysis method. Our preliminary results show that the Kai Tak River exhibits higher concentrations of pharmaceuticals than other rivers, which should be largely attributed to the sewage effluents from the nearby sewage treatment plants. More importantly, the descending trends of pharmaceutical concentrations are generally observed from the rivers to the estuaries. Overall, this study builds up the region-specific contaminant lists of pharmaceuticals in Hong Kong, and highlights their omnipresence in Hong Kong receiving waters, particularly for anti-epileptics, antihistamines, sulfonamide antibiotics, and antidepressants, calling for the follow-up necessary regulation on sewage effluents to protect Hong Kong's waters.

Keywords: pharmaceuticals, rivers, estuaries

Pharmaceutical pollution in the world's estuaries: a review

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Abstract

The aquatic system and the environment as a whole are steadily suffering from the input of contaminants in estuaries. The effects of these contaminants in estuaries are gradually becoming a burden to the aquatic system and environment at large. Among these contaminants are pharmaceuticals which are major emerging contaminants of global priority. Using meta-data analysis, this review seeks to coherently understand the prevalence, occurrence, risk, and influencing variables of pharmaceutical contamination in global estuaries. A global review has been conducted to comprehend the present state of these contaminants and to and also identify the locus of pollution, studies were retrieved over two decades from 2003–2022 In total, this review retrieved 2652 concentration data for 198 pharmaceuticals from 87 estuaries in 25 different countries across six continents including Africa, Asia, Europe, North America, South America and Oceania. Their respective ecological risks were also evaluated. With a cumulative weighted average concentration level (WACL) of 145462.86 ng/L, Africa had the highest cumulative weighted average concentration level (WACL) values. The cumulative WACL values were followed by North America (24316.39 ng/L), South America (20784.13 ng/L), Europe (5754.67 ng/L), Asia (3121.69 ng/L), and Oceania (2844.04 ng/L). Carbamazepine, diclofenac, and paracetamol were detected in all continents. A total of 32 pharmaceutical classes were identified; the most often reported classes in global estuaries were stimulants, antibiotics, and analgesics. High acute and chronic toxicity concerns were observed in 4 and 12 pharmaceuticals, respectively. Pharmaceutical pollution in estuaries were also found to be positively correlated with regional unemployment and poverty ratio but negatively correlated with life expectancy and GDP per capita. The occurrence of pharmaceuticals in estuaries is still vaguely understood globally, particularly in Africa, Oceania, and South America. As a result, this study will contribute to the existing knowledge and provide researchers insights to further studies and research.

Keywords: pharmaceuticals, global estuaries, ecological risk assessment, socioeconomic factors

Groundwater quality in Pag-asa Island, West Philippine Sea

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Abstract

Pag-asa Island, which belongs to the Kalayaan Island Group, is the largest and only island in the West Philippine Sea inhabited by a local community. The freshwater resource of this tropical island originates from its unconfined aquifer lens in the form of groundwater, which can be recharged through precipitation. Due to limited sources of freshwater on the island, it is important to assess and evaluate its quality and safety for drinking and daily use. Water samples were collected from five selected open wells and five installed piezometers around the island from February 2022 to April 2022. Ion chromatography (IC) analysis results indicate that the dominant cations and anions were Na^+, Ca^{2+}, HCO_3^-, and Cl^-, which suggests the activity of naturally occurring processes such as seawater intrusion and rock weathering, and anthropogenic signals of groundwater pollution. Furthermore, results from inductively coupled plasma mass spectrometry (ICP-MS) analysis also suggest high levels of strontium (Sr), boron (B), and heavy metals in the form of aluminum (Al), arsenic (As), nickel (Ni), zinc (Zn), and cadmium (Cd), which can be attributed to various domestic and anthropogenic activities. Overall, these results indicate that the groundwater quality on the island is potentially not suitable for drinking without proper treatment based on local and international standards, and the elevated levels of heavy metals pose major health and environmental concerns. Groundwater is an important commodity and monitoring and ensuring its quality, availability, and sustainability as an important resource especially in inhabited offshore islands with coastal development plans should be of utmost concern.

Keywords: groundwater, metals, cations, anions, water quality

Contamination status, bioaccumulation profiles, and human health risk assessment of polychlorinated biphenyls (PCBs) in shark species from Indonesia

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Abstract

Polychlorinated biphenyls (PCBs) in muscle tissues of five shark species with status ranging from near threatened to critically endangered species were analyzed to elucidate their contamination status, species-specific profiles, and potential human health risks. Muscle samples were collected from two landing ports in Indonesia: Tanjung Luar, West Nusa Tenggara, in November 2021 and May 2022; and Kutaraja Lampulo, Aceh, in September 2022. In general, PCB concentrations in shark muscles from Kutaraja Lampulo were higher than those from Tanjung Luar Landing Port and varied among different shark species depending on the trophic level. Specifically, *Sphyrna lewini, Carcharinus falciformis*, and *Prionace glauca* from the Tanjung Luar landing port, and *Galeocerdo cuvier* and *Alopias pelagicus* from the Kutaraja Lampulo landing port were detected at relatively high concentrations of 680±230, 1100±620, 1000±600, 1100±1300, and 1400±1000 ng/g lipid weight (lw), respectively. In addition, the concentrations of unintentionally produced PCBs (UP-PCBs are generated as by-products during the production of dyes/pigments, thermal incineration, or silicon rubber) were detected up to 690 ng/g in *Galeocerdo cuvier* from Kutaraja Lampulo. For dioxin-like PCBs, only CB-118 was above the detection limit, with concentrations of up to 71 ng/g lw in *Prionace glauca* from Tanjung Luar. Congener-specific PCB profiles among shark species were observed, with relatively high proportions of tetra-to-hepta-CBs. The toxic equivalent values of dioxin-like PCBs (TEQ dl-PCBs) and non-dioxin-like PCBs (Σ_6ICES-PCBs) in shark muscles were lower than the maximum values in seafood by the European Commission Regulation 1259/2011. The hazard quotient (HQ) and hazard index (HI) values for children and adult groups for other PCB congeners were below 1, which means that the consumption of shark meat from all sampling areas was at low risk. Further monitoring is necessary to provide long-term information on the bioaccumulation and exposure risks of pollutants in commercially valuable and endangered sharks, as well as to evaluate the health risks and benefits of consuming shark meat for humans, including threats from pollutant exposure, benefits of omega-3 fatty acids, and safe consumption levels of pollutants in shark meat.

Keywords: persistent organic pollutants, PCBs, human health risk assessment, shark, Indonesian seas

Organic extraction method for determination of UV stabilizers in plastics

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Abstract

Plastic pollution is a major global environmental issue that has attracted much attention, and additives are an important component of plastics. They will enter various environmental media along with plastics and cause a variety of potential negative effects. However, the current methods for quantifying the content of UV stabilizers in plastic products and marine plastic waste are different. The comparability of the results obtained from different studies is very limited, making it impossible to further assess their potential environmental risks. This study compared the extraction efficiency of three commonly used organic solvents (dichloromethane (DCM), methanol (MeOH) and methylbenzene (PhMe)) for UV stabilizers in plastics. It was found that the extraction efficiency of DCM for UV stabilizers in plastics was significantly higher than that of the other two organic solvents. We also preliminarily explored the impact of reaction time on extraction efficiency and found that there was no significant difference between 0.5h and 1h, indicating that 0.5h extraction under ultrasonic conditions is enough to extract the UV stabilizer in the plastic.

Keywords: Marine plastic waste, UV stabilizer, Extraction method

Biomagnification of mercury in marine organisms from Rayong Bay, Thailand

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Abstract

The contamination of mercury in marine ecosystems is a significant environmental issue due to its high toxicity, persistence in the environment, and ability to bioaccumulate in marine organisms. The mercury content and mercury biomagnification in the marine food web in Rayong Bay, Thailand were investigated in this study. Seawater, sediment, and marine organism samples were collected from stations in May 2022, August 2022, and February 2023. The total mercury (T-Hg) content in the seawater analyzed using cold-vapor atomic fluorescence spectrometry (CV-AFS) was in the range of 0.25–22.45 ng/L. T-Hg content in the sediment analyzed using thermal decomposition atomic absorption spectrophotometry (DTD-AAS) was in the range between 3.4 to 42.2 µg/kg on the carbonate-free basis. The T-Hg content in phytoplankton (n=13), zooplankton (n=8), fish larvae (n=6), and muscle tissue of 84 marine animal species (n=344) was analyzed. Furthermore, the nitrogen and carbon stable isotope ratios ($\delta^{15}N$ and $\delta^{13}C$) were measured for these samples to establish their trophic levels in the food web. The T-Hg content in marine organisms was in the range between 0.30 and 1261 µg/kg wet weight. Biomagnification of T-Hg in benthic and pelagic food webs in the bay was quantified using trophic magnification slopes (TMSs) and trophic magnification factors (TMFs). The highest TMS and TMF values were found in the pelagic food web (TMS=0.82 and TMFs=6.63) while the benthic food web had lower values (TMS=0.34 and TMFs=2.19). As both TMF values are greater than 1, we can infer that mercury biomagnification is occurring in Rayong Bay food webs. Furthermore, we evaluated human health risks in consuming these fish and seashell species from Rayong Bay.

Keywords: Total mercury, Trophic magnification factors, Food web, Stable isotopes, Human health risks

Eutrophication status in estuaries of Ba Ria-Vung Tau, Vietnam

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Abstract

Eutrophication in estuaries manifests as an ecological challenge marked by an excessive influx of nutrients, predominantly nitrogen and phosphorus, into the coastal ecosystems. Drawing on survey findings conducted in the Ba Ria - Vung Tau estuary during the period of 2022–2023, this study sheds light on the current environmental conditions of the study area, providing a crucial assessment of eutrophication levels aimed at supporting aquaculture management strategies. The research reveals significant fluctuations in key environmental factors such as dissolved oxygen, chlorophyll-a, and nitrogen and phosphorus nutrients between the rainy and dry seasons. Utilizing UNTRIX analysis (integrating concentrations of Chlorophyll-a, dissolved inorganic nitrogen, dissolved inorganic phosphorus, and the level of saturated oxygen), the study discerns a state of eutrophication in the estuary during the rainy season, contrasting with an improved environment during the dry season. The identified eutrophication is attributed to nutrient inputs stemming from aquaculture and agricultural activities, coupled with the impact of industrial and residential waste in the coastal areas. This analysis underscores the critical interplay of human activities and environmental dynamics in shaping eutrophication phenomena in estuarine ecosystems.

Keywords: Eutrophication, UNTRIX, estuary, aquaculture management

Can waste shells be used in the removal of contaminants of concerns in wastewater?

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Abstract

The blue economy involves the sustainable use of the ocean resources and water, forms the basis of the blue economy. However, one of the major problems threatening its realization and sustainability is pollution of water bodies from both point and non-point sources. Eutrophication of waterbodies resulting from the accumulation of excess nutrients majorly phosphorus and nitrogen, is a major type of water pollution (nutrient pollution) which affects both aquatic life, humans and the environment. Bacteria proliferation in water is also another contaminant which can render water unfit for use. Adsorption is one of the cheapest and easiest method used in the removal of these nutrients from nutrient laden wastewater. The use of low-cost materials majorly in the form of by-products from industries renders the adsorption process very cheap and affordable. Shells are major by-products generated by shell-fish companies and they can be explored as low-cost adsorbents for the removal of phosphorus and water-borne bacteria in wastewater. Waste shells were cleaned and subjected to two treatment types namely calcination and non-calcination. Batch experiments were conducted to determine the phosphorus removal efficiency of both the calcined and non-calcined shell using synthetic wastewater. To evaluate the antibacterial activity of the shells, *Escherichia coli*, a fecal coliform bacteria and indicator organism for the contamination of drinking water was selected. The indicator bacteria were prepared following the National Committee for Clinical Laboratory Standards (NCCLS) protocol. The antibacterial activity of the non-heat treated and heat treated mollusc shell waste powder were determined using the well diffusion method. Furthermore, time kill assays were also conducted. The shell samples were characterized using physico-chemical methods such as Scanning Electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDX), Fourier transform infrared spectroscopy (FTIR) and X-ray powder diffraction (XRD) analysis. The results of the batch experiment showed that the non-heat treated shells had a lower phosphorus removal efficiency when compared with the heat-treated shells. Non-heat treated mollusc shells showed no antibacterial activity against *E. coli* while the heat treated shells showed antibacterial activity. The result of the characterization study showed that heat treatment of the shell powder resulted in a change of structure, morphology and elemental composition all of which contributed to its increased phosphate removal capacity and antibacterial activity. Waste shells can thus be utilized as a low-cost adsorbent for the removal of phosphorus and water-borne bacteria in wastewater.

Keywords: blue economy, waste shells, wastewater contaminants, *E. coli*, human health

Ecological risk assessment of heavy metal pollutants and total petroleum hydrocarbons in sediments off north of the Yellow River estuary, China

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Abstract

Heavy metals and total petroleum hydrocarbons in coastal marine sediments are receiving extensive attention, as they may pose a serious threat to the coastal environment. To date, data on the long-term variations in the levels of sedimentary heavy metals and total petroleum hydrocarbons as well as their ecological risks are relatively limited. More the 500 samples from 15 cruises spanning 10 years in the Bohai Sea were collected to explore the long-term variations of heavy metals and total petroleum hydrocarbons, and to assess their potential ecological risks. The results suggested that the quality of them in sediments between 2012 and 2021 gradually tend to be good. Based on the single factor evaluation for sediment quality, it is founded that most of the evaluation factors in the study area met the requirements of sediment quality standard, except for the factor of metal Pb and Cr in some cases. The implication is that the sediment off north of the Yellow River estuary was fairly clean. However, the concentration of metal Pb exceeded the sediment quality standard in some samples, indicating that Cd could be identified as a major pollutant in surface sediments. Also, based on the ecological risk assessment of heavy metal pollutants, it is founded that the metal Pb had reached a level with potential ecological risk in some cases. Therefore, we further suggested that the Pb contamination might have a potential risk off the north of the Yellow River estuary.

Keywords: heavy metal, petroleum hydrocarbon, sediment, the Yellow River estuary

Spatial distribution, sources and ecological risk of polycyclic aromatic hydrocarbons (PAHs) in the sediment of Peter the Great Bay (the Sea of Japan/East Sea)

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Abstract

Peter the Great Bay is the largest and most densely populated bay in the Russian part of the Sea of Japan. There are located several ports with large cargo turnover that amounted to about 150 million tons in 2022. A significant part of the transshipped and transported cargo is coal, oil and petroleum products. Polycyclic aromatic hydrocarbons (PAHs) are a group of persistent organic pollutants consisting of two or more condensed rings. Because PAHs are toxic and some are even carcinogenic, they are of environmental and human health concern. Significant amounts of PAHs are released into the environment since they occur with the incomplete combustion of biomass and fossil fuels, and, moreover, are part of the latters'. PAHs are hydrophobic, and, in marine environment, they tend to adsorb onto particles and then settle down becoming part of the bottom sediments, where they can be harmful to benthic organisms. This study aimed to determine the PAH concentrations, sources and the ecological and health risk assessment of them in the surface sediment in Peter the Great Bay. The concentrations of the total 14PAH in the sediment varied from 18 to 2071 ng/g with an average value of 479 ng/g. The higher PAH concentrations were observed closer to the urbanized areas, and maximum PAH concentrations were found in the area of the internal roadstead of the Vladivostok port and near the mouth of the Tumen River which is a severely polluted transboundary river flowing through Russia, China and North Korea. In general, 4-ring PAHs prevailed, accounting for an average of 44%. Furthermore, there was a noticeable increase in the relative contribution of naphthalene in the influence zone of the Tumen River. Total PAH concentration was positively moderately correlated with the organic carbon content indicating the sorption of PAHs on organic detritus in the water column and their common deposition into the bottom sediment. The values of PAH isomer ratio identified that PAHs was mainly originated from the combustion of coal and biomass. Additionally, most sampling stations received PAHs from traffic emission. When assessing ecological risk concentration values of the individual and total PAHs obtained were lower than the ERL, with the exception of the site under the influence of the Tumen River discharge suggesting that adverse biological effects can occur

occasionally in this location. To evaluate the relative toxicity of sediments, toxic equivalence quotient (TEQ) and mutagenic equivalence quotient (MEQ) were calculated. All TEQ values were in the low range while MEQ values at some stations approached the permissible concentration threshold of 200 ng/g of benzo[a]pyrene in sediment.

Keywords: PAHs, sediments, risk assessment, Peter the Great Bay (Sea of Japan/East Sea)

Mussel watch: POPs in the Russian section of the Northeast Pacific ecosystems

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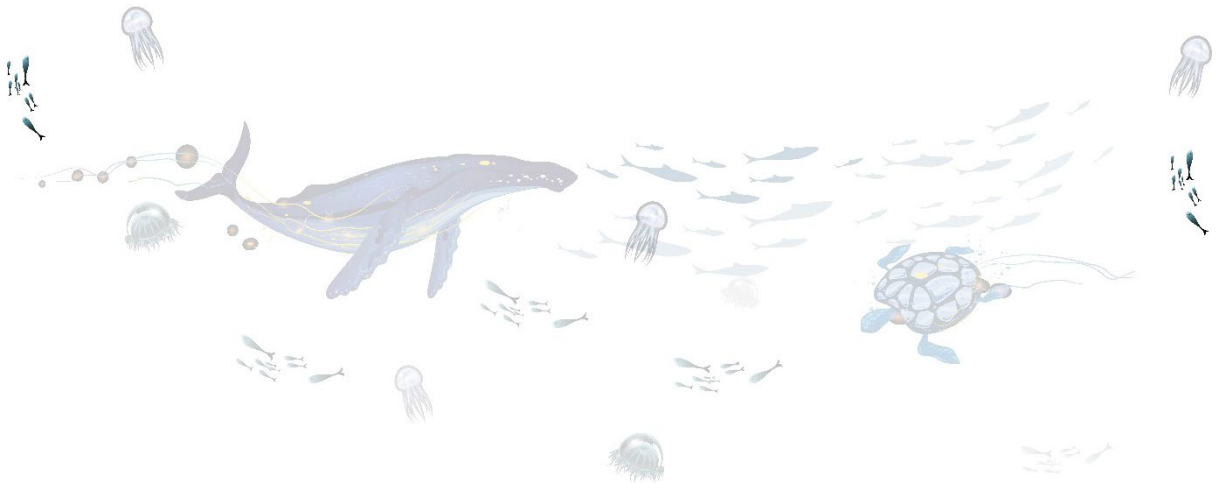
Abstract

In current investigation, three species of bivalves from Mytilidae family (*Crenomytilus grayanus*, *Mytilus trossulus* and *Modiolus modiolus*) were used as bioindicators. Mollusks samples were collected from different sites of the Peter the Great Bay in the summer of 2017 and 2018. Concentrations of organochlorine pesticides (OCPs) (α-HCH, β-HCH, γ-HCH, δ-HCH, o,p'-DDT, p,p'-DDT, o,p'-DDD, p,p'-DDD, o,p'-DDE, and p,p'-DDE) and polychlorinated biphenyls (PCBs) (congeners 28, 52, 155, 101, 118, 143, 153, 138, 180, 207) in samples were measured by gas chromatography–mass spectrometry (GC–MS), and gas-chromatography with electron capture detector (GC–ECD) for validation of results. The result showed the presence of persistent organic pollutants (∑OCPs+∑PCBs) in all soft tissue samples with the range from 0.6 to 2769.7 ng/g lipid weight. OCPs levels exceeded PCBs ones. Among OCPs DDT group dominated in all samples. Preponderate metabolite was DDE, which is DDT's descendant and, in addition, indicates chronic toxicant residence in the environment. Between HCH isomers α-, β- and δ-forms were detected with a predominance of β-HCH, which is considered to be the most stable isomer and shows a long-term intake of pollutants. PCBs were mainly represented by low-chlorinated 28 and 52 congeners in an amount of 1.8 to 610.5 ng/g lw. Data comparing the content of pesticides from 2002 to 2018 demonstrate a decrease in toxicants levels in the waters of Peter the Great Bay. In all studies in the soft tissues of mollusks, the predominance of the concentrations of the decomposition products of the initial compounds (DDE and DDD, β-HCH) was recorded. The results characterize a gradual reduction in the release of pollutants into the environment, both with river runoff from the fields of Primorsky Region and through transboundary transport from areas where OCPs are still in use. Analysis of PCBs content in the soft tissues of bivalve mollusks from Peter the Great Bay was held in the year of 1999. The results of the study showed the presence of PCBs in all *C. grayanus* individuals in the range from 2700 to 3700 ng/g lw. The data obtained during the work in 2017 indicate a decrease in PCBs concentrations. Nevertheless, despite the absence of a developed industrial complex on the territory of Primorsky Krai, mollusks' soft tissues are still liable to contamination with low-chlorinated congeners. The work was supported by the Ministry of Science and Higher Education of the Russian Federation, project no. FZNS-2023-0011.

Keywords: POPs, OCPs, PCBs, mussel watch, mollusks

Sub-theme C:
Ocean and Human Health

Session C2:
Source, transport, fate, impacts and mitigation strategies of marine plastics and microplastics



Small island waste management by using UAV images on Balang Lompo Island, Pangkep district, South Sulawesi, Indonesia

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Abstract

This research is motivated by the increase in human population on Balang Lompo Island which goes hand in hand with an increase in waste production. This is a concern given the increasingly limited availability of land. Indonesia, as the second largest plastic waste disposer in the world after China, is an important context (Jambeck *et al*., 2015). The objectives of this study are: (1) Identify the condition of the existing waste management system on Balang Lompo Island; (2) Identify community behavior related to waste management; and (3) Develop directions for waste handling and management on the island, including both consignment and local waste. Data collection methods involved primary approaches through interviews, observations, and UAV image capture, and secondary approaches through literature studies. Analysis was conducted through spatial analysis, forecasting, waste infrastructure availability analysis, descriptive analysis, and gap analysis. The results showed that the amount of household waste on Balang Lompo Island exceeds the set standards, especially on the coast of the island, especially in the north and east directions, which show significant waste accumulation. The proposed solution to overcome this problem involves the utilization of local waste and marine debris, both organic and inorganic, through the approaches of recycling, increased reuse, and increased energy conversion.

Keywords: GIS, UAV, waste, small island, Balang Lompo

Analyzing the coupled relationship between the distribution of marine microplastics in the Northwestern Pacific Ocean and global climate

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Abstract

In the backdrop of escalating global climate change, the nuanced interplay between the distribution of marine microplastics in the Northwestern Pacific Ocean and the evolving environmental landscape demands meticulous investigation. Employing a comprehensive methodology, including empirical orthogonal function decomposition and the integration of diverse datasets, this study aims to quantify the impact of climate change on the distribution of marine microplastics from 1993 to 2020. By amalgamating data on microplastic dispersion with global climate change indicators, the research seeks to discern patterns and trends reflective of climate-driven phenomena. Informed by factors such as ocean currents and coastal topography, a conceptual model is proposed to elucidate the intricate connections between climate change and the spatial dynamics of marine microplastics in the Northwestern Pacific region. Preliminary findings underscore a compelling correlation between global climate change and the proliferation of marine microplastics, with discernible trends indicative of the influence of climate-driven phenomena. The exacerbation of global climate change, particularly the intensification of extreme weather events, contributes to heightened oceanic heat redistribution, consequently intensifying the dispersion of microplastics in the marine environment. This study sheds light on the urgent need for holistic strategies to mitigate the escalating impact of climate change on marine ecosystems, emphasizing critical implications for the health and sustainability of the Northwestern Pacific Ocean.

Keywords: marine microplastics, Northwestern Pacific Ocean, global climate change, extreme weather events

Juvenile fish ingest microplastics? Juvenile fish microplastics story in the South China Sea

Xinyu Bu

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Abstract

As a crucial link in the marine food chain, juveniles play a significant role in influencing the biodiversity and sustainable development of fisheries resources in coastal areas. Microplastics in aquatic environments, and their impact on organism health, have become a global concern. However, it remains unclear to what extent, if any, fish selectively choose or avoid microplastic particles while feeding. To address these questions, researchers conducted sampling in the South China Sea at approximately 109.996°E longitude and 20.225°N latitude in June 2020 and December 2021. The samples included juveniles of four fish species: *Pennahia argentata*, *Larimichthys crocea*, *Sardinella melanura*, and *Butis koilomatodon*. The researchers used stereomicroscopy to dissect these fish, opening their stomachs and intestines for microscopic examination. Subsequently, they performed digestion and filtration processes to extract microplastics from the juvenile. In each experimental step, multiple blank control groups were established. Clean filter membranes were utilized to collect microplastics from laboratory air pollution. Optical microscopy and micro-Fourier transform infrared spectroscopy were employed for the identification of extracted microplastic particles. The study revealed that the quantity of microplastic particles in the air exceeded that found within the juvenile, and the microplastic particles identified in the juvenile were also present in the blank samples. Consequently, laboratory air pollution led to a significant overestimation of microplastics within the juvenile. This study will provide a scientifically reliable method to ensure the accuracy of detecting the quantity of microplastics in the bodies of juvenile fish and even other organisms. Future efforts will focus on observational laboratory culture experiments to demonstrate whether juveniles ingest microplastics.

Keywords: microplastic, juvenile, Fourier transformation infrared analysis, South China Sea

Session C2: Source, transport, fate, impacts and mitigation strategies of marine plastics and microplastics

Changes and transport of microplastics in the riverbed of the mainstream below the Three Gorges Dam of the Yangtze River

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Abstract

The Yangtze River has always been considered an important river for transporting microplastics into the sea. However, there is still a lack of understanding of the degree of microplastic pollution in the sediment of the middle and lower reaches of the Yangtze River, which has affected the estimation of microplastic flux into the sea. In this study, microplastics in sediments from 55 stations in the middle and lower reaches of the Yangtze River were investigated, including 48 mainstream stations, 5 estuarine stations, and 2 lake stations. Microplastics were detected in 34 stations, ranging from 0 to 71.04 n/kg of dry weight. The average concentrations of microplastics in the mainstream, estuary and lake were 6.16±8.87, 23.91±11.2, and 43.95±27.09 n/kg of dry weight, respectively. Of all the microplastics found in this investigation, fiber (59.52%) forms the main type in terms of shape; PET is the most abundant microplastic species, accounting for 51.19%. Sewage treatment plants are the most likely source of microplastics in sediment, and sediment from tributary estuaries, lake mouths, and lakes is an important sink of microplastics. Terrain, sediment transport load, biofilm, and flow velocity are important factors affecting microplastic settlement. Although there are multiple microplastic enrichment areas, the high flow velocity during the flood season makes it difficult for microplastics to remain in the sediment of the Yangtze River bed. This indicates that microplastics in riverbed sediments have little influence on the flux into the sea during flood season. This study is the first large-scale investigation of microplastics in riverbed sediments in the Yangtze River basin.

Keywords: microplastics, source, seagoing rivers, Yangtze River, Riverbed sediment, flood

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Characteristics and sources of microplastic fibers in the Yangtze River Basin, China

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Abstract

Airborne fibers are mainly derived from plastic synthetic fibers generated by human activities. Atmospheric microplastic fibers can enter the aquatic or terrestrial environment through sedimentation. Many studies have confirmed the occurrence of microplastic fibers in the atmospheric and aqueous environments, but there is a lack of comprehensive knowledge about their source and fate, especially in large river basins. To address this knowledge gap, we conducted field sampling in both atmosphere and surface water along Yangtze River basin, the largest river basin in China. Socioeconomic factors and hydrological parameters will be incorporated together with the microplastic fiber characters to identify the major sources of atmospheric fibers in the studied region and their contribution to the fibers to Yangtze River.

Keywords: microplastic fiber, Yangtze River basin, atmosphere, surface water, source-sink process

Session C2: Source, transport, fate, impacts and mitigation strategies of marine plastics and microplastics

Understanding sources, transport, and accumulation of small microplastics (<1 mm) in beach sediments of western Philippines using Nile Red staining and image-based machine learning

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Abstract

Despite growing attention surrounding microplastics pollution, effective policies and interventions to facilitate its mitigation remain scarce due to the limited baseline knowledge in the natural environment. This is driven primarily by asynchronous approaches to conduct baselining, which further contributes to the difficulty of addressing knowledge gaps on the potential sources, transport, and retention of microplastics particularly on a larger scale. Thus, there is a need to work towards harmonization and optimization of methodologies to efficiently generate large-scale baseline data that can better our understanding of the fate of microplastics in the environment. Here, we optimized methods for processing and characterization of microplastics by comparing existing techniques for control preparation and microplastics extraction. We also validated the efficacy of an image-based machine learning model called YOLOv5 to quantify and classify Nile Red-stained microplastics. These optimized methods were then applied to sediments collected from 22 beaches in western Philippines, with areas representing gradients of populations and varying sediment characteristics. Results showed that Manila Bay in aggregate exhibited the highest accumulation of small microplastics (<1 mm), while the lowest mean concentration was recorded in Western Palawan. Patterns of abundance followed trends in population density and percent gravel, suggesting the significant influence of source and site characteristics (i.e., sediment grain size) on microplastics accumulation. Results of this study provide insights on methodologies that can be considered for large-scale monitoring efforts in the Philippines, which directly

contributes to the National Plan of Action in the Prevention, Reduction, and Management of Marine Litter (NPoA-ML). This also helps promote a better understanding of the fate of microplastics in the environment, a knowledge gap repeatedly identified in microplastics research.

Keywords: microplastics, Philippines, harmonization, beach sediments, fate

Relation between surface hardness and elasticity to Carbonyl Indexes of plastic products and environmental plastic debris

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Abstract

The majority of plastics degrade and break down into macro and microplastics in the marine environment. However, the degradation and fragmentation of plastics in the environment remain insufficiently understood. Particularly, only few studies have reported the physical properties of weathered plastics in the open sea, although properties such as the carbonyl index using infrared spectra have been discussed. The objective of this study is to uncover the relationship between surface hardness, elasticity and the carbonyl index of micro and macro plastics. Additionally, we aim to investigate the connection between product plastics and environmental plastics. Fifty polypropylene (PP) products were purchased from stores or online shops, and thirty PP films were collected from the open sea in the Pacific and Indian Oceans through collaboration with volunteer commercial ships. Additionally, fifty PP debris items, such as lids from plastic bottles, films, and fragments, were collected from a Japanese beach and a rocky shore. A Dynamic Ultra Micro Hardness Tester (Shimadzu) was utilized to measure Martens hardness, and elasticity using a measurement method that we developed. Micro-Fourier Transform Infrared Spectroscopy was employed to identify polymers through ATR on their surfaces and to calculate their carbonyl indexes. The poster will demonstrate the relationship between surface hardness, elasticity and the carbonyl index of weathered PP debris and commercial products.

Keywords: plastics, degradation, Martens hardness, elasticity, carbonyl index

Session C2: Source, transport, fate, impacts and mitigation strategies of marine plastics and microplastics

Development of semi-automatic analytical methods for fine microplastics larger than 1 μm in surface water by Raman imaging microscopy

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Abstract

It is a matter of great concern that ultra-fine microplastics (UFMPs), ranging from 1μm to 20 μm, may have adverse effects on human health and wildlife. The occurrence of UFMPs in the ocean poses issues that should be addressed in the context of ecological risk assessments in aquatic environments and environmental behaviors in marine settings. However, quantifying and identifying UFMPs in water samples is challenging because each particle must often be individually identified by operators, requiring a significant amount of time and effort. In addition, Raman spectroscopy is not suitable for observing a wide range of areas to quantify and identify all UFMPs in samples, leading to high extrapolation for estimating UFMP concentrations and their upper limits of detection. Pretreatment processes for UFMPs with minimal contamination are also necessary. This presentation introduces semi-automatic analytical methods for UFMPs in the surface water of Tokyo Bay, including pretreatment methods. The pretreatment process for the water samples consists mainly of three crucial steps. The first step involves removing organic fluorescent matrices from glass apparatus and two types of membranes, achieved by heating them at 450 degrees Celsius for 2 hours. Subsequently, surface water samples were passed through a silver membrane to collect UFMPs, which are then gathered on a nickel membrane. The second step involves a digestion process using the Fenton reaction in a centrifuge tube. Following this, sodium iodide is added to the tube for density separation. The third step aims to remove excess sodium iodide and other salts in supernatants from the tube, obtained three times after centrifugation. The pooled supernatant is filtered by a nickel membrane, and hydroperoxide and hydrochloric acid are added to dissolve excess salts. Finally, the washed solution, including FHMPs, is passed through an area with a 4 mm diameter of a silicon membrane. UFMPs on the membrane can be analyzed using the DXR3xi Raman imaging microscope (Thermo Fisher Scientific). The Raman microscope has ultra-fast chemical imaging capabilities, making it possible to analyze UFMPs across more than 63.7% of the total area for 32 hours. Using this analytical method, microplastics as small as 0.3 μm could be detected. The poster will also show recovery tests conducted in our laboratory, as well as monitoring results of UFMPs in Tokyo Bay.

Keywords: ultra-fine microplastics, Raman imaging microscope, surface water. pretreatment process

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The studying of the distribution of floating debris released from river mouths in the inner Gulf of Thailand by numerical model

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Abstract

The distribution of floating debris released from 5 river mouths in the inner Gulf of Thailand, namely Petchburi, Maeklong, Tachin, Chaopraya, and Bangpakong Rivers, was studied using 2D hydrodynamic model and particle tracking model driven by tides, wind, and river runoff. At each river mouths, 100 drogues as a representative of floating debris were released and their trajectories were tracked for 1 year. In this study, a total 12 case studies for time of release (January to December) were conducted. The trajectories of debris at the same river mouth which was released during the same monsoon season were similar. After examining the final locations of floating debris, they remained within the study area and contained at least 50 particles (i.e., half of what were released) per case study. Most of them accumulated along the coastlines near the rivers and some moved back into the river as well. However, during the monsoon season, the distribution of floating debris out in the sea was greater than in the coastal areas. During the inter-monsoon, however, less floating debris was found out in the sea and instead they accumulated more in the coastal areas.

Keywords: drogue, hydrodynamic model, particle tracking model, marine garbage

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Session C2: Source, transport, fate, impacts and mitigation strategies of marine plastics and microplastics

The first multi-compartment analysis of microplastics in the Karnafully river, Bangladesh

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Abstract

The Karnafullly River, which flows through densely populated Chattogram city and falls into the Bay of Bengal, Bangladesh, is vulnerable to microplastic contamination. In this study, we looked at microplastics in the Karnafully River's surface water (5 sites), sediment (9 sites), and biota (4 species). Microplastic concentrations ranged from 0.57±0.07 items/L to 6.63±0.52 items/L in surface water, 143.33±3.33 items/kg to 1240±5.77 items/kg dry weight in sediment, and 5.93±0.62 items/species to 13.17±0.76 items/species in biota. A significant difference ($P<0.05$) was found in the concentration of MPs in the Karnafully River's sediment, biota, and surface water. High percentage of fiber-shaped and small-sized MPs (<1 mm) were detected throughout the samples. Water and sediment MPs were often transparent/white and blue, whereas biota MPs were mostly black and red, indicating a color preference during biological uptake. The Bay of Bengal received 61.3×10^9 microplastic items per day. The feeding zone of biota influenced the level of microplastics, with a trend of pelagic>demersal>benthic>benthopelagic. The most dominant polymers were polyethylene, followed by polyethylene terephthalate, polyamide/nylon, rayon, and polypropylene, indicating that multiple land-based sources of microplastics, primarily inputs from residential areas and industries. Using the average fish intake rate in Bangladesh, we computed a possible consumption of 4015–7665 items of MPs/person/year. This data will help us in learning more about MPs contamination in freshwater systems, and it will also serve as a baseline for future MPs assessment and monitoring in the research area.

Keywords: microplastics, water, sediment, biota, urban river

Microplastics in two marine sponges from Rayong Bay

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Abstract

Microplastic contamination in the environment is an emerging environmental problem that receives a lot of attention today. When living organisms ingest microplastics (MPs), their health might be affected through the release of other contaminants on the MPs. Research works on MPs in filter feeders are on a rise since these groups of animals have high risks of taking in MPs. However, studies on sponges are lagging behind other groups such as bivalves. Therefore, this work focused on determining the MPs in sponges from Rayong Bay in a hope to establish a baseline information and evaluate the potential of sponges as bio-indicators for MPs. Here we picked 30 samples from two dominant types of sponges found in the bay: *Mycale grandis* (Gray, 1867) and *Cinachyrella* sp. Size, color, shape and enumeration were done under a stereomicroscope while subsamples of potential microplastics were analyzed for polymer type via Fourier-transform infrared spectroscopy (FTIR). A total of 31 MPs found in all samples was equal to the density of 0.012±0.013 pieces per g wet weight. No significant difference was found between the two groups of sponges or between the stations. The major size class of MPs found in this study was 1,001–5,000 µm. Most MPs were fiber and blue in color. FTIR spectroscopy identified rayon, polyester and polypropylene as the most dominant polymer types found in marine sponges.

Keywords: FTIR, filter feeders, bioindicators, *Mycale*, *Cinachyrella*

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Occurrences of microplastics larger than 20 microns in surface waters of the Philippines

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Abstract

In preparation for the international treaty on the reduction of plastic pollution in 2025, and potentially following the ratification of such a treaty, countries worldwide may need to create emission inventories for plastic and monitor environmental concentrations. However, there is a significant lack of information in Asian countries to implement these measures. Moreover, it is estimated that Asia is home to rivers that contribute significantly to global plastic emissions into the ocean.

The aim of this study is to reveal occurrences of microplastics larger than 20 microns in surface waters of rivers, coastal areas, and off the coast of the Philippines. Microplastic samples were collected at various sites along the Butuanon River, which is the most contaminated river in Cebu. Microplastics were also collected in coastal areas in the Philippines. Microplastics of off the coast areas were sampled using volunteer ships. The sampling was conducted as follows: more than several hundred liters of water samples were passed through plankton nets with a pore size of 10 microns on ships or at all sampling sites. Microplastics greater than 20 microns were analyzed using micro-Fourier-transform infrared spectroscopy (micro-FTIR) according to the method established by Kameda et al. Suspended samples were digested by hydrogen peroxide in a 200 mL tall beaker. Following digestion, sodium iodide was added to the beaker for density separation. Supernatants were obtained three times, and the pooled supernatants were passed through a hydrophilic PTFE membrane. Microplastics greater than 20 microns on the membrane were measured using the imaging technique of micro-FTIR. This poster will demonstrate the concentrations, polymer compositions, and size distributions of microplastics in the surface water of the Philippines. This will be the first study to reveal occurrences of fine microplastics in the Philippines.

Keywords: microplastics, surface water, Philippines, concentrations, polymer compositions

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Patterns of plastic occurrence during the pre- and post-super Typhoon Rai (Odette) event in Olango Island Wildlife Sanctuary (OIWS), Philippines

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Abstract

Plastic waste is a growing global concern as it ends up in the marine environment around the world at staggering quantities. On one hand, the Philippines is a major pathway for typhoons, experiencing an average of 20 of these climate-related phenomenon, which can cause a massive effect on the quantities of plastic wastes in the marine environment. For instance, the Olango Island Wildlife Sanctuary (OIWS) in Cebu, Philippines was along the path of Super Typhoon Rai in 2021. The OIWS, acknowledged as a Ramsar site, holds crucial significance for migratory waterbirds within the Philippines, and plastic wastes found in this sanctuary can affect these migratory birds. Thus, this research seeks to assess how extreme weather events impact the macroplastic occurrence in a mangrove ecosystem that is found in this marine sanctuary. To determine the extent of macroplastic occurrence, five transects spanning the sanctuary's mangrove zones were sampled, along its mangrove areas which serve as a sink for macroplastics. Sampling and categorization of macroplastics was conducted in three locations along the transect – landward, middle, and seaward over three distinct periods. Satellite imagery used to track particles in the sampling area four days before and after the typhoon was generated via Detecting Marine Plastic program using Satellite data (DeMPS) technology. A total of 332 macroplastics were gathered for the first sampling, 471 for the second and 398 for the third during the study period. Notably, there was an observable shift in the distribution of macroplastics in OIWS after the event. Prior to the typhoon, a large concentration of macroplastics was primarily found in the landward sites relative to the middle and seaward sites of the mangrove area and this pattern was distinctly reversed after the typhoon. Satellite imagery corroborated the shift in the macroplastic distribution, where it depicted an increased presence of plastic particles in the seaward sites after the typhoon. This evidence of change in the plastic distribution within the sanctuary is an indication that extreme weather events can exacerbate the transport of plastics from the land to the sea, which can further worsen the plastic pollution in the marine ecosystems.

Keywords: macroplastics, typhoon, Philippines, OIWS, mangroves

Plastic Waste Analysis and Brand Audit (WABA) in mangrove ecosystems as an approach to support the enforcement of Extended Producer Responsibility (EPR) policy

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Abstract

Mangrove ecosystems in tropical regions provide significant ecological services to people and the environment. However, its complex structure and geomorphology facilitate the entrapment and degradation of plastic wastes, among other debris, which led many studies to report this ecosystem as one of the most efficient plastic sinks in the marine environment. A better understanding on the transport, fate, and accumulation of plastic wastes in these ecosystems is required in order to address its mitigation, as these plastics are known to affect the mangrove's health conditions, including those other flora and fauna found in this habitat. Thus, this study is conducted to investigate the characteristics and profiles of plastic wastes found in mangrove ecosystems around nine mangrove sites of Cebu Island, Philippines. Sampling of plastic wastes was done from both landward and seaward sections (10x10 m quadrats) of each site every quarter for a period of one year where surface plastics were collected and counted in the experimental plots. Plastic waste analysis and brand audits (WABA) were done to determine its characteristics and profiles according to quantity, type, use and or application.

In the course of the study, 2648, 446, 425, and 1238 plastic pieces were collected during the four sampling periods (quarterly). Findings reveal that there are no statistically significant differences ($p>0.05$) in both mean count-based plastic densities (1.471±2.232, 1.75±4.43, 2.71±5.83 and 0.887±1.369 pieces m^{-2}) and mean mass-based plastic densities (12.44±18.08, 8.15±20.83, 19.8±45.5 and 15.33±30.21 g m^{-2}) for each subsequent sampling period across the sites. In the mangrove ecosystem, the predominant types of plastics are consistently polyethylene- and polypropylene-based, used as plastic bags and plastic packaging, and broken as plastic fragments. About one-third of the plastics collected have labels/prints while the rest do not have any. Extensive brand audits conducted during the sampling periods have identified the top producers (based on product brands) and contributors to marine plastics pollution. Most of these labeled plastics come from the food and

beverage sector. These findings are used as basis in tracking and enforcing the extended producer responsibility (EPR) law which is enacted and recently implemented in the Philippines, and can serve to advocate for better waste management practices in industries and communities especially those which are close to these mangrove ecosystems.

Keywords: plastic pollution, waste analysis and brand audit (WABA), extended producer responsibility (EPR), mangrove ecosystems

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Stony corals as a biological sink for microplastics: a case study in Hong Kong

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Abstract

Coastal coral reefs are particularly susceptible to microplastic pollution compared to offshore ecosystems, primarily due to the terrestrial origins of microplastics. The aim of this study was to investigate the abundance of microplastics in the coral communities and their habitats within Mirs Bay, Hong Kong. Our research employed Raman microscopy to identify and quantify microplastic particles present in coral tissues, coral skeletons and the surrounding sediments. Through a comprehensive field survey, we collected paired samples of *Platygyra acuta* fragments and adjacent sediments from four distinct coral sites for microplastic analysis. Our results revealed the presence of polyethylene (PE), polypropylene (PP), polystyrene (PS), polyethylene terephthalate (PET) and polymethyl methacrylate (PMMA) within the coral tissues, skeletons and sediments. Notably, the quantity of microplastics detected in coral skeletons can be over 20 times higher than that found in sediment samples of the same volume. These findings suggest the potential for coral reefs to serve as a long-term biological sink for microplastics.

Keywords: marine microplastics, long-term sink, Raman microscopy, coral skeletons, marine sediment

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Plastic size does matter: combined effects of microplastics and the toxic dinoflagellate *Alexandrium tamarense* on the edible green-lipped mussel *Perna viridis*

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Abstract

Microplastics are now widely recognized to be ubiquitous in the environment. The uptake of microplastics by marine life has been well documented, revealing various negative effects on these organisms. Another major threat to marine ecosystems is the increasing occurrence of harmful algal blooms. Exposure to toxic microalgae presents significant health risks to marine bivalves, as well as to humans when consuming contaminated bivalve shellfish. Microplastics and toxic microalgae often co-exist in the environment, and it is of utmost importance to study their combined impacts on marine life and human health. To this end, we conducted an experiment using the green-lipped mussel *Perna viridis*, an economically important seafood which is susceptible to contamination by microplastics and toxic microalgae due to its filter-feeding nature. The mussels were separately exposed to two particle sizes of polystyrene microplastics (PS, 1 µm and 90 µm) at an environmentally relevant concentration (1 µg mL^{-1}) and fed with either the toxic dinoflagellate *Alexandrium tamarense* (strain CS300) or a non-toxic dinoflagellate of *Tetraselmis* at a bloom concentration (1000 cells mL^{-1}). The exposure lasted two hours daily for over 20 days. Mussels in the control group were not exposed to any PS but fed with *Tetraselmis*. Our results showed no significant individual or combined effects of the tested particle sizes and algal types on the rates of calcification and somatic growth of mussels. However, mussels exposed to the smaller-sized PS (1 µm) exhibited significantly lower rates of byssal attachment and byssus thread production, regardless of the algal type. Notably, the survivorship of mussels exposed to 1 µm PS and fed with the toxic dinoflagellate was significantly reduced to 33%. The same group of mussels displayed the highest metabolic rate, as indicated by their oxygen consumption. Overall, these findings demonstrated that, even at an environmentally relevant concentration, smaller-sized PS can enhance the toxicity of *A. tamarense* and induce greater negative physiological effects on *P. viridis*. Further investigation is needed to elucidate the mechanisms underlying this particle size-dependent toxicity.

Keywords: seafood, plastic pollution, size difference, harmful algae, physiological functions

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International coastal cleanup scientific report: items and monthly variations of river, beach, and underwater litters in the northeast coast of Bali

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Abstract

Healthy reefs are the base to any marine life, and it is essential for the environment and the coastal community. In recent decades, the pollution of rivers, beaches, and underwater habitats by anthropogenic litter has been recognized as a severe global environmental concern. Marine litter stands as one of the greatest threats to the ocean's well-being. Indonesia produces approximately 0,48 to 1,29 million metric tons of plastic waste that ended up as marine debris. Bali Province produces 4.281 tons of litter daily, with 11% of this waste ending up in the ocean. This number is expected to increase further due to population growth rates, socio-cultural activities, community economy, and tourism. To effectively address this issue, it's essential to analyze local litter resources to identify the main items contributing to litter. This analysis will inform stakeholders about the primary source of litter before implementing management strategies and understanding the potential ecological impact of marine pollution. Research locations are in the rivers, beaches, and seafloor of Tulamben Area, Bali. Data collection was carried out from June 2022–June 2023, resulting 1.855 kg of litter from the area within a year. During the cleanup activities, the composition litter was assessed based on the 2021 version of marine debris data from the Ocean Conservancy. The data were analyzed by using statistical method. The dominance of litter types in the three areas is different. Fishing items (lines, nets, traps, and ropes) dominate the seafloor, food wrappers (candy and chips) dominate the river area, and other plastic bags dominate the beach. Other plastic bags are the litter that dominates all areas combined. The weight of trash collected each month also varied. Waste sources can be classified based on the predominant type. Fishing items are litter from fishing and recreational fishing activities, food wrappers from economic activity, and other plastic bags from socio-cultural activity. Several activities are consistently carried out at the location, including fisheries, economics, tourism, and social culture. Aside from that, during certain months, litter from other areas is transported to this area by currents and sea waves. Differences in litter dominance and sources are essential starting points for establishing future waste management activities, particularly for plastic litter. The cleanup activities thus far have only helped clean up trash, mainly existing plastic waste, but further steps are required to manage plastic waste.

Keywords: pollution, marine litter, plastic, seafloor, Tulamben

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Macroplastics deposited in the coastal mangrove areas in Olango Island, Cebu

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Abstract

Nearly 300 million tons of plastics are produced annually worldwide, and it is reported that 80% (mainly macroplastics) end up in water bodies. This has become a pressing environmental concern, particularly in the Philippines, which is identified as one of the top plastic polluters of the marine environment. In Cebu Islands, it is found that macroplastic wastes leak toward the surrounding water bodies, leading to the accumulation of these wastes in the mangrove ecosystems. This phenomenon has extended to the mangrove areas in neighboring island groups, specifically Olango Island, a Ramsar Wetland Site. The buildup of macroplastics in these mangrove ecosystems can potentially hamper oxygen penetration in mangroves, affecting their growth and function. Hence, it is the aim of this study to determine the number of macroplastics deposited in the mangrove areas of Olango Island for two periods and to classify and characterize them in terms of surface functional groups. In addition, plastic degradation in ambient conditions observed during six months is investigated to examine structural changes.

Over 800 macroplastic samples were collected in two separate periods (2021 and 2022), and their surface characteristics were analyzed through FT-IR Spectroscopy. Based on the spectra, the top three plastic types that dominated in 2021 are low-density polyethylene or LDPE (25.98%), polypropylene or PP (20.54%), and polyethylene or PE (11.48%). In terms of specific product type, the macroplastic litter was composed largely of rubber footwear (14.50%). In 2022, the litter is mainly comprised of PE (26.17%), LDPE (25.32%), and PP (19.36%). Other plastic types that are found are nylon, polystyrene (PS), and polyethylene terephthalate (PET). The dominant functional group of LDPE is C-H, and this was altered in over 50% of the macroplastic samples. C-H is also dominant in PE and this was altered in over 70% of

the samples. For PP, the dominant functional group is still C-H and the 60% alteration in the samples is similar to LDPE. The alteration of peaks is attributed to the degradation of the macroplastics, which could influence its properties. The results of this study affirm the presence of macroplastic litter of various types in the mangrove areas of Olango Island, and this can be used to further expand the investigation of the physicochemical property changes of macroplastics during its degradation in the mangrove ecosystem. Furthermore, this study can be used to support the development of waste mitigation practices and policy recommendations to address the pressing concern of plastic mismanagement.

Keywords: macroplastic litter, mangrove ecosystem, polyethylene, low-density polyethylene, polypropylene

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Circulation and transport patterns in the Nha Trang Bay

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Abstract

Surface drifters were deployed off the coast of Nha Trang in 2022 during summer monsoon wind conditions. A simultaneous towed ADCP survey offered a comprehensive perspective on the circulation patterns within the bay. The gathered observations were utilized to characterize transport patterns and turbulent dispersion regimes under moderate wind and spring neap tidal forcing. These findings were subsequently compared to model outputs to assess the accuracy and performance of the MOHID water numerical model.

Keywords: circulation, particle tracking, Nha Trang bay, surface current, MOHID model

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Abundance and composition of microplastics in sediment from Bangpakong River, Thailand

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Abstract

Microplastics (MPs) in the environment has received growing attention during the past decades. Here, we investigated MPs in the sediment of the Bangpakong River in November 2022 (wet season) and April 2023 (dry season). The surface sediment samples were taken at eleven different locations along different parts of the river. The average MP abundances in sediment for the whole study areas in wet season (102.88±491.68 item/kg dry sediment) did not differ significantly from the average value for dry season (95.12±476.41 item/kg dry sediment). The majority of MPs are fibers (54%) followed by fragments (41%). Both fibers and fragments are considered as secondary microplastics. In terms of size, most MPs found in this study belonged to the 1–2 mm size class. Fourier-transform infrared (FTIR) spectroscopy identified the samples to be polypropylene (PP) followed by, polyethylene terephthalate (PET), rayon, nylon, polystyrene (PS), and polyvinyl chloride (PVC), according to abundance.

Keywords: FTIR, estuary, debris, fiber, fragment

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Occurrence of microplastics larger than 20 microns in sediments of Tokyo Bay

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Abstract

Microplastics (MPs) are ubiquitous in various environmental media, as indicated by previous reports. However, detailed information on their toxicity to human health and other organisms, concentrations, polymer compositions, and size distributions, especially for fine microplastics smaller than several hundred microns, remains limited. MPs have also been observed in the sediment of rivers, bays, and seas, in addition to surface water. The presence of MPs in sediment can provide crucial insights. They help us understand the environmental behavior of plastics, from terrestrial areas to the ocean.

This study focuses on the occurrences of MPs in the sediment of Tokyo Bay, which is considered one of the most contaminated bays in Japan. Initially, an analytical method for detecting MPs larger than 20 microns was established using micro-Fourier-transform infrared spectroscopy (micro-FTIR). Subsequently, ten sediment samples were collected from Tokyo Bay using an Ekman sampler in 2023. The moisture contents of these sediment samples were measured in our laboratory. These dried sediment samples were then analyzed for MPs. In the analysis process, the dried samples underwent digestion by the Fenton reaction in a 200 mL tall beaker. Following digestion, sodium iodide was added to the beaker for density separation. Supernatants were collected three times to ensure thorough separation, and the pooled supernatants were passed through a hydrophilic PTFE membrane. Microplastics larger than 20 microns on the membrane were measured using the imaging technique of micro-FTIR. The analysis specifically identified and measured 17 types of plastics. This poster will present the concentrations, polymer compositions, and size distributions of microplastics found in the sediments of Tokyo Bay, including the variety of plastic types identified.

Keywords: microplastics, sediment, Tokyo Bay, concentrations, polymer compositions

Occurrences of microplastics larger than 20 microns in surface waters at Tokyo Bay

Gaksuhi Fujimura, Yutaro Numazawa, Yutaka Kameda, and Emiko Fujita

Chiba Institute of Technology, Japan

Abstract

A release of microplastics (MPs) from the terrestrial environment via rivers is considered to be one of the sources of MPs observed in the ocean. Especially, their occurrences in the surface water of river mouths and bays are influenced by their input from their watershed. On the other hand, ecosystems in bays are very important for human activities such as fisheries and sightseeing, as well as habitats for a huge amount of wildlife. However, ecological risk assessment of microplastics is remarkably difficult because of a lack of information about MPs concentrations, polymer compositions, and size distributions.

The objective of this study is to reveal the occurrences of MPs greater than 20 microns in surface water at Tokyo Bay, which is considered one of the most contaminated bays in Japan. MPs greater than 20 microns were analyzed using micro-Fourier-transform infrared spectroscopy (micro-FTIR) according to the method established by Kameda et al. Several hundred liters of water samples were passed through plankton nets with a pore size of 10 microns on ships at 14 sites in Tokyo Bay and river mouths in 2023. Suspended samples were digested by hydrogen peroxide in a 200 mL tall beaker. Pretreatment by enzyme was also conducted. Following digestion, sodium iodide was added to the beaker for density separation. Supernatants were obtained three times, and the pooled supernatants were passed through a hydrophilic PTFE membrane. Microplastics greater than 20 microns on the membrane were measured using the imaging technique of micro-FTIR. The poster will demonstrate the concentrations, polymer compositions, and size distributions of microplastics in the surface water of Tokyo Bay.

Keywords: microplastics, surface water, Tokyo Bay, concentrations, polymer compositions

Session C2: Source, transport, fate, impacts and mitigation strategies of marine plastics and microplastics

Simulation of floating macro plastic debris particles in Karimunjawa National Park Water

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Abstract

Karimunjawa is a national marine park designated in the Karimunjawa archipelago located in Java Sea. As a tourism area, this location is facing with the marine debris problem. Including the marine plastic. This study was conducted to investigate the source, movement and fate of floating macro plastic debris using the Delft 3D model during the west season. The data processing method is divided into two main steps, namely hydrodynamic modeling which is then used as input for the floating marine debris particle trajectory model. The data inputs used in this modeling are bathymetry, tidal components, wind speed magnitude and direction of 10 meters, and the initial position of the release of particles. Hydrodynamic simulations show that currents in Karimunjawa waters are predominantly influenced by tidal activity with a pattern of current movement towards the west-northwest when conditions go to tide, and to the east-southeast when conditions are heading for low tide. The simulation results of the waste particle trajectory show that the tourist areas that have the highest potential for waste pollution in December 2018, January 2019 and February 2019 are Menjangan Kecil Island (416 kg), Batu Topeng Beach (448 kg), and Menjangan Kecil Island (352 kg). Two tourist areas that did not experience pollution when the simulation was carried out were Genting Island and Mosquito Island (February 2019) (0 kg).

Keywords: marine debris, hydrodynamics, particle trajectory, Karimunjawa

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Session C2: Source, transport, fate, impacts and mitigation strategies of marine plastics and microplastics

Effect of monsoon on microplastic bioavailability and ingestion by zooplankton in tropical coastal waters of Sabah

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Abstract

Plankton seasonality in tropical coastal waters is becoming more apparent as a result of monsoon-driven changes in environmental conditions, but research on the monsoonal variation of microplastics (MP) is still limited. We examined the monsoonal variation of MP in the water column and their ingestion by zooplankton in Sepanggar Bay, Sabah, Malaysia. MP concentrations were significantly higher during the Southwest monsoon whereas MP ingestions showed no monsoonal difference across major zooplankton taxa. Canonical Correspondence Analysis (CCA) and Generalized Additive Models (GAM) indicate that MP concentrations were driven by changes in rainfall and salinity while MP bioavailability to zooplankton was consistent regardless of monsoon. MP ingestion increased progressively up the planktonic food chain, and bioavailability of fibers and small-sized MP of high-density polymers to zooplankton was proportionately higher. Distinct changes in the MP concentration relative to the monsoons provide new insights into the seasonal variation of MP in tropical coastal ecosystems.

Keywords: microplastics bioavailability, water column, zooplankton ingestion, monsoonal variation

Microplastics in water and *Acetes* shrimps in Chao Phraya Estuary, Thailand

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Abstract

Microplastics are widely distributed in the environment and some of those might originate from fragmentation or degradation of larger plastic debris via biological, chemical, and solar energy-driven processes. Estuaries are important land-sea interfaces that bear large quantity of microplastics which is mostly land derived. Thus, Chao Phraya Estuary can be one of the hotspots for microplastic accumulation in the Gulf of Thailand since it receives river discharge from the Chao Phraya, Thailand's largest river flowing through Bangkok Metropolitan Region where almost 17 million people reside. Chao Phraya Estuary is also an important shrimp fishing grounds for the country. Therefore, we conducted this study was to assess the quantity of microplastics in *Acetes* shrimp and the water of the Chao Phraya Estuary. Five stations were sampled in November 2022 (wet season) and February 2023 (dry season). Microplastics in water were collected though filtering 100 L of water through a plankton net of 20-micron mesh size. Meanwhile, *Acetes* samples were collected using 600-micron-mesh-size net tow. All water samples were treated with hydrogen peroxide (H_2O_2) to remove any organic matter and microplastic were extracted using filtration with GF/B glass fiber filters. *Acetes* samples were sorted according to their sexes and life stages. Subsequently, each individual *Acetes* were digested with H_2O_2 to extract microplastics. The size, shape and color of microplastics were determined under a stereomicroscope and polymer identification was carried out using Fourier Transform Infrared Spectroscopy (FTIR) microscope. We found that microplastic abundance in the water in this area averaged 0.9 items/L, with the majority being in the 501-1000 µm size class (37%). Fiber was the most prominent shape (78%), followed by fragment (22%). Meanwhile, the most prevalent colors were colorless (45%) and blue (22%). FTIR analysis identified most microplastic items to be mostly of polyethylene terephthalate (PET) which is widely used in the production of bottles and packaging materials. The work to determine microplastics in Chao Phraya Estuary *Acetes* shrimps is ongoing.

Keywords: Gulf of Thailand, sea water, zooplankton, FTIR, PET

Session C2: Source, transport, fate, impacts and mitigation strategies of marine plastics and microplastics

A study on the abundance of microplastics on beaches in Southeast Sarawak, Malaysia

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Abstract

The overuse of plastics and the improper methods of disposing them has led to severe pollution of plastics in the environment ranging from the open seas to terrestrial soil. Plastics have been found on beaches throughout the world with reports indicating that most of the marine debris that is washed ashore on beaches is plastic. The plastic debris accumulating on beaches will be exposed to sunlight and degrade into microplastics. In this study, sediments from beaches in Southwest Sarawak, Malaysia, focusing on the beaches between Teluk Melano and Buntal, were collected to determine the distribution of microplastics in the region. A total of 66 samples were collected during high, medium and low tides from a total of 13 beaches. A combination of the Nile Red (NR) and Fourier-transform infrared spectroscopy (FTIR) method was used to detect the microplastics. The amount of microplastics found in the beach sediments ranged from a mean of 17.633 pieces g^{-1} to 0.467 pieces g^{-1} which are all higher than the average amounts reported in Mumbai, Tuticorin, Dhanushkodi (0.045±0.012 – 0.22±0.05 pieces g^{-1}) and in Jiaozhou Bay (0.015±0.006 pieces g^{-1}). One-way ANOVA showed that there is no significant difference between the amount of microplastics found at different tides ($P>0.05$). A more in-depth analysis on some other factors that may affect the abundance of microplastics was done at Pasir Pandak, a beach that is close to the city of Kuching in Sarawak, Malaysia. Sample collection has commenced will be done every three months at the same points from June 2023 to March 2024. Statistical analysis will be done on the data to analyse the significance of temporal changes and sampling location on the amount and shape of the microplastics found. A total of 40 samples have been collected so far, 20 each in June 2023 and September 2023, respectively. The amount of microplastics found in Pasir Pandak was 7.996±1.724 pieces g^{-1} and 16.609±3.3 pieces g^{-1} in June and September, respectively. The statistical comparison one-way ANOVA test showed significant differences ($p<0.05$) between the amount of microplastics detected and the time that the samples were collected. In contrast, no significant difference in sampling locations on the beach

was found ($p>0.05$). The relationship between the grain size distribution of the sand and the amount of microplastics will be explored in the future.

Keywords: microplastic, Nile Red, sediment, Sarawak, beaches

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Session C2: Source, transport, fate, impacts and mitigation strategies of marine plastics and microplastics

Comparative analysis of microplastic abundance in sea surface water and tap water across three states in Malaysia

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Abstract

Microplastic contamination in the environment has raised serious concern among the public, governmental and scientific community. Despite the increasing literature on microplastic detection in Malaysia, there remain many areas that have not been investigated. In the present study, we aim to quantify microplastics in tap water used for consumption and irrigation purposes, and sea surface water from the recreational beaches across East and West Malaysia. Samples were collected from Melaka (6 stations), Terengganu (8 stations), and Sabah (10 stations), and analyzed using the robust, cost- and time- effective Nile Red staining approach. The detected microplastics were further identified using Fourier-transform infrared spectroscopy (Shimadzu IRAffinity-1S coupled with QATR-10). We found the highest abundances of microplastic particles in the waters of Terengganu (78.02±32.5 item L^{-1}), followed by Melaka (129.52±29.29 item L^{-1}), and Sabah (32.03 ± 10.34 item L^{-1}). A total of 33 % and 67 % were found in tap water and sea surface water, respectively, with common plastic types such as polypropylene, polyethylene, polyethylene terephthalate, and high-density polyethylene identified. Statistical analysis demonstrated a significant different in microplastic abundances among the states ($F=10.80$, $p<0.05$) and water types ($F=8.68$, $p<0.005$). Tukey's post-hoc tests revealed the significant differences in microplastic abundances between Terengganu and Sabah ($p<0.05$). Interestingly, similar microplastic shape ratios were found in both tap water and sea surface water, with sphere-like particles predominately present, followed by fragments and fibers. Our present results further supported the existing reports of microplastic contamination of the studied states. Furthermore, the study highlighted the lower microplastic contamination in the mainland beaches compared to the islands in Terengganu. Moreover, our study also revealed the lower microplastic contamination in the coastal region compared to the river mouth and upper stream of Sungai Tuang in Melaka. Most importantly, the microplastics detected in tap water could potentially enter the human body through daily consumption. Therefore, it is recommended to

further extend the research on the origin, fate, potential toxic release, and the presence of pathogen associated microplastic.

Keywords: microplastic, tap water, sea surface water, Nile Red, Malaysia

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Vertical distribution of microplastic larger than 20 microns in Tokyo Bay waters

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Abstract

Fine microplastics (MPs) are widespread and frequently observed on the ocean surface. However, persistent concerns suggest that a substantial portion of MPs may be submerged in seawater or settle on the seabed. Despite these concerns, there is a noticeable lack of studies addressing plastic concentrations within the water column. This research aims to fill this gap by conducting a thorough examination of the vertical profile of MPs concentrations. Through the analysis of water samples from Tokyo Bay, insights are provided into potential ecological risks associated with different water depths.

MPs larger than 20 microns were meticulously analyzed using micro-Fourier-transform infrared spectroscopy (micro-FTIR), following the established method by Kameda et al. Water samples, collected by a metal submersible pump, underwent filtration with plankton nets (pore size: 10 microns) on ships at three distinct sites in Tokyo Bay, covering both surface water and depths ranging from 1.5 m to 4.7 m. The suspended samples were digested using hydrogen peroxide in a 200 mL tall beaker. After digestion, sodium iodide was added to the beaker to facilitate density separation. Supernatants were collected thrice, pooled, and passed through a hydrophilic PTFE membrane. MPs larger than 20 microns on the membrane were quantified using the micro-FTIR imaging technique. The poster will demonstrate the concentrations, polymer compositions, and size distributions of microplastics at different depths in the seawater of Tokyo Bay.

Keywords: microplastics, water column, Tokyo Bay, concentrations, polymer compositions

Session C2: Source, transport, fate, impacts and mitigation strategies of marine plastics and microplastics

Unveiling the presence of global-scale microplastics greater than 20 μm in oceans: a study with volunteer ships

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Abstract

Microplastics (MPs) in the Ocean are one of the persistent environmental pollutants of concern. Numerous researchers study them with their own method, focusing on polymers and sizes in specific area. The abundance of MPs in the world wide oceans was still not understand well. This study represents the first attempt to investigate the distribution of MPs greater than 20 μm in global oceans with one method, the same focusing on polymers and sizes. We have started to investigate the numbers, sizes and 18 polymer types of MPs in the oceans since 2020. Sampling of MPs in the ocean was conducted by 14 volunteer ships with the cooperation of a Japanese shipping company, resulting in the collection of 240 as of November 2023. Approximately 1 m^3 of sea water samples at the depth of 3–14 m were obtained from the hydrant of the ships. Particulate matters were collected on site by sailors using a 10 μm meshed plankton net following our guideline. The filtered samples underwent pretreatment through H_2O_2 digestion and NaI density separation in the laboratory. MPs polymers were characterized using a spectrum imaging method with micro-Fourier transform infrared spectroscopy.

The observed concentration of MPs ranged from 22 to 4,660 pieces m^{-3} in the ocean. Remarkably high concentrations exceeding 1,000 pieces m^{-3} found in the Kuroshio Current, California Current, Kamchatka current and North Atlantic Gyre. These results indicated a heterogeneous distribution of MPs in the oceans. The dominant polymers are Polyethylene (PE), Polypropylene (PP), Polyethylene terephthalate (PET) and Polymethyl methacrylate (PMMA). PE and PP are the most produced plastics globally. PET was the most common fibrous polymer. PMMA was predominantly detected in the Pacific Ocean and some hotspots were identified at the Kuroshio Current. Polymer types and shapes may be affected by land-based input, ocean currents and wave driven. This project will continue for several years, providing data on MPs abundance to further the understanding of MPs pollution in the ocean. The collecting data will also be utilized to develop numerical models for predicting MPs distribution in the global ocean.

Keywords: microplastics, surface water, oceans, volunteer ships, polymer compositions

Session C2: Source, transport, fate, impacts and mitigation strategies of marine plastics and microplastics

Investigations of microplastics in surface water at rivers, lakes and bays using a novel automated microplastic sample preparation system

Yutaka Kameda and Emiko Fujita

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Abstract

Microplastics (MPs) in surface water, including rivers, lakes, and oceans, are increasingly recognized as a parameter for general water quality monitoring in various countries. Currently, numerous research efforts employ pretreatment methods recommended by the National Oceanic and Atmospheric Administration (NOAA). However, these methods are known to be comprehensive, labor-intensive, and time-consuming. As a result, analytical operators require techniques to minimize contamination during pretreatment, maintain the properties of MPs, and ensure the extraction of all MPs from water samples. Additionally, they may need to modify their procedures in specific cases, such as incorporating optional treatments like the Fenton reaction or digestion by sodium hydroxide to analyze MPs in organic-rich water samples. To enable precise analysis of MPs with high efficiency, particularly for operators with limited experience, a novel automated microplastic sample preparation system (MAP-100, Shimadzu corporation) has been developed in Japan. This system can extract fragment-type MPs larger than 300 μm from suspended matter in water samples. The process involves collecting MPs in surface water using nets such as neuston nets. Operators then gather suspended matter, removing matrices larger than 5 mm through sieves. The suspended matter smaller than 5 mm is placed in a small strainer of the system, which can then automatically perform digestion by hydrogen peroxide and density separation by sodium iodide in one continuous tube. In recovery tests, where commercial polyethylene microplastics larger than 500 μm were added to ultrapure water and actual suspended matter from a river, the system demonstrated recovery rates of 99.0% and 93.3%, respectively. We also compared microplastic concentrations, polymer types and their size distributions in Tokyo Bay between by using ordinary manual pretreatment and by using MAP-100. The fragment-shaped microplastic concentrations, polymer compositions and size distributions by MAP-100 were comparable to those by manual pretreatment. On the other hand, fabric microplastics by MAP were underestimated because of loss during the automated process. However, Poster will show a revised model of MAP-100 which can measure even fabric microplastics more accurately. Therefore, this device will be a useful automatic tool for the pretreatment process of microplastic analysis for any scientists in the world.

Keywords: microplastics, automated sample preparation system, pretreatment, surface water

Development of a semi-automatic software to identify microplastics from imaging data by Micro-Fourier-transform infrared spectroscopy

Yutaka Kameda and Emiko Fujita

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Abstract

Microplastics (MPs) smaller than 300 μm can be easily detected by the imaging technique of Micro-Fourier-transform infrared reflectance spectroscopy (μFTIR). In my laboratory, Nicolet™ iN™ 10 MX (Thermo Fisher Scientific) is used to analyze microplastics greater than 20 μm in water, sediment, biota, and the atmosphere. OMNIC™ Series Software is also utilized to identify and quantify various polymers from contour diagrams of polymers, which were measured by the FTIR. However, it has been revealed that the "Profiling" feature in the software often misidentifies polymers. Therefore, many scientists have to reidentify each microplastic particle and fiber extracted by the software. This visual inspection always consumes a significant amount of time and effort. To save time and identify microplastics more precisely, a semi-automatic software, YCALOS13, was developed. The software, YCALOS 13 (You Can LOok microplasticS), is a free software based on a macro in Excel. After imaging analysis of microplastic samples by Nicolet™ iN™ 10 MX, the mapping file is converted to CSV format. YCALOS13 can extract only spectra of designed polymers from more than 100,000 spectra data in the mapping file, based on polymer-specific bands, the peak areas, and their shapes, which users can decide in the configuration. It can generate each contour diagram of many target polymers simultaneously after only pushing the start button. Finally, ImageJ software can quantify the number of MPs from the contour diagram of each polymer. We compared the abundances of MPs in river water samples and sea water samples between OMNIC software plus visual inspection and YCALOS13. It was revealed that YCALOS13 could detect concentrations comparable to OMNIC software plus visual inspection. YCALOS13 can be a useful tool to identify various polymers from imaging data from μFTIR. This poster will also introduce a novel software “YCALOS-DE,” which can also classify each MPs fragment and fiber by MPs degradation level “age.” YCALOS-DE will be a useful tool to identify environmental MPs more accurately and rapidly without professional knowledge and experience.

Keywords: microplastics, identification, semi-automatic software, polymer, imaging data

Development of a portable and affordable sampling device for microplastics in water samples

Yutaka Kameda and Emiko Fujita

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Abstract

When microplastics (MPs) in surface waters are sampled at rivers, lakes, bays, and oceans, large and heavy sampling tools such as neuston nets, many plankton nets, and large pumps are needed. Large sampling volumes are also required, several cubic meters for large MPs larger than 1 mm and several hundred liters for small MPs larger than 20 microns. As a result, investigations of MPs are very hard work and time-consuming. On the other hand, more investigations of microplastics in the aquatic environment must be conducted because occurrences of MPs in Asian countries and seas are little known. Based on the above considerations, the objective of this study is to develop a portable and affordable sampling device for microplastics in water samples. In this study, a home water purifier (ITSUBISHI CHEMICAL CLEANSUI CORPORATION) was used to collect MPs in drinking water and seawater. Hollow fiber membranes in the purifier can concentrate MPs larger than 0.5 microns in the vessel. The membrane is very small, but the filter area is approximately 3 times larger than that of a plankton net we use. The small filter cartridge is inexpensive and reusable. This presentation will show the application of the purifier to monitoring MPs in tap water as well as seawater. The size of analyzed microplastics ranges from 1 micron to 5 mm.

Keywords: microplastics, plankton nets, neuston nets, hollow fiber, portable collector

Session C2: Source, transport, fate, impacts and mitigation strategies of marine plastics and microplastics

Polyethylene terephthalate (PET) bottles along the coastline of Capayas Island, Palawan, Philippines: evidence of transboundary plastic pollution?

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Abstract

Transboundary plastic pollution provides a significant contribution to the prevalent problem of uncontrolled plastic waste in marine ecosystems. It requires global collaboration to control plastic production and modify management strategies within the South China Sea. However, the phenomenon of transboundary plastic movement in Southeast Asia remains insufficiently investigated. This study was conducted to investigate the presence of polyethylene terephthalate (PET) bottles along the coastline of Capayas Island, Bataraza Palawan, Philippines. The study involved the systematic collection of PET bottles from 17 designated quadrats, delineating a total area of 8,225 square meters surrounding the island. The findings revealed a total of 670 bottles, with 303 (45%) identified by country of origin confirmed through label verification, while 367 (55%) remained unverified and unlabeled among the collected total. Of the identified PET bottles, Malaysia (34%), Vietnam (20%), China (9%), Indonesia (7%), Thailand (4%), Singapore (2%), and Brunei Darussalam (1%) were contributors, possibly transboundary pollution. The Philippines contributed (23%) to the plastic litter. Categorically, water bottles (46%) predominated, with Malaysia as the primary contributor (57%). Carbonated drinks (20%) were primarily labeled with Malaysia (23%), while tea (12%) noted Vietnam as the top contributor (51%). Notably, the plastic density across transects was recorded (0.08 items/m^2). Furthermore, 14 days of collection to assess the temporal variation of the PET bottles landing on the island was done through citizen science. Results garnered 239 PET bottles ranging from 13–25 items per day, which was topped by Malaysia (43.3%) mostly water bottles. These empirical findings establish a baseline dataset vital for shaping pivotal environmental policies aimed at addressing the pressing concern of transboundary plastic pollution in Southeast Asia. However, despite the verified label of the PET bottles, there is still doubt that these plastics were transboundary in nature. Therefore, this study recommends the necessity for long-term research to comprehensively comprehend and proactively combat the persistent challenge of transboundary plastic pollution in the region.

Keywords: macroplastics, plastic litters, marine pollution, plastics, plastic waste

Quantity and physical characteristics of microplastics in beach sand along the coast of Mueang and Chana district, Songkhla province, Thailand

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Abstract

Recently, microplastic pollution, especially in marine environments, has been growing concern globally because of the potential negative impacts. Beach sand along the coastal area is one of the contaminated areas due to the activities of both humans and the environment. The coastal areas along Kotaew subdistrict, Mueang district and Na Tab subdistrict, Chana district of Songkhla have various activities including community, tourism, and local fishery. Moreover, there are offshore breakwaters and the mouth of the Na Tab canal in this area. Therefore, this study aims to survey and characterize quantity and physical properties (i.e., shapes, colors, and size) of microplastics in beach sand in Kotaew subdistrict, Mueang district and Na Tab subdistrict, Chana district, Songkhla province, Thailand. Six beach sand samples between Bo It beach and the mouth of Na Tab canal with a total distance of 5.6 kilometers were collected in December 2017. Microplastics were separated by using saturated NaCl solution, then investigated the quantity, shapes, colors, and size of microplastics by microscope. The results exhibited the contamination of microplastics in all beach sand samples in the range of 240–829 items/kg sand dry weight with an average of 511±209 pieces/kg sand dry weight. The dominant shape was fiber (61.70%), followed by fragment (33.95%), bar (3.59%) and round shapes (0.75%), respectively. Nine colors of microplastics found in this study were transparent, opaque white, red, black, dark blue, light blue, gray, brown and purple with the dominant colors of opaque white (21.68%) and black (19.72%). The sizes of found microplastics were between 0.02 and 10.83 millimeters. Additionally, plastic debris was found in all sampling areas. In conclusion, recreation activities, discharge water from communities, fishery, and plastic debris are the potential sources of microplastics in the study area and these activities along with microplastic contamination should be monitored continuously.

Keywords: microplastics, quantity, physical characteristics, beach sand, Songkhla

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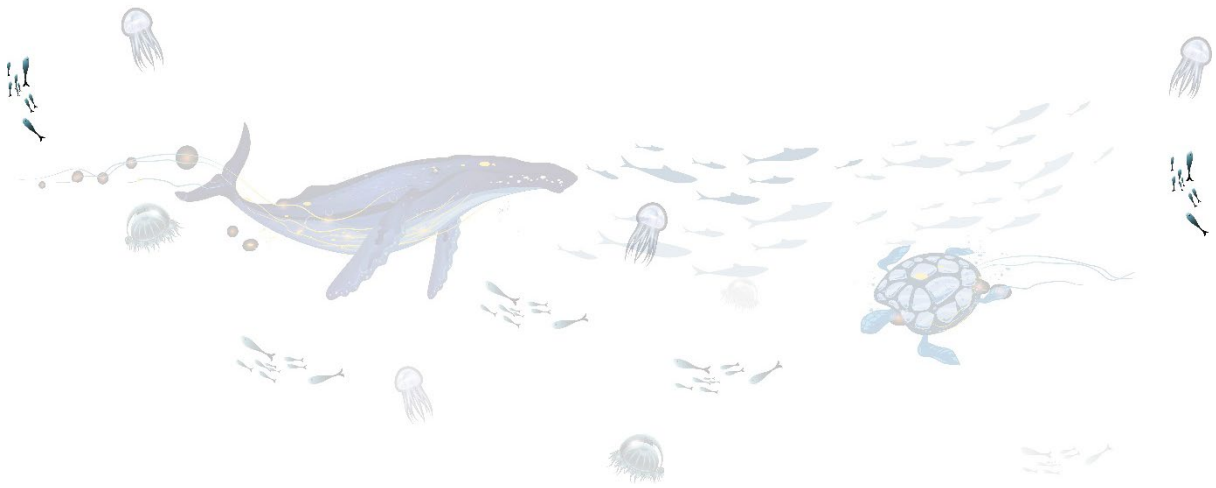
Sub-theme C:
Ocean and Human Health

Session C3:
Deoxygenation in the Western Pacific: Implications for coastal and open ocean ecosystems



Seasonal variation and spatial extent of deoxygenation in Bolinao, northwestern Philippines

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and Maria Lourdes San Diego-McGlone

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Abstract

The municipality of Bolinao includes a mariculture area where water quality has deteriorated due to excessive nutrient and organic matter input from unregulated mariculture practices. Conditions of eutrophication and hypoxia have resulted in algal blooms and fish kills. Adjacent to the mariculture area is a reef flat composed of coral reef patches and seagrass beds that have undergone changes in benthic community structure. Here, we report long-term monitoring of physico-chemical parameters (e.g., temperature, salinity, dissolved oxygen, nutrients, chlorophyll-a, carbonate chemistry) from the early 90s up to current conditions. Water quality dynamics in the mariculture area is explored together with the development of hypoxia-eutrophication-acidification which is affected by seasonality, riverine discharge, residence time, and respiration rates. The spatial extent of water quality conditions and the presence of water quality gradient are presented to show the influence of mariculture outflow on nearby coastal ecosystems. This work highlights the significance of continuous monitoring of water quality to assess potential future changes and the need to address local human activities as the main drivers of environmental stressors.

Keywords: hypoxia, ocean acidification, eutrophication, aquaculture, water quality

Sub-theme C:
Ocean and Human Health

Session C4:
Ocean acidification and its impacts on marine ecosystems

Low-pH seawater observed along Thailand coast in the northern Strait of Malacca

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Phuket Marine Biological Center, Marine and Coastal Resources Research and Development Institute, Department of Marine and Coastal Resources, Thailand

Abstract

Department of Marine and Coastal Resources (DMCR) set multiple cruises to sail along Thailand coast (approximately 25 km offshore) in the northern Strait of Malacca from 2017 to 2020, i.e., March 2017 and 2020, May 2018, and April 2019. The aim of the cruises was to collect oceanographic data and water samples for the observations of ocean acidification in the coastal water. The water samples were analyzed for pH and Total Alkalinity (TA) using spectrophotometric method and open cell titration respectively, then aragonite saturation was calculated using the program CO2SYS. Observations reveal that water columns in the northern Strait of Malacca were weakly stratified, equally attributed to temperature and salinity, during the observations, and that there was low-pH seawater found in the lower layer of the water column. Multiyear observations suggest the presence of low-pH seawater in this area is typical during the observation months. Compared to the other years, it is noticeable that cold and salty water was observed in the northern Strait of Malacca in 2020 after a strongly positive phase of Indian Ocean Dipole (IOD) in mid-2019. Together with this cold and salty water, we observed low-pH seawater extended from the northernmost station to the southernmost station along the coast. An assumption to the presence of this acidified water in the northern strait of Malacca is that the monsoonal wind induces cross-shelf transport and then upwelling. It can bring low-pH seawater in the lower-layer water onto the shelf seasonally. In addition to local wind, anomalously easterly wind along the equatorial Indian Ocean brings the lower-layer water in the Andaman Sea upward, enhancing intrusion of the low-pH seawater onshore interannually. It is noted that understanding the conditions governing the upwelling in this area is important to the coastal management as acidified water can threaten the coastal ecosystem as the water becomes more corrosive especially to calcifying marine organisms.

Keywords: ocean acidification, Thailand coast, northern Strait of Malacca

Biogeochemical properties of shallow-water CO_2 seeps in the Himeshima and Showa Iwojima Islands, Japan

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Abstract

CO_2 seeps are considered to anticipate the future marine environment, which will be a matter of concern if human society does not make efforts to drastically reduce CO_2 emissions in the future. Several shallow-water CO_2 seeps have been discovered in the seas around Japan. As they are located in coastal areas that are familiar and important to human society and are relatively easy to access, studies have been conducted in these shallow-water CO_2 seeps. However, many of the studies have been conducted from the perspective of volcanology. In this study, shallow-water CO_2 seeps around the Himeshima and Showa Iojima Islands, located in Kyushu, Japan, were investigated from the perspective of ocean acidification for the first time. Surveys were conducted after May 2022 on the Himeshima Island and after March 2023 on the Showa Iojima Island. The results of the surveys conducted to date on both islands indicate that the CO_2 concentration in seawater in CO_2 seeps is higher than in non-CO_2 seeps, and there are significant decreases in pH and calcium carbonate saturation state, which are close to the values anticipated to be reached by the end of this century unless anthropogenic CO_2 emissions are significantly reduced. Since these shallow-water CO_2 seeps are located within the Japan Geoparks, they can be positioned in the future not only as subjects of studying biological responses to future climate change but also as fields of study tour and ecotourism from the perspective of geoparks.

Keywords: CO_2 seep, ocean acidification, Himeshima Island, Showa Iwojima Island, Geopark

Carbonate chemistry baseline information on Philippine coral reefs

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Abstract

Coral reefs are widely reported to be vulnerable to ongoing ocean acidification (OA), increasing the susceptibility of their calcium carbonate ($CaCO_3$) framework to dissolution and erosion. Further, other local stressors like eutrophication may promote phase shifts to other predominant organisms like turf algae. Current and future pH levels in coral reefs remain unexplored, which is compounded by the natural carbonate chemistry variability in coastal systems. Here we present autonomous and discrete pH data collected at six reef sites across the Philippines and compare values (mean, daily minimum, and maximum) to projected OA scenarios. In addition, we use carbonate chemistry-based metric tools to assess the health of coral reefs. Total alkalinity (TA) and dissolved inorganic carbon (DIC) data were collected on a diel basis and were used to calculate the net calcification potential (ΔTA) and the relative balance of community metabolism (net community calcification (NCC) and net community production (NCP). Water quality data (nutrients, dissolved oxygen, chlorophyll-*a*) were also collected to determine the environmental range where reefs currently thrive. This work will highlight the significance of seawater chemistry data to assess the health of coral reefs and evaluate their vulnerability to ongoing stressors.

Keywords: coral reef, ocean acidification, carbonate chemistry, community metabolism, water quality

Sub-theme C:
Ocean and Human Health

Session C5:
Mitigation and management of harmful algal blooms

Session C5: Mitigation and management of harmful algal blooms

The IOC Harmful Algal Information System

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Abstract

The Intergovernmental Oceanographic Commission of UNESCO (IOC) Harmful Algal Information System (HAIS) is composed of a number of components; the IOC taxonomic list of harmful algal bloom (HAB) species, UNESCO's Ocean Biodiversity Information System (OBIS)/HABMAP, and the Harmful Algal Event Database (HAEDAT) which will soon be linked to the recently developed IOC Algal Toxins Database (Toxins). OBIS/HABMAP contains information about the taxonomy and global distribution of harmful algal species. HAEDAT contains over 10,000 records of harmful algal events from across the globe. In 2021, the IOC published the first Global HAB Status report which used OBIS/HABMAP and HAEDAT as its primary data sources to address the perception of a global increase in HABs. This analysis found no global increasing trend once the increased monitoring effort associated with an expanding aquaculture industry had been accounted for. Instead differing regional trends, driven by bloom species, type and impact were observed. Since publication, data from HAEDAT and OBIS/HABMAP has been used in further numerous publications dealing with desalination, remote sensing, regional studies and coastal HABs. To ensure these databases remain a vital resource for global HAB assessments and future publications, regional groups are updating gaps in coverage in OBIS/HABMAP and HAEDAT with information about harmful algal species and harmful algal events from their areas. Members of Westpac with relevant datasets are encouraged to review the existing data in HAIS and enter new/recent data that are missing from particular areas. For further information about HAIS and how to enter data, contact Eileen Bresnan (Eileen.Bresnan@gov.scot) or Henrik Enevoldsen (h.enevoldsen@bio.ku.dk).

Keywords: harmful algae, harmful algal events, OBIS, HAEDAT, HAIS

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Phylogeny and ultrastructure of a new non-toxigenic *Amphidoma* species isolated from the Western Pacific

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Abstract

The diarrhetic shellfish toxin azaspiracids (AZAs) are produced by several marine dinoflagellates of *Amphidoma* and *Azadinium* in the family Amphidomataceae. These AZA producing species need to be detected to secure the seafood safety in the Western Pacific, however, they have not been fully investigated because of their small size (<20 µm long) and difficulty of culture establishments. Recent studies reported the occurrences of several *Azadinium* species, including a toxigenic species *Azadinium poporum*, in this region. On the other hand, for the genus *Amphidoma*, rDNA sequences related to an AZA-producing species *Amphidoma languida* have been detected by environmental DNA metabarcoding, but its morphology and AZA production are not known. In the present study, phylogeny, ultrastructure and AZAs production of nine *Amphidoma* strains isolated from Japan (seven strains), Malaysia (one strain), and the Philippines (one strain) were examined. Cell size and organelle position were observed by light microscopy, thecal plates and thecal pores were observed by scanning electron microscopy, and intracellular ultrastructure was observed by transmission electron microscopy. Phylogenetic trees inferred from rDNAs (SSU, ITS and LSU rDNA) showed the monophyly of nine Pacific strains, which was a sister to the clade of *A. languida* including toxigenic strains from the Atlantic. Cells were ovoid, 8.7–16.7 µm in length and 7.5–14.0 µm in width. A nucleus was posteriorly located and a stalked pyrenoid surrounded by a starch sheath was penetrated by tubular cytoplasmic invaginations. Thecal tabulation was Po, cp, X, 6', 6'', 6C, 5S, 6''', 2'''', which is typical of *Amphidoma*. A ventral pore was located on the anterior right side of 1', beside the 6' plate. A ventral depression (ca. 0.28 µm in diameter) was located on the anterior end of anterior sulcal plate. A large antapical pore, containing ca. ten small pores, was observed on the 2'''' plate. This species differed from *A. languida* in the presence of ventral depression and *A. trioculata* (16.6–21.0 µm in length, 16.1–20.4 µm in width) in the size range. AZAs were not detected from the strains by LC-MS/MS. This non-toxigenic *Amphidoma* is an undescribed species morphologically discernible from the toxigenic *A. languida* and other

Amphidoma species. Nine strains of this *Amphidoma* species had an identical SSU rDNA (V4) sequence different 3 bp from *A. languida* strains, and the Tara Ocean environmental DNA database showed a wide distribution of the *Amphidoma* species, not only in the Western Pacific.

Keywords: Amphidomataceae, azaspiracid, shellfish poisoning toxin, ventral depression, ventral pore

Session C5: Mitigation and management of harmful algal blooms

Morphology and phylogeny of kareniacean dinoflagellates from the eastern coast of Hokkaido, Japan

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Abstract

In September–November 2021, a devastating harmful algal bloom of *Karenia selliformis* occurred along the eastern coast of Hokkaido, Japan. In the bloom, co-occurrences of other kareniacean dinoflagellates were observed. Since the occurrence information of kareniaceans is limited in Hokkaido, we established cultures of six kareniacean species in 2021 and 2022, and their morphology and phylogeny were examined. Culture strains were established by single-cell isolation from coastal seawaters of eastern Hokkaido, in September 2021 at 13–17°C and in June 2022 at 12–13°C. DNA sequences of ITS and LSU rDNA (D1–D3) were obtained from the cultures and aligned with sequences from GenBank. Cell sizes and positions of organelles such as nucleus, chloroplast and pyrenoid were examined by light microscopy, and cell surface ultrastructure such as apical structure complex by scanning electron microscopy. Molecular phylogeny showed the presence of *Karenia longicanalis*, *Kr.* cf. *longicanalis*, *Kr. mikimotoi*, *Karlodinium* cf. *digitatum*, *Takayama* cf. *acrotrocha*, and *Takayama* sp. Cells of *Kr. longicanalis* found in 2021 and *Kr.* cf. *longicanalis* found in 2022 had a long apical structure complex, striations on the epicone, and multilobed chloroplasts. The former had a longitudinally ellipsoidal nucleus in the center of the cell. The number of chloroplasts (4–7) was smaller than the original description (as many as 30). The latter had 18–52 (mean 31.5) chloroplasts, and a spherical and anteriorly positioned nucleus is different from the original description. Cells of *Kr. mikimotoi* were found in both years and phylogenetically similar to the previous reports. A longitudinally ellipsoidal nucleus was located on the left side of the hypocone and usually extended into the epicone. Chloroplasts were bean-shaped and 13–19 in number. *Karlodinium* cf. *digitatum* was phylogenetically related to *Kl. digitatum*, but its cell length was 14.6 µm and smaller than the original description (21.5 µm in length). *Takayama* cf. *acrotrocha* belonged to the clade of the species. A nucleus was laterally elongated along the dorsal of the epicone and a large pyrenoid was located in the center of the hypocone. *Takayama* sp.

was phylogenetically related to *T. tasmanica* but its cells were 35.2–48.8 µm long in the field samples, which is larger than *T. tasmanica* (16–27 µm long). A laterally elongated nucleus was dorsally positioned near the cingulum. Multiple pyrenoids were located in the center of the cell.

Keywords: cold water bloom, *Karenia*, *Karlodinium*, red tide, *Takayama*

Sub-theme C:
Ocean and Human Health

Session C6:
Marine toxins and seafood safety

Economic loss of white spot syndrome virus disease in whiteleg shrimp (*Litopenaeus vannamei*) farming business

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Abstract

Indonesia has a great fishery potential and growing rapidly, especially vannamei shrimp (*Litopenaeus vannamei*), but infection such as White Spot Syndrome Virus (WSSV) that causes death in vannamei shrimp can cause economic losses such as decreased income, shrimp production, and price changes. The purpose of this study was to determine the economic losses experienced by the vannamei shrimp farming business due to WSSV infection, the policies implemented by the government to deal with economic losses that occurred due to WSSV infection, and the preventive measures taken to minimize losses due to WSSV infection. The method used in this study is a systematic literature review, which is an identification process to provide answers to research questions. The data used in this study is the last 10 years (2010–2020). The results obtained are vannamei shrimp cultivation systems consisting of intensive, semi-intensive, and traditional cultivation where the production of vannamei shrimp in Indonesia continues to increase with prices reaching IDR 100,000/kg. WSSV infection can be found in almost all crustaceans, one of which is vannamei shrimp, and shows clinical symptoms such as the appearance of white spots on the shell of the shrimp. The total production at the beginning of the development of vannamei shrimp cultivation in Indonesia in 2005 was around 500,000 tons, while in 2018 it was 717,094 tons. However, in 2015 the production of vannamei shrimp experienced a drastic decrease in production from 442,380 tons to 421,089 tons. It can be concluded that at the beginning of the emergence of WSSV Indonesia suffered a loss of almost USD 1 billion with the policies used to overcome economic losses were implementing APPIK and fish quarantine. In addition, to prevent WSSV can be done utilizing herbs and giving probiotics. Farmers should pay attention to the quality of the water used to minimize WSSV infection.

Keywords: vannamei, WSSV, economic loss, Indonesia, aquaculture

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Light-regulated microalgae metabolite retinal transport and transformation through the food chain effectively inhibited the growth and disturbed the liver-gut axis of marine medaka (*Oryzias melastigma*)

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Abstract

Marine microalgae are commonly used as bait in aquaculture. Recently, the global demand for microalgae has increased. To promote the growth rate of algal cells and improve the economic benefits of breeding, high light-intensity conditions are usually used to cultivate bait algae. However, changes in light intensity may cause changes in the production of metabolites in microalgal cells. Whether this has adverse effects on aquatic animals has not been thoroughly investigated. In this study, the accumulation of the microalgal metabolite retinal (RAL) in *Thalassiosira pseudonana* was measured under low and high light conditions. By simulating the food chain transmission among *T. pseudonana*, brine shrimp (*Artemia salina*), and marine medaka (*Oryzias melastigma*), the transformation of RAL and its derivatives, retinoic acid (RA), was determined, and their toxic effects on fish individuals and tissues and the mechanism of toxicity were examined. This study demonstrated that high light exposure caused *T. pseudonana* to produce and accumulate large amounts of RAL, which was transferred through the food chain to marine medaka, converted to RA, and enriched in the gut, liver, and spine. Through informatics and biochemical analyses, we evaluated the toxic effects of RA on the spine, liver, and intestine, explored the interactions between different tissues, and elucidated the potential effects of RA on the growth and gut-liver axes of marine medaka. Our findings imply that light induces large amounts of RAL production in marine microalgae, which is then transmitted through brine shrimp, converted to RA, and enriched in marine medaka by retinal dehydrogenase; additionally, RA enrichment was indicated to result in the following: gut microbiota dysbiosis; altered gut microbial function; disrupted the gut barrier, causing oxidative stress, and triggering inflammation through affecting liver structure and function through the gut-liver axis; liver tissue fibrosis, resulting in hepatic oxidative stress and inflammation; and down regulation of the transcription of genes related to the regulation of bone growth and development in liver tissue, leading to spinal deformation, causing spinal oxidative stress and spinal inflammation, and toxic damage to marine medaka individuals, affecting individual development. Overall, high light intensity may promote RAL production, which is transformed into RA through the food chain and enriched in marine medaka, while causing toxic damage to tissues

related to the growth and gut-liver axes. As a result, the potential effects of light on wildlife and human health through the regulation of the accumulation of marine microalgal metabolites and their transmission through the food chain need proper investigation and may have broader implications.

Keywords: retinal, retinoic acid, food chain, gut-liver axis, microbiota dysbiosis

Plant growth promoting bacteria associated with edible sea grapes *Caulerpa lentillifera* (J. Agardh 1837)

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Abstract

This study aimed to isolating and characterizing plant growth-promoting bacteria associated with eligible seaweed which is now most abundant planting in coastal seawater in Vietnam. All isolates were accessed for phytohormone indole acetic acid production, ability to solubilize phosphate, zinc and potassium, fixed nitrogen and produced ammonia, hydrogen cyanide production, and the enzymes pectinase, cellulase and chitinase. A total of 130 seaweed associated bacteria were isolated, with 68 of them showing some plant growth characteristics: 52% phosphate solubilizers, 49% zinc solubilizers, 26% potassium solubilizers, 16 % nitrogen fixers and 16 % producing IAA, and one one strain HCN producer. The five best isolates were tested for their ability to promote plant growth in host. They belong to the *Bacillus,* the *Klebsiella*, the *Enterobacter* and the *Pseudomonas* genera. This study suggested that needed further exploiting of those potential bacteria as biofertilizers, especial for aquaculture.

Keywords: plant growth promoting bacteria, seaweed, *Bacillus*, *Klebsiella*, *Enterobacter*, *Pseudomonas*.

Investigate lipid and protein oxidation in herring (*Sardinella gibbosa*) by sodium acetate during preservative time

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Abstract

The study was carried out to investigate lipid oxidation in herring (*Sardinella gibbosa*) which was treated with (2.5% w/v) sodium acetate and stored at 4^{o}C. After 3, 6, 9, and 12 days, lipid oxidation was evaluated using indexes, including pH, peroxide (PV), and thiobarbituric acid-reactive substances (TBARS). The results showed that pH was from 6,33± 0,005 to 7,47± 0,005, without significant difference between control and treatments ($p>0.05$). However, PV in the control group was higher than in the samples treated with sodium acetate and ranged from 1.73±0.31 to 7.13±0.5 mEq/kg. TBARS value in the control group was higher than in the treatments, ranging from 53.3±0.28 to 207.4±0.47 µmol MDA/ kg, and these values significantly differed from the groups ($p<0.05$). As a consequence, sodium acetate is an effective solution in preventing lipid oxidation and extension of the herring flesh's life.

Keywords: herring, natri acetate, lipid oxidation, protein oxidation.

Session C6: Marine toxins and seafood safety

Light-induced algae retinal stress can deform fish spines

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Abstract

Retinoids, especially retinoic acids and their corresponding metabolites, are reported to be teratogenicity in animals. The ecological influence of retinal (RAL) are largely unknown. This study focuses on the effects of RAL on marine organisms. The contents of RAL in three species of marine algae *Thalassiosira pseudonana*, *Aureococcus anophagefferens*, *Tetraselmis subcordiformis* were detect. Furthermore, we studied the accumulation of RAL by the changed light environment and investigated the possible regulation of retinol dehydrogenase (RDH). Teratogenic effects of RAL on embryos and juveniles of marine teleost medaka (*Oryzias latipe*), Brine Shrimp (*Artemia salina*), and food chain transmission characteristics were explored separately. The results suggest that high light exposure, blue light exposure, and biomass increases during algal blooms were all possibly to increase the accumulation of RAL, which more likely to cause teratogenic effects on vertebrate fish through the food chain.

Keywords: light stress, algae, teratogenic effects, food chain, retinal

Seasonal changes of tetrodotoxin and its analogue composition in *Takifugu niphobles* pufferfish caught in Korean waters

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Abstract

Tetrodotoxin (TTX) is a potent neurotoxin found in pufferfish. Pufferfish poisoning accidents occur frequently in East Asia, especially Korea and Japan. However, there is lack of knowledge on TTX and its analogues (TTXs) composition in Korean puffer fish. In this study, the seasonal changes of TTXs in various tissues of the Korean *Takifugu niphobles* pufferfish were investigated by using multiple reaction monitoring (MRM) mode of an ultra high-pressure liquid chromatography triple quadrupole tandem mass spectrometry (UHPLC-QqQ-MS/MS) with electrospray ionization (ESI). In the result, a total number of six TTXs were identified and quantified. In addition to TTX, the primary TTXs were deoxy analogues (i.e., trideoxy-, dideoxy-, and deoxy-TTX), regardless of seasons. Most *T. niphobles* samples showed highest TTXs contents in the ovary. The edible part, muscle, showed the lowest TTX contents in most *T. niphobles* samples. *T. niphobles*, purchased between November 2022 and February 2023, showed high levels of TTX contents. This study may contribute to establish the database of pufferfish toxicity information of *Takifugu niphobles* sold in Korean.

This research was supported by a grant (20163MFDS641) from Ministry of Food and Drug Safety in 2024.

Keywords: *Takifugu* pufferfish, TTX, tissue distribution, LC-MS/MS, trideoxy TTX

Session C6: Marine toxins and seafood safety

Temporal monitoring of pinnatoxins in shellfish collected from the Korean Peninsula

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Abstract

Rapid changes in the marine ecosystem have brought attention to emerging new marine toxins that pose serious risk. In fact, cases of exposure to the risk of new toxicity are continuously reported in various European countries, but the lack of established international standards hinders effective management. Novel toxins analysis present analytical challenges due to the limited availability of commercial standards (only 7 out of more than 40 reported new toxins) and their presence at very low concentrations in marine organisms along with numerous interfering substances. Herein, we developed a method to simultaneously identify and quantify three types of pinnatoxin analogs, the most famous novel marine toxins, encompassing extraction, purification, analysis, and data interpretation. Using this method, we successfully monitored PnTX E, F, and G in approximately 400 species of shellfish collected over a span of 4 years from the Korean peninsula, where the emergence of novel marine toxins had not been reported so far. Note that PnTX G (4.131~14.42 pg/g) was detected for the first time in about 110 species. Detected PnTX G concentrations exhibited a positive correlation with increasing sea surface temperature. The emergence of PnTX, a cyclic imine group, in marine life in Asia once again highlights the importance of continuous monitoring of biological toxins and the implementation of guidelines and standards for their safe management.

Keywords: pinatoxins, shellfish, Korean peninsula cyclic imines

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Rapid monitoring of Cyclic Imines in marine organisms using LC-MRM-MS platform

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Abstract

Cyclic imines (CIs) produced by microalgae species and accumulating in the food chain of marine organisms are novel biotoxins that do not belong to the classical group of marine biotoxins. In the past, CIs were found only in limited areas, but in recent years, rapid changes in marine ecosystems have led to widespread CIs, increasing exposure to toxic risks. Therefore, proactive monitoring of CI is necessary, but its analysis is still difficult due to high levels of analogs and interference from other lipophilic substances. Herein, we developed the LC/MRM-MS-based quantitative platform that can selectively enrich for marine-derived CIs and monitor commercially available seven CIs simultaneously: pinnatoxin (PnTX E, PnTX F, PnTX G), gymnodimine (GYM A), and spirolide (13-desMe SPX C, 13,19-didesMe SPX C, 20-Me SPX G). In particular, the combination of chromatographic separation by the hydrophobic nature of intrinsic residues of CIs with monitoring of CI structure-specific product ions generated by CID-MS/MS significantly improves the selectivity and sensitivity for simultaneous quantitative analysis of seven CIs. Indeed, three CIs corresponding to PnTX G, GYM A, and 13-desMe SPX C could be successfully determined at the level of part-per-trillion (ppt) in three species of shellfish collected around the Korean Peninsula. Our rapid analytical platform with high sensitivity and selectivity can help accelerate marine biology as well as various other fields requiring CI analysis.

Keywords: LC/MRM-MS, pinnatoxin, gymnodimine, spirolide, cyclic imines

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Session C6: Marine toxins and seafood safety

Mass spectral matching-based detection for pteriatoxin isomers in marine organisms

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Abstract

Pteriatoxins are a group of cyclic imine toxins, which are a growing class of lipophilic organic compounds produced by some species of marine dinoflagellate microorganisms. These toxins accumulate in shellfish and are extremely toxic and pose a significant threat to public health as they adversely affect consumers. The detection and monitoring of pteriatoxin isomers in shellfish is of utmost importance for ensuring food safety and safeguarding public health. Pteriatoxin isomers are structurally similar variants of the pinnatoxin, differing only in their substituents or stereochemistry. Despite their subtle structural variations, these isomers can exhibit considerable differences in toxicity, making their identification and quantification crucial. Traditional analytical methods for detecting pteriatoxins often suffer from limited selectivity, sensitivity, and capability to distinguish isomers. Here, we have developed an analytical strategy that combines chromatographic separation with CID-MS/MS spectral library matching to detect isomers of pteriatoxin (A and B/C) in shellfish. Based on the physicochemical similarities with commercially available pinnatoxin, an *in silico* library consisting of retention time (RT) and MRM transition (precursor-product ion pairs) was developed for pteriatoxin. That is, the pteriatoxin isomers were first predicted using elution time by distribution coefficient on reverse phase LC, and then identified and quantified by combining structure-specific ions from the residual part with the same ions of the common imine structure. About 30 species of shellfish including *Haliotis discus hannai, Azumapecten Farreri, and Rudutapes philippinarum* collected from the Korean domestic market, were screened for pteriatoxin isomers at the ppt levels but were not detected. Our assays can facilitate various marine toxin studies, including risk assessment, safety management, and contamination monitoring.

Keywords: pteriatoxins, dinoflagellate, CID-MS/MS, cyclic imines

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Dietary exposure assessment of azaspiracids (AZAs) in imported shellfish using maximum likelihood estimation from left-censored data

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Abstract

Azaspiracids (AZAs) represent a group of shellfish toxins known to cause azaspiracid shellfish poisoning (AZP). They have been consistently detected in mussels (*M. edulis*) and oysters (*C. gigas*) in foreign countries (Netherlands, Ireland, Italy, France, UK). This study aimed to evaluate the risk assessment of AZAs for the consumption of imported shellfish based on the Korea National Health and Nurition Examination Survey. A total of 467 imported shellfish from 2020 to 2023 were purchased from retail and wholesale markets in South Korea. The simultaneous detection of AZA1, AZA2, AZA3, AZA4, and AZA5 was performed using ultra-high performance liquid chromatography-tandem mass spectrometry (UHPLC-MS/MS) by following AOAC ISO 17025 guidelines. While AZA1, AZA3, AZA4, and AZA5 were not detected in any imported shellfish, two Russian stone clams were AZA2- positive above the limit of detection (LOD) but below the limit of quantification (LOQ), with concentrations ranging from 0.68 and 0.71 ng/g. The annual per capita human exposure to imported shellfish in the Korean population, by AZA2, was measured at an average standard deviation of 1.62E-06±4.24E-06 μg/kg b.w./day/person. The dietary exposure to AZA2 identified in Russian stone clams was 3.98E-10±5.96E-10 μg/kg b.w./day/person. Based on these findings, the hazard levels for AZA1, AZA2, AZA 3, AZA4 and AZA5 in all shellfish are respectively 0.0011%, 0.0038%, 0.0008%, 0.0009%, and 0.0008%. In addition, the maximum hazard levels for AZA1, AZA2, AZA 3, AZA4 and AZA5 detected in Russian stone clams are approximately less than 0.0001%. Considering left-censored data, dietary exposure of AZAs in imported shellfish was safe in Korea. The Ministry of Food and Drug Safety provided support for this research through grant number 20163MFDS641 in 2024.

Keywords: azaspiracids (AZA), shellfish, left-censored data

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Maximum likelihood estimation of brevetoxin (BTX) in imported shellfish in Korea

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Abstract

Brevetoxins (BTXs) are a group of neurotoxic shellfish toxins produced by *Karenia brevis*. Although neurotoxic shellfish poisoning (NSP) has not been reported in Korea, this study monitored four BTX-group toxins (BTX1, BTX2, BTX3, and BTX3-42) in imported shellfish using ultra-high performance liquid chromatography-tandem mass spectrometry (UHPLC-MS/MS) and evaluate the risk assessment of BTXs in dietary exposure of imported shellfish. Imported shellfish from 10 countries were collected between 2020 and 2023. UHPLC-MS/MS analysis was carried out in compliance with AOAC ISO 17025 guidelines. Among a total of 467 samples from 21 different species, only BTX3-42 was detected in 1 Chinese scallops at a concentration of 25.35 ng/g. As the BTX3-42 was detected infrequently with very low concentration, the left-censored data were used to evaluate the dietary exposure in Korean population. The annual per capita human exposure to BTX3-42 from the consumption of imported shellfish has an average standard deviation of 8.13E-05±4.49E-04 μg/kg b.w./day/person. Based on this, the maximum hazard level of BTX3-42 from the annual consumption of imported shellfish is 0.4068%. This corresponds to 0.41% of the human exposure safety standard. Furthermore, the maximum hazard level targeting individuals aged 65 and above is 0.53% higher than the data for the overall age group. However, monitoring of BTXs in imported shellfish will be needed because of global warming and harmful algae bloom. The Ministry of Food and Drug Safety provided support for this research through grant number 20163MFDS641 in 2024.

Keywords: shellfish, brevetoxins (BTXs), neurotoxic shellfish poisoning (NSP), human exposure

Simultaneous surveillance of pectenotoxins (PTXs) in imported shellfish and their dietary exposure assessment

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Abstract

Pectenotoxin (PTX) group toxins are marine biotoxins causing diarrhetic shellfish poisoning (DSP) in humans. Since they have been found in microalgae and shellfish in Australia, Japan, New Zealand, and several European countries, surveillance of PTXs was not performed in Korea. This study aimed to investigate the presence of PTX-group toxins in shellfish imported to South Korea and evaluate the dietary exposure by left-censored data. A total of 467 samples imported from 10 countries were submitted to monitor PTX-2 and PTX-11 seasonally. Ultra-high-performance liquid chromatography coupled to a triple quadrupole mass spectrometer was performed by AOAC ISO 17025 guidelines. Among all 467 samples, PTX-11 was detected in only one Japanese scallops at a concentration of 3.16 ng/g. PTX-2 was detected above the limit of detection (LOD) but below the limit of quantification (LOQ) in five imported shellfish. PTX-2 levels in mussel, clam, and scallop samples ranged from 0.66 to 1.36 ng/g and four samples containing PTX-11 at concentrations between 0.86 and 1.55 ng/g. Interestingly, PTX was only found in the internal organs of scallops and not in their adductor muscles. The annual per capita human exposure to PTX-2 and PTX-11 from the consumption of imported shellfish had average standard deviations of 4.98E-05±8.45E-05 and 8.31E-06±2.29E-05 μg/kg b.w./day/person, respectively. When narrowed down to scallops among all shellfish, these results indicated that PTX-2 showed a tendency to decrease to 3.88E-07±1.76E-06, and PTX-11 to 5.80E-07±1.30E-06 μg/kg b.w./day/person. The maximum hazard level of PTX-2 was 0.0686%, and PTX-11 is 0.0214%. These levels are significantly lower compared to the human exposure safety standard for PTX-2 and PTX-11 (0.8 μg/kg b.w.). Therefore, considering the left-censored data, dietary exposure to PTXs from imported shellfish can be considered safe in Korea. The Ministry of Food and Drug Safety provided support for this research through grant number 20163MFDS641 in 2024.

Keywords: shellfish, risk assessment, pectenotoxins (PTXs), diarrhetic shellfish poisoning (DSP)

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UHPLC-MS/MS detection and dietary exposure assessment of YTX and in imported shellfish in South Korea

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Abstract

This study aimed to monitor a comprehensive analysis of Yessotoxins (YTXs) on 467 imported shellfish using ultra-high performance liquid chromatography-tandem mass spectrometry (UHPLC-MS/MS). Optimization and validation of analysis methods for both YTX and its analog, homo-YTX, were performed according to AOAC ISO 17025 guidelines. Only 36 samples of scallops imported from China and Japan were positive for YTXs, with a maximum concentration of 13.12 μg/kg. However, Homo-YTX, an analog of YTX, was not detected in any of shellfish. Compared with adductor muscle and whole homogenates, YTX was not detected in samples of adductor muscle extracted from scallops. The human exposure safety standard for YTX is 20.0 μg/kg b.w. Based on the detected YTX levels, the annual per capita human exposure through the consumption of imported shellfish is calculated to be an average of 3.73E-04±2.84E-03 μg/kg b.w./day/person. This corresponds to a significantly low value of 0.097% of the human exposure safety standard. When narrowing down the scope to scallops, the annual per capita human exposure average slightly increases to 9.24E-06±3.09E-05 μg/kg b.w./day/person compared to the overall shellfish average. However, this result, similarly to the overall shellfish average, remains significantly low compared to the human exposure safety standard. The Ministry of Food and Drug Safety provided the support for this research through grant number 20163MFDS641 in 2024.

Keywords: dietary exposure assessment, yessotoxins (YTXs), shellfish

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TTX screening of *Atergatis floridus* (Linnaeus, 1767) and *Atergatis integerrimus* (Lamarck, 1818) collected from Jeju Coast using a competitive ELISA

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Abstract

Xanthid crabs are recognized for harboring highly potent neurotoxins like paralytic shellfish poison (PSP) and tetrodotoxin (TTX), leading to human intoxication. Predominantly, these toxic crabs are found in tropical and subtropical regions. Recently, *Atergatis floridus*, recognized for its high TTX content, and *A. integerimmus*, a species not previously recorded in Korea, have been collected from the southern region of Jeju Island. However, data on the toxicity levels of these species within Korea remains scarce. To date, TTX toxicity has been determined using various methods, including liquid chromatography-tandem mass spectrometry, high-performance liquid chromatography, enzyme-linked immunosorbent assay (ELISA), and mouse bioassay. Among methods, the ELISA employing a TTX-specific antibody, offers a rapid method for screening and quantifying TTX. This approach is sufficiently sensitive to identify TTX at nanogram levels within the matrix. In this study, we screened for the TTX levels in xanthid crab, *A. floridus*, and *A. integerimmus* collected from Jeju Island using a competitive ELISA kit (EuroProxima, Netherlands) with decision limit (CCα) of 9.4 ng/g and the detection capability of 20 ng/g. The cELISA results indicated that the walking leg muscle had the highest TTX level ranging from 15.1 to 28.7 μg/g, followed by the gonad (4.8–16.1 μg/g), hepatopancreas (3.2–13.5 μg/g), chelipeds muscle (0.5–12.6 μg/g), stomach (3.1–8.8 μg/g), gills (2.3–6.2 μg/g), and cephalothorax muscle (0.5–1.1 μg/g) in *A. floridus*. On the other hand, The ELISA revealed that TTX levels in the all analyzed tissues of *A. integerimmus* were below the CCα. Based on these findings, the TTX concentration in *A. floridus* from Jeju Island was observed to be within a similar range to that of specimens previously studied in Nagasaki, Japan. The absence of detectable TTX levels in *A. integerimmus* suggests species-specific variations in toxin accumulation. However, due to the limited number of specimens analyzed, there remains a possibility that the toxicity levels may vary depending on the sampling season, necessitating further analysis to ascertain these potential seasonal variations in toxicity. This research was supported by a grant (20163MFDS641) from the Ministry of Food and Drug Safety in 2024.

Keywords: Jeju island, *Atergatis floridus*, *Atergatis integerrimus*, cELISA, TTX

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Semi-quantitative non-targeted screening of novel marine toxins using LC/MRM-MS

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Abstract

As rapid changes in marine ecosystems increase the consumer exposure to toxicological risks from novel biotoxins, significant efforts are being made to develop and validate analytical methods for the screening of cyclic imines. However, it remains an inherently challenging task due to few available standards, very low concentrations, many analogues, as well as interference with other marine lipophilic substances. Recently, non-targeted analyses with liquid chromatography/mass spectrometry (LC/MS) have gained much popularity as it can identify a variety of compounds in a single sample run. In this study, we introduced a semi-quantitative analytical strategy to detect CI analogs without authentic standards, combining RT predictions with tandem MS spectral library matching built on known structures. First, a C18-based chromatography was applied to provide excellent retention and resolution for lipophilic CIs. In particular, CI standards were eluted in the order increasing partition coefficients according to hydrophobicity differences caused by their unique epitopes, so that CI analogues can be initially assigned though retention time prediction. We also observed that C-C bond cleavage on CID-MS/MS occurred at the same locations in each CI analogue but the fragmentation patterns including m/z values and peak intensities differed depending on side chains such as methyl and hydroxyl. Based on fragmentation tendencies, we constructed putative spectral library for over 40 CIs in which common and specific ions of CI analogues. Indeed, we were able to quantify ppt levels of CIs such as PnTX G, GYM A, 13-desMe SPX C which have not been reported around Korean Peninsula, and detect even two CIs without standards including PnTX H and SPX H. Our standard-free assays can be used as an effective way to manage the risk of novel marine biotoxins for which standards are lacking.

Keywords: non-target, liquid chromatography/mass spectrometry, cyclic imines

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Quantification of tetrodotoxin (TTX) and its analogue in boxfish *Ostracion immaculatum* Temminck & Schlegel, 1850 from Jeju Island, Korea

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Abstract

Pufferfishes are indeed regarded as one of the most valuable fisheries resources in the northwest Pacific region. The predominant species of pufferfish are known to harbor tetrodotoxin (TTX), a neurotoxin that can be fatal if ingested improperly. Among pufferfish, the boxfish, *Ostracion immaculatum*, while included in the list of importable pufferfish species, is not commercially available in the market and is frequently consumed privately by local fishermen. However, there is a lack of information on the toxicity of this species distributed in Korean waters. Moreover, since pufferfish accumulate TTX through their food sources, there is concern that toxicity may increase if TTX-bearing prey are introduced due to environmental changes such as sea temperature rises. Therefore, we carried out a quantitative analysis to assess the levels and distribution of TTX and its analogues in *O. immaculatum* collected from Jeju Island, South Korea. The levels of TTX and its analogues in the muscle, liver, gonad, skin and intestine of *O. immaculatum* were analyzed using LC-MS/MS. The LC-MS/MS results indicated that the skin had the highest TTX level ranging from N.D. to 4.32 μg/g, followed by the gonad (N.D.–2.23 μg/g), muscle (N.D.–1.03 μg/g), liver (N.D.–0.37 μg/g) and intestine (N.D.–0.12 μg/g). In muscle, which is designated as the edible part, TTX was mostly undetectable or present only in trace amounts below 10MU. Additionally, six TTX analogues, including 4-*epi*TTX, 4,9-anhydroTTXs, deoxyTTXs, dideoxyTTXs, trideoxyTTXs, and norTTX, were identified. All tissue showed low total TTX analogues content, with concentrations less than 1 μg/g. The results suggest that the probability of TTX-induced intoxication from consuming *O. immaculatum* appears negligible, given the low or undetectable levels of TTX in the edible parts. However, the potential presence of other toxins necessitates further analysis to ensure comprehensive safety evaluation and risk assessment. This research was supported by a grant (20163MFDS641) from the Ministry of Food and Drug Safety in 2024.

Keywords: Jeju island, boxfish, *Ostracion immaculatum*, TTX, TTX analogue

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Investigation of extraction efficiency and matrix effect in Palytoxin quantification using LC/MRM-MS

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Abstract

Palytoxin (PTX) is a non-protein molecule derived from soft coral of the genus *Palythoa* and one of the most poisonous marine toxins known to date. To mitigate toxicological risks up the food chain, regulatory agencies, including the European Food Safety Authority (EFSA), have emphasized the importance of establishing reliable analytical methods for risk assessment and monitoring of PTX in marine organisms. Here, we developed an analytical platform for PTX quantification using liquid chromatography coupled with multiple reaction monitoring mass spectrometry (LC/MRM-MS). Moreover, accuracy, sensitivity, and the matrix effect throughout the entire process from sample preparation to LC/MS analysis were evaluated to ensure the best results. First, the MRM transition, which can improve both selectivity and sensitivity for PTX quantification, was obtained through fragmentation by CID-tandem MS in positive mode. Namely, one transitions (*m/z* 1340.7 $[M+2H]^+ \rightarrow$ *m/z* 327.1 $[M+H]^+$) was selected and monitored for PTX. To further evaluate efficiency and matrix effect on the extraction and purification of PTX from marine organisms containing complex biological substances, spiking experiments were performed on clams and mussels, respectively, as negative control samples in which PTX was not detected. They were spiked with a standard mixture ranging from 5 ng/g to 500 ng/g each, which represents the linear range of our assay. After methanol-based liquid extraction and HLB-SPE, the responses corresponding to PTX in the spiked samples were compared based on values calculated from the standard calibration curve. The recovery rate of each PTX across all concentration in both clam and mussels ranged from 79.4 to 129.8 % (SD<9.1 %). These results clearly suggest that the PTX preparation step by 50 % MeOH extraction and HLB-SPE can yield reliable quantitative values from marine organisms that contain interferences that may affect the assay. Ultimately, our analytical conditions using LC/MS may serve as a reference to support the development of SOPs to achieve enhanced results in the analysis of the potent toxin palytoxin.

Keywords: palytoxins, LC/MRM-MS, matrix effect, shellfish

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Investigation of contamination levels of CI toxins in imported shellfish products available in South Korea

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Abstract

Cyclic imine toxins (CI toxins) pose significant health risks due to their neurotoxic effects and presence in shellfish. This study aimed to assess CI toxin contamination levels in imported clam products in South Korea. Using LC/MS/MS, we focused on spirolides (SPX-C), pinnatoxin (PnTX), and gymnodimine-A (gym-A). Samples were collected and analyzed for CI toxin presence and concentration. SPX-C was detected at 227.84 ppt in New Zealand mussels, PnTX-G at 80.42 ppt in Chilean mussels, and gym-A at 118.79 ppt in New Zealand mussels. Our findings highlight the importance of monitoring CI toxins in imported shellfish to ensure consumer safety. Continued research is essential for understanding and managing the risks associated with CI toxins. Regulatory measures should be implemented to mitigate health hazards posed by these toxins in shellfish products.

Keywords: imported shellfish toxins, pinnatoxin, gymnodimine, spirolide, cyclic imines

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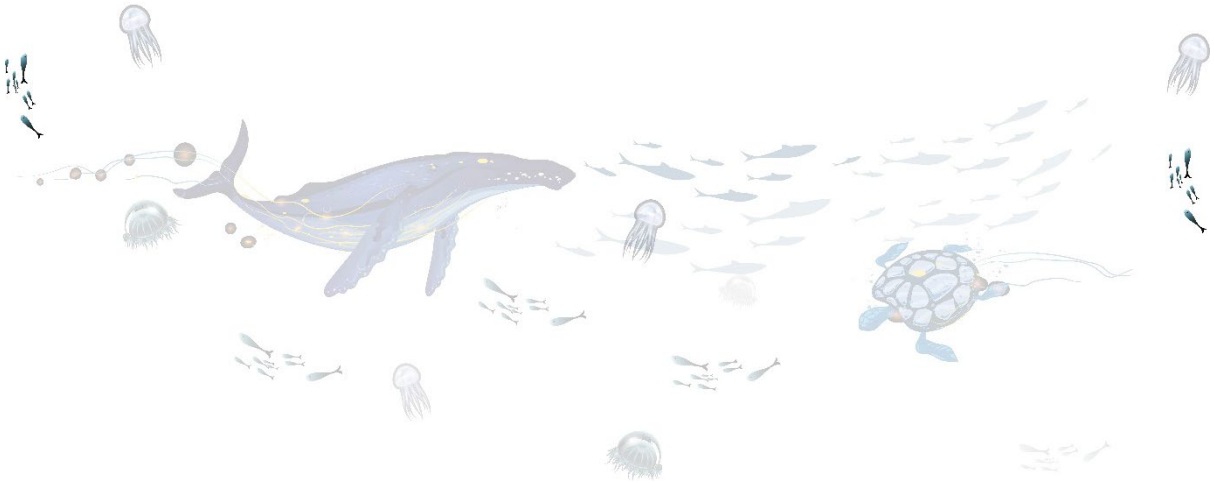
Sub-theme C:
Ocean and Human Health

Session C7:
Harmful jellyfish in the Southeast Asian region:
Networking across the ocean



New records of two box jellyfish in the eastern Gulf of Thailand

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Abstract

Box jellyfish are known to pose a significant threat to tourists and locals alike. To effectively manage and mitigate risks from fatal jellyfish stings, information regarding their identities and distribution is indispensable. However, systematic studies of jellyfish taxonomy, biology, and ecology are still lacking. Out of 10 species of Cubozoa jellyfish currently recorded in Thai waters, only 6 were taxonomically identified: *Alatina morandinii*, *Chiropsoides buitendijki*, *Tripedalia binate*, *Morbakka virulenta*, *Chironex indrasaksajiae* and *Gershwinia thailandensis,* with the latter two being described for the first time in Thailand. In this study, two of the previously unidentified species from the Eastern Gulf of Thailand were diagnosed based on their morphological characteristics as *Chironex yamaguchii* and *Meteorona kishinouyei*. Their distributions are also observed. *Chironex yamaguchii* was identified based on the number of their tentacles and the shape of their pedalial canals and are relatively prevalent in waters around Mak and Kood islands during the northeastern monsoon. *Meteorona kishinouyei* with its unique trait of having only one tentacle per pedalium among the Chirodropida are more common in the southwestern monsoon season, inhabiting the coastal areas.

Keywords: box Jellyfish, *Chironex yamaguchii*, *Meteorona kishinouyei*, Eastern Gulf of Thailand

Should we worry about box jellyfish sting to the face?

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Abstract

Theoretically, jellyfish sting to the face, especially by box jellyfish, could cause sinister consequences for a few reasons. First, the thinnest part of the human skin can be found at the eyelids and postauricular region, hence can likely increase the venom absorption into the body system. Second, it may trigger inflammation in the surrounding structures, particularly the airway, causing airway obstruction. Thirdly, the skin breach increases the chances of spreading infection to the intracranium structures. We report a case of a 7-year-old boy who was stung by jellyfish over the face and bilateral upper limb but only presented to the emergency department 19 hours after the incident due to transportation issues. Upon evaluation, he has neither systemic manifestation of jellyfish sting nor airway issue. Nematocyst skin sampling analysis confirms the diagnosis of a sting by the endemic box jellyfish species *Chironex yamaguchii*. He was admitted for two days and covered for superimposed marine infection and responding to the antibiotic, which was later discharged after 48 hours of admission. Unfortunately, he did not attend the follow-up appointment.

Keywords: *Chironex sp*, marine envenomation, jellyfish sting to the face

First documented case of jellyfish sting with Irukandji like syndrome in Sabah coastal water

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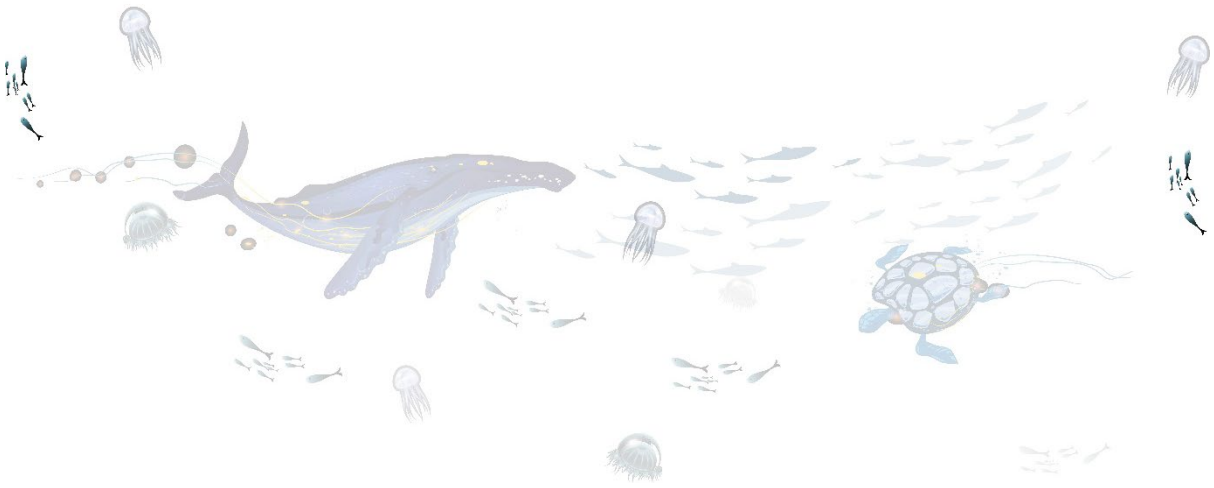
Abstract

We describe a case of a 46-year-old male with no known medical illness who presented with generalized severe muscle pain, especially in the lower back, lower abdomen, bilateral thigh, and calf, at 8.3 hours post stung by palm size, transparent, box shape jellyfish on his anterior chest and central abdomen. Inspection of skin lesions showed fewer tentacle imprints on the skin, which were minimal in number and less inflammation. Skin sampling showed minimal nematocyst yield, mastigaphore type, lack of band, thinning, and more straight compared to endemic *Chironex yamaguchii* species. He was treated as Irukandji-like syndrome secondary to an unidentified jellyfish sting and given a titrated dose of analgesia, intravenous drip hydration and intravenous magnesium sulphate, to which he responded to treatment. Based on the clinical presentation, skin inspection and nematocyst analysis, the culprit was suspected to be carybdeid box jellyfish, likely *Morbakka sp*. Unfortunately, there is no record of such species in Sabah coastal water, and Irukandji-like syndrome was not described to occur in this state. A field survey was conducted at the incident site, and we retrieved carybdeid box jellyfish species, likely *Morbakka sp*. Unfortunately, the phenotypical and molecular analysis was not done due to a technical error. Regardless, this case highlights a crucial lesson for us, particularly in dealing with patients with jellyfish stings who presented with the new envenoming syndrome, as it might be due to undescribed species yet to be found. Collaboration between clinicians, clinical toxinologists and marine biologists may not only be beneficial for patient outcomes but also expand the research in the field of jellyfish.

Keywords: Irukandji like syndrome, marine envenomation, delayed muscle pain, carybdeid box jellyfish

Sub-theme D: Emerging Ocean Science and Cross-cutting Issues

Session D1: Ocean observing technology and systems in the Indo-Pacific: Major advances and challenges



Field observation of rip currents at Kata Noi Beach, Phuket, Thailand

Suriya Kumnaundao, Bojara Asvakittimakul, Suchai Worachananant, and Jitraporn Phaksopa

Department of Marine Science, Faculty of Fisheries, Kasetsart University, Thailand

Abstract

Rip currents naturally occur around the surf zone. This hazard that poses a significant risk to beach swimmers and causes hundreds of deaths annually worldwide. Identification, continuous monitoring, and warning of these currents are essential for the safety of beachgoers and able to prevent drowning cases. In this study, the beach morpho dynamics associated with rip current formation were observed from field measurements (GPS drifter, dyes, RTK GNSS Network) and video imagery data during southwest monsoon (September 2022) and northeast monsoon (January 2023) at the study site, Kata Noi, Phuket, Thailand. The results showed that rip current occurrences were associated with environmental proxies. It had been observed that the rip currents were relatively strong during the SWM, which presented the channel rip currents (fixed rip currents) and could be due to the change in the beach morphology. The deflection rip currents had speeds of ~0.2 m/s and lasted several minutes. Additionally, rip currents coincided with sea level, as evidenced by the higher frequency and longer duration during low tide. The strongest rip currents occur in ebb faster than during flood, so more precautionary procedures to prevent accidents from tourism use are recommended. Moreover, the large tidal range (spring tide) activated the rip current incidence. The study results provide a helpful reference for beach safety management and rip current warning system.

Keywords: rip current, marine safety, image processing, video analysis, coastal zone

Session D1: Ocean observing technology and systems in the Indo-Pacific: major advances and challenges

Advancing *in-situ* measurements for enhanced understanding of the Gulf of Thailand's environmental dynamics

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Abstract

The Gulf of Thailand (GOT), located in the shallow southwestern region of the South China Sea (SCS), plays an important role in providing essential resources and ecosystem services to the surrounding nations of Cambodia, Malaysia, Thailand, and Vietnam. This study addresses critical environmental challenges in the GOT, encompassing sea level rise, eutrophication, deoxygenation, coastal erosion, marine debris, microplastic pollution, coral degradation, and declining fisheries. Recognizing the urgent need for an enhanced understanding of the GOT's dynamic system, this research aims to overcome the current deficiency in systematic and continuous *in-situ* measurements across Thailand's coastline and the expansive GOT. Presently, only a limited number of monitoring stations are operational, with sparse data accessibility for crucial parameters such as water levels, temperature, salinity, and flow velocity. This study presents recent efforts to establish a comprehensive *in-situ* measurement system with an online real-time database, incorporating various measurement platforms in Thai waters. These platforms include online near-coast stations, offshore near-surface stations, auto-profiler multi-parameter CTDs for depth profiles, and satellite drifters developed in Thailand. Offshore stations strategically positioned on oil platforms belonging to the PTT Exploration and Production company, approximately 180 km offshore, provide a unique vantage point for data collection. Preliminary analysis of the gathered data reveals significant influences of tide components (M2, S2, O1, and K1), non-tidal water levels (driven by remote wind and SCS sea levels), river discharge at coastal areas, monsoonal effects on hydrographic features, and seasonal interactions between the GOT and SCS. Satellite drifters exhibit clear linkages between the GOT and SCS, showcasing rapid movements towards Vietnam's sea during the southwest monsoon and to areas near Singapore during the northeast monsoon. All data from diverse platforms are centralized in a public-accessible data server managed by the Hydro-Informatics Institute (Public organization). The potential expansion of monitoring stations/programs is advocated to enhance the comprehensive understanding and sustainable management of the GOT's intricate system. This initiative is poised to catalyze accelerated development

in marine research/effective management of the sea across Thailand and the broader GOT region.

Keywords: Telemetering station, satellite drifter, auto-profiler, oil platform, hydrographic data

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Session D1: Ocean observing technology and systems in the Indo-Pacific: major advances and challenges

Zonal structure of tropical Pacific surface salinity anomalies affects the eastern and central Pacific El Niños differently

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Abstract

Maximum sea surface salinity (SSS) anomalies are found in the central Pacific during the eastern Pacific El Niño (EPEN) while located further westward during the central Pacific El Niño (CPEN), but whether these affect the two events remains unclear. By performing ocean general circulation model experiments by modifying freshwater flux anomaly, we found salinity effects on surface warming during both types are highly sensitive to zonal locations of SSS anomalies, with the strongest warming induced by the SSS anomalies in 180°–170°W. Further analysis reveals that vertical mixing and entrainment dominate this temperature sensitivity, with the strongest response to SSS anomalies occurring in the central Pacific. The central Pacific SSS anomalies increase the EPEN warming by 0.15℃ while the westward-located SSS anomalies have little contribution to the CPEN. Therefore, the distinctly zonal structures of SSS anomalies facilitate stronger EPEN than the CPEN, increasing their difference in intensity by about 10%.

Session D1: Ocean observing technology and systems in the Indo-Pacific: major advances and challenges

Satellite observed multisource internal tide radiation and interference in the Banda Sea

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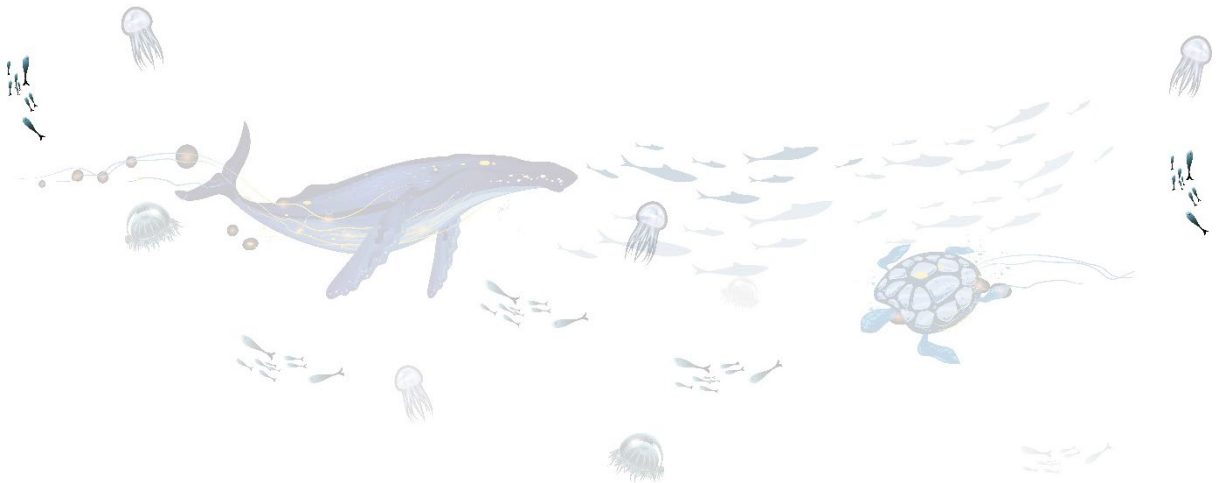
Abstract

Both the semidiurnal and diurnal internal tides in the Banda Sea were investigated using multi-satellite altimeter data, through a combination of plane wave analysis technique and two-dimensional band-pass spatial filtering. The west and central Banda Sea are found to be dominated by semidiurnal internal tides, while the diurnal internal tides dominate the east. Multiple internal tidal sources were located at or nearby the Banda Arc, radiating significant internal tides inwards in complex interference patterns in the Banda Sea basin. The semidiurnal sources were situated on the northern and southern sides of the Banda Arc, emanating internal tides in opposite meridional directions. The semidiurnal tidal beams then experienced interference, shaping the heterogeneous energy fields in the west and central Banda Sea. The primary diurnal source was situated over the steep slope in the Aru Basin, with significant energy radiation westward and diffraction in the east Banda Sea. Based on the estimation of 27-year coherent satellite results, the total energy flux of mode-1 internal tides into the Banda Sea is about 4.82 GW, 58% contributed by semidiurnal tides and 42% by diurnal tides. This study represents the first observed mapping of the complex and inhomogeneous mode-1 semidiurnal and diurnal internal tidal energy fields over the entire Banda Sea. Furthermore, this study enables further characterization of tidal mixing properties and improvement of model mixing parameterizations in the Indonesian seas.

Keywords: satellite altimetry, internal tides, tidal mixing, the Banda Sea, the Banda Arc

Sub-theme D:
Emerging Ocean Science and Cross-cutting Issues

Session D2:
Advanced molecular technologies in marine ecosystem research



Exploring the biodiversity at Koh He, Phuket, using eDNA technique together with metagenomics analysis

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Abstract

Marine biodiversity plays an important role for conservation management. Information of living organisms including animals, plants and microorganisms in marine ecosystems are important for planning, organization and control the utilization of marine resources. Therefore, a marine biodiversity database should be created. Presently, environmental DNA (eDNA) is an effective technique for monitoring biodiversity though the advantage in faster, non-invasive and cost-effective aspects. As a result, this study aims to investigate the biodiversity of Koh He in Phuket in the Andaman Sea of Thailand using eDNA technique with metagenomics analysis. Nine liters of seawater from the 0.50 m above the reef at Koh He were collected. Shotgun metagenome was performed and the results of direct sequencing eDNA samples showed 50,844,250 of total reads and 35,938,972 mapped reads. The variety of four domains including, archaea, bacteria, eukaryote and viruses could be detected with 4%, 54%, 0.4% and 2% of total reads, respectively. Seven phyla of Cnidaria, Nematoda, Annelida, Mollusca, Arthropoda, Echinodermata, and Chordata were detected. This results also revealed that metagenomics analysis could identify the vast number of genomes presented in eDNA samples in a short time without laborious diagnostic techniques. Information obtained in this project indicated that eDNA technology could support and confirm species identification of conventional method and that will be useful for establishing the marine database of Thailand.

Keywords: database, environmental DNA (eDNA), marine biodiversity, metagenomics

Effects of artificial light at night on gene expression in the coral, *Acropora digitifera*

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Abstract

Artificial Light At Night (ALAN) is an emerging stressor for marine ecosystems, especially those near densely populated and urbanized coastal areas. ALAN disrupts the natural pattern of light and dark that governs rhythmic biological processes. Corals subjected to ALAN exhibit changes in physiology and behavior, as well as disrupted spawning. However, the molecular mechanisms underlying the responses of corals to ALAN are not well understood. In this study, we determined the effect of ALAN on key cellular processes in the coral, *Acropora digitifera*, and its associated symbionts. Coral colonies were subjected to "cool white" light, "warm white" light, or to natural moonlight for two months during gamete maturation and prior to the spawning period. Changes in gene expression patterns between treatments and timepoints were assessed using RNA sequencing. Differentially expressed genes in the coral host were enriched in functions related to immune response, cell cycle, metabolism, gene regulation, transport, signaling, and development. On the other hand, symbionts showed enrichment of genes involved in photosynthesis, metabolism, biosynthesis, heat response, light response, transport, and signaling. Results of this study help us better understand the impacts of ALAN on corals and contribute to conservation plans to alleviate its adverse effects.

Keywords: artificial Light at Night (ALAN), moonlight, coral, *Acropora digitifera,* gene expression

Evaluating three environmental DNA (eDNA) sampling methods to observe small pelagic fish community compositions

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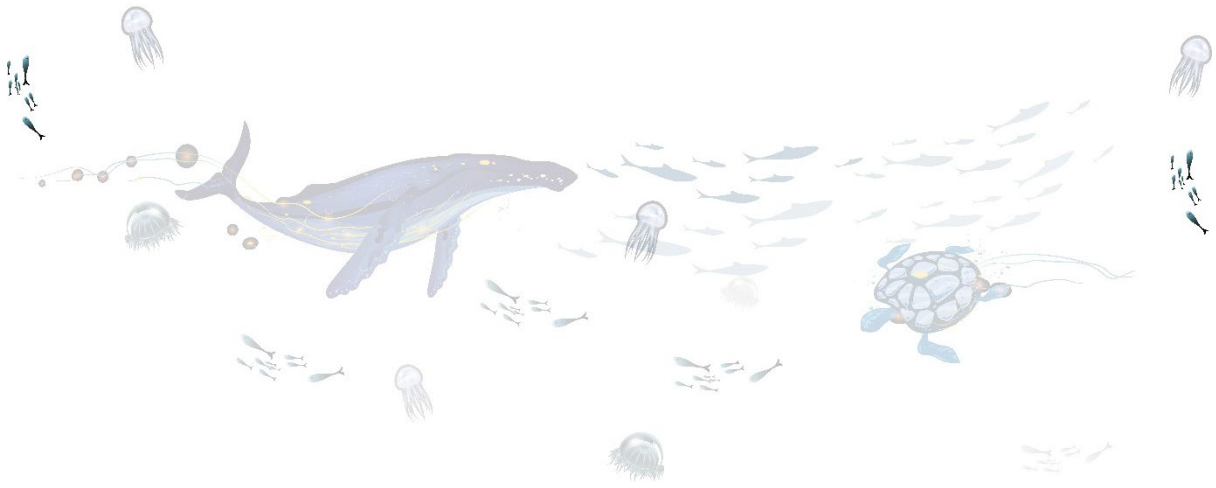
Abstract

Providing a foundation for the sustainable use of fisheries resources requires an increased understanding of accurate information on the diversity and distribution of species in marine ecosystems, which is challenging with traditional approaches. For this purpose, environmental DNA (eDNA)-based techniques arise as time-efficient, cost-effective, noninvasive, and environmentally friendly alternatives. However, in the open ocean, the influence of eDNA sampling methods on eDNA detection results has not been thoroughly studied. In this study, the three most used eDNA sampling methods including clean-bucket sampling, Niskin bottle sampling and intake pumped sampling were chosen to investigate how sampling methods affect the eDNA based fish assessments. Chub mackerel (*Scomber japonicus*), blue mackerel (*Scomber australasicus*), Japanese anchovy (*Engraulis japonicus*), Japanese sardine (*Sardinops melanostictus*), Japanese jack mackerel (*Trachurus japonicus*) and Pacific saury (*Cololabis saira*) are small pelagic fishes that inhabiting the upper 200 m of both coastal zones and open oceans, which are well-known as commercially important species in the western North Pacific. To efficiently perform quantitative analysis of eDNA, a multiplex real-time PCR method was combined with these three methods for the 6 small pelagic fishes. A total of 105 samples from 35 stations during four cruises throughout the western North Pacific were collected in 2021. Our results show that no significant differences were observed in alpha-diversities using Shannon index between Niskin bottle samples and Intake pumped samples both within each cruise and among all cruises. However, there are significant differences between samples from the clean-bucket and other two methods ($p<0.01$). Beta-diversities were estimated based on the Bray-Curtis dissimilarity and we visualized them with a non-metric multidimensional scaling ordination (NMDS) among all cruise samples. Statistical analyses showed no significant differences for NMDS1 but did show significant differences with NMDS2 ($p<0.01$) between the clean-bucket samples and other two method samples. To investigate the influence of sampling distance from coast on the community composition obtained from each sampling method, we used generalized additive model fits and the results show that community structures analyzed from clean-bucket samples near coastlines contained more jack mackerel abundance than the other two sampling methods. Jack mackerel typically spawn in coastal areas, which suggests that the differences between these three sampling methods might be caused by the aggregation of eggs and juveniles near the surface.

Keywords: eDNA, sampling methods, small pelagic fish, community compositions

Sub-theme D: Emerging Ocean Science and Cross-cutting Issues

Session D3: Satellite and airborne remote sensing techniques for marine ecosystem monitoring and management



Long-term variations in phytoplankton production measured by satellite ocean remote sensing data in the Northwest Pacific

Seunghyun Son[1, 2], Nikolay Nezlin[1, 3], Christopher Brown[1, 3], Prasanjit Dash[1, 4], and Paul DiGiacomo[1]

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Abstract

The Northwest Pacific is a large ocean basin with a variety of marine ecosystems, including some of the most productive in the world. There were noticeable changes in marine ecosystems of the Northwest Pacific in the last several decades. Interannual variations in phytoplankton production in the Northwest Pacific are driven by climate variability, such as El Nino-Southern Oscillation (ENSO) events and the Pacific Decadal Oscillation (PDO) region, as well as human activities. Particularly, ENSO and PDO are important factors causing large changes not only in physical environments but also in phytoplankton production and fisheries. Phytoplankton size classes and phytoplankton production can be largely influenced by interactions between water temperature, mixed layer depth, and nutrient regime in the Northwest Pacific, which subsequently affect potential fisheries. In this study, long-term time series of satellite ocean remote sensing data including Ocean Colour Climate Change Initiative (OC-CCI) data (1998–2023) from the European Space Agency (ESA) and the Moderate Resolution Imaging Spectroradiometer (MODIS) data (2002–2022) on board Aqua from NASA are used and analyzed to identify abrupt and persistent changes in phytoplankton production in the Northwest Pacific, in respect to climate variability (ENSO and PDO). In particular, a recently proposed sequential method of regime shift detection is also applied to the satellite ocean remote sensing data to investigate any significant changes in phytoplankton production in the Northwest Pacific.

Keywords: regime Shift, ocean remote sensing, Northwest Pacific, marine ecosystem

Development of neural network models for distributions of plastics patches in the ocean by Sentinel-2 high-resolution data

Yutaka Kameda and Emiko Fujita

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Abstract

Microplastics (MPs) are widespread in the surface water of boundless expanses of the ocean. However, MPs range from less than 1μm to 5 mm, and their analytical and sampling methods have not been developed nor integrated globally. Moreover, recent reports suggest that large MPs, such as macro MPs or meso MPs, aggregate in surface layers of the ocean, floating with various debris as big islands or long lines accumulated by tides. It is also known that their distributions in the ocean change dramatically. Though these results indicate that the size and distributions of MPs in the ocean are very complex, it is important to reveal time trends in the geographical distributions of these plastic patches to estimate their ecological risk and control their concentrations. However, it is challenging to monitor their distributions by general grab sampling of MPs samples from the ocean. In this study, methods for estimating seasonal geographical distributions of plastic patches in the ocean are developed using satellite data and generic models. We used four bands of spectral data from Sentinel-2 satellites, following a previous report by Biermann et al. We also used two indicators, the Floating Debris Index (FDI) and Normalized Difference Vegetation Index (NDVI), to distinguish plastic pixels from others. One strong point in our study is the establishment of a generic model capable of downloading satellite data from websites, easily correcting the data with Atmospheric Correction for OLI lite version 20181210.0 (ACOLITE), and calculating FDI values and NDVI values for each pixel. The model can also classify each pixel into nine materials such as plastic, ships, water, pumice released from volcanoes, sand, clouds, rocks, plants, and woods using the K-nearest neighbor algorithm in Python. However, the accuracy of the K-nearest neighbor algorithm is not high enough, approximately 60%. Further revisions, such as replacing the algorithm with neural network models, are needed. Nevertheless, this novel model will enable all users, including non-experts, to generate geographical distributions of plastic patches in widespread areas such as the Japan Sea, the Mediterranean Sea, the North Atlantic Sea, and other bays and lakes all over the world.

Keywords: plastic patches, Sentinel-2, neural network model, global ocean, distribution

Working time of acoustic survey methods for the truthing of optic remote sensing

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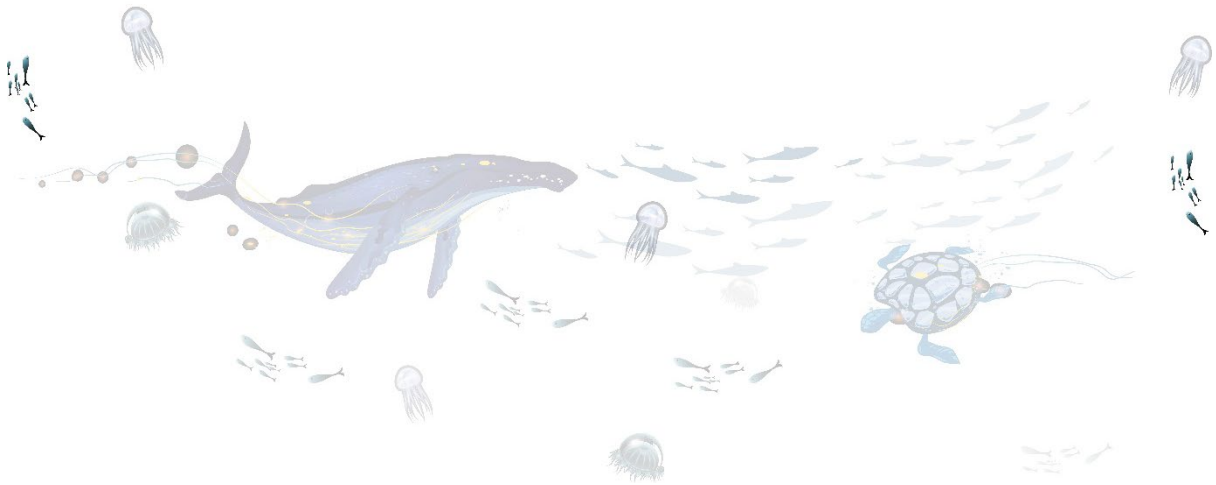
Abstract

Optic remote sensing is used for seagrass mapping, bottom classification, and satellite-derived bathymetry (SDB). It can cover a large area but needs ground truthing. Acoustic methods could be appropriate for ground truthing because these methods can survey efficiently. We compared all working times of some sonars: pole-mount single-beam echo sounders (SBES), pole-mount multi-beam echo sounders (MBES), and towed side scan sonars (SSS), and SSS mounted on a micro autonomous underwater vehicle (AUV), to be referred as a ground truthing data of optic remote sensing. Firstly, we compared SBES, SSS, and MBES in shallower seagrass beds than 10 m. The working time, which includes installation and uninstallation times and survey time, of SBES, SSS, and MBES were 2, 1.3, and 5 hours, respectively. The survey distances and areas were 4 km, 16,266, and 22,029 m^2, respectively. Secondly, we compared towed high-grade SSS and a micro AUV with low-cost SSS. Towed SSS can cover 1,550,616 m^2 with 2.5 hours of survey times and 1.5 hours of installation and uninstallation time. Conversely, a micro AUV surveyed 251,270 m^2 with 2 hours of survey time. The installation and uninstallation times were only a few minutes, but the mission was needed to be set into the machine (about 1 hour). MBES can survey with high positioning accuracy but needs a long installation time. The shallower the water depth was, the narrower the cover width with a scan. SBES needed a short installation time, but it could get the data only on the ship tracking line. SSS was towed. The installation time was so short. The survey efficiency was not affected by water depth. AUV side scans could be used to survey limited areas because of battery limits and other reasons. AUV needed a few install times, which could be approximate for a small area survey.

Keywords: single-beam echo sounder, multi-beam echo sounder, side scan sonar, micro AUV

Sub-theme D: Emerging Ocean Science and Cross-cutting Issues

Session D5: Gas hydrates and methane fluxes in the Indo-Pacific region



Methane seepage caused by gas hydrate dissociation in the middle Okinawa Trough since the Last Glacial Maximum

Ang Li[1, 2], Nengyou Wu[1, 2], Qing Li[1, 2], Zhou Wang[3], Yizhao Wan[1, 2], Feng Cai[1, 2], Zhilei Sun[1, 2], and Dong Feng[2, 4]

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Abstract

Methane seepage can be potentially promoted by the dissociation of marine hydrates surrounding continental margins during climatic changes in geological history. This may cause de-oxygenation and acidification of oceans and possibly accelerate climatic warming if entered the atmosphere. Information of this methane seepage was preserved in the authigenic carbonates close to the seeping environment, but up to date such kind of records are insufficient to confirm that varying oceanic conditions globally control the stability of gas hydrates and the subsequent methane seeps since the Last Glacial Maximum (LGM). Here we present the cores of an aragonite-rich carbonate crust at the seafloor drilling site D1 in a currently active seeping area of the middle Okinawa Trough, out of the shelf-edge of the East China Sea. XRD analysis results show that the mineral of the authigenic carbonate is dominated by aragonite and its content ranges from ~75 to ~94 %. The stable isotopic compositions vary between −37.6‰ to −22.7‰ VPDB for $\delta^{13}C$ and 3.3‰ to 6.2‰ VPDB for $\delta^{18}O$. The enhancement of $\delta^{18}O$ values is very likely caused by ^{18}O-enriched pore fluids released from the inferred underlying reservoir of gas hydrate. Its depth-age profile determined by uranium-thorium systematics dating reveals that the carbonate crust grew downwards from the paleo-seabed during 14–6 ka, while upwards at a slower rate due to the temporarily incomplete self-clogging effect. The ages of the seep carbonates coupled with the numerical modelling indicate the sustaining fluid seepage activity during the sea-level rise since the LGM. Higher geothermal regime in the back-arc basin of the Okinawa Trough leads to the regional thinning of the gas hydrate stability zone, and thus decreases the time lag of heat transfer from warming bottom water towards the hydrates at its base. Consequently, the ages of the carbonate crust sample should be closer to the period of the gas hydrate dissociation. Our study better support the hypothesis that marine hydrates could be destabilized in a delayed response to the climatic change during the last glacial-interglacial transition.

Keywords: cold seep, authigenic carbonate, U/Th dating, gas hydrate, Okinawa Trough

Session D5: Gas hydrates and methane fluxes in the Indo-Pacific region

Gas hydrates and natural gas discharge in the Sea of Okhotsk

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Abstract

The Sea of Okhotsk is one of the active areas of submarine gas discharge in the northern hemisphere and the most interesting object for methane gas hydrate study in the Far Eastern Region. Nowadays in the Sea of Okhotsk there are 3 areas of gas hydrate occurring in the bottom sediments: the eastern Sakhalin slope (for the first time they were discovered in 1991, hypothesized in 1988 as a result of reveal of submarine gas fluxes), the area nearby Paramushir Island (1986), and the Kuril Basin (2012). Gas hydrates are discovered in the bottom sediments in gas vent areas, located nearby fluid conductors like active deep faults, diapirs and, possibly, mud volcanoes.

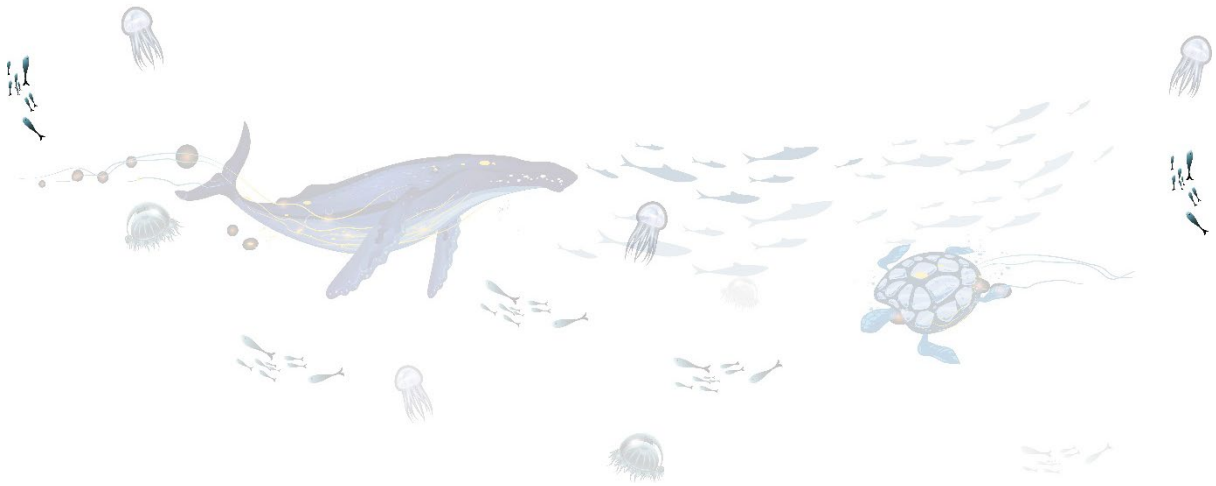
Before 2009 in the north-western part of the Okhotsk Sea Area there are discovered about 400 natural gas vents (mainly, methane composition) from bottom sediments to the sea water and 11 structures where gas hydrates were sampled. Gashydrates are revealed nearby seafloor layers of sediments in various forms like lenses, layers, interlayers and their fragments, for instance. Expedition research from 1998 to 2002 (Biebow N., Huetten E, 1999; Biebow N., Kulinich R., and Baranov B., 2002) point to that all these natural gas vents are referred to the intersection zones of the faults of the north-western and north-eastern direction controllable by East Sakhalin fault zone, influencing the seismo-tectonic activity of north-eastern shelf and slope of the Sea of Okhotsk.

Research of the gas parts of sediments in the Sea of Okhotsk shows: in the cores where gas hydrates are not found as a rule methane concentrations increase from a depth of 200 cm (0,1 – 1 ml/l and more), probably, it is explained by the presence of sulfate-reduction zone over the depth. In the sediments containing gas hydrate this regularity is not observed because gas hydrate intervals can contain sufficiently a huge volume of methane and locate at different sub-bottom depths. In the cores where gas hydrates are found independently of depth methane concentrations increase up to 500 ml/l and more, sometimes reaching 3000 ml/l.

Keywords: Sea of Okhotsk, methane, gas hydrates

Sub-theme D: Emerging Ocean Science and Cross-cutting Issues

Session D6: Sustainable financing of blue carbon



The impact of density on biomass: a study of changes in blue carbon in the seagrass ecosystems of Thailand

Tipamat Upanoi

Phuket Marine Biological Center, The Department of Marine and Coastal Resources, Thailand

Abstract

Seagrass plays an important role in maintaining the carbon balance in the sea. This is because seagrass can absorb carbon dioxide dissolved in water for respiration and growth. It is stored in the form of organic matter in living organisms, such as carbohydrates. This amount of carbon circulates in the ecosystem through the food chain. When seagrass dies Some parts will decay. while others will slowly decay. or have been buried over time. In Thai waters, 13 species of seagrass have been reported. The objective of this study is to explore patterns in the relationship between percentage cover and the amount of carbon stored in the various sections of each seagrass species. The results of the study reveal that all 10 seagrasses species of the Andaman sea of Thailand can store carbon on average of 28.5% of its weight. Each seagrass species has a different ability to store carbon depending on its species. *Cymodocea rotundata* is the most carbon, at 37.8%, while *Halophila decipiens* is the least amount of carbon, only 10.9%. Most seagrass species, except *Halophila beccarii* stored more carbon in their leaves (29.2%) than in underground part of stems and roots (27.7%). When using data on density, biomass, and carbon content in each percentage range of cover to analyse the relationship, it was found that all seagrass species had a positive linear relationship between percentage cover and dry biomass. That means when the percentage of seagrass cover increases, Dry biomass tends to increase which consider together with the carbon composition of each seagrass species. The equation for the relationship between percentage cover and carbon content was found to be in the same pattern. It creates a positive linear relationship which more dense seagrass beds also tend to store more carbon. The results can be used to evaluate the potentially carbon storage of seagrass. The information will provide basic information to support long-term management and mitigation of the impacts of climate change on marine resources and coastal areas.

Keywords: seagrass, Thailand, blue carbon

Special Forum

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Marine protected areas contribute to sustainable socio-economic development

Nguyen Van Vu

The Management Board of the Cu Lao Cham Marine Protected Area, Vietnam

Abstract

Cu Lao Cham Marine Protected Area (MPA) was established in 2005, covering an expansive 23,500 hectares. This includes a core area of 205 hectares, an ecological restoration zone spanning 192 hectares, 10,201 hectares for administrative services, a buffer zone of 11,290 hectares, and seven small islands. Typical ecosystems are coral reefs and seagrass beds. There are approximately 2,500 people living in the MPA. Before 2005, over 90% of households relied on various fishing activities such as trammel nets, guns, and diving. Unfortunately, these activities had negative impacts on coral reef ecosystems, seagrass beds, and biodiversity. However, local people were still caught in a vicious circle of poverty, with about 50% of households being poor. In response, stakeholders and the Management Board of the MPA have implemented numerous solutions. Several outstanding programs include allocating 19.5 hectares of sea area for 95 households to protect and exploit marine resources; organizing co-management of land crabs (*Gecarcoidea lalandii*) with 43 community members; establishing a community patrol network to protect the MPA with more than 50 members; restoring more than 20 hectares (with about 100,000 coral reef consortiums) with community participation; restoring one breeding ground for sea turtles; changing 8% of fishing boats for visitor transport; establishing an eco-tourism model for 35 households, and convincing 100% of local people to commit to reducing the use of plastic bags, plastic straws, and single-use plastic products. After nearly 20 years of persistently implementing solutions, Cu Lao Cham's economy has shifted strongly towards tourism services, constituting over 70% of the islands' economic activity. Poverty has been completely eliminated. GDP has increased 9 times compared to 2005, reaching nearly 2,250 USD/person. More than 12 new livelihoods have been created. Coral reefs are maintained at a stable level, with a coverage of 57%, and the sea water is within the safe threshold according to national standards (QCVN 10:2023/BTNMT).

Keywords: Cu Lao Cham, MPA, social economic development

Reef coral decline and adaptive solutions for coral reef conservation in Nui Chua National Park, Vietnam

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Abstract

Ninh Hai's coral reef, located within Nui Chua National Park, constitute the largest expanse of shoreline fringing reefs of Vietnam, with 310 species of hard corals in 60 genera and 15 families recorded. The results studied in the period from 2005 to 2023 show that the reef coral are facing severe degradation. The significant decline in hard coral cover was found from 2005 to 2007 (from 47.06% to 29.17%), followed by a moderate and a slight increase from 2008 to 2013 (29.9% to 38.31%), gradually decreased from 2013 to 2019 (38.31% to 23.54%), and had the lowest cover in 2023 (<10%). Major reef stations in the core zone (Bai Nho, Hang Rai and Thai An) were severely deteriorated. In contrast, coverage of the reef coral in the ecological restoration zone such as My Hoa and Mui Thi remained stable at moderate covers. The report shows that coral reefs in Ninh Hai district have suffered many negative impacts due to unsustainable development, natural disasters and coral-damaging organisms outbreaks. Especially from 2010 to 2021, coral reefs in Ninh Hai district were affected by bleaching, and the health of the coral reefs was weakened. At the same time, COTs and *Drupella* outbreaks. Spread throughout the region, resulting in reduced coral cover on the reef. Tropical storms also caused damage to coral reefs in the area. Since 2017, the development of tourism has increased the pressure on resource extraction. To better understand the impact of different activities, the area can be divided into impact groups. Vinh Hy – Bai Nho areas are mainly affected by tourism, while areas from Bai Nho to Thai An are affected by COTs, *Drupella* snails and storms. The Mui Thi – Hon Chong region faces many problems, including coral bleaching, agricultural activities, aquaculture and starfish outbreaks. These challenges highlight poor coral reef management, difficulties with natural regeneration, and unsustainable pressures from tourism development. Land and sea use planning must be adapted to ensure the conservation of coral reefs and associated living resources. To maintain the region's important biodiversity, measures for effective conservation and restoration must be taken.

Keywords: Nui Chua National Park, coral decline, impact, solution, reef conservation

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The study on social and economic impacts from marine protected area announcement and the utilization of the Losin Island, Pattani, Thailand

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Abstract

Losin Island was announced as Marine Protected Area (MPA) in March 2022. It is the second MPA in Thailand; however, the impacts on social and economic aspects from the new regulation have not been studied. Therefore, the study initiated to understand these impacts and the utilization of the Losin Island. The research employs a mixed research method with a sample of 190 individuals from fishing communities, conservation groups, local tourism operators, private sector, and related agencies. Finding indicated that (1) Losin Island is utilized as scuba diving tourism and fishing activity outside the Island. It also serves as a conservation and rehabilitation hub for marine resources, (2) the social impacts were overall high, (3) the economic impacts were generally high too, except for creating new careers in the community and dept decreasing that were moderate, (4) Environmental impacts from utilization of the Island were high, in line with the other two aspects. Additionally, the samples' satisfaction on the utilization was high and the majority supported the declaration of Losin Island as a protected area, emphasizing its significance as a tourist attraction with beautiful coral reefs. Recommendations include (1) mooring buoys should be sufficient to prevent anchoring in coral areas; (2) diving zone should be clearly demarcated and requirements on experiences and numbers of divers per day should be identified; (3) strict controlling together with application of technology is required for effective surveillance. Weak and untransparent control can lead to corruption of government officers on tourism operators on increasing quota of divers. Medium-scale fishing vessels do not require to install Vessel Monitoring System (VMS), therefore, they can illegally operate fishing in the area and sometime cause ghost fishing over coral reef; (4) initiation of local tourism boats should be promoted and supported for local income. This is due to the current tour boats are from other province; and (5) the knowledge of Losin Island should be included in education system to ensure the sense of resource ownership to the youth.

Keywords: utilization, social impacts, economic impacts, Losin Island, protected areas

Achievements in sea turtle conservation in Con Dao waters, Vietnam

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Abstract

Con Dao National Park is the first place in Vietnam carrying out sea turtle conservation activities, which have been started since 1987. Until 1993, five protection stations were established to manage 18 green turtle breeding grounds (*Chelonia mydas*). Activities at the stations include: preserving coral reefs and seagrass beds, protecting mother turtles and their eggs from harassment and harvest, relocating turtle eggs to incubation tanks, rescuing baby turtles, and conducting ecotourism. Over 30 years (1993–2022), 12,654 mother turtles were recorded on the beach to lay eggs, 36,939 turtle nests containing 3,211,535 eggs were relocated to the incubation lake, and 2,419,295 baby turtles were hatched and released into the sea. The ratio of turtle egg hatching increased from 27% in 1993 (when there was no intervention to relocate eggs to incubation tanks) to over 80% in 2022. The number of sea turtles coming to nest and lay eggs on Con Dao Islands is the highest in the country with about 700 individuals/year. In parallel with law enforcement, many media activities have been conducted to contribute to raising awareness of local communities and fishermen about nature conservation. A model of business participating in sea turtle conservation was also built. Con Dao National Park also cooperates with international organizations and scientists to conduct researches on sea turtles, including wearing tags to monitor the biological characteristics of 6,611 mother turtles, and attaching chips to track migration routes of turtles via satellite; researching the effect of temperature in the egg nest on the sex of baby turtles; researching the impact of coastal change on sea turtle reproduction; and studying the DNA structure of sea turtles on Con Dao. It has been determined that green turtles (*Chelonia mydas*) migrated to the waters of Phu Quy island, Truong Sa archipelago (Vietnam), Palawan island waters (Philippines), Sihanoukville sea area (Cambodia), the eastern seaboard of Pahang state in peninsular Malaysia, and the Natuna sea (Indonesia) after breeding on Con Dao. Therefore, sea turtle conservation on Con Dao is not only important for Vietnam but also has cross-border significance and international cooperation in this field is extremely necessary.

Keywords: green turtle, spawning grounds, migration, Con Dao, cross-border

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Basic cognition, methods, and implementation route of marine detailed planning from the perspective of territorial spatial planning

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Abstract

From the perspective of territorial spatial planning, the overall planning and related special planning are limited in terms of depth of marine core control content, compatibility arrangements, and comprehensive and differentiated control measures. The above limitations result in a gap between the existing planning and the implementation of sea use projects, leaving technical space for the preparation of detailed marine planning. In the long run, detailed marine planning is expected to adopt a hierarchical and dynamic compilation model at two levels: unit and sea block. In the short-term exploration stage, marine detailed planning can be carried out in areas such as usable uninhabited islands, land sea integrated utilization space, stock reclamation areas, and specific intensive sea use areas. The exploration work of marine detailed planning needs to grasp the logical relationships between rigidity and elasticity, planning and rules, inventory and increment, etc., gradually forming norms and standards for marine detailed planning, and determining the legal effectiveness of marine detailed planning in a stable and timely manner. Based on the considerations in the practical process of marine detailed planning for Hainan Yazhou Bay Science and Technology City, this paper proposed a progressive transmission system for the compilation of unit level marine detailed planning and the content framework that should be reflected as much as possible. Furthermore, it is proposed to establish a closed-loop transmission process through marine detailed planning, management implementation measures, and management information platform to ensure the smooth implementation of marine detailed planning.

Keywords: marine detailed planning, necessity, logical relationship, progressive system, planning content

Special Forum: Science for local-level environmental management, ecosystem conservation and sustainable use in the South China Sea and Gulf of Thailand

Promotion of blue economy in Trat Province, Thailand

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Abstract

The blue economy initiative was launched in Thailand in 2017 with the primary goal of achieving sustainable management of marine resources. This initiative is the studied project under Thailand-China Cooperation on Marine. The partners of this project are the Department of Marine and Coastal Resources (DMCR), Thailand, and the Third Institute of Oceanography (TIO), China. The studied site is at Trat province which is located at the Eastern coast of the Gulf of Thailand. The Blue Economy's core objectives encompass sustainability, innovation, social equity, and a participatory approach. To realize these goals, various programs have been implemented for stakeholders within the coastal communities of Trat province. From 2016–2019, meetings were organized to outline the program's details, and baseline information on the status of marine and coastal resources, environmental conditions, socio-economic factors, and community attitudes were gathered. From 2020–2023, the project conducted workshops and meetings to deepen the understanding of the Blue Economy. The activities identified to drive the Blue Economy, based on consensus among local communities and relevant government agencies, include 1) the rehabilitation of marine and coastal resources such as coral reefs and seagrasses, 2) fostering of knowledge and experience in marine resources management, covering areas like mariculture, marine tourism, and addressing marine debris 3) supporting of the development to improve livelihoods for local communities and 4) advocating for law and regulation amendments. The project's outcomes in Trat province were evaluated by a third party based on activities spanning from 2017 to 2021. The results indicated a lack of positive trends in the status of marine resources, the environment, and the income of coastal communities because of challenges posed by external factors, such as other sources impacting marine resources and the COVID-19 pandemic. However, there was a positive trend in the attitudes of coastal communities towards marine and coastal conservation. This shift in perspective was attributed to the recognition of the concept and underlying principles of promoting sustainable resources, aiming to maintain abundant marine and coastal resources for sustainable economic and social benefits. These benefits include contributions to food and livelihood security, employment, health, safety, and poverty alleviation.

Keywords: blue economy, Trat Province, coastal communities

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A conceptual framework for blue economy resilience to build sustainable and adaptive capacity

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Abstract

The blue economy is poised to significantly benefit marine ecosystems, economies, and climate sustainability. The extensive exploitation of marine resources highlights the urgent need for blue economic resilience. However, the lack of a clear definition and assessment methods of blue economic resilience poses a challenge. Firstly, this paper proposes a comprehensive concept of blue economic resilience, defining it as the ocean's capacity to resist, adapt to, recover from, and innovate in the face of various external shocks and challenges, such as tsunamis, financial crises, and public health emergencies, at different stages. Then, this paper distinguishes the fundamental distinction between resilience and vulnerability while highlighting the profound impact of sustainable development on society and ecology within the context of resilience. Furthermore, to address this gap, a comprehensive assessment framework for blue economic resilience has been developed. This framework covers four key dimensions: social, economic, ecological and policy. Its purpose is to thoroughly clarify the evolving role and mechanisms of resilience within the context of specific disasters on a global scale. The research findings have the potential to drive equitable and innovative transformation in the blue economy on a global scale, which could promote economic growth, enhance livelihoods, and most importantly, safeguard marine ecosystems.

Keywords: blue economy, blue economic resilience, conceptual framework, sustainability

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Eutrophication reduced carbon sequestration in tropical seagrass beds

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Abstract

Seagrass bed ecosystem is one of the most effective carbon capture and storage systems on earth, yet factors that affect sediment organic carbon (SOC) sequestration are poorly characterized. Seagrass roots are the key link of carbon flow between leaf-root-sediment, and the release of dissolved organic carbon (DOC) from seagrass roots through exudation and decomposition are vital sources to the SOC in the seagrass beds. Unfortunately, human-induced eutrophication may change the release process of DOC from seagrass roots, thereby affecting the sediment carbon storage capacity. However, little is known about the effect of nutrient enrichment on the release of DOC from seagrass roots, hindering the development of seagrass underground ecology. Therefore, we selected *Thalassia hemprichii*, the tropical dominant seagrass species, as the research object, and made a comparison of the release of DOC from roots through exudation and decomposition under different nitrate treatments. We found that under control, 10 μmol L^{-1}, 20 μmol L^{-1} and 40 μmol L^{-1} nitrate treatments, soluble sugar of *T. hemprichii* roots were 71.37±3.43 mg g^{-1}, 67.03±5.33 mg g^{-1}, 49.14±3.48 mg g^{-1}, and 18.51±2.09 mg g^{-1}, respectively, while the corresponding root DOC exudation rates were 7.00±0.97 mg g DW $root^{-1}$ h^{-1}, 5.11±0.42 mg g DW $root^{-1}$ h^{-1}, 4.08±0.23 mg g DW $root^{-1}$ h^{-1}, and 3.78±0.74 mg g DW $root^{-1}$ h^{-1}, respectively. There was a significant positive correlation between root soluble sugar and DOC exudation rate. DOC concentration of sediment porewater and SOC content also decreased under nitrate enrichment, which were both significantly positively correlated with the rate of root exuded DOC. Meanwhile, nitrate enrichment also reduced the release rate of DOC from seagrass roots during initial decomposition, and the release flux of DOC from decomposition. Therefore, nutrient enrichment could decrease nonstructural carbohydrates of seagrass roots, reducing the rate of root exuded DOC, thereby lowered SOC, as well as the DOC release from seagrass root decomposition. In order to increase the release of DOC from seagrass roots and improve the carbon sequestration capacity of seagrass beds, effective measures should be taken to control the coastal nutrients input into seagrass beds.

Keywords: Nutrient, tropical seagrass, root organic carbon exudation, decomposition, sediment organic carbon

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Hydrogen-producing capability of green microalgae found in Sarawak, Malaysia

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Abstract

In light of the critical global warming issue caused by climate change, renewable energy should be sought after, such as hydrogen gas. This is because hydrogen can be stored as a fuel and later used in transportation, with the by-product being water. An interesting method of producing hydrogen is through phototrophic microorganisms, such as microalgae. Microalgae can produce hydrogen directly using sunlight and water through biophotolysis. This process involves the enzymes hydrogenase and nitrogenase, which catalyze the conversion of water or organic substrates into hydrogen gas. However, biohydrogen production from microalgae is still mostly in the research phase. Therefore, in this study, 10 strains of microalgae were isolated through micromanipulation from water samples obtained from the Malaysia-China Friendship Park, Kuching, Sarawak, Malaysia. Given the importance of marine ecosystems as sources of (novel) microalgae, additional sampling and isolation will be carried out from surface waters collected in the coastal waters near Kuching, Sarawak, Malaysia. Species identification will be carried out via Polymerase Chain Reaction (PCR), and the biophotolysis process will be carried out to assess their potential to produce biohydrogen. Then, gas chromatography will be used to measure the concentration of the hydrogen produced. The presentation will discuss species diversity from both fresh- and marine water sampling efforts as well as their ability to produce hydrogen.

Keywords: microalgae, biohydrogen, biophotolysis, gas chromatography

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Reef caretaker: coral rehabilitation as part of participatory management of marine parks in Lang Tengah Island, Malaysia

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Abstract

Marine protected areas are useful tools for conserving biodiversity and managing fisheries. Malaysia has established marine parks to facilitate the recovery of overexploited marine resources and conserve coral reef ecosystems. The Reef Caretaker initiative under the Marine Parks program involves local stakeholders in preserving coral reefs. Lang Tengah Turtle Watch (LTTW) is one of the Reef Caretakers in Lang Tengah Island. The island is rich in hard coral species, however, part of the reefs are highly degraded. As part of LTTW's coral rehabilitation efforts, this study aims to evaluate the survival and growth of different coral species from the nursery to the transplant site. Coral of opportunity were collected from Blue Coral and transported to three coral tree nurseries at Turtle Bay. The survived corals were transplanted at Tanjung Telunjuk after 11 months. We recorded the length, width, and height, status (alive, dead, or detached), and signs of bleaching of the corals at various intervals. Growth rates were determined by calculating the daily linear extension. A data logger was deployed at the transplant site since March 2022 to record sea surface temperatures. In 2021, 176 fragments (66 *H. rigida*, 44 *A. muricata*, and 66 *A. florida*) were collected. The average linear length was 8.57 cm (SD=1.37). After 304 days in nursery, the survival rates of *A. florida*, *H. rigida*, and *A. muricata* were 75.8%, 80.3%, and 34.1%, respectively. *A. florida* and *H. rigida* grew 0.018 mm day^{-1}, while *A. muricata* grew 0.27 mm day^{-1}. A total of 103 fragments were transplanted into the natural reefs, which consist of 30 *A. florida*, 26 *A. muricata* and 47 *H. rigida*. After transplanted into the natural reefs for 545 days, the survival rates for *A. florida, A. muricata,* and *H. rigida* were 75%, 34.6%, and 40.4%, respectively. *A. florida, A. muricata*, and *H. rigida* grew 0.22 mm day^{-1}, 0.55 mm day^{-1}, and 0.016 mm day^{-1}, respectively. Coral mortality in the nursery and transplant site was attributed to the detachment of corals. When sea surface temperature reached 30^{0}C between April and June 2022, approximately 12.9% of the transplanted corals showed bleaching and mortality. This study established a preliminary data of the survival and growth of three coral species in Lang Tengah Island. Besides ongoing monitoring, future research should also explore the effects of environmental factors on the coral survival and growth of diverse species, and alternative attachment methods to advance coral rehabilitation efforts.

Keywords: coral transplantation, *Acropora* spp., *Hydnophora* sp., growth rates, survival rates

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