Session 1：**COASTAL BLUE CARBON: MEASUREMENTS, MODELING, AND ASSESSMENT**

Moderator：Jianwu Tang; Comoderator: Hualei Yang

1. One or two major highlights from each presentation

Keynote speech (**Xiaowei Li**) –Valuation of wetland ecosystem services in national nature reserves in China's coastal zones

- This study is the first attempt to establish a valuation framework and database for the nine ecosystem services of 13 wetland types in China's coastal zones. We constructed a literature database containing over 170 papers (808 observations) on field-scale research for wetlands in China's coastal zones.
- This study provides a picture of the ESV of 13 wetland types and shows that spatial, statistical, and literature data are useful and inexpensive in estimating ESV of different wetland types in coastal zones.
- The values of wetland ecosystem services revealed considerable spatial variability along China's coastal zones;
- The results provide insight into wetland trade-offs and the prioritization of wetland types with high service values, which would provide scientific support for resource managers and policy-makers in wetland conservation and restoration.

Oral Presenter 1 (**Susana Lincoln**) - Carbon stocks of seagrass meadows in Vanuatu, South Pacific

- In Efate Island, seagrasses carbon storage lower than global average.
- Near developing urban area of Port Vila, seagrasses challenged by poor water quality.
- Protection and management needed to ensure sustainable seagrass ecosystem services.
- Seagrass data still lacking.

Oral Presenter 2 (**Mohammad Rozaimi**) - Insights into blue carbon storage and ecosystem connectivity from studies of the seagrass meadows in Sungai Pulai estuary (Johor, Malaysia)

Pacific

- Spatial heterogeneity of carbon storage.
- Estuarine deposits of mangrove-derived carbon = connectivity of blue carbon habitats.
- Temporal and spatial scale variation in carbo sequestration by macroalgae.

Oral Presenter 3 (**Vincent Saderne**) - Total alkalinity production in a mangrove ecosystem reveals an overlooked Blue Carbon component

- Dissolution of calcium carbonates can be a major, permanent, sink of atmospheric CO_2 in mangroves growing on carbonate soils.

Oral Presenter 4 (**A'an Johan Wahyudi**) - Carbon offset potential from tropical seagrass conservation in Indonesia

- Emission reduction at the year 2020 ranged 0.03-1.02 tC/yr(with leakage)or 0.05-2.04 tC/yr (without leakage).
- The percentage of emission reduction among the five provinces ranged from0.75%to 11.3%.
- About 9.03 tC/yr emission from seagrass ecosystems in Jakarta will decrease by up to 8.01 tC/yr.

Oral Presenter 5 (**Xiaoguang Ouyang**) - Mangrove respiration is coupled with carbon and nitrogen uptake in the microphytobenthos of mangrove sediments

- Mangroves provide C and N for maintaining the growth of MPB.
- MPB obtain C and N from mangrove biomass via porewater.
- Mangrove-MPB coupling is a new mechanism regulating carbon and nitrogen cycling in mangrove forests and should be incorporated into models partitioning the fate of mangrove derived carbon, along with the duration of nutrient uptake.

Oral Presenter 6 (**Nirupama Saini**) - Exploring the seasonal variabilities of carbonate chemistry parameters in a mangrove ecosystem of the Northern Indian Ocean

- Invaluable to conservation because with the worid's fast dwindling seagrass ecosystems, every bit of even the smallest seagrass beds is worth conserving to maintain the ecosystem services which human beings depend on. Understanding the characteristics of this ecosystem will help us build a more resilient ecosystem and aids in Blue Carbon storage patterm.

Oral Presenter 7 (**Anisah Jessica Lee**) - Spatio-temporal analysis of local scale seagrass of MiddleBank in the northern Straits of Malacca

- Monthly data from 2014 to 2020-pCO_2, in surface water varies from 57.68uatm to 1,17,160.34uatm. Possible source of CO_2?
- Observation of high pCO_2 values in post-monsoon and monsoon indicates the contribution of riverine discharge in elevating the pCO_2 concentration in the surface water.
- pH is found to be the major driver of pCO_2 in the region.

Poster Presenter 1 (**Laetitia Allais**) –Investigation of geochemical, biological, and physical controls on the carbon storage capacity in Hong Kong coastal wetlands

- Overall, our data show that the mangrove ecosystems around Hong Kong are bambly heterogeneus. The different environmental charactenstics point towards possibly different biogeochemical cycles driving carbon burial within each site.
- These are also likely to drive the microbial commities, which are key for carbon degradation and bunal With anthropogene activities influencing environmental characteristics withm wetland addressing the geochemical and biological drivers of carbon sequestration remain an essential and step.

Poster Presenter 2 (**Jianqu Chen**) –Estimation of seaweed biomass in the intertidal zone of GouQi Island based on multispectral UAV

- It was found that each seaweed had different correlation with different spectral parameters, but they all showed significant correlation with infrared derived vegetation index.

Poster Presenter 3 (**Jenny Choo**) –Study of DOC, DIC and its $\delta^{13}C$ drivers from tropical peat-draining rivers: Implications on blue carbon loss

- our findings showed considerable amount of DOC (804.81 ± 95.71 µM) was being discharged into the river systems (i.e. Simunjan, Sebuyau, Pusa) in 2016/2017, with depletion of d13C-DOC values ranged from -47 to -20.1 ‰. As such, these findings provide insights on the impacts of peatlands disturbances which have resulted in carbon loss into our river systems over time.

Poster Presenter 4 (**Gao Qin**) –Organic carbon burial records since the Late Pleiocene in Hangzhou Bay, China

- The good correspondence of these events with low OC-AMAR indicated that cold climate events during geological history in the Hangzhou bay adversely affected carbon burial in the sediments.

Poster Presenter 5 (**Zhiyao Xiong**) –A new method of estimating carbon sequestration and biological pump efficiency in coastal waters

- This study developed a new method for estimating carbon sequestration and biological pump efficiency (BPE) based on an increase in DIC in the pycnocline layer and bottom layer due to respiration release of DIC.

2. One paragraph of session summary

   This session discussed the blue carbon sink, storage in the biomass above ground and sediments, and the associated geochemical, biological, and physical controls in salt marshes, mangroves, seagrass, phytoplankton, and macroalgae ecosystems. It also discussed the blue carbon loss induced by lateral exchanges of carbon in the coastal wetlands. This session deepened the understanding of the dynamic carbon process within coastal wetlands to better monitor and manage the blue carbon ecosystems.

3. New IMBeR West Pacific Marine Biosphere Research projects/directions for the next three years from this session (one or two bullet points)

✔ -The complete blue carbon budget, including vertical and lateral exchanges of carbon, and blue carbon modeling.

✔ - Carbon market and coastal blue carbon trading

IMBeR West Pacific Symposium 2021

Session 2: Strengthening Coral Reef Resilience to Climate Change and Human Impacts

Session Moderators: Dr. Thamasak Yeemin and Dr. Takashi Nakamura
Rapporteur: Dr. Wichin Suebpala
November 23, 2021

Session Introduction

The virtual session 2: Strengthening Coral Reef Resilience to Climate Change and Human Impacts was started at 1.00 UTC on 23 November 2021 with a total of 283 participants who registered for this session. The session was moderated by Dr. Thamasak Yeemin and Dr. Takashi Nakamura and Dr. Wichin Suebpala was a rapporteur.

1. One or two major highlights from each presentation

Keynote Presenter 1 Makoto Tsuchiya

- Capacity of coral reefs to supply ecosystem services, resilience of coral reefs, ecosystem connectivity and integrated coastal management
- Payment for ecosystem services

Keynote Presenter 2 Peter J. Mumby

- Coral bleaching, recovery, and coral reef refugia
- Coral reef resilience, adaptation, restoration and protection

Oral Presenter 1 Christine Baran

- Investigation of susceptibility of soft corals to bleaching in the Philippines.
- Soft corals *Sarcophyton* and *Sinularia* are more susceptible to bleaching than *Lobophytum.*

Oral Presenter 2 Katya Bonilla

- Fertilization and settlement successes of the massive coral *Favites abdita.*
- F1 colonies in succeeding massive coral sexual propagations can be applied to restore degraded reefs.

Oral Presenter 3 Dio Dirgantara

- Tissue necrosis infection process in coral *Acropora* sp. accelerated by addition of pathogenic bacteria in the surrounding water in Japan.
- Rapid infection and mortality in healthy corals can be induced by pathogenic agents.

Oral Presenter 4 Christine Segumalian

- Hard coral recruitment in eutrophic reefs of Bolinao, Pangasinan, Northwestern Philippines.
- High nutrient inputs and sedimentation cause low coral recruitment.

Oral Presenter 5 Mariyam Shidha Afzal

- Coral reef assemblages and reef resilience across a latitudinal gradient on the Ryukyu Archipelago, Japan.
- High latitudinal populations have lower species richness compared with low latitudinal populations.

Oral Presenter 6 Nguyen Van Long

- Recovery and resilience of coral reefs in Cu Lao Cham marine protected area, south-central Vietnam
- Slow recovery of coral reefs was found, even they were in the MPA. Only protection measures are not enough for enhancing coral recovery.

Oral Presenter 7 Vina Listiawati

- Seagrass meadow as a refugia for corals against ocean acidification.
- Coral calcification decreases as seagrass density become denser.

Oral Presenter 8 Man Ying Mok

- Role of sea urchins as biological controllers of algae on a reef flat in Rawa Island, Peninsular Malaysia.
- Herbivory of sea urchins was more effective compared to herbivorous fish.

Oral Presenter 9 Norhanis Razalli

- Phylogenetic structure of false clownfish, *Amphiprion ocellaris*, in the Straits of Malacca and South China Sea.
- The larvae dispersal potential of the false clownfish depends primarily on the period of the larval stage.

Oral Presenter 10 Matt Glue

- Promoting the rehabilitation of coral reefs in Cambodia through community-led enforcement.
- Community-led enforcement helps safeguard both biodiversity and small-scale fisheries and support MPA management.

Oral Presenter 11 Wichin Suebpala

- Roles of governments and other sectors enhancing local efforts in management and conservation of coral reefs in Thailand.
- Collaboration of various sectors and local communities drives local efforts in support of coral reef resilience.

Poster Presenter 1 Kok Lynn Chew

- Effects of physical damage on recovery and growth rates of corals with different adaptive strategies at Pulau Rawa, Johor, Malaysia.
- Corals with different adaptive strategies (r, k) have different recovery capacities from physical damages.

Poster Presenter 2 Jihad Wajdi Mohd Erfino

- Regenerative capacity of apical and basal transplants of *Acropora muricata* and *Echinopora horrida*
- Regeneration rate and health recovery of the transplants from the apical and basal regions remain similar.

Poster Presenter 3 Syamil Sahar

- Assessment of coralline Ba/Ca ratios as riverine runoff proxy in Talang-Talang Island, Sarawak.

- The surges of Ba/Ca ratios can be applied to indicate terrestrial runoff mainly caused by the growth of industrial oil palm plantations.

Poster Presenter 4 Febrianne Sukiato

- The effect of shading on colour and growth of *Acropora muricata* and *Porites lutea* in Malaysia.
- The benefits of reduced light stress through shading could be species-specific.

Poster Presenter 5 Charernmee Chamchoy

- High diversity and abundance of coral recruits in Mu Ko Chumphon, the Western Gulf of Thailand to support coral reef resilience.
- Diversity and abundance of coral recruits vary spatially between reef flat and reef slope.

Poster Presenter 6 Wanlaya Klinthong

- Coral recruitment on settlement plate experiments from different sediment loads in the Gulf of Thailand.
- Higher sediment load causes a lower density of coral recruitment.

Poster Presenter 7 Laongdow Jungrak

- Community structure of soft bottom macrofauna on fringing reefs in the Western Gulf of Thailand.
- The composition and abundance of macrofauna living in the soft bottom at reef sites vary spatially.

Poster Presenter 8 Takashi Nakamura

- Monitoring of mass coral bleaching impacts and recovery potentials in the Islands of Ryukyu Archipelago, Japan.
- Multidisciplinary research is highly required for solving coral reefs in the Anthropocene.

Poster Presenter 9 Chiara Pisapia

- Multidecadal changes in coral reef community structure and function following multiple disturbances.
- Multiple acute disturbances such as bleaching with anthropogenic stressors may interfere the dynamics of coral reef ecosystem function.

Poster Presenter 10 Makamas Sutthacheep

- Underwater pinnacles can be used as a thermal refuge in the Andaman Sea, Thailand.
- With diverse corals, benthic macroinvertebrates, and reef fishes, underwater pinnacles can also be promoted as ecotourism sites.

Poster Presenter 11 Joana Andrea Maningas

- Coral response and recruitment in an acidified environment in Mabini, Batangas, the Philippines.
- Higher algal cover and lower hard coral coverage were observed in the vent site (acidic) than the non-vent site.

Poster Presenter 12 Wiphawan Aunkhongthong

- Coral restoration project for enhancing stress-resistant coral populations in the Gulf of Thailand.
- Parent coral colonies from shallow reef flat environments are relatively high stress-resistant, which can be used for coral transplantation.

Poster Presenter 13 Arirush Wongnutpranont

- Quantification of microplastics in scleractinian corals from estuarine environment in the Inner Gulf of Thailand.

- Microplastic contamination can be found in corals and may have some negative impacts on corals, particularly potential effects on calcification and growth.

Poster Presenter 14 Ploypailin Rangseethampanya

- High diversity and abundance of target fish for fisheries on Hin Phae underwater pinnacle compared to a fringing reef at Ko Mattra in the Gulf of Thailand.
- The underwater pinnacle, which is relatively isolated from the nearshore environment can support high fish biodiversity.

Session summary

This session was organized consisting of three major activities; keynote lectures, oral and poster presentations. Two keynote speakers delivered their keynote presentations, including Prof. Dr. Makoto Tsuchiya with his presentation entitled "*Payments for ecosystem services offered by coral reefs*" and Prof. Dr. Peter J. Mumby with his presentation entitled "*Rising to the challenge of managing the impacts of coral bleaching*". There were eleven oral presentations in this session. Most of the presentations were relevant to ecology and molecular biology of corals in support of coral reef resilience. There was a paper explaining how seagrass meadow can be as refugia for corals against ocean acidification. The other paper revealed the interaction between sea urchins and coral reefs in terms of the support of coral reef resilience. Two of them focus on the socio-economic dimension, particularly the roles of local communities in promoting coral reef resilience. For poster presentation, a total of fourteen papers were presented, relating to various aspects. Most of them focused on recovery, growth, adaptive capacity, coral recruitment, bleaching, changes in community structure, and restoration of coral reefs. Three of them were relevant to the community structure of soft-bottom macrofauna, reef fishes, and coralline algae. One paper assessed microplastics in scleractinian corals and the other one presented underwater pinnacle as a thermal refugium during climate change.

In the discussion, several key points were raised as follows:

- Information on water quality is important; however, long-term monitoring data in most areas in this region is still limited. More monitoring stations should be established covering critical areas. It is also important to develop a system for supporting data sharing among the west Pacific countries.
- Coral reef resilience is linked with ecosystem connectivity. The connectivity should also be studied as this information is important for managing marine protected areas and enhancing coral reef resilience.
- Both quantitative and qualitative research on socio-economic aspects, particularly resource utilization, ecosystem services etc., as well as the integration of ecological data and socio-economic information, should be promoted to support the management for sustainable utilization and coral reef resilience.
- Research collaboration can be enhanced by mutually creating research proposals at a regional scale where researchers in different countries work together. This kind of research collaboration can also help develop standard methods and protocols as well as benchmarking in this region.
- It is important that research networks should be built up and maintained to enhance the research collaboration in the western pacific regions. It is also beneficial in research mentoring and the communication among researchers and scientists who have different expertise, thus supporting transdisciplinary research projects.

New IMBeR West Pacific Marine Biosphere Research projects/directions for the next three years from this session (one or two bullet points)

- ✓ - Ecological and socio-economic monitoring for resilience-based management of coral reefs in the West Pacific region
- ✓ - Establish a formal network for research collaboration on coral reef resilience in the West Pacific region

IMBeR West Pacific Symposium 2021

Session 3: Dried Small Fish

Summary Report

Session Moderators: Dr. Nireka Weeratunge and Dr. Derek Johnson

Rapporteur: Madu Galappaththi

Number of participants: 56

Session Introduction

This session is a first of its kind on dried small marine pelagic fish, and included a keynote address, twelve oral presentations, and a stimulating discussion. Oral presentations were categorized into three geographical regions — East Asia, Southeast Asia, and South Asia - and across the Pacific and Indian oceans for a cross-fertilization of knowledge across several disciplines. Under each region, the presentations focused on the themes of ecology, value chains, and nutrition.

Major highlights from each presentation

Keynote: Dr. Shakuntala Haraksingh Thilsted, Winner of the World Food Prize 2021

- Aquatic food, including dried small fish, are 'superfoods' of rich nutritional content, which go far beyond their economic value.
- For nourishing the West Pacific through aquatic foods, we require transformations in food systems towards sustainability, nutrition, and equity; gender and poverty gaps in food insecurity have increased after COVID-19.
- To enable such transformations, we must recognize the crucial role that aquatic foods play; amplify investments in research and innovation across from households to global levels; and rethink the value of aquatic foods in nourishing, rather than merely feeding, populations by expanding focus beyond monetary values.
- Fundamental guiding principle in these efforts should be 'diversity' — food-wise, people-wise, benefit-wise, as well as solution-wise.

➢ EAST ASIA

Ecology:

Oral Presenter 1: Shuhao Liu

- Using the species distribution model, this study predicted that rising ocean temperatures in Japanese sea due to climate change will result in a northward habitat shift and an increase in relative abundance of wintering Japanese anchovy (*Engraulis japonicus*).

Oral Presenter 2: Takeshi Tomiyama

- Central Seto Inland Sea is a Japanese region where larvae, juvenile, and adult anchovy comprise different popular dried fish products.
- Annual stock assessments in the fishing grounds in Central Seto inland sea shows location-specific dynamics in larvae and juvenile populations, and in egg abundance of Japanese anchovy.

- Although the impact of predation by Japanese Spanish mackerel (main predator) is low, prey availability for anchovy has decreased while leading to an abundance of lower quality anchovy eggs. Lower quality eggs, however, result in good quality dried anchovy due to low fatness of juveniles and adults.

➢ SOUTHEAST ASIA

Ecology

Oral Presenter 3: Alexanra Regalado

- A study of catch composition, seasonal variations, and critical habitats associated with lobo-lobo fishery in western Visayan Sea (The Philippines) demonstrates the need for gear regulation and habitat protection to ensure sustainability.
- The lobo-lobo fishery includes a variety of species of small fish, but also the juveniles of larger fish as well.

Value Chains

Oral Presenter 4: Nova Almine

- A scoping study of dried anchovy value chains in Thailand revealed critical research gaps in three areas: a) impact of changing fisheries regulations on the industry; b) raw material sources, trade flows, gendered labour, and emerging markets associated with different scales of production; and c) the vulnerabilities and coping strategies to ensure the survival of small-scale producers.

Oral Presenter 5: Ruby Napata

- Value chain functions and organization of dried sardine industry in the Philippines vary depending on the scale of production and seasonality, with significant contributions made by small-scale long-term producers.
- The strengths and challenges faced by the producers also vary across value chain nodes. Improving value chain performance thus calls for a variety of targeted interventions including policy changes, technology interventions, and capacity building programs inclusive of all actors.

Nutrition

Oral Presenter 6: Wae Win Khaing

- A household consumption survey in Myanmar shows the significance of dried fish in local diets emphasizing the product- and quantity-wise variations in consumption across sub-country regions.
- Subsistence consumption, cultural importance to different ethnic groups, and women's labour contributions towards sustaining processing activities, are among the key insights that emerge from this study.

DFM Synthesis – Southeast Asia

Oral Presenter 7: Ben Belton and Kyoko Kusakabe

- Available accounts of dried fish in Southeast Asia are patchy at best.
- Despite inter- and intra-country variations in products, processing practices, and consumption preferences, broad general tendencies exist across the Southeast Asian region.
- Dried fish remains deeply integrated into everyday rhythms, responds quickly to changes in demand, and is often perceived as a traditional sector, which is partly why the sector remains overlooked and marginalized.

- The sector therefore is surprisingly dynamic and persistent while showing obsolete characteristics at the same time.

➢ SOUTH ASIA

Ecology

Oral Presenter 8: Abilasha Sharma

- Climate change impact on small pelagic fish distribution (e.g., Indian oil sardine) along the Southwest coast of India has caused a shift northwards and into greater depths.
- Fishing gear changes creates drastic demand and price dynamics (e.g., bottom trawling lead to low value by catch destined for fish meal at a much lower price) with significant implications on the livelihoods and nutrition security of dried fish-dependent communities.
- Better understanding the impacts of climate change and other environmental factors, changes in resource utilization (e.g., gear use), and value chain dynamics is crucial for sustainably managing small pelagic fisheries in Indian waters.

Value chains

Oral Presenter 9: Tara Nair

- The sustainability of dried fish and artisanal fisheries in Kutch coast in Gujarat (India) continues to be threatened by government-supported coastal industrialization activities, depleting catch levels, and shrinking dried fish-based local economies among other challenges.

Oral Presenter 10: Shalika Wickrama

- A value stream analysis across dried Smoothbelly Sadinella value chain in Northwest coast of Sri Lanka shows inequitable profit distribution relative to the value each actor embeds in terms of their effort and time (e.g., processors who add the most value to the product earn the least profit margin compared to wholesalers and retailers).

Nutrition:

Oral Presenter 11: Sami Farook

- An analysis of Bangladesh's national consumption data over the past two decades shows an increasing gap in dried fish consumption between poor and non-poor income categories, suggesting that the poor are increasingly substituting dried fish with chicken and aquaculture-produced fish.
- Harnessing the potential benefits of dried fish therefore calls for nutrition-sensitive policy interventions that takes into consideration the product affordability, consumption patterns, as well as the changing consumer preferences.
- Dried fish also plays critical role towards food and nutrition security during natural disasters and economic shocks, particularly for the poor in Bangladesh.

DFM Synthesis – South Asia

Oral Presenter 12: Nikita Gopal

- Despite the economic, social, cultural, and nutritional importance of dried small fish to South Asia, the sector is threatened by multiple vulnerabilities related to catch variations, competition for coastal space, gendered labour issues, debt-tied sales arrangements, and policy blind spots among many other issues.
- Ecological changes directly impact the small pelagic fish availability and use.

- Processing technology improvements and interventions that meaningfully address the issues faced by women who sustain the processing node may help elevate the visibility of the sector.

Discussion:

- The widening gap in dried fish consumption between the poor and rich is a complex issue. Factors that contribute to this divide may include increasing prices, changes in taste preferences as well as the methods of preparation as dried fish often involve culinary knowledge and traditional recipes that may take more time and be perceived as less convenient.
- Understanding who has access to dried fish is crucial in ensuring food security and equity among income groups. For example, promoting value added products may make dried fish less accessible to the poor. Commercialization of value chains may also threaten the livelihoods of traditional small-scale producers.
- Dried fish price level increases might be a result of fish production/supply reaching the maximum capacity, for example, in the case of Bangladesh's marine production.
- Accuracy should be checked for the available small fish datasets because the data may have been underreported for small fish varieties compared to larger fish varieties (In Africa, large fish data shows more accuracy than the small fish data).
- A major concern related to the health of small fish stock levels is the juvenile catch. In addition to existing regulations in some places (e.g., banned mesh sizes, seasonal closures), regulating the demand for juvenile products at the market end may also be an avenue for reducing juvenile catches.
- Addressing the issue of small fish use for fishmeal seems a governance issue because a policy intervention like zero-tolerance on small fish use for non-human consumption purposes may mean increased discards at sea, which impact the overall supply of small fish. There is also a scale dimension to this issue as the fishing methods like trawling result in large by-catch levels compared to small catches from artisanal boats.

Overall summary of the session

The session brought together a keynote and a series of oral presentations, contributing new insights and a rich exchange towards addressing the large knowledge gaps that exist in the emerging area of dried small fish research. The insights gained from an ecological perspective show that small pelagic fish are declining and changing their patterns of movement, due to a complex mix of both human and environmental factors. There appear to be considerable gaps in the ecological knowledge of small pelagic fish in South and Southeast Asia, including impacts of climate change on the distribution of fish stocks.

From a value chain perspective, access to small pelagic fish is becoming a challenge for all actors, especially for the processors, with declining fish stocks and competing use as fishmeal. A picture of the inequities among actors within value chains emerges but there is a need for precise analyses, and the challenges posed for value chain governance. While knowledge on the value chains is increasing in both South and Southeast Asia, more research is needed in East Asia.

Under the nutrition and consumption theme, despite the high cultural value in consumption of dried small fish in many Asian countries, there is a lack of data on how consumption is

distributed across income groups and regions, and how important it might be in economic and nutrition terms. Existing knowledge on patterns and preferences of dried fish consumption, with particular attention to the dependency of low income and vulnerable groups for their food and nutrition security, especially during natural disasters require critical attention across the three regions.

Overall, one of the important highlights from this session is that the decline and changes in the movement of small pelagic fish, as well as competing demands from the fishmeal industry, pose challenges for food security and nutrition, especially of the poor, as well as the continuity of livelihoods for small-scale fishers, processors, and traders across the West Pacific.

New IMBeR West Pacific Marine Biosphere Research projects/directions for the next three years from this session

- The links between ecology, value chains, and nutrition related to small pelagic fish should continue to be explored and recognized as a new knowledge frontier for collaborative research in the West Pacific, linking current initiatives in South and Southeast Asia with potential partners in East Asia.
- This area of research fits well within the IMBeR Innovation Challenge 4 towards improving the integration of natural and social science data for ocean governance.
- This research area also falls within the objectives of Grand Challenge II to develop alternative scenarios to bridge the gap between physical climate sciences and humanities, and Grand Challenge III on supporting sustainable, equitable and inclusive governance approaches to fisheries and aquaculture, as well as towards climate change adaptation and mitigation.

IMBeR West Pacific Symposium

Changing West Pacific Ocean: Science and Sustainability

Session 4: Ecosystem-Social Interactions in the Coastal Sea

November 22, 2021: UTC 09:00-15:50

Session Introduction:

Continental marginal systems are supporting human well-being from important and valuable goods to services, but anthropogenic activity and climate change have substantially altered the oceans and are impacting their ability to sustain ecological and human communities. Integrating environmental, ecological and economic knowledge of continental margin systems, and how these systems may change under different perturbation scenarios, is imperative to understand the interplays between human uses of the oceans, present management strategies of marginal systems, and optimize the services they provide. Lessons learned from multidisciplinary syntheses and inter-regional comparative studies of coastal socio-ecological systems will help rationalize and optimize marginal seas management approaches. This session is aimed at improving our understanding of marginal social-ecological systems, guiding sustainable development of resources and advising governance regimes to facilitate sustainable governance, facilitating equitable sharing of margin resources, and evaluating alternative research approaches and partnerships that address major margin challenges.

Co-moderators: Sumei Liu (Ocean University of China, China) and **Suvaluck Satumanatpan** (Mahidol University, Thailand)

Rapporteur: Jingling Ren (Ocean University of China, China)

Number of participants: 100

1. One or two major highlights from each presentation

I: Key note speeches and oral presentations:

1) Key note speech 1- **Ratana Chuenpagdee** (Memorial University, Canada) **Governing the ungovernable: challenges in governance of coastal seas**
   - ✓ Coastal seas are complex and dynamic social-ecological systems. Issues and challenges in coastal seas are wicked problems. It is social problem, not only scientific problem. Difficult to define and differentiate from other problems. No formula, no stopping rule, no solution, only resolution.

- ✓ We should think about how to expand from “integrated coastal management (ICM)” to “interactive coastal governance (IGC)” and address current and emerging challenges in coastal seas through ICG requires. Look for governability problems and opportunities in all three orders of governance. Being creative, innovative and transformative in our research for solution/resolution. Embracing a “transdisciplinary” approach in co-identifying problems / co-creating solutions.

2) Key note speech 2 - **Juying Wang**, (National Marine Environmental Monitoring Center, China)
National strategy research for climate change adaption in the ocean and coast in China
   - ✓ Through reviewing on long term changes in SST, sea level rise, ocean acidification, hypoxia, climate related disasters and their impacts on marine ecosystem (e.g., fishery resources, habitats) in the marginal seas of China, try to provide decision support for the preparation of national climate change adaptation strategy 2035.
   - ✓ Existing experience in adaptation to climate change is achieved through improving the risk response capacity and protecting and restoring the marine ecological environment.
   - ✓ Recommendations on the oceanic adaption in China: 1) improve the capability of monitoring, early warning, risk assessment of marine disasters; 2) strengthen infrastructure construction in coastal areas, improve relevant systems and mechanisms, and further improve the capability to prevent and resist disaster; 3) promote the synergy between marine pollution reduction and climate change, improve the quality of marine ecosystem; 4) promote the synergy between ecological conservation and adaptation to climate change, and enhance the resilience of marine and coastal ecosystems.

3) Oral Presenter 1 – **Andrew Allison (**National Institute of Water and Atmospheric Research, New Zealand**)**, Cumulative effects and coastal management in New Zealand: making room for expression of knowledge
   - ✓ The interactions of multiple stressors act to push systems closer to tipping points and thresholds. These stressor interactions may be synergistic or antagonistic and operate on a variety of spatial and temporal scales.
   - ✓ Avoidance of environmental bottom lines can be used to move toward avoiding ecological bottom lines through management of multiple stressors.
   - ✓ With increasing complexity driven by anthropogenic stressors including climate change and land use change, society needs better spaces to think through interdisciplinary work on multiple interacting stressors: spaces to allow us to get to grips with cumulative effects.

4) Oral Presenter 2 – **Qinhua Fang (**Xiamen University**)**, Marine spatial planning evaluation for island seas based on an Ecological Vulnerability Index
   - ✓ A framework combining three dimensions of Exposure, Sensitivity and Adaptability to evaluate the marine spatial planning (MSP) of Pingtan Island sea area based on

ecological vulnerability is proposed.

- ✓ The Island Ecological Vulnerability Index (IEVI) of the main island of Pingtan and its surrounding waters is on a 0.58-0.60 scale, which is in a moderate to low vulnerability state. Indicators of ecological vulnerability of marine spatial planning scenarios are interlinked. The evaluation results can inform the revision of marine spatial plan to reduce ecological vulnerability.

5) Oral Presenter 3 – **Dhanya Kandarattil (Asmabi college, India)**, Livelihood diversification among the fisherfolks of Kerala Coast of India
   - ✓ This talk is to explore the level and relative contribution of the determinants of livelihood diversification across different regions and demographic conditions among the fisheries folks in Kerala, India.
   - ✓ Three factors of livelihood diversification are: 1) Risk related diversification 2) Economic related diversification 3) Psychological related diversification. Livelihood diversification was high in the fishers those who are engaged in motorized fishing. The lack of interest in the younger generation to take up the fishing field as a profession is another reason for the occurrence of livelihood diversification.
   - ✓ The government should undertake actions and programs to uplift the living conditions of the fisher folks through proper governance and developmental initiatives; Initiatives should be taken to keep the fishermen in their own traditional employment coupled with programs facilitating their revenues which ensure the sustainability.
6) Oral Presenter 4 – **Kamalaporn Kanongdate (**Mahidol University, Thailand**)**, Responsible consumption and production embedded in the Thai marine shrimp farming certification programs
   - ✓ This talk aimed at reviewing the progress of implementing the certification programs on the marine shrimp farming in Thailand through gathering and analyzing data from the Fishery Department and other responsible organizations. The ASC (Aquaculture Stewardship Council) and CoC (Code of Conduct) certification for Thai shrimp are mainly concerned with sustainable farming/aquaculture that assist consumers to track the quality of each product from the farms.
   - ✓ Certification schemes for shrimp products throughout the whole supply chains assist leading to achieve Sustainable Development Goal 12 (sustainable consumption and production, SCP). However, voluntary application of certification schemes may be obstacle for the goal of achievement. Expanding small shrimp farms on land has been increasing that may affect well monitoring.

7) Oral Presenter 5 – **Jarina Mohd Jani (**University Malaysia Terengganu, Malaysia**)**, Making a case for community-based artificial reefs management for the sustainability of coastal fisheries resources and livelihoods
   - ✓ This talk present the role of artificial reefs in the lives of small scale coastal fisher folks in Terengganu, Malaysia, using the Sustainable Livelihoods Approach, a case study for establishing community based fisheries management (CBFM).
   - ✓ Integrating the existing local practices associated with traditional artificial reefs could bridge the perceived technological divide between fisheries users and managers who in the end want the same thing, albeit in different ways.
   - ✓ The resources and use of the resources by humans can be monitored, and the information can be verified and understood at relatively low coast. Rates of change in resources, resource-user population, technology, and economic and social conditions are moderate. Communities maintain frequent face to face communication and dense social networks. Outsiders can be excluded at relatively low coast from using the CBFM. Users support effective monitoring and rule enforcement.
8) Oral Presenter 6 – **Ming-An Lee (**National Taiwan Ocean University**),** Fishery-based adaption to climate change: The case of migratory species grey mullet in Taiwan Strait, Northwestern Pacific
   - ✓ This talk analyzed the long-term (1954–2020) records of grey mullet catch and sea surface temperature in the Taiwan Strait (TS) to investigate the influences of climatic indices on the annual catch of grey mullet at multiple timescales.
   - ✓ Increases in SSTs may be a main reason for the decreased catches of grey mullet after 1980. Current velocity is the most important environmental variables. The fishing grounds of grey mullet shift to the north following changes in the 20^{o}C isotherm. Fishing method was dominated for gill net with the low coast expense as the abundance increased since 2013.
   - ✓ Fishery-based adaption of the resilience between purse seiner and gill net fleet conducted from fishermen responding to the mullet catch fluctuation, climatic index and cost benefit is identified.
9) Oral Presenter 7 – **Arkaprava Mandal (**Indian Institute of Science Education and Research Kolkata**)**, Tracking the ecological health of a mangrove ecosystem from the Northern Indian Ocean - Applicability of benthic foraminifera as bioproxy
   - ✓ This talk is to decipher the ecological health of Sundarbans mangrove ecosystem using benthic foraminifera as biological proxy and to explore biocomplexity of benthic foraminifera across coastal biotopes of the Northern Indian Ocean.
   - ✓ Observed diversity of benthic foraminifera is low. Dead test outnumbered the live ones,

indicating the studied ecosystem are prone to severe disturbances. The dominance of populations of stress-tolerant taxa *Ammonia* spp. and decreasing *Jadammina macrescens* population across studied sites indicate rapid degradation of ecosystem quality.

10) Oral Presenter 8 – **Hui Liu (**Yellow Sea Fisheries Research Institute**)**, Status and perspectives on mariculture spatial planning and implementation
    - ✓ This talk provides an account of how mariculture is implemented and the processes experienced for MFZ (marine functional zoning) in China, and MSP in EU, Norway and Canada. The comparison of how mariculture is implemented in the stepwise processes of MFZ and MSP frameworks clarifies the differences in status of mariculture among the countries.
    - ✓ Overcapacity is one of the most challenging issues for mariculture in China. MFZ at all levels is the legal framework regulating the use of marine space in China. Ecological redline is a necessary supplement to MFZ. We should balance the relationship between intensification and environmental sustainability. Mariculture spatial planning in China is carried out by policy suitability assessment, environmental suitability assessment, modelling of individual growth and ecosystem coupling.
11) Oral Presenter 9 – **Roshni Subramaniam (**Sydney Institute of Marine Science**)**, Ecosystem modelling to support decision making for the coastal South-West Pacific (Eastern Australia)
    - ✓ This talk is to understand how the complex coastal ecosystem is changing to plan effective mitigation and adaption strategies in the south-west Pacific Ocean.
    - ✓ Using qualitative and quantitative (Ecopath) ecosystem models to simulate ecosystem responses under different perturbation scenarios by using 46 functional groups, and to provide an understanding of current ecosystem structure and function. The works are helpful to understanding ecosystem change in New South Wales and their socio-ecological consequences.

II: Poster Presentations / Speed-Talk presentations:

1) Poster presenter 1 – **Jiayu Bai & Kailei Zhu,** Review of Fukushima nuclear contaminated water discharge event: International law analysis and stakeholders' response
    - Japan's recent intention to discharge Fukushima nuclear waste water into the sea is a major challenge to today's international law and violates relevant obligations under international law. In order to protect the domestic marine ecological environment and national health of stakeholders, it is necessary to analyze the illegality of Japan's treatment of Fukushima nuclear wastewater, and summarize the response measures proposed by current stakeholders from three aspects of politics, law and culture.

2) Poster presenter 2 – **Mohammed Bouchkara,** Study of morphodyanmic changes along the lagoon of Oualidia (Morocco) using bathymetric data
    - Changes in morphodynamics and sedimentation in the Oualidia lagoon after the sediment trap dredging were studied using bathymetric data surveys and a 3D GIS analysis tool. The remarkable changes in average height and eroded area/volume are mainly related to natural (hydrodynamics, waves, currents...) and anthropogenic (dikes, sediment traps...) factors. Creation of sediment trap in 2011 can increase the current velocity inside the lagoon and facilitate hydrodynamic which leading to an increase in depth of the main channel.
3) Poster presenter 3 – **Beatriz Casareto,** Community structure and rearing experiments of the Shrimp *Lucensosergia lucens* Hansen 1922 (Crustacea, Decapoda, Sergestidae) (Sakura-ebi) in Suruga Bay
    - Several measures to limit the catches have been taken by Yui Fishermen's Association in Suruga Bay, particularly in fall season. This resulted in positive effect for the recovery of shrimp *Lucensosergia Lucens*. Rare experiments of *Lucensosergia Lucens* are been conducted in order to assess larvae growth, mortality rates and food preferences. Suitable rearing conditions and food combinations for growing the shrimps to juveniles in a laboratory aquarium were determined.
4) Poster presenter 4 – **Kai Chen,** Evaluation of marine ecosystem services in China based on meta-analysis
    - Using OLS and MLM methods to study the impact of various factors on ecosystem service value in China based on meta-analysis. The regional distribution, research methods and ecosystem services of marine ecosystems have significant effects on ecosystem service value.
5) Poster presenter 5 – **Xiaokun Ding,** Seasonal variations of nutrient concentrations and their ratios in the central Bohai Sea
    - Develop a vertical one-dimentional physical-biological coupled model to capture the seasonal variations in nutrient concentrations and the N/P ratio in the central Bohai Sea (CBS). N/P stoichiometry in phytoplankton uptake was lower than seawater, which leading to lowest nutrient concentration and highest N/P ratio in summer. River input, atmospheric deposition and sediment release are the major sources of nutrient in the CBS, while benthic nitrogen loss is the key factor maintaining the nitrogen balancing in summer and autumn.
6) Poster presenter 6 – **Nouhaila Erraji Chahid,** Hydrodynamic and morpho-sedimentary modelling of the Moulay Bousselham lagoon and their impact on the socio-environment: Application to the study of "Fishing" and "Agricole" practices

- Using numerical model to understand the processes of sediment dynamics in the Moulay Bosselham Lagoon and to help decision maker for the proper management of this ecosystem and the mitigation of human impacts. This multidisciplinary methodology highlight the links between socio-economic and climate change and their impacts on the lagoon, bearing in mind that conflicts of use, environmental or societal are multiplying, which will call for Integrated Coastal Zone Management.

7) Poster presenter 7 – **Mohammad Saydul Islam Sarkar,** Integration of the socioeconomic status into MSP-theoretical aspects and recommendations for Moheshkhali Island
   - A case study to evaluate the direct economic impacts linked to the development and implementation of Marine Spatial Planning (MSP) for Moheshkhali Island is presented. Conduct a respondent analysis based on various types and stages of people's participation is a key factor for a successful management regime of MSP process for sustainable ocean governance.
8) Poster presenter 8 – **Faddrine Jang,** Increased transfer of trace metals and *Vibrio* sp. from biodegradable microplastics to catfish *Clarias gariepinus*
   - Polylactic acid and polyamide 12 act as shuttles for trace metals from the seawater to catfish *Clarias gariepinus*. Continuous uptake the microplastic coated with trace metals altered the gut microbiome and lowered the fish immunity thus enabling potentially pathogenic *Vibrio* infections.
9) Poster presenter 9 – **Yerkenaz Karibayeva,** Caspian Sea: Isolated, yet mutually engaged
   - Caspian Sea's ecosystem is sensitivity to climate and also is polluted by uncontrolled or unauthorized waste disposal. Priorities of protection action for the Caspian Sea should be established by assessing the relative importance of impacts upon marine and coastal ecosystems and resources, public health, socio-economic benefits, including cultural values. Social and political interaction can provide a platform for implementation of sustainable ecosystems management approaches.
10) Poster presenter 10 – **Hyun-Woo Kim,** Fish biodiversity survey in Korean waters using environmental DNA analysis
   - Establish a pipeline for fish diversity survey using eDNA metabarcoding in Korean waters.Metabarcoding analysis clearly demonstrated seasonal and regional differences in fish assemblage within the Gamak Bay. Fish assemblages constructed by eDNA metabarcoding showed much higher sensitivity and diversity suggesting it would be one of good alternative methods to replace the laborious traditional methods.
11) Poster presenter 11 – **Elsa Cordelia Durie Lambat,** A community-based qualitative vulnerability assessment tools for rivers in developing participatory response to land-use changes

- Community based qualitative vulnerability assessment tool is an exploratory work that assess the river systems in relation to land-use changes. The development of this tool need to undertake the integration of natural and social science and highly consider the participation from local communities.

12) Poster presenter 12 – **Shanshan Li,** Source, composition and reactivity of particulate organic matter along the salinity gradient in the Changjiang Estuary and its adjacent sea
    - Source, transformation and fate of POM in the Changjiang Estuary and its adjacent sea (CJEAS) are discussed using multi-parameters. POM variations in the CJEAS are mainly controlled by both terrigenous input and in situ phytoplankton production. Two end-member mixing model calculation results show that the contribution of terrigenous of POM in winter is prominently higher than in spring, while phytoplankton-derived POM dominated the sources in the CJEAS from winter to spring.
13) Poster presenter 13– **Shengkang Liang,** Identification jurisdiction responsibility and land-sea synergistic regulation for coastal total nitrogen based on water quality target in Laizhou Bay, China
    - The polluted segments of Laizhou Bay (LZB) is discerned through land-sea synchronous investigation in this study. Simulating results from water quality model shows that the deadline for achieving the water quality standard through the scheme of the "differentiated percent reduction" is six years earlier than that through the "equal percent reduction" in each justification.
14) Poster presenter 14 – **Deju Lin,** Effect of iron on the preservation of organic carbon in marine sediments
    - Fe and clay contents play important roles in the preservation of OC in the sediments of the marginal seas of China. Two binding mechanisms between Fe and OC are largely influenced by the marine environment.
15) Poster presenter 15 – **Marsya Jaqualine Rugebregt,** Sediment quality in Halmahera Sea waters, North of Maluku
    - Heavy metal concentrations in the sediments of Halmahera, North Maluku, are presented. The sediments of Halmahera are not polluted by the six heavy metals and with small PLI value (<1).
16) Poster presenter 16 – **Abiola Osanyintuyi,** Long-term shoreline analysis of Brunei coast: An application of Digital Shoreline Analysis System (DSAS)
    - Using multispectral satellite images to identify the shoreline behavior of the Brunei coastline exposed to the South China Sea. Erosion dominates despite several coastal engineering modifications including groynes and breakwaters put in place to protect the coastline of Brunei.

17) Poster presenter 17 – **Lihini Prematilaka,** On the bliss of nature: Leveraging Nature based Solutions (NbS) for coastal management
    - A case study from Sri Lanka to highlight the possibility of adopting NbS to reduce coastal disasters while enhancing community well-beings. NbS could be helpful in tackling the issues that the coasts face including climate change, disaster damage, biodiversity crisis, food and water security and societal coherence in the Anthropocence.
18) Poster presenter 18 – **Jing-Ling Ren,** Impacts of human activities on Arsenic transport in the Huanghe (Yellow River)
    - TDIAs concentrations at Kenli and middle and lower reaches of Huanghe both have significant seasonal and annual variations. Seasonal variations of SPM, riverine runoff (regulated artificially) and Chla have direct impacts on the TDIAs concentrations and distributions. TDIAs concentration in the Huanghe is at pristine level and has small long term variations.
19) Poster presenter 19 – **Matt Roberts,** The potential value of establishing Oyster Shell Recycling (OSR) programmes
    - Oyster Shell Recycling (OSR) programmes have been used as a successful mechanism for procuring lost oyster shells that are crucial to restoring oyster populations. The study undertook processes that experimentally validated shell as a preferred substrate for oyster spat and identified the extent of oyster shell available in Hong Kong to evaluate the cost-benefit and feasibility of implementing an OSR programme.
20) Poster presenter 20 – **Huiying Sun,** China's coastal ecological restoration policies: Evolution, problems, and proposals
    - The poster reviews the development of relevant policies of coastal ecological restoration, the history and major phase of which are implemented in China and gives an analysis on the experience and shortage of it. A holistic restoration approach, fundamental research of coastal ecosystems, and the construction of coastal zone management system, are concluded as the main features.
21) Poster presenter 21 – **Chika Suzuki,** Elucidation of incentive structures for researchers to focus on coastal ecological conservation activities and promotion of industrial use of the ocean
    - This study aimed to obtain knowledge beneficial for improving the university management through policy and to promote partnership with industry and local community. Study promote factors and satisfaction are close related in division of marine sciences. Professors are active in partnership and personnel evaluation and the others tend to give incentives in division of business. Improvement of personnel evaluation to

prevent from aging of researchers caused by shortage of post, wage and research funds increase is needed.

22) Poster presenter 22 – **Wenqi Xu,** Effects of integrated multi-trophic aquaculture on the nutrients and phytoplankton size structure in Sanggou Bay
    - Nutrient distribution in the Sanggou Bay (SGB) has significant seasonal variation. Tidal exchange, fluvial input, kelp culture and large scale shellfish culture are important influencing factors of nutrient composition in the SGB.

III. Discussion and conclusion:

All attendees discuss on the following issues: What are our understanding about social-ecological interactions and how best to work across disciplines in promoting social-ecological interactions in the West Pacific Region. Through thorough discussion, we have got some consensus as followed.

Social and natural scientists can work together to provide strength and share the understanding about social ecological interactions to policy maker to enhance sustainability of ecosystem and their contribution to human being. Including mariculture into Marine Spatial Planning (MSP) is great combination of science and policy and benefit on conserving marine ecosystem. We should think about how to increase nature contribution to human kinds in the coastal region and promote transdisciplinary research across the region.

Capacity buildings are important to help understanding about social-ecological interactions in the coastal sea, especially in the West Pacific Region, that lead to policy implications (such as MSP, Interactive governance, DPSIR, Integrated coastal management, vulnerability & resilience concept, and etc.). How can we understand the contributions of natural processes' changing and some other effects of human activities? Communications is important for scientists from social and natural scientists. Model should be started from case study to understand the interactions in the coastal seas.

2. Session summary

Coastal seas in the West Pacific Ocean are surrounded by land regions with a rapid population rise and economic development, which have experienced strong stresses from human perturbation and climate change. How ecosystem in the coastal seas may change under complex perturbations and how to enhance sustainability of ecosystem are one of the key scientific questions of IMBeR. Two invited keynote speakers and 31 oral and poster presenters give talks in session 4, with concerning issues covering the multidisciplinary studies and inter-regional comparative studies of coastal socio-ecological systems. Social and natural scientists should work together to understand the impacts of the major social service needs on the eco-environment

of the coastal seas and their further consequences for human-being, to establish the scientific basis for actions needed to enhance the sustainable use of ecosystems and their contributions to human well-being, to meet the Grand Challenges in the earth system for global sustainability. We need to improve our understanding of marginal social-ecological systems, guiding sustainable development of resources and advising governance regimes to facilitate sustainable governance, facilitating equitable sharing of margin resources, and evaluating alternative research approaches and partnerships that address major margin challenges. For the future directions, we should build a transdisciplinary (TD) research network on coastal seas governance in the region, in order to enhance knowledge, exchange good practices, and develop capacity required to address current issues and emerging threats. Apply for funding to conduct a large-scale collaborative TD research project on coastal seas governance for the region.

3. New IMBeR West Pacific Marine Biosphere Research projects/directions for the next three years from this session

A healthy and sustainable ocean is essential for maintaining prosperous societies now and in future. The marine ecosystems are impacted by human activities both on land and at sea. A sustainably managed coastal environment has immense economic, cultural and aesthetic value. It is vital to adopt an integrated coastal /ecosystem-based management system to protect these valuable and vulnerable ecosystems.

Encourage and strengthen the use of scientific knowledge and monitoring results relevant for the management of ocean ecosystem and economies, in particular by providing mechanisms and opportunities to access such a knowledge base. Consider establishing a formal mechanism on the regional level, such as a scientific advisory body, to underpin coordinated and holistic use of knowledge in instituting overarching policies on the development of ocean economy and the implementation of ecosystem-based integrated ocean management.

Session 5: Towards the Sustainable Indo-Pacific Region (IPR): Marine Biogeochemistry and Biodiversity

Session Moderators: Shan Jiang, Aazani binti Mujahid, Deo Florence L. Onda, Romanus Edy Prabowo and Jing Zhang

November 25, 2021

The IPR is the linkage between the West Pacific Ocean (WPO) and the East Indian Ocean (EIO), covering complex ocean channels and numerous tropical islands. As an important node for global ocean conveyor belt, the IPR hosts active interactions among atmosphere, water and soil/sediments. The high-level biodiversity in the IRP is also well known, likely supported by the diverse biogeochemical processes and warm environment. This session focuses on the biogeochemistry studies from the view of climate change, e.g., solute dispersion, chemical transformation and biological assimilation, as well as biodiversity research across temporal scales, e.g., species diversity, evolutionary origins and biodiversity drivers. Furthermore, as a region deeply influenced by anthropogenic activities, topics regarding marine economics and management are also contained in this session.

The session was headlined by a keynote address from Prof. Fan Wang, the Chair of the Centre for Ocean Mega-Science, Chinese Academy of Sciences (CAS) and Yantai Institute of Coastal Zone Research, CAS (YICCAS). Prof. Wang introduced the importance of IPR as the centre for matter and energy transport on a global scale and highlighted the complex biogeochemical transformations and high-level biodiversity driven by the multi-sphere interactions. According to the database established from cruises organized by CAS and predicted climate change scenarios, Prof. Wang also highlighted the possible variations of biodiversity in the IRP in the future, which received great attention from session attendees.

The first two speakers, Erika Grace Gernato and Prof. Aida Sartimbul are marine biologist. Erika offered a presentation on community structuring of bacteria/archaea in a mariculture-impacted area, located at the Philippine coast. The correlation between microbial distribution pattern and environment settings highlighted the influence of anthropogenic activities on marine environment stability and resilience. The presentation from Prof. Sartimbul detailed the variability of Sardine community at

fishing ground Prigi-Trenggalek via the mtDNA information. The annual changes in species and population from the present research benefit the local fishery community and offers a reference for investing the pressure of climate changes on marine culture. The third speaker, Prof. Yan Du, gave attendees an excellent summarization on ocean currents in the IRP. He highlighted the complexity of deep-water circulation and importance of monsoons as a water circulation driver. Afterwards, Man Ying Mok, another marine biologist, shared her latest finding on sea urchin community distribution in Peninsular Malaysia. The environmental factors, e.g., water temperature and primary production, as previously outlined by Prof. Du, would be key drivers for sea urchin distribution in the IRP.

The fifth presentation, from Prof. Masao Ishii, attracted our attention from coastal zone to open ocean. He detailed ocean acidification in the tropical Pacific, typically in the region of the warm pool. The solid observation data and historical review on CO_2 accumulation in the equatorial ocean received great interests from oceanographers. Followed with the thread of carbon, Prof. Patrick Martin, showed a comprehensive study on the terrestrial carbon transport and transformation in tropical peat systems and displayed the significant increases in land-derived carbon loading during the past 20 years due to the land-use changes. Afterwards, Dr. Punyasloke Bhadury and Maria Anna Michaela De La Cruz also offered presentations related with carbon cycling, focusing on marine planktonic cyanobacterial communities and pico-eukaryotic microbial communities, respectively. The dynamic of plankton in tropical oceans, frequently driven by monsoons, triggers the variation of dissolved organic carbon concentration in the photic zone. Yixue Zhang, a speaker from East China Normal University, highlighted such variations in the South China Sea and linked the composition of pelagic organic matter to biological province in her presentation. Apart from phytoplankton, mangrove forests are also key primary producers in tropical ocean systems. Prof. S.M. Mustafizur Rahman and Prof. Ashraful Azam Khan demonstrated health status and nutrient dynamics in mangrove ecosystems, respectively, according to their long-term survey in Bangladesh mangroves. At the end, Dr. Haiyan Sun illustrated publishing details in Elsevier Oceanography journals and warmly invited research submissions to the symposium special issue. Beside oral presentations, several researchers showed their important outcomes via posters (online).

As aforementioned, the IRP is an important node on ocean conveyor belt and supports the livelihood for millions of people. A scientific understanding on marine biogeochemistry and related biodiversity in the IRP is critical, especially for reaching a sustainable economy development for coastal citizens. This research challenge calls for continuous efforts from the scientific community, managers and stakeholders.

IMBeR West Pacific Symposium 2021

Session 6: Marine Extreme Events: Impacts, Forecasting, and Risk Management

Convener: Alistair J. Hobday

November 25, 2021

Marine extremes including heatwaves, deoxygenation events, upwelling, and flood plumes – are becoming more common in many regions of the world. These extremes are often exacerbated by climate change, such that impacts on marine resource users and coastal communities is greater than in the past. Even earthquakes have led to coastal ecosystem impacts and fishery closures, as occurred after the 2016 Kaikōura event in New Zealand. Managers closed the local pāua (abalone) fishery for 6 years (Dec 2021) to protect the surviving animals and associated habitat, as well as other shellfish and seaweed resources along the earthquake-affected coastline.

This conference session was headlined by a keynote address from Prof. Neil Holbrook, a founding member of the International Marine Heatwaves working group. Prof Holbrook described the impacts of marine heatwaves (MHW) on three tropical western and central Pacific Island nations and their communities – Palau, Fiji and Samoa. These regions are among the most vulnerable to climate change and extreme events, with observed changes to coral reef and seagrass habitats and livelihoods. The link between climate drivers, such as ENSO, and MHWs is not straight forward, however, projections are clear – more MHWs are expected in this region over the next 20 years regardless of the emission scenario, but after 2040 the likely frequency depends on choices that society makes about emission reduction.

The first two of eight invited papers covered impacts of a tropical cyclone in Indonesia (Riza Setiawan) which led to an injection of nutrients to the euphotic zone and enhanced primary production, and a 2016 flood plume event in the East China Sea which injected sediments and changed water turbidity (Jianzhong Ge). A multi-component numerical model used to examine the effects of this flood plume and provided a realistic simulation to examine a range of nutrient responses.

The drivers of extreme events were covered in the next two presentations, both with a focus on MHWs, while a third explored the ocean-atmosphere coupling as part of a 2017 El Nino. Maxime Marine developed a heat budget analysis of extreme upper ocean MHWs in a global ocean circulation model (10 km, 1982-2014, OFAM3), and characterised the heat contribution from the atmosphere (heat flux) and the ocean (advection) to determine the driving mechanisms of MHWs. Ying Zhang explored the formation of long-lasting MHWs in the tropical Indian Ocean, an understudied region, and identified the important role of subsurface warming induced by downwelling oceanic waves. Qihua Peng described how extreme sea level anomalies along the coast were associated with the 2017 extreme “coastal” El Nino and developed an understanding that suggest prediction was possible 1 month in advance.

The next two presentations covered prediction of MHW events using a dynamical model in the Pacific (Grant Smith), and a statistical model in Australia (Fabio Boschetti) and show that

warning for the probability of these extreme events several months into the future is now possible. These prototype forecasts are providing early warning for coral reef systems, and ocean areas around Australia. The final invited presentation (Simon Nicol) considered the management responses that could be implemented in response to climate change. These same themes – impacts, drivers, prediction, and management were covered in a series of short talks, which added richness and more examples to the Session.

Clearly, an understanding of impacts, forecasting, and risk management for extreme events is critical in the West Pacific, where many coastal communities rely on the ocean for food, transport, and livelihoods. The research community must work together with West Pacific nations to speed progress from extreme event process understanding to developing response options in this region.

REPORT

IMBeR West Pacific Symposium 2021
Session 7: Connectivity of the West Pacific and Southern Ocean: the Importance of Oceanic Top Predators

Wed 24 November 2021 (UTC 1:00-04:30)

Session Introduction

Oceanic top predators are an important link between the West Pacific and Southern Ocean and function as indicators of ecosystem change across the region. The main determinants of predator movements are the distribution and abundance of their prey, which are not distributed homogeneously. Prey distribution is determined and influenced by oceanographic processes that influence biological productivity and/or increase the availability of prey, thus creating areas where foraging is more energetically efficient. The spatio-temporal scales on which these processes operate vary greatly, from vertical mixing at centimeters to meters over time scales of seconds-hours-days, to climate features such as El-Niño Southern Oscillation and Southern Annular Mode that occur over hundreds of thousands of kilometers at time scales of years to decades. Consequently the impact on trophic structure and predator responses also varies greatly; from localised and short-term changes in foraging efficiency and prey availability to long-term population trends. This session aims to further disentangle the relationship and relevant lag-times between oceanographic processes in the West Pacific and Southern Oceans, and predator responses from foraging behaviour to large-scale demographic trends and future population viability under plausible climate scenarios. While focussed on this region, we also invite submissions from elsewhere which can provide valuable lessons that can be applied to understanding predator responses in the West Pacific and Southern Oceans. The session will feature both talks and posters, and the authors will have the opportunity to publish their works in a special volume of a renowned peer-reviewed international journal. We particularly encourage submissions from ECR and members from underrepresented groups in science.

This session represents a joint ICED (Integrating Climate and Ecosystem Dynamics in the Southern Ocean) CLIOTOP (CLimate Impacts on Oceanic TOp Predators) initiative.

Session co-moderators: Luis Huckstadt (University of Exeter / University of California Santa Cruz) and Jaimie Cleeland (University of Tasmania / Australian Antarctic Division),
Co-conveners: Emma Carrol (The University of Auckland) and Pia Ricca (The University of Hong Kong)
Rapporteurs: Jaimie Cleeland and Leena Riekkola (University of Auckland)
Number of participants: 63

Major highlights from each presentation

Keynote: Dr Michelle LaRue, University of Canterbury

- This project combined crowd-sourcing and high resolution satellite images to provide the first ever population estimate of Weddell seals in Antarctica.
- Citizen scientists were asked to look at satellite images and to first identify whether there were any seals ('presence-absence'), and then later to count (by 'clicking on') seals in the same images.
- "CrowdRank" algorithm was used to translate crowd based estimates into a population estimate using a 'consensus' approach: the more people that agreed on a feature in an image being a seal, the more likely that it actually was one.
- Investigated the entirety of fast ice around Antarctica - ~260,000km^2, seals present on 0.55% of available fast ice - so very patchily distributed. First ever population estimate: 202,135 breeding Weddell seals - not as many as expected. The Ross Sea

area had the most seals (42% of all seals) and the Amundsen Sea had the fewest seals.
- Weddell seal presence was more likely farther away from Adelie penguin colonies, seal presence was more likely when nearby an emperor penguin colony (as long as the colony was not too big).

Invited talk: Dr Mao Mori, Tokyo university of Marine Science and Technology

- Key toothfish habitat occurs on the continental slopes, shelves and seamounts. In the Southern Ocean food web system, toothfish are an important prey to other species during e.g. the egg and larval stages, therefore understanding toothfish life cycle is essential.
- Access during winter is hard, therefore no samples of small larval fish have yet been collected, however an earlier study found potential toothfish spawning grounds. Ocean currents are important for successful transport of early life stages, but they are not well known in the East Antarctic region.
- SAM is the dominant atmospheric circulation variability mode in the Southern Hemisphere, and it can affect toothfish egg and larval transport around the continental slope-shelf region in the East Antarctic. This was studied using ocean-sea-ice-coupled model (COCO).
- Toothfish larvae settling occurs on northern slopes in positive SAM phases - greater distribution under these conditions. Most particles successfully settled in local regions in negative SAM phases. Unsuccessful eastwards transport under positive SAM phases.

Oral Presenter 1: Sophia Volzke (Institute for Marine and Antarctic Studies - University of Tasmania)

- There are complex relationships between climate and predator population dynamics - shifts in prey availability will affect top predator survival long term, but studying the lower trophic levels can be hard.
- The Macquarie Island elephant seal populations have been declining while other populations have been stable/increasing. Capture-Marck-Recapture datasets exist for early (60s) and modern (90s to early 00s) time periods, but we only now have the computing ability to do complex matrix population models equipped to deal with: life history (developmental stages) and imperfect data (resight effort).
- The modelling incorporated climate lags (SAM/SOI), with the best fit occurring with lagged SAM and unlagged SOI. SOI had a negative relationship with juvenile and adult survival (direct effect, no time lag). +SOI = La Nina year/event → negative odds of survival. During El Nino events - small positive contribution to juvenile survival. In contrast, SAM, lagged SAM1 = strong relationship with juvenile survival.
- Not all individuals are affected equally, perhaps, because juveniles remain closer to breeding grounds. Or, SAM is indirectly influencing prey and adults can compensate for poor conditions by moving away from the island (lag effect - one year for impacts to manifest in food web).

Oral Presenter 2: Peng Lian (University of Chinese Academy of Sciences)

- Eastern yellowfin tuna are highly migratory and have connections across the Pacific. This work used longlining fishery data, different scale climate indices and local-scale environmental parameters, Argo, remote sensing and ocean model data to study spatiotemporal distribution of yellowfin tuna.
- Decadal shift was identified in CPUE throughout the year. Semilunar pattern in spatiotemporal distribution arose during the last ten years. Increased mixing and rainfall during El Nino == high CHLa. Zonal wind, upwelling also increased.

- For decadal scale, under the circumstances of more Central Pacific types in EPO, yellowfin tuna seem to concentrate within a preferred temperature range from 18-25°C.
- Central Pacific El Nino type often brings the SST fronts which provide a more suitable habitat for tuna. For seasonal scale, zonal wind and precipitation play an important role in periodic variation in tuna's spatiotemporal distribution, and the mechanistic understanding may give us a valuable insight into physical/biological processes in EPO ecosystems.
- Finer spatio-temporal scales can help detect fluctuation of yellowfin tuna in a timely manner, which facilitates risk assessment. Tuna CPUE and environmental factors are to be analysed on the same time scale.

Oral Presenter 3: David Green (Institute for Marine and Antarctic Studies - University of Tasmania)

- The Southern Ocean is experiencing rapid changes. Important to understand the links between predators and their prey, which can be limited by our understanding of biophysical connections. We can overcome this knowledge gap by using ocean circulation and biogeochemical models.
- Aim of this project is to predict how much mid-trophic level prey can be produced, where would it be distributed based on underlying circulation.
- Part 1a&b of the work - Matching modelled prey fields to elephant seal tracking data. How well does variability in modelled prey biomass predict fitness outcomes of marine predators? Important habitat matched quite well with known Macaroni penguin habitat.
- Part 2 of the work - reconfigure SEAPODYM framework for Antarctic krill (modelling krill spawning habitat). Model had pretty good match with what expected to be good spawning habitats
- Prey models already provide meaningful biological signals, but they can be and are being improved as well. Prey models will be globally applicable.

Oral Presenter 4: Stuart Corney (Institute for Marine and Antarctic Studies - University of Tasmania)

- Changes are occurring in the SO and the impacts are felt both across species and within populations. For example, the Macquarie Island (MI) elephant seal population is declining (~1.5% per year), but the population drivers are unclear.
- This work used dynamic energy budget models (already showcased to work on southern elephant seals) to understand the population change. Four hypotheses were considered: H1 climate variability, H2 reduction of yearling survival, H3 reduction in fecundity of mothers, H4 density dependence. DEB-IBM allows testing of hypotheses over >10 generations.
- Three main questions: 1. Can the results from the hypothesis reproduce the exponential decline as observed on Macquarie Island? 2. How well does the emergent change in the population dynamics match the MI data? 3. Is the change in population projection from the modelled data realistic given the changes in emergent individual behaviour and population dynamics?
- The modelled population trajectory for three of the scenarios closely followed the observed trend in the decline of southern elephant seals. Each of these scenarios (in isolation) was considered too simplistic and did not match interannual variability well. H1 climate scenarios were too extreme in variation. H2 yearling survival scenario created unrealistic transition ages between sexual and physical maturity stages and also affected the fecundity of mothers (increased). H3 fecundity scenario did not cause decline despite quite severe changes in variables.H4 density dependence scenario is a blunt instrument but closely matched that of MI. Likely a combination of drivers has resulted in population change at MI.

Oral Presenter 5: Pauline Machful (Oceanic Fisheries Programme, The Pacific Community)

- Tuna are top predators in the food chain and key target species for fisheries worldwide. Biological sampling program run by SPC. 15,928 stomachs sampled of 3 tuna species (yellow fin, big eye and skipjack), 8,089 examined at SPC laboratory
- The aim was to understand trophic dynamic and trophic ecology of tuna using an informative index to quantify ingested food. But, there are metric problems (biases: fish size, thickness of the stomach walls), and subjectivity. So the alternative is to include fish size in the metric.
- Tested whether spatial patterns in fullness are driven by ecological, fishery and/or environmental components? Effects of fishing gear (significant effects): fuller stomachs in pole and line fishery, significantly emptier stomach when caught by purse seine gear. Significant effect of fish school association: fuller stomachs in free schools (tuna feed better in free schools), seamounts (mostly targeted by pole+line). Emptier stomachs in drifting FADs (purse seine target the most).

Oral Presenter 6: Julie McInnes (Institute for Marine and Antarctic Studies - University of Tasmania)

- Predator-prey interaction can be very hard to monitor at sea. But, we are starting to see that fish and squid pathways especially in the sub-Antarctic are important (in addition to traditional krill food web pathways) -- key to include in models.
- This work used DNA metabarcoding - scat DNA to see what prey is in it. Universal markers give broad signatures (fish, squid, krill), or group specific to identify species. But we must first ensure we have the reference sequences. Lack of recent dietary info from Australian sub-Antarctic islands (Heard and Macquarie).
- Aim 1: Develop a marine ecosystem monitoring framework using scat DNA from predators to assess species composition in the Subantarctic - select candidate species - want to represent different areas of the water column, but also different distances from the islands.
- Aim 2: Apply the diet monitoring framework using a multi-species predator case study - Macquarie Island; figure out what we need to collect in future; are the species changing over time?
- Starting to see the prevalence of jellyfish in the diet of some animals; in more pelagic species (penguins) krill becoming more prevalent in diet; not a lot of difference in diet between locations around MI. Next stage is to look at fish, krill and cephalopod species, and then might see more variability around the island in the individual species.

Poster/Speed-talk Presenter 1: Silvia Olmastroni (Università degli Studi di Siena)

- The aim of this work was to improve measurements of a series of genetic and physiological parameters of Adelie penguins, and to compare neighbouring colonies.
- Three colonies of different sizes were located within 70km. Breeding biology showed similar trends at the different sites, but colonies were genetically structured (low migration rates).
- Satellite tracking of breeders found breeders foraged near fast and pack ice, which was in line with previous research and confirms that prey availability in front of a colony may help adults to cope with reproductive output and time constraint (more opportunity for chicks to survive).

Poster/Speed-talk Presenter 2: Won Young Lee (Korea Polar Research Institute)

- A large piece of drift sea ice was found 10km from an Adelie penguin colony in Terra Nova Bay, blocking the path of the penguins' foraging route.

- The sudden appearance of large drift ice didn't cause penguins to change their foraging path direction, instead they crossed the sea ice to get to the opposite edge to forage.
- The large drift ice affected penguin foraging behaviour compared to a neighbouring population: foraging trips were longer in duration and penguins conducted shallow dives by the drift sea ice.
- Presence of the large drift sea ice was not permanent (~1 week) and therefore had no long term effects, but in the short term it had slightly negative effects on penguin foraging behaviour (spending more energy and time).

Poster/Speed-talk Presenter 3: Benjamin Viola (Institute for Marine and Antarctic Studies - University of Tasmania)

- Currently, there is a deficit in Snow Petrel habitat use research (especially during winter, and beyond breeding colony areas)
- This work aims to improve our understanding of snow petrel habitat use by focusing on three core areas: i) Use ship based surveys to understand habitat at sea habitat use during Austral summer, ii) Use GLS tracking data to understand habitat use during non-breeding period (Austral winter), iii) Use the outputs of the first two steps to project year-round habitat suitability under different CMIP6 climate scenarios.
- Preliminary results of GLS tracking data: Foraging occurs throughout night/nocturnal hours during winter months (in East Antarctica). Individuals can cover 10s of thousands of km in the winter periods.

Poster/Speed-talk Presenter 4: Anna Kurnosova (Pacific branch of Russian Federal Research Institute for Fisheries and Oceanography)

Poster presenter not present.

Panel discussion

Convener: Jaimie Cleeland

Panelists: Natalie Kelly (Australian Antarctic Division), Jeong-Hoon Kim (Korea Polar Research Institute - KOPRI), Nobuo Kokubun (National Institute of Polar Research - NiPR), Emma Carroll (Whale DNA Lab, The University of Auckland)

The panel discussion aimed to highlight current research in the Western Pacific nations, to provide a glimpse of future voyages being planned, as well as to provide an opportunity for ECRs to learn about what work is currently being done and what open data streams are being used.

The panel discussed and provided their insights and personal experiences on the following topics:

- What is the focus of your research, how does it contribute to our understanding of SO ecosystem functioning and to your national Antarctic Program?
- Sharing experience and advice for successful international collaborations.
- Information and background on the Antarctic stations and facilities.
- Plans and capabilities of the new Australian Antarctic Division icebreaker, Nuyina.
- The use of remote devices and technology when answering questions about top predator ecology in remote regions or during winter.
- Advice for planning field work in data poor and hard to access regions. Challenges encountered and lessons learned from remote field work.
- What motivated you to become a scientist?

Session summary

The IMBeR West Pacific Symposium 2021 session Connectivity of the West Pacific and Southern Ocean: the Importance of Oceanic Top Predators was jointly developed by ICED (Integrating Climate and Ecosystem Dynamics in the Southern Ocean) CLIOTOP (CLimate Impacts on Oceanic TOp Predators). The session brought together over sixty scientists and

post-graduate researchers from thirty countries to show how population assessments, demographic analysis, tracking, ecological modelling and diet studies can be used to investigate the influence of climate change and other key threatening processes on top predators within the region. Scientists illustrated how citizen science, big data, new technology and advanced modelling techniques enabled comprehensive investigation at high spatial and temporal resolutions. The session culminated in a panel discussion which highlighted the research stations, ships and technology currently supporting top predator science in the Western Pacific sector of the Southern Ocean. Attendees were also imparted with personal experiences and advice from senior Antarctic research scientists from Japan, Korea, Italy, Australia and New Zealand.

Session 8: Ecosystem, Biogeochemistry, and Interventions in the Western Pacific and its Marginal Seas: Beyond the Disciplinary Borders

Mon 22 Nov. Shanghai time 09:00-13:25

Co-moderators Hiroaki Saito and Ying Wu

Rapporteur Yixue Zhang

Number of Oral and Poster Participants: 23 (26 in the original plan)

Session Introduction

Anthropogenic perturbation is inducing the degradation of marine ecosystem services, which are the foundation of human society, and have affected economic activities and the welfare of coastal residents. Science-based policymaking is necessary for the sustainable use of marine ecosystem services under the on-going pressures. Preparing the best scientific knowledge to decision makers is an emergent request from society to scientists.

Keynote speech (Jie Yin)

Flood Modeling and Emergency Response in Coastal Cities

-The study revealed the time series of annual maximum water levels and the evolvement of flood protection in Shanghai, the flood inundation is likely to occur in low-lying and poorly protected periurban/rural areas of the city even under the present-day sea level

-The pluvial flood modeling is able to accurately capture the general patterns of inundated areas at the city scale and the details of inundated areas at the street level.

Oral Presenter 1 (Masahiko Fujii)

-With high CO_2 emission scenario, calcifiers will suffer from too warm and too sour conditions in summer and winter, respectively, by the end of this century.

-It may be helpful that local coastal industries take adaptation strategies, such as raising calcifier larvae artificially in low CO_2 conditions.

Oral Presenter 2 (Charles Addey)

-This study adds to the current knowledge of the Northwest Pacific Ocean as a net sink of CO_2.

- The surface pCO_2 are most likely affected by the combined impacts of numerous dynamical processes such as the Kuroshio Current, lateral and vertical mixing, surface wind, and typhoons.

Oral Presenter 3 (Eun Young Kwon)

-Stoichiometric ratio of exported organic matter was proposed, and export C:P is up to 100% larger for the DOM than POM.

-Stoichiometric plasticity has large influence on net primary productivity and CO_2 uptake in oligotrophic gyres including the Northwest Pacific.

Oral Presenter 4 (Miaolei Ya)

-Different contributions of fossil fuel and biomass to PAH species were proved and the $\Delta^{14}C$ of PAHs were controlled by river input, atmospheric deposition, and coastal currents.

-Fluvial erosions and urban oil spills affect the $\Delta^{14}C_{perylene}$ in the estuary, and estuarine inputs and coastal currents affect the $\Delta^{14}C_{perylene}$ on the coasts.

Oral Presenter 5 (Chia-Jung Lu)

-Physical mixing and photobleaching resulted in the decline of FDOM in Otsuchi Bay.

-Excitation-emission matrix and parallel factor analysis (EEM-PARAFAC) makes it possible to distinguish DOM and POM into bio-labile and refractory organic matters and their sources.

Oral Presenter 6 (Weiqi Li)

-Sufficient light and nutrients in the transitional waters cased highest Chl a concentration between the plume front and sediment front off the Changiang river estuary.

-The distinct reduction of nutrient supply resulted in a relatively low Chl a in shelf water zone.

Oral Presenter 7 (Kristina Cordero)

- By means of a one-dimensional coupled physical-biological individual-based model, it was revealed the nutrient availability and copepod grazing were the main drivers the formation of the SCM in the Philippine Sea.

-It was estimated that the deepening of the SCM and the shift of the plankton population in response to an increase in temperature will happen.

Oral Presenter 8 (Zhixuan Feng)

-The regional hydrodynamic-ecosystem model makes it possible to reproduce nutrient and phytoplankton dynamics in the southern East/Japan Sea.

-East Korea Warm Current, the northward-flowing branch of Tsushima Warm Current, causes nutricline tilting and facilitates upward nutrient supply on the SE Korean coast via bottom Ekman transport.

Oral Presenter 9 (Siyu Jiang)

-The high phytoplankton growth rate in the oligotrophic central North Pacific was a result of the utilization of DON by dominated *Prochlorococcus*.

-At the equatorial EIO, the surface phytoplankton bloom was initiated by physical events induced nutrient enrichment and ceased by nutrient exhaustion.

Oral Presenter 10 (Young-Je Park)

-GOCI &GOCI-II data are useful to monitor *Saragassum* blooms in ECS and YS due their frequent and low-noise observations.

-Significant inter-annual variability in both location and density are observed for years between 2011-2021, and massive blooms in ECS was observed since 2012.

Oral Presenter 11(Hee Yoon Kang)

-An improved energetic balance in overwintering clams in warmer winters ensures the replenishment of nutrient reserves and the fast gamete development, consequently advancing the timing of spawning.

-Despite physiological benefits from warmer winter temperatures, the phenological shifts may make the clam populations more vulnerable to collapse as a result of a mismatch with seasonal food availability.

Oral Presenter 12 (Goutam Kundu)

-Intensification of TWC will reduce benthic-pelagic coupling.

-Pelagic food webs are more prone to the predicted environmental changes, and in future, fisheries could shift from pelagic to benthic.

Poster Presenter 1 (Yosuke Iida)

-The method of reconstruction was potentially used for evaluating sea-air CO_2 flux and carbon sink in the seas around Japan in combination with a proper atmospheric CO_2 product.

Poster Presenter 2 (Yunia Witasari)

No presentation

Poster Presenter 3 (Yan Chang)

-Use of $\delta^{82/76}Se$ values in ancient marine sediments as a proxy for the oxygenation history of the oceans and atmosphere make no allowance for fractionation of Se isotope by processes internal to the oceans, assuming that all Se isotope fractionation recorded in marine sedimentary rocks reflects oxidative weathering on the continents.

Poster Presenter 4 (Jing Zhang)

-Most produced PON exports to sediments, while some moves to the Tsushima Strait.

-Increasing DIN from the Changjiang puts environmental pressure on the outer shelf, and contributes 12-42% to the ECS carbon sequestration.

Poster Presenter 5 (Yoonja Kang)

-The polynomial regression models illustrated that the diatom-dominated microplankton biomass declined with increasing temperature and ammonium, while cryptophyte-dominated nanoplankton and cyanobacteria-dominated picoplankton biomass increased with a temperature increase.

-Small phytoplankton (nanoplankton and picoplankton) play a substantial role in the bay ecosystem, in which concerns regarding declining water quality and reduced nitrate are ongoing.

Poster Presenter 6 (Yi Xu)

- Trend analysis reveals that Chl tends to decrease during the SeaWiFS periods (1998-2007), and increase from 2008-2019 in the MODIS periods. This tendency is consistent with the sea surface temperature (SST) and wind stress curl trends, which suggest that the biology variability are attribute more to the oceanic processes.

Poster Presenter 7 (Kailin Liu)

-In the Gulf of Anadyr and Kamchatka Strait, phytoplankton high microzooplankton grazing rates were observed, indicating a strong top-down control.

-In the oceanic Bering Sea, the phytoplankton growth was not limited by macronutrient, but could be limited by Fe availability

Poster Presenter 8 (Yixuan Li)

-Significant variation in diel vertical distribution of mesoplankton communities indicates the diel vertical migration (DVM), of which the pattern differed between the continental shelf and continental slope.

-The ratio of rRNA and rDNA revealed metabolically active lineages as Acantharia and Ciliophora in the continental shelf, and Annelida in the continental slope, which were highly affected by temperature and nutrient concentration.

Poster Presenter 9 (Sang Rul Park*)

No presentation

Poster Presenter 10 (Subrata Kumar Ghosh)

-Temperature changes drive significant dysbinsis in the gut and skin microbiota of chum salmon with potential risk to it' s immunity.

-Chum salmon microbiota is assembled by environmental selection due to temperature change in the gut.

Poster Presenter 11 (Sk Istiaque Ahmed)

-Some clusters of fish determined by eDNA analysis are only distributed in either upstream or downstream and controlled by the Kuroshio front.

-The dominant species in each cluster co-exists with some other species which indicates ecosystem functioning of that area.

Poster Presenter 12 (Ben Li)

-Wind farms should not only be avoided in natural coastal wetlands, i.e., the four important habitats for waterbird conservation on the Chongming Islands, but also in a buffer zone (800-1300 m) behind these natural wetlands defined according to the characteristic movements of waterbird species.

Poster Presenter 13 (Hyun Je Park)

No presentation

Poster Presenter 14 (Florina Richard)

-The oil palm area in Betong increased by 60.72km^2 from 2013 to 2018 and decline in fish population may be linked to the OP land use change

-There is a promising potential in using Landsat-8, ML techniques and the Open Data Cube to detect oil palm land use.

Session Summary

Marine ecosystems are under anthropogenic perturbations such as global warming, ocean acidification, coastal development. However, our understanding on the complex and diverse ecosystem structure and dynamics of the biogeochemical cycle, and their response to climate change is limited. As well as remote sensing sensors and molecular biological techniques, mathematical simulation of marine system progress a lot in recent years. However, the lack of data (eg. nutrients in rivers, coastal topography, stable isotope composition) prevent the data assimilation of the models. Development of fine-scale or end-to-end models with high predictability is a emergent issues to understand the mechanisms of ecosystem response to anthropogenic forcing, forecast the future and support best decision making. To advance the study, it is essential the combination of the study to understand the mechanisms of ecosystem change and development of state of art models beyond the disciplinary borders. IMBeR provides a great platform for inspirations of new ideas and many collaborative studies. The future efforts could focus on the model applications to ecosystems and human systems, to meet the emergent risk of global warming and other issues.

New IMBeR West Pacific Marine Biosphere Research projects/directions for the next three years from this session (one or two bullet points)

- ✓ Accelerate the studies of the structure and dynamics of marine ecosystems in the western Pacific and its adjacent seas where rapid economical growth and increase in population degrade the marine ecosystem services.
- ✓ Development and improvement of the biogeochemical and ecosystem models and its application to ecosystems and human systems.
- ✓ Data collection by each scientist, organization, country and the promotion of data sharing to realize better data assimilation in mathematical models.