



IMBeR West Pacific Symposium

CHANGING WEST PACIFIC
OCEAN: SCIENCE AND
SUSTAINABILITY

Program & Abstracts

2021 Online
Event
11/22 - 25

CONTENTS

Program..... 1

<i>Session 1: Coastal Blue Carbon: Measurements, Modeling, and Assessment.....</i>	<i>1</i>
<i>Session 2: Strengthening Coral Reef Resilience to Climate Change and Human Impacts</i>	<i>2</i>
<i>Session 3: Dried Small Fish: Ecology, Value Chains and Nutrition</i>	<i>4</i>
<i>Session 4: Ecosystem-Social Interactions in the Coastal Sea</i>	<i>6</i>
<i>Session 5: Towards the Sustainable Indo-Pacific Region (IPR): Marine Biogeochemistry and Biodiversity</i>	<i>9</i>
<i>Session 6: Marine Extreme Events: Impacts, Forecasting, and Risk Management</i>	<i>11</i>
<i>Session 7: Connectivity of the West Pacific and Southern Ocean: The Importance of Oceanic Top Predators</i>	<i>13</i>
<i>Session 8: Ecosystem, Biogeochemistry, and Interventions in the Western Pacific and its Marginal Seas: Beyond the Disciplinary Borders.....</i>	<i>15</i>

Abstracts..... 17

<i>Session 1: Coastal Blue Carbon: Measurements, Modeling, and Assessment.....</i>	<i>17</i>
<i>Session 2: Strengthening Coral Reef Resilience to Climate Change and Human Impacts</i>	<i>32</i>
<i>Session 3: Dried Small Fish: Ecology, Value Chains and Nutrition</i>	<i>57</i>
<i>Session 4: Ecosystem-Social Interactions in the Coastal Sea</i>	<i>69</i>
<i>Session 5: Towards the Sustainable Indo-Pacific Region (IPR): Marine Biogeochemistry and Biodiversity</i>	<i>103</i>
<i>Session 6: Marine Extreme Events: Impacts, Forecasting, and Risk Management</i>	<i>123</i>
<i>Session 7: Connectivity of the West Pacific and Southern Ocean: The Importance of Oceanic Top Predators</i>	<i>139</i>
<i>Session 8: Ecosystem, Biogeochemistry, and Interventions in the Western Pacific and its Marginal Seas: Beyond the Disciplinary Borders.....</i>	<i>150</i>

Program

SESSION 1: COASTAL BLUE CARBON: MEASUREMENTS, MODELING, AND ASSESSMENT

Wed 24 Nov.	UTC 06:00-09:15	Click to find your local time	
Moderator	Jianwu Tang		
06:00 - 06:05	Welcome and Introduction		
Keynote speech			
06:05 - 06:35	Xiaowei Li		[S1-1]
	Valuation of wetland ecosystem services in national nature reserves in China's coastal zones		
Oral presentations			
06:35 - 06:50	Susana Lincoln		[S1-2]
	Carbon stocks of seagrass meadows in Vanuatu, South Pacific		
06:50 - 07:05	Mohammad Rozaimi		[S1-3]
	Insights into blue carbon storage and ecosystem connectivity from studies of the seagrass meadows in Sungai Pulai estuary (Johor, Malaysia)		
07:05 - 07:20	Vincent Saderne		[S1-4]
	Total alkalinity production in a mangrove ecosystem reveals an overlooked Blue Carbon component		
07:20 - 07:35	A'an Johan Wahyudi		[S1-5]
	Carbon offset potential from tropical seagrass conservation in Indonesia		
07:35 - 07:45	Break		
07:45 - 08:00	Xiaoguang Ouyang		[S1-6]
	Mangrove respiration is coupled with carbon and nitrogen uptake in the microphytobenthos of mangrove sediments		
08:00 - 08:15	Nirupama Saini		[S1-7]
	Exploring the seasonal variabilities of carbonate chemistry parameters in a mangrove ecosystem of the Northern Indian Ocean		
08:15 - 08:30	Anisah Jessica Lee		[S1-8]
	Spatio-temporal analysis of local scale seagrass of MiddleBank in the northern Straits of Malacca		
Speed-Talk presentations			
08:30 - 08:33	Laetitia Allais		[S1-9]
	Investigation of geochemical, biological, and physical controls on the carbon storage capacity in Hong Kong coastal wetlands		
08:33 - 08:36	Jianqu Chen		[S1-10]
	Estimation of seaweed biomass in the intertidal zone of GouQi Island based on multispectral UAV		
08:36 - 08:39	Jenny Choo		[S1-11]
	Study of DOC, DIC and its $\delta^{13}\text{C}$ drivers from tropical peat-draining rivers: Implications on blue carbon loss		
08:39 - 08:42	Xunmeng Li		[S1-12]
	A new method for studying the patterns of macroalgae communities in the intertidal zone: power law model		
08:42 - 08:45	Gao Qin		[S1-13]
	Organic carbon burial records since the Late Pleiocene in Hangzhou Bay, China		
08:45 - 08:48	Zhiyao Xiong		[S1-14]
	A new method of estimating carbon sequestration and biological pump efficiency in coastal waters		
08:48 - 09:15	Discussion & Session 1 Wrap up		

Program

SESSION 2: STRENGTHENING CORAL REEF RESILIENCE TO CLIMATE CHANGE AND HUMAN IMPACTS

- Tue 23 Nov. UTC 01:00-04:05 [Click to find your local time](#)
Co-moderators **Thamasak Yeemin** and **Takashi Nakamura**
01:00 - 01:05 [Welcome and Introduction](#)
[Keynote speeches](#)
01:05 - 01:30 **Makoto Tsuchiya**
Payments for ecosystem services offered by coral reefs
01:30 - 01:55 **Peter J. Mumby**
Rising to the challenge of managing the impacts of coral bleaching
[Oral presentations](#)
01:55 - 02:10 **Christine Baran** [S2-1]
Genus-specific susceptibility of soft corals to bleaching
02:10 - 02:25 **Katya Bonilla** [S2-2]
Fertilization and settlement successes of the different gamete combinations from wild and F1 colonies of the massive coral *Favites abdita*
02:25 - 02:35 [Break](#)
02:35 - 02:50 **Dio Dirgantara** [S2-3]
Tissue necrotic in coral accelerated by addition of pathogenic bacteria in the surrounding water
02:50 - 03:05 **Christine Segumalian** [S2-4]
Hard coral recruitment in eutrophic reefs of Bolinao, Pangasinan, Northwestern Philippines
03:05 - 03:20 **Mariyam Shidha Afzal** [S2-5]
Variation in coral reef assemblages and reef resilience across a latitudinal gradient on the Ryukyu Archipelago, Japan
03:20 - 03:35 **Van Long Nguyen** [S2-6]
Potentials of recovery and resilience of coral reefs in Cu Lao Cham marine protected area, south-central Vietnam
03:35 - 03:50 **Vina Listiawati** [S2-7]
Seagrass meadow can be a refugia for corals against ocean acidification?
03:50 - 04:05 **Man Ying Mok** [S2-8]
The Unsung sea urchins and their potential in enhancing coral reef resilience

Tue 23 Nov. UTC 06:00-07:15 [Click to find your local time](#)
06:00 - 06:15 **Norhanis Razalli** [S2-9]
Phylogenetic structure of false clownfish, *Amphiprion ocellaris*, and its implication to coral reef resources management in the Straits of Malacca and South China Sea
06:15 - 06:30 **Matt Glue** [S2-10]
Promoting the rehabilitation of coral reefs in Cambodia through community-led enforcement
06:30 - 06:45 **Wichin Suebpala** [S2-11]
Enhancing local efforts to support coral reef resilience: A reflection from Thailand
06:45 - 07:15 [Discussion and Conclusions](#)

List of poster presentations at virtual symposium platform

- Kok Lynn Chew** [S2-12]
Short-term study on the effects of physical damage on recovery and growth rates of corals with different adaptive strategies at Pulau Rawa, Johor, Malaysia
- Jihad Wajdi Mohd Erfino** [S2-13]
Investigation of the regenerative capacity of apical and basal transplants of *Acropora muricata* and *Echinopora horrida*
- Syamil Sahar** [S2-14]
Assessment of coralline Ba/Ca ratios as riverine runoff proxy in Talang-Talang Island, Sarawak
- Febrienne Sukiato** [S2-15]
The effect of shading on colour and growth of *Acropora muricata* and *Porites lutea*
- Charernmee Chamchoy** [S2-16]
High diversity and abundance of coral recruits in Mu Ko Chumphon to support coral reef resilience
- Wanlaya Klinthong** [S2-17]
Comparing coral recruitment on settlement plate experiments from different sediment loads in the Gulf of Thailand
- Laongdow Jungrak** [S2-18]
Community structure of soft bottom macrofauna on fringing reefs in the Western Gulf of Thailand
- Takashi Nakamura** [S2-19]
Mass coral bleaching impacts and recovery potentials in the Islands of Ryukyu Archipelago
- Chiara Pisapia** [S2-20]
Multidecadal changes in coral reef community structure and function following multiple disturbances
- Makamas Sutthacheep** [S2-21]
Exploring an underwater pinnacle as a thermal refuge in the Andaman Sea
- Joana Andrea Maningas** [S2-22]
Insights on coral response and recruitment in an acidified environment in Mabini, Batangas
- Wiphawan Aunkhongthong** [S2-23]
A coral restoration project for enhancing stress-resistant coral populations in the Gulf of Thailand
- Arirush Wongnutpranont** [S2-24]
Microplastics in scleractinian corals from estuarine environment in the Inner Gulf of Thailand
- Ploypailin Rangseethampanya** [S2-25]
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

Program

SESSION 3: DRIED SMALL FISH: ECOLOGY, VALUE CHAINS AND NUTRITION

Thur 25 Nov. UTC 11:00-14:00 [Click to find your local time](#)

Co-moderators **Nireka Weeratunge** and **Derek Johnson**

11:00 - 11:05 [Welcome and Introduction](#)

[Keynote presentation](#)

11:05 - 11:25 **Shakuntala Thilsted**

Aquatic foods for nourishing the West Pacific

11:25 - 11:30 Keynote questions

[Oral presentations](#)

East Asia

Ecology:

11:30 - 11:38 **Shuhao Liu, Yang Liu, Irene D. Alabia, Yongjun Tian** [S3-1]

Evaluating the impact of climate change on potential distribution of Japanese anchovy (*Engraulis japonicus*) using species distribution model

11:38 - 11:43 **Takeshi Tomiyama, W. Deguchi, T. Fujita, M. Yoneda, N. Kono, M.**

Yamamoto, K. Harada [S3-2]

Potential impact of predation by larval Spanish mackerel on larval anchovy in the central Seto Inland Sea, Japan

Southeast Asia

Ecology:

11:43 - 11:51 **Alexandra B. Regalado, Wilfredo L. Campos** [S3-3]

The lobo-lobo fry fishery in western Visayan Sea: Catch composition and potential fisheries impact

Value chains:

11:51 - 11:59 **Nova Almine, R. Chuenpagdee, S. Satumanatpan** [S3-4]

Contributions, challenges, and opportunities of the small-scale anchovy fisheries in Thailand

11:59 - 12:07 **Ruby Napata, A.S. Sefil, T.A.G. Famatid, E.M. Peralta, H.M. Monteclaro, E.E.S. Yap** [S3-5]

A value chain analysis of the dried sardine industry in the Philippines

Nutrition:

12:07 - 12:15 **Wae Win Khaing, Sithu Lin, Benjamin Belton** [S3-6]

Dried fish consumption in Myanmar

DFM Synthesis:

12:15 - 12:27 **Benjamin Belton, Kyoko Kusakabe** [S3-7]

Towards a social economy of dried small fish in Southeast Asia

12:27 - 12:37 [Break](#)

South Asia

Ecology:

12:37 - 12:45 **Abilasha Sharma, I. Khot, N. Namboothri** [S3-8]

Climate change and small pelagic fish in India: Implications for fisheries and nutrition

Value chains:

12:45 - 12:53 **Tara Nair, Bharat Patel** [S3-9]

Small fish and small fisheries on the Kutch coast: Insights from a field study

12:53 - 13:01 **Shalika Wickrama, D.N. Koralagama** [S3-10]

Value stream analysis and middlemen impact on smoothbelly sardinella dried fish value chain on the Northwest coast of Sri Lanka

Nutrition:

13:01 – 13:09 **Sami Farook, B. Belton, K. Pendakur, D. Johnson, E. Haque, S.Thilsted**
Dried fish for nutrition: Change in consumption patterns and preferences, and implications towards nutrition security [S3-11]

DFM Synthesis:

13:09 - 13:21 **Nikita Gopal, Amalendu Jyotishi, Emdad Haque, Ramachandra Bhatta, Holly Hapke** [S3-12]

Towards a social economy of dried small fish in South Asia

13:21 - 13:55

Discussion

- Questions on presentations
- Themes for discussion:
 - What is the comparative importance of dried small fish for food systems across Asian regions?
 - What are the strengths and weaknesses of dried small fish food systems in Asia in terms of ecology, value chains, and nutrition?
 - How best to work across disciplines in the analysis of dried small fish food systems in Asia?

13:55 - 14:00

Conclusions

Program

SESSION 4: ECOSYSTEM-SOCIAL INTERACTIONS IN THE COASTAL SEA

Mon 22 Nov.	UTC 09:00-13:15	Click to find your local time
Co-moderators	Su Mei Liu and Suvaluck Satumanatpan	
09:00 - 09:05	Welcome and Introduction	
Keynote speeches		
09:05 - 09:25	Ratana Chuenpagdee	
	Governing the ungovernable: Challenges in governance of coastal seas	
09:25 - 09:45	Juying Wang	
	National strategy research for climate change adaption in the ocean and coast in China	
Oral presentations		
09:45 - 09:57	Qinhua Fang	[S4-1]
	Marine spatial planning evaluation: An Ecological Vulnerability Index perspective	
09:57 - 10:09	Mingbao Chen	[S4-2]
	Temporal and spatial evolution and influencing factors of land-sea social-ecological system	
10:09 - 10:21	Andrew Allison	[S4-3]
	Creating space for expression of knowledges when managing for cumulative effects in coasts and oceans	
10:21 - 10:33	Anoop Das	[S4-4]
	The indigenous traditional knowledge and sustainability: A case study from the Kerala Coast of India	
10:33 - 10:45	Dhanya Kandarattil	[S4-5]
	Livelihood diversification among the fisherfolks of Kerala Coast of India	
10:45 - 10:55	Break	
10:55 - 11:07	Kamalaporn Kanongdate	[S4-6]
	Responsible consumption and production embedded in the Thai marine shrimp farming certification programs	
11:07 - 11:19	Jarina Mohd Jani	[S4-7]
	Making a case for community-based artificial reefs management for the sustainability of coastal fisheries resources and livelihoods	
11:19 - 11:31	Ming-An Lee	[S4-8]
	Fishery-based adaption to climate change: The case of migratory species grey mullet in Taiwan Strait, Northwestern Pacific	
11:31 - 11:43	Arkaprava Mandal	[S4-9]
	Tracking the ecological health of a mangrove ecosystem from the Northern Indian Ocean - Applicability of benthic foraminifera as bioproxy	
11:43 - 11:55	Hui Liu	[S4-10]
	Status and perspectives on mariculture spatial planning and implementation	
11:55 - 12:07	Roshni Subramaniam	[S4-11]
	Ecosystem modelling to support decision making for the coastal South-West Pacific (Eastern Australia)	
12:07 - 12:17	Break	

Speed-Talk presentations

12:17 - 13:01

- Jiayu Bai & Kailei Zhu** [S4-12]
Review of Fukushima nuclear contaminated water discharge event: International law analysis and stakeholders' response
- Mohammed Bouchkara** [S4-13]
Study of morphodynamic changes along the lagoon of Oualidia (Morocco) using bathymetric data
- Beatriz Casareto** [S4-14]
Community structure and rearing experiments of the Shrimp *Lucensosergia lucens* Hansen 1922 (Crustacea, Decapoda, Sergestidae) (Sakura-ebi) in Suruga Bay
- Kai Chen** [S4-15]
Evaluation of marine ecosystem services in China based on meta-analysis
- Xiaokun Ding** [S4-16]
Seasonal variations of nutrient concentrations and their ratios in the central Bohai Sea
- Nouhaila Erraji Chahid** [S4-17]
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
- Mohammad Saydul Islam Sarkar** [S4-18]
Integration of the socioeconomic status into MSP-theoretical aspects and recommendations for Moheshkhali Island
- Faddrine Jang** [S4-19]
Increased transfer of trace metals and *Vibrio* sp. from biodegradable microplastics to catfish *Clarias gariepinus*
- Yerkenaz Karibayeva** [S4-20]
Caspian Sea: Isolated, yet mutually engaged
- Hyun-Woo Kim** [S4-21]
Fish biodiversity survey in Korean waters using environmental DNA analysis
- Elsa Cordelia Durie Lambat** [S4-22]
A community-based qualitative vulnerability assessment tools for rivers in developing participatory response to land-use changes
- Shanshan Li** [S4-23]
Source, composition and reactivity of particulate organic matter along the salinity gradient in the Changjiang Estuary and its adjacent sea
- Shengkang Liang** [S4-24]
Identification jurisdiction responsibility and land-sea synergistic regulation for coastal total nitrogen based on water quality target in Laizhou Bay, China
- Deju Lin** [S4-25]
Effect of iron on the preservation of organic carbon in marine sediments
- Marsya Jaqualine Rugebregt** [S4-26]
Sediment quality in Halmahera Sea waters, North of Maluku
- Abiola Osanyintuyi** [S4-27]
Long-term shoreline analysis of Brunei coast: An application of Digital Shoreline Analysis System (DSAS)
- Lihini Prematilaka** [S4-28]
On the bliss of nature: Leveraging Nature based Solutions (NbS) for coastal management
- Jing-Ling Ren** [S4-29]
Impacts of human activities on Arsenic transport in the Huanghe (Yellow River)
- Matt Roberts** [S4-30]
The potential value of establishing Oyster Shell Recycling (OSR) programmes.

Huiying Sun [S4-31]

China's coastal ecological restoration policies: Evolution, problems, and proposals

Chika Suzuki [S4-32]

Elucidation of incentive structures for researchers to focus on coastal ecological conservation activities and promotion of industrial use of the ocean

Wenqi Xu [S4-33]

Effects of integrated multi-trophic aquaculture on the nutrients and phytoplankton size structure in Sanggou Bay

13:01 - 13:15

[Discussion and Conclusions](#)

Program

SESSION 5: TOWARDS THE SUSTAINABLE INDO-PACIFIC REGION (IPR): MARINE BIOGEOCHEMISTRY AND BIODIVERSITY

Thur 25 Nov.	UTC 06:00-9:50 Click to find your local time	
Co-moderators	Shan Jiang, Aazani binti Mujahid, Deo Florence L. Onda, Romanus Edy Prabowo and Jing Zhang	
06:00 - 06:05	Welcome and Introduction	
	Keynote speech	
06:05 - 06:25	Fan Wang Multi-sphere interactions in the Indo-Pacific Convergence Center of Matter and Energy	
	Oral presentations	
06:25 - 06:40	Erika Grace Gernato Changes in the community structuring of bacteria and archaea in a mariculture-impacted area	[S5-1]
06:40 – 06:55	Aida Sartimbul Molecular and phylogenetic analysis of <i>Sardinella lemuru</i> at fishing ground Prigi-Trenggalek inferred d-loop mutations of mtDNA	[S5-2]
06:55 - 07:10	Yan Du Multi-scale ocean dynamical processes in the Indo-Pacific Convergence Zone and their climatic and ecological effects	[S5-3]
07:10 - 07:25	Man Ying Mok Getting to know the underwater gardener: Sea urchin community distribution in Peninsular Malaysia	[S5-4]
07:25 - 07:40	Masao Ishii Ocean acidification from below in the tropical Pacific	[S5-5]
07:40 - 07:50	Break	
07:50 - 08:05	Patrick Martin Understanding the fate of dissolved organic carbon from tropical peatlands in Southeast Asia's shelf sea	[S5-6]
08:05 - 08:20	Punyasloke Bhadury Biogeography of marine planktonic cyanobacterial communities from coastal oceans - what can we learn from 'omics' based approaches?	[S5-7]
08:20 - 08:35	S.M. Mustafizur Rahman Diagnostic of critical health status for an estuarine mangrove ecosystem	[S5-8]
08:35 - 08:50	Maria Anna Michaela De La Cruz Monsoonal shifts in taxonomic and functional diversity of picoeukaryotic microbial communities in a tropical coastal environment	[S5-9]
08:50 - 09:05	Yixue Zhang Seasonal dynamics of surface dissolved organic matter in the South China Sea and the Straits of Malacca: Implications for biogeochemical province delineation of marginal seas	[S5-10]
09:05 - 09:20	Ashraful Azam Khan Nutrient dynamics in the river system of the Sundarban Mangrove, Bangladesh	[S5-11]
09:20 - 09:30	Haiyan Sun Publishing in Elsevier Oceanography journals	
09:30 - 09:50	Discussion	

Virtual poster exhibit on Whova app

- Huatao Yuan** [S5-12]
Diversity distribution, driving factors and assembly mechanisms of free-living and particle-associated bacterial communities at a subtropical marginal sea
- Yash Yash** [S5-13]
Exploring environmental dynamics of Sundarbans mangrove of the Northern Indian Ocean- the importance of time series monitoring
- Yongqi Liang** [S5-14]
Probing air-sea exchange with radiocarbon in the maritime air and sea surface water of the West Pacific
- Aobo Wang** [S5-15]
Transport and dilution of fluvial antibiotic in the Upper Gulf of Thailand
- Tianying Chen** [S5-16]
Peer inside the deepest blue hole: diel vertical dynamics of plankton in Yongle Blue Hole, South China Sea
- Christian Lønborg** [S5-17]
Organic matter as an active component of biogeochemical cycles in tropical waters
- Weiwei Liu** [S5-18]
Distribution patterns of ciliate diversity in the South China Sea
- Chayan Chakrabarty** [S5-19]
Seasonal mesozooplankton dynamics and its predictive future: need of freshwater in marine dominated estuaries of Indian Sundarban
- Aida Sartimbul** [S5-20]
Dynamics of pelagic fisheries and their relation to the water temperature, chlorophyll-a and Indian Ocean Dipole: Case study of Prigi Water, Indonesia

Program

SESSION 6: MARINE EXTREME EVENTS: IMPACTS, FORECASTING, AND RISK MANAGEMENT

- Thur 25 Nov. UTC 0:00-03:30 [Click to find your local time](#)
- Moderator **Alistair Hobday**
- 00:00 - 00:05 [Welcome and Introduction](#)
- Keynote speech
- 0:05 - 0:30 **Neil Holbrook**
Impacts of marine heatwaves on tropical western and central Pacific Island nations and their communities
- [Oral presentations](#)
- 0:30 - 0:45 **Riza Setiawan** [S6-1]
Impacts of tropical cyclone Seroja on the phytoplankton chlorophyll-a and sea surface temperature in the Savu Sea, Indonesia
- 0:45 - 01:00 **Jianzhong Ge** [S6-2]
Impacts of fluvial flood on physical and biogeochemical environments in estuary–shelf continuum in the East China Sea
- 01:00 - 01:15 **Maxime Marin** [S6-3]
Local drivers of extreme upper ocean marine heatwaves assessed using a global ocean circulation model
- 01:15 - 01:30 **Ying Zhang** [S6-4]
Long-lasting marine heatwaves instigated by ocean planetary waves in the tropical Indian Ocean
- 01:30 - 01:40 [Break](#)
- 01:40 - 01:55 **Dongxiao Wang** [S6-5]
The role of ocean–atmosphere coupling in the 2017 extreme coastal El Niño
- 01:55 - 02:10 **Grant Smith** [S6-6]
Predicting marine heatwaves over seasonal timescales in the Pacific
- 02:10 - 02:25 **Fabio Boschetti** [S6-7]
Statistical prediction of marine heatwaves via machine learning
- 02:25 - 02:40 **Simon Nicol** [S6-8]
Use of species distribution models to extend the capabilities of ecological risk assessments to quantify the vulnerability of sharks to fishing impacts under a changing climate
- [Speed-Talk presentations](#)
- 02:40 - 02:42 **Tolulope Emmanuel Oginni** [S6-9]
Ocean response to Super-Typhoon Haiyan
- 02:42 - 02:44 **Ming Feng** [S6-10]
Monitoring marine heatwaves and impacts using an ocean observing system
- 02:44 - 02:46 **Imane Joudar** [S6-11]
Application of swan and swash models to the marine submersion hazard on the Moroccan coast: Case of El Jadida bay
- 02:46 - 02:48 **Jonson Lumban-Gaol** [S6-12]
Understanding the impact of monsoon, El Niño and Indian ocean dipole events on oily sardine (*Sardinella lemuru*) production using ocean color data in the Bali Strait, Indonesia
- 02:48 - 02:50 **Yanzhen Du** [S6-13]
Characteristics and drivers of summer marine heatwaves in the Kuroshio-Oyashio Extension region

02:50 - 02:52	Hey-Min Choi Deep-learning model for sea surface temperature prediction near the Korea Peninsular	[S6-14]
02:52 - 02:54	Dahlia Foo Capturing the impact of extreme weather events on the survival of endangered New Zealand sea lions	[S6-15]
02:54 - 02:56	Abu Hena Muhammad Yousuf Marine pollution in Bangladesh: A critical analysis of the legal and institutional regimes for the sustainable ocean governance	[S6-16]
02:56 - 03:25	Discussion	
03:25 - 03:30	Closing	

Program

SESSION 7: CONNECTIVITY OF THE WEST PACIFIC AND SOUTHERN OCEAN: THE IMPORTANCE OF OCEANIC TOP PREDATORS

- Wed 24 Nov. UTC 1:00-04:30 [Click to find your local time](#)
Moderator **Jaimie Cleeland** and **Luis A. Huckstadt**
- 01:00 - 01:05 [Welcome and Introduction](#)
Convener **Luis A. Huckstadt**
- 01:05 - 01:30 **Michelle LaRue**
Crowd-sourcing reveals secrets about Antarctica's iconic mammal, the Weddell seal
- [Invited talk](#)
- 01:30 - 01:45 **Mao Mori** [S7-1]
The change in oceanic transports of the early stage of fish by the shifts of climate mode: Investigating egg and larval transport of Antarctic Toothfish (*Dissostichus mawsoni*) in the Indian sector of the Southern Ocean under extreme SAM event
- [Oral presentations](#)
- [Convener](#) **Luis A. Huckstadt**
- 01:45 - 02:00 **Sophia Volzke** [S7-2]
Climate influences on female survival in a declining population of southern elephant seals (*Mirounga leonina*)
- 02:00 - 02:15 **Peng Lian** [S7-3]
Variations in the spatiotemporal distribution of yellowfin tuna (*Thunnus albacares*) in the eastern Pacific Ocean
- 02:15 - 02:30 **David Green** [S7-4]
The missing link: Pelagic prey field prediction for Southern Ocean predators
- 02:30 - 02:45 [Break](#)
- [Convener](#) **Emma Carroll**
- 02:45 - 03:00 **Stuart Corney** [S7-5]
Using a dynamic energy budget IBM to assess the drivers of decreasing elephant seal population at Macquarie Island
- 03:00 - 03:15 **Pauline Machful** [S7-6]
Feeding ecology of three species of pacific tuna: An alternative stomach fullness metric.
- 03:15 - 03:30 **Julie McInnes** [S7-7]
Diet of marine predators as an indicator of Southern Ocean ecosystem health: Design and implementation of an effective genetic monitoring approach in the Subantarctic.
- 03:30 - 03:40 [Break](#)
- [Speed-Talk presentations](#)
- [Convener](#) **Pia Ricca**
- 03:40 - 03:45 **Silvia Olmastroni** [S7-8]
Ecology, reproduction and adaptation for a climate change sentinel: Monitoring the Adélie penguin population in mid Victoria Land, Ross Sea
- 03:45 - 03:50 **Won Young Lee** [S7-9]
Foraging behaviors of Adélie penguins confronting a sudden appearance of large drift ice

- 03:50 - 03:55 **Benjamin Viola** [S7-10]
Investigating habitat use by East Antarctic seabirds in the context of historical, contemporary, and forthcoming environmental shifts
- 03:55 - 04:00 **Anna Kurnosova** [S7-11]
Herring shark seasonal distribution in Northwest Pacific
- 04:00 - 04:30 [Panel discussion](#)
Convener **Jaimie Cleeland**
Invited Speakers
Nadine Johnston, Integrating Climate and Ecosystem Dynamics ([ICED](#)) and British Antarctic Survey ([BAS](#))
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](#)

Other speakers will be confirmed soon!

Program

SESSION 8: ECOSYSTEM, BIOGEOCHEMISTRY, AND INTERVENTIONS IN THE WESTERN PACIFIC AND ITS MARGINAL SEAS: BEYOND THE DISCIPLINARY BORDERS

Mon 22 Nov. UTC 01:00-05:25 [Click to find your local time](#)

Co-moderators **Hiroaki Saito** and **Ying Wu**

01:00 - 01:10 [Opening and Welcome](#)

01:10 - 01:15 [Outline and Structure of Session](#)

[Keynote speech](#)

01:15 - 01:35 **Jie Yin**

Flood modeling and emergency response

[Oral presentations](#)

01:35 - 01:50 **Masahiko Fujii** [S8-1]

Continuous monitoring and future projection of ocean warming, acidification, and deoxygenation on the subarctic coast of Hokkaido, Japan

01:50 - 02:05 **Charles Addey** [S8-2]

Spatiotemporal variability in surface ocean pCO₂ and sea-air CO₂ flux across the Northwest Pacific Ocean

02:05 - 02:20 **Eun Young Kwon** [S8-3]

Flexible carbon-to-phosphorus stoichiometric ratio of exported marine organic matter and a potential feedback on climate change

02:20 - 02:35 **Miaolei Ya** [S8-4]

Compound-specific radiocarbon reveals sources and land–sea transport of polycyclic aromatic hydrocarbons in an urban estuary

02:35 - 02:50 **Chia-Jung Lu** [S8-5]

Fluorescence tracking of dissolved and particulate organic matter in a coastal ocean

02:50 - 03:05 **Wei qi Li** [S8-6]

Effects of dual fronts on the spatial pattern of Chlorophyll-a concentrations in and off the Changjiang River Estuary

03:05 - 03:15 [Break](#)

03:15 - 03:30 **Kristina Cordero** [S8-7]

Changes in the phytoplankton community structure at the subsurface chlorophyll maximum in the Philippine Sea: Mechanisms and possible temperature influence

03:30 - 03:45 **Zhixuan Feng** [S8-8]

Elucidate the roles of Tsushima warm current on the southwest East/Japan sea primary productivity using a high-resolution physical-biogeochemical coupled model

03:45 - 04:00 **Siyu Jiang** [S8-9]

Transient phytoplankton blooms and their formation mechanisms in oligotrophic subtropical and tropical oceans

04:00 - 04:15 **Young-Je Park** [S8-10]

Floating sargassum blooms in the ECS and YS based on the satellite images from GOCI and GOCI-II

04:15 - 04:30 **Hee Yoon Kang** [S8-11]

Warmer winters advanced clam phenology in the temperate East Asian marginal sea coast

04:30 - 04:45 **Goutam Kundu** [S8-12]

Seasonal variation in trophic structure of fish community in the Southern Sea of Korea/Northern East China Sea

Speed-Talk presentations

04:45 – 05:05

- Yosuke Iida** [S8-13]
Ocean acidification in marginal seas of the western North Pacific
- Yunia Witasari** [S8-14]
Paleoclimate interpretation by Clay mineral contents in the surface sediment of Cirebon waters, Indonesia
- Yan Chang** [S8-15]
Biogeochemistry of selenium in Western Pacific, selenium isotope perspective
- Jing Zhang** [S8-16]
Budget of Riverine Nitrogen over the East China Sea Shelf
- Yoonja Kang** [S8-17]
Responses of size-fractionated phytoplankton to environmental variables in Gwangyang Bay focusing on the role of small phytoplankton
- Yi Xu** [S8-18]
Inter-annual and inter-decadal variabilities of Chlorophyll over the East China Sea and southern Yellow Sea
- Kailin Liu** [S8-19]
Planktonic food web dynamics along the western area from North Pacific to Bering Sea in summer
- Yixuan Li** [S8-20]
High-throughput sequencing of 18S rDNA and rRNA reveals the diel vertical dynamics of mesoplankton assemblages at continental shelf and slope sites in northern South China Sea
- Sang Rul Park** [S8-21]
Population dynamics of the 'Golden Tides' seaweed, *Sargassum horneri*, on the southwestern coast of Korea: The degree and formation of golden tides
- Subrata Kumar Ghosh** [S8-22]
Temperature modulation of the gut and skin microbiota in the smolt of chum salmon (*Oncorhynchus keta*)
- Sk Istiaque Ahmed** [S8-23]
Detection of fish community distribution by MiFish analysis and comparison of typical fish community assemblage with ocean frontal structure
- Ben Li** [S8-24]
The solutions to balance the coastal wind energy development and waterbird conservation along East China Coast
- Hyun Je Park** [S8-25]
Feeding ecology of walleye pollock, *Gadus chalcogramma*, in the western East/Japan Sea revealed by stable isotope analyses
- Florina Richard** [S8-26]
Land use land cover classification and oil palm detection in Sarawak using Landsat-8 and the Open Data Cube

05:05-05:25

[Discussion](#)

Valuation of wetland ecosystem services in national nature reserves in China's coastal zones

Xiaowei Li^{1,2,3}, **Xiubo Yu**^{4,5}, **Xiyong Hou**^{1,2,3,*}, **Yubin Liu**^{1,2,3,6,12}, **Hui Li**^{7,13}, **Yangming Zhou**⁸, **Shaoxia Xia**⁴, **Yu Liu**⁴, **Houlang Duan**^{4,6}, **Yuyu Wang**⁹, **Yuehan Dou**^{10,14}, **Meng Yang**⁴, **Li, Zhang**^{11,*}

¹Yantai Institute of Coastal Zone Research, Chinese Academy of Sciences, Yantai, China

²CAS Key Laboratory of Coastal Environmental Processes and Ecological Remediation, Yantai Institute of Coastal Zone Research (YIC), Chinese Academy of Sciences (CAS); Shandong Key Laboratory of Coastal Environmental Processes, YICCAS, Yantai, China

³Center for Ocean Mega-Science, Chinese Academy of Sciences, Qingdao, China

⁴Key Laboratory of Ecosystem Network Observation and Modeling, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China

⁵College of Resources and Environment, University of Chinese Academy of Sciences, Beijing, China

⁶University of Chinese Academy of Sciences, Beijing, China

⁷School of Resources and Environmental Engineering, Ludong University, Yantai, China

⁸School of Geography and Environment, Jiangxi Normal University, Nanchang, China

⁹School of Ecology and Nature Conservation, Beijing Forestry University, Beijing, China

¹⁰Land Use Planning Group, Wageningen University and Research, Wageningen, The Netherlands

¹¹Key Laboratory for Biodiversity Science and Ecological Engineering, Ministry of Education, College of Life Sciences, Beijing Normal University, Beijing, China

¹²Present address: School of History and Social Development, Qilu Normal University, Jinan, China

¹³Present address: Market supervision administration of Chang Island Comprehensive Test Zone, Yantai, China

¹⁴Present address: School of Environmental Science and Engineering, Southern University of Science and Technology, Shenzhen, China

*** Correspondence:**

Hou Xiyong

xyhou@yic.ac.cn;

Zhang Li

asterzhang@bnu.edu.cn;

SESSION 1: COASTAL BLUE CARBON: MEASUREMENTS, MODELING, AND ASSESSMENT

Abstract

Wetlands provide ecosystem services for regional development, and, thus, have considerable economic value. In this study, a combination of evaluation methods was carried out to evaluate the wetland ecosystem services provided by national nature reserves in 11 coastal provinces/municipalities in China. We constructed a literature database containing 808 observations (over 170 papers) on field-scale research for wetlands in China's coastal zones. Using this literature database, as well as land use (LU) data, net primary productivity (NPP), and statistical data, and digital elevation model (DEM) data, we established a valuation framework and database for nine important ecosystem services of the 13 wetland types in the study area. After the large-scale academic literature review, the ordinary kriging offered by Geostatistical Analyst tools was used to interpolate the physical dimensions of the unmeasured locations. The results showed that: (1) the wetland ecosystem services in 35 national nature reserves have a total value of 33.168 billion USD/year; (2) the values of wetland ecosystem services revealed considerable spatial variability along China's coastal zones; and (3) assessments provide additional insights into the trade-offs between different ecosystem services and wetland types. The valuation framework and database established in this study can contribute to the mapping of wetland ecosystem services in coastal zones.

Carbon stocks of seagrass meadows in Vanuatu, South Pacific

L. Benson¹, Susana Lincoln^{1,*}, M. Vannoni¹, C. Shaw², V. Molisa³, J. Bremner¹

¹The Centre for Environment, Fisheries and Aquaculture Science (Cefas), Lowestoft, UK

²Vanuatu Environmental Science Society (VESS), Port Vila, Vanuatu

³Department of Environmental Protection and Conservation, Port Vila, Vanuatu

*** Correspondence:**

Susana Lincoln

susana.lincoln@cefas.co.uk

Abstract

Intertidal and subtidal seagrass meadows are highly productive ecosystems with capacity to absorb large amounts of dissolved carbon dioxide and store it as organic carbon, locked away from the atmosphere for very long periods of time, unless disturbed or degraded. That carbon, otherwise known as “blue carbon” is stored in the biomass above ground, but mostly within the sediments. As well as forming a blue carbon habitat and therefore a nature-based solution for climate regulation, seagrass meadows provide many other important ecosystem services benefits including good water quality, sediment stabilisation and nursery and feeding grounds for many marine species, from invertebrates to turtles and marine mammals. These services become all the more important in small island developing states, and of those, particularly in tropical islands like those in the Pacific Ocean that are facing the combined challenge of climate change impacts alongside the consequences of rapid population growth and urban development. But there remain important knowledge gaps in terms of the extension of seagrass meadows and their capacity for carbon storage and climate regulation, particularly in the types of sediment found in the Pacific Islands. In this study we present the results of a field study of seagrass meadows in Efate Island, Vanuatu, in the South Pacific. The potential for these seagrass meadows as a carbon sink and storage is discussed in the context of current efforts to manage the use of the marine environment of this island.

Insights into blue carbon storage and ecosystem connectivity from studies of the seagrass meadows in Sungai Pulai estuary (Johor, Malaysia)

Mohammad Rozaimi¹, Nur Hazlin Hazrin-Chong², Nur Farah Ain Zainee¹, Natasha Arina¹, Nur Hidayah¹, Chandran Raynusha¹

¹Department of Earth Sciences and Environment, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, Selangor, Malaysia

²Department of Biological Sciences and Biotechnology, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, Selangor, Malaysia

*** Correspondence:**

Mohammad Rozaimi
mdrozaimi@ukm.edu.my

Abstract

Sungai Pulai is a riverine system primarily consisting of mangrove forests with seagrass meadows located in the lower estuarine zone. Both the mangrove and seagrass habitats face land use changes that include coastal development, port construction and land reclamation for urbanisation purposes. There has been a number of blue carbon research conducted in the seagrass meadows here since 2015. Work went into: quantifying organic carbon and calcium carbonate stocks; pinpointing the sources that contributed to the carbon stocks through stable isotope and environmental DNA approaches; understanding habitat characteristics that influenced carbon storage; and identifying the role of phytal biodiversity in carbon sequestration. A synthesis of these work parcels provided insights into carbon storage and the connectivity of the macrophyte compartments within the Sungai Pulai system. Among which, we found that mangrove and algal inputs are significant in contributing to the bulk carbon pool of the seagrass meadows. Other findings demonstrate the variation in allochthonous carbon inputs due to seasonal and land-use changes, which tied very closely with the supply of macroalgal biomass. The next steps in expanding our research into coastal blue carbon will revolve around deciphering seagrass-mangrove-algal relationships in aiming to better understand carbon dynamics representative of tropical systems.

Total alkalinity production in a mangrove ecosystem reveals an overlooked Blue Carbon component

Vincent Saderne, Marco Fusi, Timothy Thomson, Aislinn Dunne, Fatima Mahmud, Florian Roth, Susana Carvalho, Carlos M. Duarte

Abstract

Mangroves have the capacity to sequester organic carbon (C_{org}) in their sediments permanently. However, the carbon budget of mangroves is also affected by the total alkalinity (TA) budget. Principally, TA emitted from carbonate sediment dissolution is a perennial sink of atmospheric CO₂. The assessment of the TA budget of mangrove carbonate sediments in the Red Sea revealed a large TA emission of 403 ± 17 mmol m⁻² d⁻¹, independent of light, seasons, or the presence of pneumatophores, compared to -36 ± 10 mmol m⁻² d⁻¹ in lagoon sediment. We estimate the TA emission from carbonate dissolution in Red Sea mangroves supported a CO₂ uptake of 345 ± 15 gC m⁻² yr⁻¹, 23-fold the C_{org} burial rate of 15 gC m⁻² yr⁻¹. The focus on C_{org} burial in sediments may substantially underestimate the role of mangroves in CO₂ removal. Quantifying the role of mangroves in climate change mitigation requires carbonate dissolution to be included in assessments.

Carbon offset potential from tropical seagrass conservation in Indonesia

A'an Johan Wahyudi^{1,4,*}, Udhi Eko Hernawan^{1,4}, La Ode Alifatri^{1,4}, Bayu Prayudha^{1,4}, Sofia Yuniar Sani^{2,4}, Febty Febriani^{3,4}, Yaya Ihya Ulumuddin^{1,4}

¹Research Center for Oceanography, Indonesian Institute of Sciences, Jakarta, Indonesia

²Bureau of Cooperation, Legal and Public Relations, Indonesian Institute of Sciences, Jakarta, Indonesia

³Research Center for Physic, Indonesian Institute of Sciences, Jakarta, Indonesia

⁴National Research and Innovation Agency, Jakarta, Indonesia

*** Correspondence:**

A'an Johan Wahyudi

Contact email: aanj001@lipi.go.id | ajwahyudi@gmail.com

Abstract

Aside from the targeted sectors such as energy, industry, forestry, agriculture, and waste management, the marine sector has been considered a promising sector for contributing to the negative carbon emission. One of the promising actions is to conserve the capacity of the blue carbon ecosystem (marine vegetation) to sequester carbon. Marine vegetation such as the seagrass can experience a decline from year to year. Therefore, the conservation program (i.e., Marine Protected Area) is necessary for climate change mitigation. However, the recent challenge is to estimate the carbon offset from the conservation program of the seagrass area. Carbon emission from seagrass ecosystems is mainly due to the land-use change; therefore, any kind of conservation such as MPA will be the approach for the carbon offset. A method for estimating carbon offset from seagrass conservation activity through MPA has been developed. The present study aims to evaluate the carbon offset potential of the seagrass ecosystem by applying the method within the five provinces in Indonesia. Among five provinces, North Maluku has the largest seagrass area (24,003.74 ha). However, the seagrass area that is included within the MPA is only 5%. Meanwhile, Jakarta has the highest percentage of seagrass within the MPA. Emission reduction at the baseline year 2020 ranged from 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 from 0.75 to 11.30 %. For instance, 9.03 tC/yr emission of seagrass ecosystem in Jakarta will decrease up to 8.01 tC/yr. The further assessment shows that emission reduction is a linear function of the conserved seagrass extent. There is a positive correlation between the percentage of conserved seagrass area and the percentage of emission reduction. This study is expected to be a preliminary for developing a carbon inventory system for tropical seagrass ecosystems.

Mangrove respiration is coupled with carbon and nitrogen uptake in the microphytobenthos of mangrove sediments

Xiaoguang Ouyang, Shing Yip Lee, Simon F.S. Li

¹Marine Science Laboratory, School of Life Sciences, The Chinese University of Hong Kong, Hong Kong SAR, China

Background

Microphytobenthos (MPB) assemblages in mangrove forests are poorly known but are expected to contribute to their carbon dynamics. However, few studies explored coupling of carbon and nitrogen dynamics between the MPB and mangroves.

Methods

Seedlings of *Kandelia obovata* were planted in the tidal mesocosms following a factorial design, i.e. enrichment × seedling density × enrichment time (i.e. every 10 days over one month), to test if significant coupling of C and N flow occurred between mangrove seedlings and the MPB. ¹³C and ¹⁵N enriched and unenriched urea solutions were applied daily, respectively, to the leaves of mangrove seedlings in each of the paired treatment and control mesocosms (n=6).

Results

MPB $\delta^{13}\text{C}$ and/or $\delta^{15}\text{N}$ values were significantly higher in enriched (mean: $\delta^{13}\text{C} = -20.6\text{‰}$, $\delta^{15}\text{N} = 27.7\text{‰}$) than unenriched ($\delta^{13}\text{C} = -26.5\text{‰}$, $\delta^{15}\text{N} = 0.3\text{‰}$) mesocosms, as were other samples. Component ¹³C and/or ¹⁵N decreased in the sequence of leaves, roots, sediments, porewater dissolved inorganic carbon (DIC) and MPB in the enriched mesocosms. This suggests that MPB in mangrove sediment may obtain carbon and nitrogen from seedling leaves indirectly via porewater, probably through respiration of the belowground parts of the seedlings. Further, there is a significant negative relationship between MPB $\delta^{13}\text{C}$, and porewater DIC $\delta^{13}\text{C}$ and concentration. Enrichment time and seedling density had significant effects on MPB-specific carbon and nitrogen uptake rates (V_c and V_n). Further, V_c and V_n were significantly higher in the third than the first and second sampling times but there was no significant differences between the latter two. These results suggest porewater as a media for the mangrove-MPB coupling.

Implications

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.

Exploring the seasonal variabilities of carbonate chemistry parameters in a mangrove ecosystem of the Northern Indian Ocean

Nirupama Saini, Punyasloke Bhadury

¹Integrative Taxonomy and Microbial Ecology Research Group, Department of Biological Sciences, Indian Institute of Science Education and Research Kolkata, West Bengal, India

Abstract

Throughout the last and present centuries, there has been ever increasing emission of CO₂ in the atmosphere due to increasing anthropogenic activities. As a result, the flux of CO₂ between atmosphere and oceans are adversely affected resulting in changes in carbonate chemistry of the biotopes, linked biodiversity and resulting ecosystem processes. Mangrove ecosystem is known to capture carbon and can be crucial towards mitigating adverse effects of CO₂ emission. We investigated the variability of seasonal carbonate chemistry within a mangrove ecosystem located in the coastal Northern Indian Ocean. Sundarbans represents the world's largest contiguous mangrove ecosystem which is a UNESCO World Heritage Site and Ramsar Site and located at the delta of Ganga-Brahmaputra-Meghna riverine systems; diurnally influenced by coastal water entering from the Bay of Bengal. We analyzed the available carbonate chemistry dataset of surface water representing between 2014-2020 from the Sundarbans Biological Observatory Time Series (SBOTS) located in western most part of Sundarbans. The analysis was focused on monsoon and post-monsoon seasons to understand the effect of precipitation, increased freshwater flow from major rivers, among others on carbonate chemistry trends of SBOTS. The salinity ranged from 0 to 25.5 during the study period. The pH and total alkalinity varied from 6 - 9.10 and 933 – 4600 μmol/kg during monsoon and 7 - 9.2 and 533 – 4734 μmol/kg during the post-monsoon period, respectively in SBOTS. The calculated pCO₂ values of SBOTS revealed that surrounding surface waters of the Sundarbans remains supersaturated with CO₂ most of the year and thus acts as a source of CO₂ to the atmosphere. In particular, the pCO₂ value ranged from 58 to 9113 μatm in monsoon and 63 to 1,17,160.34 μatm during the post-monsoon period. The data also revealed that total alkalinity is not strongly influenced by prevailing salinity in Sundarbans. A simple regression analysis of the pCO₂ with several environmental parameters including dissolved oxygen and total alkalinity has also been undertaken to better understand the possible driver of pCO₂ trends. The study provides an initial mechanistic understanding of the prevailing carbonate chemistry in Sundarbans of Northern Indian Ocean and can help us to understand the long-term implications on biological communities and linked ecosystem processes such as regional carbon flux.

Spatio-temporal analysis of local scale seagrass of MiddleBank in the northern Straits of Malacca

Anisah Jessica Lee^{1,*}, A.A Anscelly², S.H. Tan³, Y. Zulfigar³

¹Geoinformatic Unit, Geography Section, School of Humanities, Universiti Sains Malaysia, Penang, Malaysia

²World Wildlife Fund Malaysia, Kota Kinabalu, Malaysia

³Centre for Marine and Coastal Studies, Universiti Sains Malaysia, Penang, Malaysia

*** Correspondence:**

Anisah Jessica Lee
anisah@usm.my

Abstract

The purpose of this study was to determine the potential shift in seagrass density distribution between 2003 and 2019 on a seagrass bed surrounding a man-made islet, Pulau Gazumbo. This islet, located at the southern extremity of the MiddleBank area in the northern Straits of Malacca, was suspected to have been impacted by nearby coastline reclamation efforts. The major species' shoot density data used were *Halophila ovalis* (R.Br.) Hook.f. (1858) and *Halophila beccarii* den Hartog (1977). The density of seagrass shoots was measured in the upper and lower littoral zones using the Line Intercept Transect (LIT) technique and the NaGISA Protocol. To determine this shift, the ArcGIS Standard Deviational Ellipse (SDE) and Standard Distance (SD) were applied to data from 2003 to 2009, representing the pre-coastal reclamation phase, 2009 to 2012, representing the on-going phase, and 2012 to 2019 representing the post-coastal reclamation phase. The SDE of seagrass shifted from north-west to north-north-west from 2003 to 2009, seemingly away from the coastal land reclamation locale. The SD result demonstrated that the seagrass distribution around the islet migrated from west to east in 2019. The shifts in seagrass mean centre from west to east also aligned with the SD analyses, with the greatest distance measured from the centroid in 2012 being 28.21m and 32.14m in 2019. The difference in distance was small (4.2m) from 2012 to 2019, possibly because it was the post-reclamation phase. Mean seagrass densities were likewise greater, with the northeast quadrant of the sampling region falling into the high density category (>4,000 shoots/m²). The seagrass direction trend, density, and mean center were observed to be directed away from and concentrated further away from the coastal reclamation site by 2019.

Investigation of geochemical, biological, and physical controls on the carbon storage capacity in Hong Kong coastal wetlands

Laetitia Allais^{1,2,*}, Christelle Not^{1,2}, Benoit Thibodeau³

¹Department of Earth Sciences, Faculty of Science, University of Hong Kong, Hong Kong SAR, China

²The Swire Institute of Marine Science, University of Hong Kong, Hong Kong SAR, China

³Simon F.S Li Marine Science Laboratory, School of Life Sciences, The Chinese University of Hong Kong, Hong Kong SAR, China

*** Correspondence:**

Laetitia Allais

u3006445@connect.hku.hk

Abstract

Wetlands are important carbon storage ecosystems pertaining to high organic matter burial. The extent carbon storage is driven by environmental conditions that in turn influence biogeochemical and ecological processes, such as microbial activity, that render an ecosystem a net sink or source of carbon. To understand the dynamics of carbon burial within coastal ecosystems, we have developed a project that investigates the relationship between environmental conditions, geochemical cycles, and microbial activity around mangrove ecosystems in Hong Kong. Mangroves are abundant around Hong Kong, but are subjected to contrasting environmental conditions (e.g., salinity, water temperature variations, etc.) on the western side, through water discharge by the Pearl River, compared to the eastern side, bordered by the South China Sea. They are, therefore, of great potential to evaluate the impact that environmental variability could have on the complex biogeochemical interactions involved in carbon burial in coastal ecosystems. Moreover, with global change affecting environmental parameters and anthropogenic activities increasing pollution in ecosystems, addressing how geochemical and biological cycles may be impacted by those changes will help us apprehend how carbon sequestration in wetland might evolve in the long term. By measuring carbon isotopes from sediment cores around the estuarine (Pearl River estuary) side and marine (South China Sea) side of Hong Kong, we estimated the net carbon burial as a function of the environmental characteristics associated to our study sites. Overall, we found that sites on the estuarine side stored more carbon but are also subject to much larger variability. These variations were closely linked to environmental conditions, especially salinity, pH, temperature, tree density, and sediment characteristics. Linking those changes to microbial diversity and activity is our next step to apprehend the complex biogeochemical processes involved in storage of carbon in wetlands.

Estimation of seaweed biomass in the intertidal zone of GouQi Island based on multispectral UAV

Jianqu Chen¹, Xunmeng Li¹, Kai Wang^{1,*}, Shouyu Zhang^{1,*}

Abstract

The assessment of above ground biomass (AGB) of intertidal seaweed is the basis for rational development and utilization of marine resources, calculation of total nearshore carbon sink and evaluation of offshore ecosystem restoration effect. To analyze the spectral parameters of three kinds of intertidal seaweed, explore their contribution rate to biomass inversion, and discuss the biomass evaluation method of intertidal seaweed, evaluate the biomass of intertidal seaweed more accurately, and evaluate the biomass of intertidal seaweed. In this paper, the UAV is equipped with a multispectral camera to take aerial photos of the intertidal zone of Houtou Bay, GouQi island. Combined with the real-time in-situ sampling data, multiple linear regression, Gradient Boosting Decision Tree (GBDT), Random Forest (RF), Support Vector Machine (SVM) are applied, Twenty spectral parameters were selected as eigenvalues to quantitatively evaluate the biomass of *Ulva pertusa*, *Sargassum thunbergii* and *Sargassum fusiforme*. The results showed that the biomass collected from the field of three seaweed species and 20 spectral parameters were analyzed by one-way ANOVA and Pearson correlation analysis. It was found that each seaweed had different correlation with different spectral parameters, but they all showed significant correlation with infrared derived vegetation index. The precision of biomass regression prediction by GBDT is the highest. The biomass of *Ulva pertusa*, *Sargassum thunbergii* and *Sargassum fusiforme* in the intertidal zone of GouQi island in summer are 411.060g/m², 2380.388g/m², 411.486g/m², respectively (the inversion R² is 0.91, 0.764 and 0.778 respectively), and the seaweed's biomass per unit area is about 7000g/m². The study is helpful to evaluate the biomass of seaweed in the near shore, and provides strong technical support for the ecological monitoring and restoration effect evaluation of seaweed farm and the construction of marine pasture.

Study of DOC, DIC and its $\delta^{13}\text{C}$ drivers from tropical peat-draining rivers: Implications on blue carbon loss

Jenny Choo^{1,*}, J.M.Oakes², A. Mujahid³, M. Müller¹

¹Swinburne University of Technology, Faculty of Engineering, Computing and Science, Sarawak, Malaysia

²Centre for Coastal Biogeochemistry, School of Environment, Science and Engineering, Southern Cross University, Lismore, Australia

³Department of Aquatic Science, Faculty of Resource Science and Technology, University Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia

* Correspondence:

Name of corresponding author: Jenny Choo

Contact email: jccy89@gmail.com/JChoo@swinburne.edu.my

Abstract

Blue carbon system, such as the tropical peatlands in Borneo, Malaysia region, has experienced large scale land-use change activities for more than a decade. Here, we explore how carbon storage and loss in these tropical peatlands are affected by human activities in this region. In this study, two hundred and forty-four (244) water samples were studied from disturbed and undisturbed peat-draining river sites in year 2016/2017 and 2019 to assess the biogeochemistry status of these rivers systems. In disturbed peat-draining river systems ($\text{SPM} > 30 \text{ mg/L}$), our findings showed considerable amount of DOC ($804.81 \pm 95.71 \mu\text{M}$) was being discharged into the river systems (i.e. Simunjan, Sebuyau, Pusa) in 2016/2017, with depletion of $\delta^{13}\text{C}$ -DOC values ranged from -47 to -20.1 ‰. While limited sampling sites were carried out in 2019, inconclusive results recorded depleting $\delta^{13}\text{C}$ -DOC value of -40 ‰ in 2019, which may suggest a continuous loss of DOC over time as a result of on-going peat-draining activities. Conversely, undisturbed river systems (Maludam and Samusam rivers) showed slightly higher average DOC values ($1221.55 \pm 111.54 \mu\text{M}$) in 2016/2017, with a comparable $\delta^{13}\text{C}$ -DOC in the range of -45 to -17.4 ‰. Yet, in 2019, our findings indicated a shift of increased $\delta^{13}\text{C}$ -DOC values, ranged from -30 to -20 ‰ in these undisturbed river systems. For the case of DIC findings, the $\delta^{13}\text{C}$ -DIC values were generally more depleted (-33 to -20 ‰) within undisturbed systems in both 2016/2017 and 2019 years, in comparison to disturbed river systems (-26.8 to -0.4 ‰). As such, these findings provide insights on the impacts of peatlands disturbances which have resulted in carbon loss into our river systems over time. Essentially, our findings further encourage us to explore the various sources and impacts of carbon loss to better monitor and manage our blue carbon system in this region.

A new method for studying the patterns of macroalgae communities in the intertidal zone: power law model

Xunmeng Li, Jianqu Chen, Kai Wang, Zhenhua Wang, Shouyu Zhang

Abstract

Spatial heterogeneity of macroalgae in intertidal zone affects the ecosystem stability of communities, which has an important ecological value of resisting external disturbance and maintaining the coastal biodiversity. We took Lvhua island in Zhejiang Province as an example, explored the feasibility of applying power law model to analyze the spatial distribution characteristics of macroalgae in intertidal zone, and analyzed the spatial heterogeneity of each species. The results show that the spatial distribution pattern of macroalgae in intertidal zone fits well to the power law model, $R^2 = 0.98$. There was a positively associated between occurrence frequency (p_i) and spatial heterogeneity index of macroalgae species (δ_i). The spatial heterogeneity of macroalgae community in the intertidal zone of Lvhua island was higher than that of random distribution. The distribution of community was patchy. Therefore, the power law model can be applied to analyze the spatial pattern of macroalgae in intertidal zone, which provides a new method for macroalgae community ecology.

Organic carbon burial records since the Late Pleiocene in Hangzhou Bay, China

Gao Qin¹, Zilong LI^{1,*}, PeiSun Lou¹, M.P. ALEXANDER², Huai Yang³, Zengqing Guo³, Dongqin Huang¹, Yanting Chen¹

¹Institute of Marine Geology and Resources, Ocean College, Zhoushan, China

²Department of Earth Sciences, University of Cambridge, Cambridge, UK

³Power China Huadong Engineering Corporation Limited, Hangzhou, China

Abstract

Estuary area is an active land-sea interaction area, which is the organic carbon main deposit area, and plays an important role in the biogeochemical cycle of global carbon. Sediment carbon sequestration plays an essential role in mitigating atmospheric CO₂ increases and the subsequently global greenhouse effect. To clarify the late Pleiocene Strata and carbon burial records in Hangzhou Bay, detailed analysis of particle size, organic nitrogen, organic carbon, sedimentary characteristics and chemical parameters in situ sediments, was performed on core HZW1907, 84 m in length and obtained from Hangzhou bay in 2019. Five depositional units were identified. A comprehensive analysis method of historical geography and sedimentary geology was used to determine the precise depositional ages of the Hangzhou Bay, from which previous Hangzhou bay ages were deduced. The IC content of Core HZW1907 sediments varied between 0.03% and 3.24%, with larger variability since the Late Pleistocene. The OC contents of the shallow-sea deposit were the highest in terms of high productivity, and the average IC and TC contents peaked in the shallow-sea deposit, where they reached 0.70% and 2.28%, respectively. Sediment grain size was one factor that controlled C abundance. The carbon sequestration rate was higher in the sediments of the estuarine deltaic wetlands than in continental shelf sediments. The ASR was the dominant modulator of the OC-AMARs and TC-AMARs. The OC-AMARs were significantly correlated with OC contents. 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.

A new method of estimating carbon sequestration and biological pump efficiency in coastal waters

Yafeng Zhang^{1,2,3,*}, Zhiyao Xiong^{2,3,*}, Yongyi Xie, Junjian Liang^{2,3}, Zhiqiao Chen^{2,3}, Lei He^{2,3}, Kedong Yin^{2,3,*}

Abstract

Most studies of estimating biological pump rely on net community production (NCP) in the surface layer or euphotic zone and ignore the export flux of particulate organic carbon across the pycnocline to bottom layer, which is carbon sequestration. In this study, we develop 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. We tested the new method by using vertical profiles of salinity, temperature and dissolved inorganic carbon (DIC) during two cruises in May and August 2016 in the coastal northern South China Sea (SCS). A three end-member mixing model of T-S diagrams is used to establish the conservative mixing of the water masses and to estimate biologically uptake or release of DIC (Δ DIC) in relation to the conservative mixing of DIC. Based on the density gradient threshold of $0.03 \text{ kg m}^{-3} \text{ m}^{-1}$, the water column is separated into the surface mixed layer, the pycnocline layer and bottom layer, the integrated Δ DIC in the three layers are estimated. The results showed that during algal blooms in May due to the influence of the Pearl River estuarine waters, there was little release of DIC below the stratified water column. In contrast, as the water column stratification is strengthened in August, without algal blooms in the surface layer, the maximum of fluorescence, the minimum of apparent oxygen utilization (AOU) and the Δ DIC maximum simultaneously occurred in the subsurface layer. The estimate based on our new method shows that carbon sequestration due to biological pump was few in May and ranged in $10.90 \sim 182.26 \text{ mmol C m}^{-2}$ (average $99.82 \pm 42.63 \text{ mmol C m}^{-2}$) in August in the coastal northern SCS. As a result, BPE was very low in May due to little sinking of phytoplankton, but in August, BPE increased to $16.02 \sim 54.1\%$ (average $28.52 \pm 11.05\%$). The new method is based on vertical changes of DIC and therefore, is more effective and direct to estimate carbon sequestration and BPE from the surface layer into bottom layer in coastal waters.

Genus-specific susceptibility of soft corals to bleaching

Christine Baran^{*}, RMA. Luciano, CS. Segumalian, DAM. Valino, MV. Baria-Rodriguez

¹Marine Science Institute, University of the Philippines Diliman, Quezon City, Philippines

***Correspondence:**

Christine Baran

cbaran@msi.upd.edu.ph

Abstract

Soft corals are zooxanthellate sessile animals supporting various organisms in coral reefs, especially in Asia Pacific region. However, their populations are threatened by the impacts of ocean warming. In this study, we examined the bleaching prevalence of three soft coral genera (*Lobophytum* n=1318 colonies, *Sarcophyton* n=116, *Sinularia* n=639 colonies) in Bolinao-Anda Reef Complex (BARC), Pangasinan, northwestern Philippines. These genera were chosen for their differences in life forms and abundance in the study site. The percentage of bleached portions in each colony was used to determine its bleaching category: no bleaching (0%), moderately bleached (1-50%), and heavily bleached (> 50%). Quantification of bleaching prevalence and susceptibility of colony sizes were determined by colony count and mean diameter measurements taken from quadrat photographs in October 2020. During the field survey, tissue samples (~3 cm) were excised in each colony of three soft coral genera represented by each bleaching category. These tissues were used to examine the zooxanthellae density per bleaching category of each genus. *Lobophytum* colonies had the lowest bleaching prevalence (19%), followed by *Sinularia* (51%) and *Sarcophyton* (56%). All colony size classes of the three genera were susceptible to bleaching. However, more than 70% of smaller colonies of *Lobophytum* (<15 cm), *Sarcophyton* (<5 cm) and *Sinularia* (<5 cm) showed no sign of bleaching. Zooxanthellae density was significantly reduced in moderately and heavily bleached colonies. Our results highlight that bleaching susceptibility is genus specific, with *Sarcophyton* and *Sinularia* as more susceptible to bleaching than *Lobophytum*. Smaller colonies seemed to be less susceptible to bleaching than large-sized soft corals suggesting differential thermal stress response. Considering the frequency and intensity of bleaching and ocean warming, long term monitoring on soft coral bleaching is recommended to understand how their populations and diversity may adapt or vanish in changing climate scenarios.

Fertilization and settlement successes of the different gamete combinations from wild and F1 colonies of the massive coral *Favites abdita*

Katya Bonilla^{1*}, CA. Ligson¹, DW. dela Cruz², JR. Guest³, PL. Harrison², MV. Baria-Rodriguez¹

¹Marine Science Institute, College of Science, University of the Philippines, Diliman, Quezon City, Philippines

²Marine Ecology Research Centre, School of Environment, Science and Engineering, Southern Cross University, Lismore, Australia

³School of Natural and Environmental Sciences, Newcastle University, Newcastle upon Tyne, United Kingdom

*** Correspondence:**

Katya G. Bonilla

ktybnll@gmail.com

Abstract

Sexual propagation of corals has the potential to be a valuable aid in restoring reefs. A number of field-based trials have been successful in producing first filial (F1) generations from a range of coral species. Once F1 colonies reach sexual maturity, they provide a potential source of gametes for subsequent sexual propagations. The vast majority of coral sexual propagation has been done with fast-growing branching species and information on massive slow-growing corals is still lacking. This study aimed to evaluate fertilization and settlement successes of a massive coral, *Favites abdita*, in combining gametes from F1 colonies alone and those mixed with gametes from wild colonies. Gravid wild and F1 colonies (8.2–27.4 and 6.9–15.8 cm, respectively) were collected in northwestern Philippines on May 24, 2021 (two days before full moon) and were transported to the outdoor hatchery of Bolinao Marine Laboratory. Colonies spawned four nights after the full moon with nine wild and nine F1 donor colonies for the three gamete combinations (F1 × F1, F1 × wild, wild × wild) in triplicates. At four hours post fertilization (PF), all combinations reached 100% fertilization success. Initial results of the settlement success revealed that at eight days PF, wild × wild combinations had the highest mean percentage of settled larvae at 14% followed by F1 × wild crosses with 12% then F1 × F1 crosses with 5%. Results of this experiment highlight the role of F1 colonies in succeeding massive coral sexual propagations to restore degraded reefs. However, experiments must be done to further compare the effects of these gamete combinations on the different post-settlement stages and survival.

Tissue necrotic in coral accelerated by addition of pathogenic bacteria in the surrounding water

Dio Dirgantara¹, Mariyam Shidha Afzal¹, Nozomi Fujiwara¹, Ruri Hondo¹, Kento Touyama¹, Emmeline Jamodiong², Rhesi Kristiana³, Takashi Nakamura^{1,*}

¹35 Laboratory, Faculty of Science, University of the Ryukyus, Okinawa, Japan

²MISE Laboratory, Faculty of Science, University of the Ryukyus, Okinawa, Japan

³Marine Education & Research Organization, Bali, Indonesia

*** Correspondence:**

Associate Professor. Takashi Nakamura, Ph.D
takasuke@sci.u-ryukyu.ac.jp

Abstract

Tissue necrosis is one of the recognized lethal disease on coral since 1980's. Thus far it still offers question on which genuine causative agent causing tissue necrosis and how was the infection mechanism affect coral. This study aims to investigate the effects of tissue necrosis infection process by measuring its physiological responses under variety of treatments mimicking the several cases can be observed in the field. We prepared 4 different treatments using coral *Acropora* sp.2 sampled from Sesoko station as the main target in the experiment to reveal physiological impacts of disease infection. Results from the Treatment 1 (healthy coral fragment and diseased coral nubbin) showed no mortality or physiological impact on the coral nubbin during the experimental period. However, in the Treatment 2 (healthy coral + diseased coral + pathogenic bacteria exposure) and Treatment 3 (healthy coral + pathogenic bacteria exposure), pathogenic bacteria aggregation on coral significantly caused physiological disfunctions of *Acropora* sp.2 in both gross O₂ production and consumption (photosynthetic and respiration) as well as maximum efficiency of Photosystem II (F_v/F_m) of its symbiotic algae. Rapid tissue loss occurred in the healthy coral within the Treatment 2 and Treatment 3 lead due to mortality within a few days. Meanwhile, in Control (healthy coral fragment only) tank did not show any sign of disfunctions in all physiological variable where no mortality was found. Given our findings, combination of pathogenic agent in the water diseased/infected coral nearby can induce rapid infection and mortality in healthy corals. Contrastively, coral infected tissue necrosis did not affect healthy coral during the experiment. While the pathogenic agent remains unknown, prevention on the pathogenic bacteria exposure can increase coral survivability against tissue necrosis disease.

Hard coral recruitment in eutrophic reefs of Bolinao, Pangasinan, Northwestern Philippines

Christine Segumalian*, MVB. Rodriguez

¹Marine Science Institute, University of the Philippines Diliman, Quezon City, Philippines

***Correspondence:**

Christine S. Segumalian

cssegumalian@msi.upd.edu.ph

Abstract

Coral reefs worldwide are suffering from major losses due to an array of anthropogenic activities. Reef resilience and recovery is governed by multiple factors (e.g., disturbances, presence of adult populations, etc.) significant in maintaining ecological and economic benefits provided by these dynamic marine ecosystems. Here, we monitor coral recruitment patterns through quarterly deployment ($n = 60$) of settlement plates ($10 \times 10 \times 0.6$ cm) in three coral reef sites with different proximities from mariculture areas (i.e., Trinchera = 1 km; Lucero = 3 km; Malilnep = 6 km). Coral recruits were identified under stereomicroscope (2x magnification). Preliminary results showed that highest recorded recruitment was in Lucero at 5 ± 4.04 (mean \pm SD), representing 14 recruits per tile which was observed between months of April and May, the reported multispecies spawning period in Bolinao, Pangasinan. This may be attributed to presence of high coral adult populations in the site. However, the lowest recorded recruitment was in Trinchera (0 – 1 spat per tile), an area exposed to high nutrient inputs and sedimentation due to its proximity to mariculture, tourist, and residence areas. The number of coral recruits observed for two years was relatively low, with an average of 1 – 2 recruits per tile for each site, as compared to observations in other regions ranging from an average of 34 – 38 recruits per tile. In addition, most of the observed recruits belonged to the brooding Poritidae which are also widely known to be resilient to disturbances, while recruits from broadcasting Acroporidae were found in least numbers. Generally, our results might be an indication of low supply of competitive larvae and low coral reef resilience due to decreasing water quality in the study area.

Variation in coral reef assemblages and reef resilience across a latitudinal gradient on the Ryukyu Archipelago, Japan.

Mariyam Shidha Afzal¹, Konomi Takeuchi², Dio Dirgantara³, Takashi Nakamura⁴

^{1,2,3,4} 35 Lab, Graduate School of Engineering and Science, University of the Ryukyus, Okinawa, Japan

Correspondence:

Mariyam Shidha Afzal

s.hidha@hotmail.com

Abstract

Japan's coral reefs have changed dramatically over the last several decades due to anthropogenic impacts and climate change. The major coral bleaching event of 1998 decimated Japanese coral reefs, where almost all the coral communities of Ryukyu Islands were affected. The Ryukyu archipelago offers a unique environmental gradient to study the interactions between environmental variations, connectivity, resilience, climate change and adaptation of marine biodiversity as the islands are scattered along a wide latitudinal gradient. Coral reefs are present in the Ryukyu Islands from latitudes 24 to 31 N, where majority of the reefs are fringing reefs. To obtain detailed baseline assessments of the reefs of Ryukyu Islands, we carried out Point Intercept surveys to evaluate substrate compositions and coral species diversity around Yakushima, Amami Oshima, Yoron Island, Kerama Island, Tarama Island and the Sekisei lagoon. A total of 69 individual reef sites were surveyed for this study from 6 different localities. The overall hard coral cover for Ryukyu archipelago was 22.41% \pm 7.98 (Mean \pm SD) from pooled dataset. The highest overall substrate assemblage was recorded for turf algae (39.72% \pm 7.21). The highest overall assemblages for hard coral cover were recorded in Amami Oshima (35.60% \pm 11.76), whereas hard coral cover was lowest for Sekisei Lagoon (13.67% \pm 6.03). The highest assemblages of Turf algal cover were recorded for Yoron (54.56% \pm 4.35) whereas, the turf algal cover was lowest for Amami Oshima (6.43% \pm 5.65). Apart from Amami Oshima, turf algal cover remained above 40% of overall benthic cover for all the localities surveyed. A total of 286 coral species were recorded from the Ryukyu archipelago during the course of this study. The total number of coral species ranged from 92-110 species for high latitudinal Islands (Yakushima, Amami Oshima and Yoron). For low latitudinal Islands the species richness ranged from 100-176 species (Kerama, Tarama and Sekisei Lagoon). High latitudinal populations have highest assemblages of corals belonging to Merulinidae family, whereas low latitudinal populations are dominated by corals belonging to Acroporidae family (mainly *Acropora* and *Montipora*) communities. Based on coral coverage, the reefs of low latitudinal localities are showing signs of degradation.

Potentials of recovery and resilience of coral reefs in Cu Lao Cham marine protected area, south-central Vietnam

Van Long Nguyen^{1,2,*}, Hoang Phan Kim¹, Tuan Vo Si¹

¹Institute of Oceanography, VAST, Viet Nam

²Graduate University of Science and Technology (GUST), VAST, Viet Nam

*E-mail: longhdh@gmail.com

Abstract

Cu Lao Cham marine protected area (MPA) has been considered as one of the most effective MPAs in terms of management in Vietnam. During the last twelve years, coral reefs in this area have been influenced by natural and anthropogenic impacts, but their effect on recovery processes and the resilience of coral reefs is not yet well documented and understood. In this study, 10 permanent monitoring sites of coral reefs of the MPA were surveyed comparing benthic cover (hard and soft corals, fleshy seaweeds) and densities of herbivore fishes (surgeonfishes, parrotfishes, and rabbitfishes) and sea urchins (*Diadema* spp.) between the study years of 2004, 2008 and 2016. Although the densities of predatory and herbivore fishes, and *Diadema* sea urchin stably maintained between 2004 and 2016, but there were notable declines in live coral cover (both hard and soft corals) and a significant increase in cover of fleshy algae. This indicates that protection has contributed to the maintenance of fishing activities but the recovery of live coral cover depended on factors (increase in frequencies of storm and flooding discharged freshwaters with low salinity and high sediments and nutrients from adjacent rivers, outbreaks of crown of thorn starfish and coral bleaching) other than protection. The decline in live coral cover, the increase in cover of fleshy algae and the maintenance with low densities of herbivore groups may suggest that recovery of coral reefs in the MPA is taken slowly and this may limit the resilient potentials of coral reefs to disturbances in the future, especially climate change. It is necessary to augment MPA with other management strategies surrounding rather than improvement of management capacity inside of the MPA.

Seagrass meadow can be a refugia for corals against ocean acidification?

Vina Listiawati^{1,2,*}, Haruko Kurihara²

¹Faculty of Science, University of the Ryukyus, Okinawa, Japan

²Department of Biology Education, Universitas Muhammadiyah Surakarta, Surakarta, Indonesia

*** Correspondence:**

Vina Listiawati

vina.listiawati@ums.ac.id

Abstract

The declining of seawater pH due to ocean acidification (OA) is suggested to threaten coastal ecosystems around the world. Coastal ecosystems such as seagrass meadows, however, exhibit diurnal pH fluctuation that equivalent to predicted magnitude of pH change under future OA. Diurnal fluctuation in seagrass meadows may also influence the adjacent ecosystems such as coral reefs. Seagrass meadows is hypothesized could provide a refugia for corals against OA. Seagrass is expected to increase seawater pH in daytime due to large uptake of CO₂ during photosynthesis, thus may alleviate the negative impact of OA on coral calcification. On the other hand, respiration by seagrass during nighttime is also suggested to further decrease seawater pH and that may worsen the impact of OA on coral. However, little is known whether this diurnal fluctuation may really benefit coral and whether there is a pH fluctuation threshold that coral can accept for their best growth. Here, we aimed to investigate how changes in diurnal pH by different seagrass density will affect the calcification of coral. We used seagrass *Thalassia hemprichii* and coral *Montipora digitata* that are living co-exist in Bise, Okinawa, Japan. In this study, we used two pCO₂ conditions; ambient (control) and high pCO₂ (OA) that were selected as present and predicted future 2100-year condition, and four seagrass density conditions; no seagrass (NS), low density (LD), medium density (MD), and high density (HD) of seagrass to create eight different experimental combinations. We found that coral calcification decreased as seagrass density become denser. On the other hand, we observed that coral calcification was not affected under future OA. Although diurnal fluctuation by seagrass *T. hemprichii* did not prevent the negative impact of OA on the calcification of coral *M. digitata*, high biomass of seagrass still important to provide other ecological services for other organisms.

The Unsung sea urchins and their Potential in enhancing coral reef resilience

Man Ying Mok^{1,*}, Amri Affendi Yang¹, Jillian Ooi Lean Sim^{1,2}

¹Institute of Ocean and Earth Sciences, Universiti Malaya, Kuala Lumpur, Malaysia

²Department of Geography, Faculty of Arts and Social Sciences, Universiti Malaya, Kuala Lumpur, Malaysia

*** Correspondence:**

Mok Man Ying

mokmanyong@um.edu.my

Abstract

To deal with regional declines of coral cover, management and conservation interventions should incorporate knowledge of the ecological mechanisms that support reef resilience. Sea urchins have been shown to enhance reef resilience by preventing the proliferation of algae that negatively impact coral settlement, growth, and survivorship and subsequently, prevent coral-algal phase shifts. However, sea urchin studies have been drawn overwhelmingly from regions in the Caribbean, leaving large knowledge gaps in our understanding of role of sea urchins in Indo-Pacific coral reefs. To fill this knowledge gap, this study aimed to look into the potential role of sea urchins as biological controllers of algae on a reef flat in Rawa Island, Peninsular Malaysia. In July 2019, *in-situ* herbivore exclusion experiments were conducted to analyse grazing activities by urchins (SU) upon the algal communities and its possible impact on Scleractinian coral settlement. Cages (50x50x25 cm) with mesh nettings (n=5) were deployed for each treatment category: (1) Closed cages to test the effect of grazing (-SU & -fish); (2) Open-top cages to test the effect of fish grazing (-SU), and (3) Cages with no netting (controls) (+SU & +fish). Four unglazed terracotta tiles (10x10 cm) were placed in each cage for four months, then all tiles were collected and the algae's percentage cover and dry weight biomass was quantified. One-way analysis of variance followed by Post Hoc Tukey (HSD) tests showed when herbivores were excluded, algal dry mass and coverage was 2 and 5 times higher, respectively, compared to the control plots. In fact, herbivory of sea urchins was more effective compared to herbivorous fish as algal growth in both closed and open-top cages were similar. In conclusion, this study accentuate the ecological importance of sea urchins in affecting algal communities, thus would be crucial to be considered in coral resilience efforts.

Phylogenetic structure of false clownfish, *Amphiprion ocellaris*, and its implication to coral reef resources management in the Straits of Malacca and South China Sea

Norhanis Razalli¹, N. Nithiyaa¹, Y. Zulfigar¹, S.H. Aileen Tan^{1,*}

¹ Centre for Marine & Coastal Studies, Universiti Sains Malaysia, Penang, Malaysia

*** Correspondence:**

Aileen Tan Shau Hwai
aileen@usm.my

Abstract

The phylogenetic structure of the false clownfish, *Amphiprion ocellaris*, populations in the Straits of Malacca and South China Sea were established based on sequence data generated from the cytochrome b (cytb) and the mitochondrial control region (CR) gene. Based on the neighbour-joining analysis, restricted gene flow was observed between disjunct populations of *A. ocellaris* in the Straits of Malacca and the South China Sea. The false clown anemonefish possesses two-phase life history whereby the larvae are planktonic, and the adults are strongly site attached. Therefore, the larvae dispersal potential depends primarily on the period of the larval stage, which lasts about 8-12 days. Due to its localized biology and dependency on specific anemone hosts, strong genetic structuring is expected in *A. ocellaris*. However, the present surface ocean currents are poorly correlated with the phylogeographic structure of *A. ocellaris* in the study. The strong genetic structuring of the extant *A. ocellaris* may be influenced by past sea level changes and the major river drainage system on the Sunda Shelf, which allows “seeding” during rising sea levels. Low larval exchange estimates between populations were often observed over small geographic distances and are not connected by drainage systems. The knowledge of connectivity, the exchange of individuals among populations through dispersal or migration, is of great importance for Marine Protected Area (MPA) spatial planning. Optimally spaced MPAs provide a spill-over effect to adjacent nonprotected areas, enhancing ecosystem resilience through connectivity among protected areas and maximally representing species and genetic diversity.

Promoting the rehabilitation of coral reefs in Cambodia through community-led enforcement

Matt Glue, Srey Oun Ith, and Henry Duffy

Abstract

Marine habitats in Cambodia are some of the least studied across all Southeast Asian nations. Multi-decadal baseline data for Cambodian marine ecosystems upon which to develop marine management strategies do not exist. With assumptions on historical biodiversity and productivity of the Cambodian marine environment has been inferred through anecdotal evidence or fisheries records from neighbouring countries. However, it is presumed that the Cambodian shelf was once regarded as one of the most productive areas in the Gulf of Thailand.

Unfortunately, at present coral reefs in Cambodia are a habitat that has been degraded and overexploited by rapidly intensifying coastal fisheries, particularly trawls. To mitigate this, the Cambodian government, supported by NGOs has been implementing marine management strategies and establishing marine protected areas which incorporate community-led enforcement and aim to safeguard both biodiversity and small-scale fisheries.

Coral reef monitoring is utilised to compliment and assess the impact of marine management on impacted coral reef habitats. Monitoring throughout Cambodia's first MPA, has revealed that some key biological indicators used to measure reef health are showing signs of stabilisation, suggesting a positive influence from marine management.

It is hoped that knowledge gained from MPA development and management can now be applied to the Koh Sdach Archipelago, where baseline data collection has been completed and community consultations are underway to establish Cambodia's third MPA. Initial results from baseline data collection highlight the potential of the archipelago, with localised high abundance of key fish families and with one site containing the highest coral cover yet observed in Cambodia. This reinforces the importance of implementing both fisheries' management and conservation in Koh Sdach, that will help to improve resilience to climate change.

This presentation will share key findings from conservation activities and surveys with recommendations for how apply these for future management of Cambodia's reef ecosystems.

Enhancing local efforts to support coral reef resilience: A reflection from Thailand

Wichin Suebpala^{1,*}, Makamas Sutthacheep¹, Thamasak Yeemin¹

¹Marine Biodiversity Research Group, Department of Biology, Faculty of Science, Ramkhamhaeng University, Bangkok, Thailand

*** Correspondence:**

Wichin Suebpala
wichin.s@gmail.com

Abstract

Impacts from climate change and anthropogenic activities have exacerbated coral reefs across the globe, leading to coral bleaching, mortality and reef degradation. Human, particularly island and coastal communities, is inevitably impacted, resulting from a degraded quality of the ecosystem services from coral reefs. Global actions on climate mitigation, adaptation, and biodiversity conservation have been recognized in order to enhance coral reef resilience. Several cases illustrate that local efforts play vital roles in supporting such actions. In this study, we conduct a critical review and analyze the roles of local efforts to support coral reef resilience in Thailand. At a national scale, the implementation of climate mitigation, adaptation, and biodiversity conservation have been accelerated, contributing to the achievement of Thailand's SDGs and climate change policy. At a local scale, coastal communities, and other partners like NGOs and private sector, are engaged as a key stakeholder in various projects, resulted from the national policy and promotion of public participation and decentralization. Several local actions and projects on climate mitigation and biodiversity conservation are beneficial to enhance coral reef resilience. For instance, promoting low-carbon marine ecotourism of local communities helps reduce the emission of GHGs, along with the reduction of pollution and other stresses on coral reefs. Besides, local communities also participated in mangrove reforestation and seagrass restoration, which increase the capacity of carbon sequestration. Other local conservation projects such as coral reef restoration, clean-up projects, land-based pollution reduction, restocking marine organisms, etc., also support biodiversity conservation, thus elevating coral reef resilience. This analysis highlights the needs of local community engagement and their roles to enhance coral reef resilience in a changing climate.

Short-term study on the effects of physical damage on recovery and growth rates of corals with different adaptive strategies at Pulau Rawa, Johor, Malaysia

Kok Lynn Chew¹, YA Affendi¹

¹Institute of Ocean and Earth Sciences, Institute for Advanced Studies, Universiti Malaya, Kuala Lumpur, Malaysia

Abstract

Climate change is projected to increase storm intensity, bringing more physical damage to fragile branching coral species responsible for corals reefs' structural complexities. Corals need time to recover from damages inflicted during storm events. However, little is known about the recovery rate of branching corals with different adaptive strategies in Malaysia. This study investigated the recovery capabilities of major reef-building branching coral species with r and K adaptive strategies – *Acropora muricata* (r) and *Echinopora horrida* (K) from artificially induced physical damage in the shallow reef of Pulau Rawa, Johor, Malaysia. Recovery was measured via lesion recovery and growth rates of broken branches for 129 days. Firstly, thirty donor colonies were selected for each coral species on the reef, and two branches were broken and tagged. The lesion site of *A. muricata* healed as much as 99.94% ± 0.040 S.E. , compared to *E. horrida* with a value of 86.97% ± 3.526 S.E at the end of the experiment (p<0.01). On day 129, *A. muricata* had a relative cumulative growth of 70.37% ± 6.132 S.E. , more than double the value of *E. horrida* with 29.11% ± 2.444 S.E. (p<0.01). The short-term results in this study show that *A. muricata* (r) has a better capability to recover from physical damage than *E. horrida* (K). More species from both adaptive strategies need to be tested to confirm further, but it is suggested that coral conservation efforts in Malaysia should start focusing on rehabilitating coral species with K adaptive strategy as they require a longer time to recover after being physically damaged.

Investigation of the regenerative capacity of apical and basal transplants of *Acropora muricata* and *Echinopora horrida*

Jihad Wajdi Mohd Erfino¹, YA. Affendi², NA. Majid¹, N. Mohamad-Fauzi^{1,2}

¹Institute of Biological Sciences, Faculty of Science, Universiti Malaya, Kuala Lumpur, Malaysia

²Institute of Ocean and Earth Sciences, Universiti Malaya, Kuala Lumpur, Malaysia

***Correspondence:**

Nuradilla Mohamad-Fauzi

dilfauzi@um.edu.my

Abstract

As climate change continues to threaten coral reefs worldwide, active restoration efforts such as transplantation of fragmented corals are conducted to recover the coral population. Although this technique had been employed extensively, the success rates of these efforts are inconsistent, low, and sometimes unknown. In corals, the apical regions of a colony are known to be actively proliferating in comparison to the basal. The effects of this on coral transplantation had not been well studied. Thus, choosing a specific region to transplant could make a difference. Therefore, for this study, donor colonies of the branching corals *Acropora muricata* (n=6) and *Echinopora horrida* (n=4) were chosen where from each colony, a branch from the basal and apical region were sampled and transplanted to a fixed-to-bottom nursery. The growth in linear extension and surface area of these fragments were monitored for 93 days along with their health. Growth of the fragments were monitored through photography and measured with CPCe software whereas fragment health was analysed with a Coral Health Chart. We found that growth in linear extension and surface area of *A. muricata* and *E. horrida* were higher in apical branches compared to basal, although not statistically significant. All fragments went from darker to lighter in colour 14 days after transplantation and then remained relatively stable until day 93. The loss of colour postulates a decrease in symbiotic zooxanthellae density or loss of pigmentation, but no mortalities were recorded. We conclude that transplants from the apical and basal regions are not significantly different in regeneration rate nor their health recovery. However, a longer period of study may provide a more definitive result. Work is currently in progress to investigate whether the donor colony size and the telomere dynamics of these species could be indicative factors of regeneration capacity.

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

Syamil Sahar^{1,*}, A. Mujahid¹, J. T. I. Tanzil², R. Thyartan³, N. Goodkin⁴, J. N. Lee⁵, Z. Waheed⁶, M. A. S. Hussein⁶, M. Müller³

¹Universiti Malaysia Sarawak, Faculty of Resource Science and Technology, Sarawak, Malaysia

²National University of Singapore, Tropical Marine Science Institute, Singapore

³Swinburne University of Technology, Faculty of Engineering, Computing and Science, Sarawak, Malaysia

⁴Nanyang Technological University, Earth Observatory of Singapore, Singapore

⁵Universiti Malaysia Terengganu, Faculty of Science and Marine Environment, Terengganu, Malaysia

⁶University Malaysia Sabah, Borneo Marine Research Institute, Sabah, Malaysia

*** Correspondence:**

Syamil Sahar

syamilsahar@gmail.com

Abstract

Land-use changes have severely impacted the coral reef ecosystem in Sarawak over the past few decades through intensified forest removal. Long-term discussions on these issues are lacking due to the limited temporal range of instrumental records. Hence, this work aims to highlight the magnitude of terrigenous pressure in Sarawak reefs by assessing skeletal Ba/Ca ratio in massive *Porites* sp. retrieved from Talang-Satang National Park. Coralline Ba/Ca was analysed using ICP-OES and a series of validation assessments were conducted to determine Ba/Ca reliability as runoff proxy. From the assessments, Ba/Ca ratios from three *Porites* corals were not spatially reproducible. However, Ba/Ca and G/B pairing indicated that both coral proxies were modulated by homogenous environmental variability i.e., riverine runoff. Ba/Ca displayed a uniform seasonal cycle throughout the year where geochemical signals peaked during high G/B and rainfall, and during low SST and SSS, aligning to intense riverine runoff during the Northeast monsoon. The coral proxies have a fairly modest coefficient strength with the runoff indicators ($r < 0.70$). The 64-year Ba/Ca signals showed a constantly increasing trend throughout the decade with a higher mean value recorded during each elevation stage corresponding to the evolution of land-use changes in Lundu. The growth of industrial oil palm plantations was identified as the main factor for terrestrial runoff and Ba/Ca surges. The current study predicts that coralline Ba/Ca values in Talang corals will continue to rise in the future. The Ba/Ca profile also displayed a significant temporal delay during major deforestation in 2008 and 2011 that could be modulated by tidal driven sediment resuspension. Despite the in-sync seasonal cycle with runoff indicators, the results suggest that Ba incorporation in coral aragonite is more complex than we thought and the Ba/Ca interannual variabilities within this region could be controlled by additional environmental factors or vital effects.

The effect of shading on colour and growth of *A. muricata* and *P. lutea*

Febrienne Sukiato^{1,*}, Affendi, AY. Amri¹, N. Osman²

¹Institute of Ocean and Earth Sciences (IOES), Universiti Malaya, Kuala Lumpur, Malaysia

²Institute of Biological Sciences, Faculty of Science, Universiti Malaya, Kuala Lumpur, Malaysia

*Correspondence

Febrienne Sukiato

febri.suki@gmail.com

Abstract

Scleractinian (hard) corals in the Anthropocene suffer increasingly intense and frequent mass bleaching events. Coral bleaching occurs when stressed corals expel photosynthetic endosymbiotic algae causing coral decolouration, slower growth, and possibly death. Periods of high seawater temperatures typically induce stress. Excess light intensities further exacerbate stress, leading to bleaching.

Studies in controlled tank environments have found that reducing light intensities through shading during thermal stress conditions significantly reduced bleaching of several coral species. However, few studies have investigated shading responses of corals *in-situ* which are critical to assess shading as a viable tool to reduce coral bleaching in the field.

The present study evaluated the effect of shading on coral fragments (n=30) of *Acropora muricata* and *Porites lutea* by subjecting them to either 0% (full sunlight) or 75% shading for 30 days from October to November 2020 in Pulau Rawa, Malaysia. The health of each fragment was measured by fragment colour. Vertical growth rates of *A. muricata* fragments were also monitored.

Coral colour was assessed using the Coral Health Chart, a proxy of symbiont and chlorophyll-a density. Coral colour of *A. muricata* remained similar between treatments and did not change throughout the experiment, but *P. lutea* had significantly improved in colour after 18 days of shading. Shaded *P. lutea* scored 22.6% higher in colour compared to their unshaded counterparts after 30 days.

Vertical growth rates of *A. muricata* were not significantly affected by shading, though shaded fragments were found to have grown slightly less.

Enhanced colour of *P. lutea* suggests that shading may improve coral resiliency towards stressors, but the unchanged colour and reduced growth rates of *A. muricata* implicate that shading may be detrimental to this species. The results of this experiment suggest that benefits of reduced light stress through shading may be species-specific.

High diversity and abundance of coral recruits in Mu Ko Chumphon to support coral reef resilience

Charernmee Chamchoy^{1,*}, T. Yeemin¹, M. Sutthacheep¹, C. Ruangthong², W. Klinthong¹

¹Marine Biodiversity Research Group, Department of Biology, Faculty of Science, Ramkhamhaeng University, Bangkok, Thailand

²Chumphon Marine National Park Operation Center 1, Department of National Parks, Wildlife and Plant Conservation, Chumphon Province, Thailand

*** Correspondence:**

Charernmee Chamchoy

charernmee14@hotmail.com

Abstract

The concept of coral reef resilience has been proposed and applied for coral reef management to combat with climate change impacts. Coral recruitment is important component, supporting the coral reef resilience. Coral recruitment is crucial for enhancing reef biodiversity and recovery after experiencing disturbances. Coral reefs in the Gulf of Thailand have experienced severe coral bleaching events and anthropogenic disturbances during the last two decades, leading to coral deterioration. Understanding on coral recruitment in Thailand is significant for managing coral reefs. This study assesses the composition and abundance of coral recruits on shallow reef flats and reef slopes at Mu Ko Chumphon National Park, in the western Gulf of Thailand. The results showed that high densities of coral recruits were found in shallow reef flats and were significantly higher than those on reef slopes. The diversities of coral recruits were relatively high on reef slopes, compared with the reef flats. The coral recruits *Pavona*, *Favites* and *Pocillopora* were dominant on reef flats, while *Favites*, *Pocillopora* and *Goniopora* were dominant on reef slopes. The highest diversity of coral recruits was recorded at Ko Kula while the highest diversity of adult colony was recorded at Ko Rang Kachiu. This study provides comprehensive information on coral recruitment in Mu Ko Chumphon which is needed for formulating appropriate management plans to enhance coral recovery and promote coral reef resilience.

Comparing coral recruitment on settlement plate experiments from different sediment loads in the Gulf of Thailand

Wanlaya Klinthong^{1,*}, T. Yeemin¹, M. Sutthacheep¹, W. Aunkhongthong¹, C. Ruangthong², S. Pengsakun¹, C. Chamchoy¹

¹Marine Biodiversity Research Group, Department of Biology, Faculty of Science, Ramkhamhaeng University, Bangkok, Thailand

²Chumphon Marine National Park Operation Center 1, Department of National Parks, Wildlife and Plant Conservation, Chumphon Province, Thailand

*** Correspondence:**

Wanlaya Klinthong
klinthong_fai@hotmail.com

Abstract

Coral recovery following natural and human impacts depends partly on coral recruitment, which is a critical ecological process on tropical coral reefs to enhance coral populations following major disturbances, particularly coral bleaching events. Quantitative studies on coral larval supply and recruitment patterns in the Gulf of Thailand are limited. We used settlement plate experiments to examine coral recruitment patterns at six study sites in Mu Ko Chumphon and Mu Ko Angthong, the Western Gulf of Thailand. The sedimentation rates at reef sites in Mu Ko Angthong were higher than those in Mu Ko Chumphon. This study investigated coral recruitment on the reefs using the settlement plate experiments. The settlement plates were made from terracotta and submerged at the study sites from April 2016 to March 2018. The densities of coral recruits on settlement plate experiments at reef sites in Mu Ko Chumphon were significantly higher than those at Mu Ko Angthong. The highest density of coral recruits was found at Ko Kula in Mu Ko Chumphon, while the lowest one was observed at Ko Wua Kan Tang in Mu Ko Angthong. Coral recruits mainly attached settlement plates on a horizontal angle. *Pocillopora* spp. was the most dominant coral recruit on the settlement plate experiments at all study sites. The dominant coral recruits included *Porites* sp., *Fungia* spp. and *Goniastrea* spp. Filamentous algae were also the most dominant group on the settlement plates. This study provides quantitative baseline scientific data to understand coral recruitment patterns in different coral reef conditions in the Western Gulf of Thailand. A long-term monitoring program for coral recruitment in the Gulf of Thailand is required.

Community structure of soft bottom macrofauna on fringing reefs in the Western Gulf of Thailand

Laongdow Jungrak^{1,*}, T.Yeemin¹, M. Sutthacheep¹, S. Phoaduang¹, S. Rongprakhon¹
¹Marine Biodiversity Research Group, Department of Biology, Faculty of Science, Ramkhamhaeng University, Bangkok, Thailand

*** Correspondence:**

Laongdow Jungrak
Laongdow8853@gmail.com

Abstract

Soft bottom macrofauna in coastal habitats, particularly seagrass beds and coral reefs, is one of the major components of coastal ecosystems. Connectivity between reef structure and their associated communities is linked to food web complexity in the coral reef ecosystem. There are no studies on soft-bottom macrofauna on coral reefs in the western Gulf of Thailand. This study examined the composition and abundance of macrofauna living in the soft bottom at three coral reef sites, i.e., Ko Mattra, Ko Maphrao and Ko Lawa, in Mu Ko Chumphon, the Western Gulf of Thailand. The sediment sample was collected by a novel device that was pushed into the sediment. Overall, the densities of macrofauna were significantly different among reefs sites. The major groups of macrofauna at nearshore reef sites were bivalves, gastropods, and calanoid copepods. On the other hand, nematods, some species of polychaetes and amphipods were the main components of offshore reef sites. This study highlights that soft-bottom macrofauna in coral reefs can be used as a bioindicator of the coral reef ecosystems. Moreover, they can be utilized for fisheries, mariculture as well as pharmaceutical and cosmetic products.

Mass coral bleaching impacts and recovery potentials in the Islands of Ryukyu Archipelago

Takashi Nakamura¹, Mariyam Shidha Afzal², Dio Dirgantara, Konomi Takeuchi, Kana Ikeda³

¹Faculty of Science, University of the Ryukyus, Okinawa, Japan

²Graduate School of Engineering and Science, University of the Ryukyus, Okinawa, Japan

³Regeneration network of the sea in Yoron Island (NPO), Kagoshima, Japan

*** Correspondence:**

Takashi Nakamura

takasuke@sci.u-ryukyu.ac.jp

Abstract

Catastrophic disturbances including thermal anomaly-induced “Coral bleaching”, the paling of corals through loss of symbiotic algae “Zooxanthellae” and/or loss of photosynthetic pigments from algae, has become the major concern in coral reef ecosystem during the last several decades. Ongoing monitoring revealed serious impacts of recent mass-bleaching event as well as the variations in recovery potentials from the mass bleaching event among Islands of Ryukyu Archipelago. Coral reefs in the Anthropocene must tackle the complex interactions involving ecosystem itself as well as the human activities in social and economic aspects to prevent the further decline in coral populations and associated degradation. The “Ridge to Reef” strategic conservation approaches supported by multidisciplinary research should be taken to solve such problem.

Multidecadal changes in coral reef community structure and function following multiple disturbances

Chiara Pisapia^{1,*}, Alessandra Conversi²

¹King Abdullah University of Science Technology, Kingdom of Saudi Arabia

²ISMAR-Lerici - Institute of Marine Sciences Lerici- CNR - National Research Council of Italy, Italy

*** Correspondence:**

Chiara Pisapia

chiara.pisapia.1@gmail.com

Abstract

In a rapidly changing world dominated by anthropogenic disturbances and global change, there is a great need to understand the ways through which coral reef structure and function are being perturbed and their potential trajectories. Understanding future trajectories is fundamental to develop the best management approaches to avoid coral reef collapse. Current efforts may not be enough to identify the fundamental mechanisms causing changes in ecosystem structure and function. To contribute to understanding how coral reefs change in response to environment and anthropogenic stressors, we need to better understand long-term coral demographic processes and in-situ dynamics of ecosystem function. Here we document multidecadal changes in reef community structure and metabolic function following multiple acute disturbances such as bleaching. By 2050, the window to act on climate change mitigation will have closed. With no time to spare, it is fundamental to develop management actions to ensure a positive pathway for the future of globally threatened coral reefs.

Exploring an underwater pinnacle as a thermal refuge in the Andaman Sea

Makamas Sutthacheep^{1,*}, Sittiporn Pengsakun¹, Wanlaya Klinthong¹, Prarop Plangngan², Supawadee Hamanee³, Thamasak Yeemin¹

¹Marine Biodiversity Research Group, Department of Biology, Faculty of Science, Ramkhamhaeng University, Bangkok, Thailand

²Phuket Marine National Park Operation Centre 2, Department of National Parks, Wildlife and Plant Conservation, Phuket Province, Thailand

³School of Business Administration, Sripatum University, Bangkok, Thailand

***Correspondence:**

Makamas Sutthacheep
smakamas@hotmail.com

Abstract

There are several unexplored underwater pinnacles in the Andaman coast of Thailand which can be dive sites due to their unique environment and high biodiversity. Some of the underwater pinnacles are mainly covered by scleractinian corals and their associated marine organisms which provide ecosystem services as important as coral reef ecosystems. It is recognized that marine ecotourism is one of the coral reef ecosystem services, greatly contributing to the economic growth and livelihoods of Thailand and other tropical countries. Exploring new marine ecotourism sites is very important for the solutions to reduce pressures on major dive sites and providing coral refuges from bleaching events. This study found the coral communities on a newly discovered dive site, Prathong underwater pinnacle, in the Upper Andaman Sea. It is a potential dive site for ecotourism development. We observed several dominant coral species on the underwater pinnacle, such as *Porites lutea*, *Symphyllia radians*, *Pocillopora eydouxi*, *Tubastraea coccinea*, *Tubastraea micranthus*, etc. The other benthic macroinvertebrates included a sea anemone (*Heteractis magnifica*), soft corals (*Acanthogorgia* spp., *Annella* spp., and *Dendronephthya* sp.). We also observed some dominant reef fishes, including *Chromis cinerascens*, *Chromis weberi*, *Pomacentrus moluccensis*, and *Thalassoma lunare*. Based on the ecotourism assessment, Prathong underwater pinnacle has a high potential to be developed as a new dive site in the Andaman Sea. This study provides integrated baseline information of a newly discovered underwater pinnacle as a coral refuge in the Andaman Sea, to promote sustainable ecotourism management and mitigate negative impacts on vulnerable corals in the Western Pacific.

Insights on coral response and recruitment in an acidified environment in Mabini, Batangas

Joana Andrea C. Maningas¹, Katya G. Bonilla¹, Atsuko Yamazaki², Maria Vanessa Baria-Rodriguez¹

¹The Marine Science Institute, University of the Philippines, Diliman, Quezon City, Philippines

²Department of Earth and Planetary Sciences, Faculty of Science, Kyushu University, Fukuoka, Japan

***Correspondence:**

Joana Andrea Maningas
jcmaningas@up.edu.ph

Abstract

Coral reefs exhibit different adaptive responses to local and global environmental disturbances. Controlled experiments under laboratory settings have been essential in identifying ecosystem response to threats such as ocean acidification. The presence of CO₂ bubbles escaping through shallow water vents resulting in lower pH in Mabini, Batangas served as the natural laboratory for coral fragment transplantation experiment and deployment of recruitment tiles. The study area was categorized into two 5x5 m quadrats designated as Non-vent (control) and Vent sites where fragments (9-12 mo) and tiles (3 and 9 mo) were deployed prior to their retrieval. Site characterization exhibited a pH range of 7.93 and 7.99, Ω_{arag} values were at 2.87 and 3.20, for Vent and Non-vent respectively. Benthic coverage for Vent site had higher algal cover and lower hard coral coverage than the Non-vent site. Both sites were dominated by corals from the genus *Porites*. Transplantation of the dominant genera showed that survival rate in Non-vent was 6% higher than Vent site, as well as remaining live radial tissue cover. However, calcification rates of fragments transplanted in Vent site were higher (0.321 g cm⁻³ mo⁻¹) than in Non-vent (0.240 g cm⁻³ mo⁻¹). Variability of environment conditions in each site could have influenced local physiological acclimatization of coral fragments. Coral recruitment was higher in Vent site with 0.52 recruit m⁻¹ on tiles retrieved at 9 mo. Settlement of crustose coralline algae was higher on tiles retrieved at 9 mo while bryozoans were lower. These information sheds light on the potential local acclimatization of reefs to environmental conditions with high pCO₂ levels.

A coral restoration project for enhancing stress-resistant coral populations in the Gulf of Thailand

Wiphawan Aunkhongthong^{1,*}, M. Sutthacheep¹, T. Yeemin¹, S. Pengsakun¹, C. Chamchoy¹, C. Ruengthong², J. Cowintawong³

¹Marine Biodiversity Research Group, Department of Biology, Faculty of Science, Ramkhamhaeng University, Bangkok, Thailand

²Chumphon Marine National Park Operation Center 1, Department of National Parks, Wildlife and Plant Conservation, Chumphon Province, Thailand

³Marine National Park Management Division, Department of National Parks, Wildlife and Plant Conservation, Bangkok, Thailand

*** Correspondence:**

Wiphawan Aunkhongthong
toeytoeywiphawan@gmail.com

Abstract

The shallow reef flat, varying about 0.5-1.0 meters in depth, has variations in temperature, salinity, and light intensity. However, several scleractinian corals are resistant to extreme environmental and coral bleaching events. A coral reef restoration project was developed using small fragments of high stress-resistant corals from a breeding stock in shallow reef flats. Selected healthy coral colonies of *Porites lutea*, *Pocillopora acuta*, *Pavona decussata*, *Dipsastraea favus* were transplanted to the dome-shaped nursery areas, placed at the reef slopes. The coral fragments at the nursery areas were assessed in terms of their growth rate, partial mortality, coral diseases and bleaching resistance. The selected coral fragments were then transplanted to the degraded reef sites in the national park for enhancing live coral cover and diversity. Several shallow reef flat corals such as *Favitea abdita*, *Turbinaria mesenterina* and *Goniopora columna*, etc., were also available for coral restoration projects in the Gulf of Thailand. This study provides a case study of coral reef restoration project, using parent coral colonies from shallow reef flat environments, showing a strategy to enhance high stress-resistant coral populations for the climate change crisis.

Microplastics in scleractinian corals from estuarine environment in the Inner Gulf of Thailand

Arirush Wongnutpranont^{1,*}, M. Sutthacheep¹, D. Sangiamdee², L. Sangsawang³, N. Sangmanee¹, C. Chamchoy¹, S. Phoaduang¹, T. Yeemin¹

¹Marine Biodiversity Research Group, Department of Biology, Faculty of Science, Ramkhamhaeng University, Bangkok, Thailand

²Department of Chemistry, Faculty of Science, Ramkhamhaeng University, Bangkok, Thailand

³Marine and Coastal Resources Research and Development Center, Eastern Gulf of Thailand, Department of Marine and Coastal Resources, Klaeng District, Thailand

*** Correspondence:**

Arirush Wongnutpranont
arirush.wong@gmail.com

Abstract

Microplastics are plastic fragments having a size of less than 5 mm in diameter, which are considered a significant problem in marine ecosystems worldwide. The majority of microplastics are from land-based sources, discharged into the sea via rivers. The Chao Phraya and Bang Pakong are the main rivers, considered as the main gateway where microplastics particles are transported along the rivers to the Inner Gulf of Thailand. The estuarine environment and its vicinity, particularly coral communities, are affected by microplastics. This study aimed to quantify the density of microplastics in corals living near the estuaries in the Inner Gulf of Thailand. Several corals were collected from the coral communities at Mu Ko Sichang, located near the river mouths. Microplastic particles were found in several dominant coral species, i.e. *Acropora muricata*, *Galaxea fascicularis*, *Pocillopora acuta*, *Porites lutea*, *Favites abdita* and *Favia speciosa*. The microplastics were generally observed in the mouth and among the mesenteries of the coral polyps. The microplastic particles identified by using a Fourier transform infrared spectroscopy (FTIR) showed that the densities of microplastics varied among coral species. The highest density of microplastics was found in *Galaxea fascicularis*. The fibrous microplastics were mainly found and were identified as Polyethylene terephthalate (PET). Our results showed that microplastic contamination can be found in corals and may have some negative impacts on corals, particularly potential effects on calcification and growth.

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

Ploypailin Rangseethampanya^{1,*}, T. Yeemin¹, M. Sutthacheep¹, C. Ruengthong²

¹Marine Biodiversity Research Group, Department of Biology, Faculty of Science, Ramkhamhaeng University, Bangkok, Thailand

²Chumphon Marine National Park Operation Center, Department of National Parks, Wildlife and Plant Conservation, Chumphon Province, Thailand

*** Correspondence:**

Ploypailin Rangseethampanya
ploypailinr@outlook.com

Abstract

Coral reefs provide essential habitats for fish across a wide range of spatial scales. They are increasingly threatened by climate change associated with rising sea surface temperatures. Fish assemblages may be affected under these changing climate events, given that many species utilize coral reef ecosystems as a food source and refuge. Deeper habitats such as underwater pinnacles may offer some shelters from the climate change impacts. Since the fundamental knowledge of coral reefs is mostly from nearshore reefs studies, Communities on underwater pinnacles are not widely scientifically investigated. This study was undertaken on an underwater pinnacle, Hin Phae and a fringing reef, Ko Mattra located in Chumphon Province, the Western Gulf of Thailand. Fish assemblage structures were assessed using Underwater Visual Census techniques (UVC). A total of 48 fish species from twenty families were identified. Hin Phae appeared a higher diversity ($H' = 5.8$) with 44 species from 16 families, while Ko Mattra showed a lower diversity ($H' = 1.3$), with 34 species from 16 families. Three families of target fish presented at both study sites were six species of Serranidae, four species of Nemipteridae, three species of Lutjanidae, one of each Muraenidae and Carangidae. The target fishes were considerably more diverse at Hin Phae (14 species) than those in Ko Mattra (5 species). Overall, this study indicates that the underwater pinnacle is relatively isolated from nearshore environment and supports high fish biodiversity. The underwater pinnacle should be properly managed to enhance its resilience to climate change and anthropogenic disturbances.

Evaluating the impact of climate change on potential distribution of Japanese anchovy (*Engraulis japonicus*) using species distribution model

Shuhao Liu¹, Yang Liu^{1,*}, Irene D. Alabia², Yongjun Tian¹

¹Laboratory of Fisheries Oceanography, College of Fisheries, Ocean University of China, Qingdao, China

²Arctic Research Center, Sapporo, Japan

*** Correspondence:**

Yang Liu
yangliu315@ouc.edu.cn

Abstract

Japanese anchovy (*Engraulis japonicus*) is a small pelagic fish that plays an important role in the marine ecosystem of the Northwestern Pacific and is likewise a valuable species for human consumption. The spatial distribution and fluctuations in abundance of Japanese anchovy are largely affected by climate change and marine environmental variations. We explored the link between abundance of Japanese anchovy and environmental conditions using species distribution models (SDM). The SDM were fitted with the catch per unit effort (CPUE) as the response variable and remotely sensed data [sea surface temperature (SST), sea surface chlorophyll-a], numerical model-predicted sea surface salinity (SSS), meridional and zonal ocean flow components, and bathymetry as environmental covariates. A comparison of all SDMs showed that generalized additive models (GAM) perform well in predicting potential distribution of wintering Japanese anchovy. Our results showed that the CPUE was significantly influenced by SST, SSS, feeding opportunity, and ocean currents. The salinity front was detected as the main sea surface feature associated with wintering ground of Japanese anchovy, highlighting a strong relationship between SSS and CPUE distributions in winter. Based on GAM, the rising temperatures will result in the wintering Japanese anchovy northward habitat shift and the increasing relative abundance by the end of the century. The relationship between CPUE and SST in winter also showed a significant positive correlation ($R^2=0.69$, $p < 0.01$), both indicated a significant negative correlation with Niño 1+2. Our results highlight how changing climate will affect the geographic distribution of a major fish stock, with implications for both ecosystem dynamics and fishery benefits.

Potential impact of predation by larval Spanish mackerel on larval anchovy in the central Seto Inland Sea, Japan

W. Deguchi¹, T. Fujita², M. Yoneda³, N. Kono⁴, M. Yamamoto², K. Harada¹, Takeshi Tomiyama^{1,*}

¹Graduate School of Integrated Sciences for Life, Hiroshima University, Higashi-Hiroshima, Japan

²Kagawa Prefectural Fisheries Experimental Station, Takamatsu, Japan

³Hakatajima Field Station, Fisheries Technology Institute, Japan Fisheries Research and Education Agency, Imabari, Japan

⁴Fisheries Resources Institute, Japan Fisheries Research and Education Agency, Hatsukaichi, Japan

*** Correspondence:**

Takeshi Tomiyama

tomiya@hiroshima-u.ac.jp

Abstract

Japanese Spanish mackerel (JSM) *Scomberomorus niphonius* is a top predator in the Seto Inland Sea in Japan, and its piscivory is known to occur from the larval stage. In the central Seto Inland Sea, the catch of larval Japanese anchovy *Engraulis japonicus* has decreased considerably since 2014, but the causes driving this reduction have not well been determined. The recruitment per egg abundance of the anchovy, as a proxy of early survival rate, has dramatically decreased in the last decade, while the stock of JSM in the Seto Inland Sea has increased. Thus, we hypothesized that the change in the prey-predator relationship between anchovy and JSM during early life stages may account for reduction of anchovy recruitment. Here, we investigated the abundances of larval JSM and larval anchovy, using a bongo net, in the field in 2018 and 2019, and estimated the predation impacts of larval JSM on larval anchovy. The density of larval JSM was relatively low at 2-5 individuals per 100 m³, whereas that of larval anchovy was high at 100-1000 individuals per 100 m³. The abundance of larval JSM was higher than that in the past survey from 2002-2005. Our model simulation suggested that consumption of larval anchovy by larval JSM was occasionally high around 7% in a few cohorts of the anchovy, but these findings did not fully support our hypothesis abovementioned.

The lobo-lobo fry fishery in western Visayan Sea: Catch composition and potential fisheries impact

Alexandra B. Regalado, Wilfredo L. Campos

¹Oceanbio lab, College of Arts and Sciences, University of the Philippines Visayas, Miagao, Iloilo

aabagarinao@up.edu.ph

Abstract

Lobo-lobo are small fishes that are caught using fine mesh nets in western Visayan Sea. It serves as local delicacy with high consumer demands. It is targeted year-round and is not only comprised of several species but also of early juvenile fish. If so, continuous heavy exploitation could eventually lead to the depletion of adults in the stock. This study was conducted in Northern Iloilo, Philippines, specifically in Concepcion. Catches of fine-meshed round haul seine which target large amounts of small and early juvenile fishes were monitored daily from June to December 2016. One (1) kg of lobo-lobo were randomly subsampled from the catches 4x a month and preserved in 10% buffered formalin. A total of 32 samples were processed and analyzed (~15,000 individuals identified to family level) during the study period, covering both monsoon seasons (southwest and Northeast monsoon). Several species comprise the *lobo-lobo* catches (25 families), dominated by Engraulidae (76.0 %) and Clupeidae (21.1%) that are mostly comprised of post larvae to early juvenile stage with size ranging from 0.7-3.6cm. The estimated catch of the gear during the period of study is 163.9 mt. The concentration of fishing operations appears to be consistent but catches differed seasonally. Catches during southwest monsoon was dominated by Engraulidae while northeast monsoon was dominated by Clupeidae. The abundance of clupeids during these months coincides with the reported spawning season of sardines in the Visayan Sea. Most post-larval and early juvenile clupeids, engraulids and leiognathids were caught in specific areas which provides insights on potential spawning and nursing grounds of these species. This area appears to be a critical habitat, supporting the growth of a number of species. Protecting these areas and restricting the use of fine-meshed nets targeting fry will likely have a positive impact on sardine and other small pelagic stocks.

Contributions, challenges, and opportunities of the small-scale anchovy fisheries in Thailand

Nova Almine^{1,*}, R. Chuenpagdee¹, S. Satumanatpan²

¹Department of Geography, Memorial University of Newfoundland, Canada

²Faculty of Environment and Resource Studies, Mahidol University, Thailand

***Correspondence:**

Nova Almine

nmalmine@mun.ca

Abstract

Small fish such as anchovies, which are one of the most landed fish globally targeted by large-scale and small-scale fisheries, are a good source of protein and packed with micronutrients, especially when eaten whole. While anchovies from the large-scale fisheries are destined for fishmeal, catch from the small-scale fisheries goes to direct human consumption, processed as dried, smoked, and fermented to extend shelf life, allowing for ease in storage and distribution to remote areas, providing thus a steady supply of fish protein throughout the year. Although smaller in terms of production, small-scale fisheries provide jobs and livelihoods to many people both in harvest and post-harvest sectors, particularly in low-income communities. However, compared to the large-scale sector, information on the small-scale anchovy fisheries is limited. This paper aims to fill the knowledge gaps with the study of the small-scale anchovy fisheries in Thailand, which is a leading country in anchovy production with a total catch of 143,000 tons in 2019. Anchovy is an integral part of the Thai diet, often processed into fish sauce, fish paste, and dried fish, supplying both domestic and export markets. The study compares large-scale and small-scale anchovy fisheries in Thailand in terms of catch, values, and utilization through literature review and based on existing data sources and field observations. It also captures critical issues and concerns affecting the sustainability of small-scale anchovy fisheries.

A value chain analysis of the dried sardine industry in the Philippines

Ruby Napata^{1,*}, A.S. Sefil², T.A.G. Famatid³, E.M. Peralta², H.M. Monteclaro³, E.E.S. Yap²

¹Institute of Fisheries Policy and Development Studies, College of Fisheries and Ocean Sciences, University of the Philippines Visayas, Philippines

²Institute of Fish Processing Technology, College of Fisheries and Ocean Sciences, University of the Philippines Visayas, Philippines

³Institute of Marine Fisheries and Oceanology, College of Fisheries and Ocean Sciences, University of the Philippines Visayas, Philippines

*** Correspondence:**

Ruby P. Napata

rpnapata@up.edu.ph; rubynapata@gmail.com

Abstract

Seafood is considered as one of the most important internationally traded food commodities. The increased seafood trade activities resulted to the growing concerns for the sustainability of fisheries and the distribution of benefits from trade activities in the primary sectors (Gudmundsson *et al.*, 2006). In the Philippines, sardines are among these well-traded seafood commodities. The sardine fisheries remain a commercially important aquatic resource in the country that has an economic value both for the small-scale (municipal) and the large-scale (commercial) production sectors. It is a major industry which provides jobs and generate revenues at the local and national levels. However, just like any other seafood commodities, the economic opportunities derived from the sardine industry are highly dependent on the state of the resource. Similar to any fishery resource, the risk of overharvesting or overexploitation of sardines is high.

The methodology used in this research was based on the concept of the value chain in which the sardine fish value chain networks were mapped and for each part of the chain, primary data were collected through surveys and focus group discussions. A total of 71 sardine dryers in the five regions of the country where sardines are one of their major fishery commodity were interviewed. The entire supply chain was examined. Data on the source of sardines, fishing practices, handling and drying practices, packaging and marketing, perceptions on laws and policies regarding sardines and resource management interventions were discussed. Finally, some policy recommendations were drafted based on all the data gathered.

Dried fish consumption in Myanmar

Sithu Lin¹, Benjamin Belton², Wae Win Khaing³

¹Department of Gender and Development Studies, Asian Institute of Technology, Bangkok, Thailand

²Department of Agricultural, Food and Resource Economics, Michigan State University, East Lansing, USA

³Department of Anthropology, University of Manitoba, Winnipeg, Canada

*** Correspondence:**

Wae Win Khaing

khaingww@myumanitoba.ca

Abstract

Most people consume dried fish in Myanmar, and it is of vital nutritional, economic, social, and cultural importance. Dried fish products are important for poor and vulnerable people as it is some of the cheapest and most widely available nutritious food. Regardless of several challenges including large number of women and vulnerable labors, poor working conditions, poor food safety, the dried fish production and distribution in Myanmar is overlooked. Myanmar Dried Fish Consumption Survey (MDFCS) is conducted in 2019 and 2020 to understand different patterns of dried fish consumption in the country as part of the Dried Fish Matters Project Phase I. It is a quantitative survey that captures the type and amount of dried fish and fish products consumed by a family, source of fish consumed, location of purchases, and their consumption behaviors based on their locations. Both fresh and processed fish including dried fish are consumed once a week by the households living in Ayeyarwady, Yangon, Mon, Kayin, Mandalay and Sagaing except Northern Shan, which is located in the hilly region. However, 55% of the responded households consumed at least one type of fish product within a week. Consumption of dried fish products contribute daily nutrition across the surveyed areas, and it is highly correlated to the locations of respondents. The consumption patterns change according to the locations and availability of the products.

Towards a social economy of dried small fish in Southeast Asia

Benjamin Belton^{1,2,*}, **Kyoko Kusakabe**³

¹WorldFish, Penang, Malaysia

²Department of Agricultural, Food and Resource Economics, Michigan State University, East Lansing, USA

³Department of Development and Sustainability, Asian Institute of Technology, Pathum Thani, Thailand

*** Correspondence:**

Ben Belton

b.belton@cgiar.org

Abstract

The drying of fish provides a low cost, elegant solution to the preservation of small fish in Southeast Asia that delivers important nutritional benefits to large populations. At the same time, dried fish processing practices, preferences, histories, culinary styles, and other aspects of dried fish value chains vary substantially across Southeast Asia. We label this diversity as the different social economies of dried fish in Southeast Asia. This presentation summarizes key findings about the variability in dried fish social economies, based on literature reviews and scoping studies in three Southeast Asian countries (Cambodia, Myanmar, Thailand), emerging from the Dried Fish Matters project. We reflect in particular on how different patterns within the region reflect contextual factors and distinctive trajectories of change, and how this intra-regional variability may influence the ecological and nutritional sustainability of dried fish value chains.

Climate change and small pelagic fish in India: Implications for fisheries and nutrition

Abilasha Sharma¹, I. Khot^{1,*}, N. Namboothri^{1,*}

¹Dakshin Foundation, Bengaluru, India

***Correspondence:**

I. Khot

ishaan.khot@dakshin.org

N. Namboothri

naveen.namboog@gmail.com

Abstract

Small pelagic fish such as sardines, anchovies, and mackerels, are economically significant and form the backbone of Indian fisheries. In 2019, they made up about 19% of the total marine fish landings in India. The shoaling nature of these species and their high abundance in nearshore waters make them accessible to thousands of small-scale fishers, thus ensuring their livelihood. Small pelagic fish, both in fresh and dried forms, also offer an affordable source of protein and essential micronutrients, especially for coastal communities. Additionally, small pelagics such as the Indian oil sardine are also utilized to extract high-quality fishmeal and fish oil to rear high export value species like shrimp.

Though abundant, populations of these fish are known to fluctuate significantly and are sensitive to slight changes in the environment. Further, rising sea surface temperatures, an important indicator of climate change, can alter the critical process of upwelling, affecting the abundance of phytoplankton which forms the base of the marine food chain.

Studies along the Indian coastline have shown changes in the distribution patterns and biology of pelagics in response to sea surface temperatures. While the distribution of the Indian oil sardine increased towards northern latitudes, that of the Indian mackerel increased vertically, towards deeper waters. These shifts in distribution and changing utilization patterns are in turn changing the fishing patterns across the Indian coastline. This can increase the fishing pressure on these already stressed pelagic fish populations. Overfishing coupled with climate change has emerged as the reason behind the recent drastic decline in Indian oil sardine catches. Impacts of such declines can ripple through the trophic structure, impacting the marine ecosystem, and have cascading impacts on the associated socio-economic aspects. In this presentation, we will synthesize existing research on the subject and also share preliminary insights from Dakshin Foundation's ongoing work. We will discuss the potential implications of such transitions and highlight directions for further research.

Small fish and small fisheries on the Kutch coast: Insights from a field study

Tara Nair^{1,*}, **Bharat Patel**²

¹Gujarat Institute of Development Research, Ahmedabad

²CPR-Namati Environmental Justice Program, Kutch

***Correspondence:**

Tara Nair

tara01@gmail.com

Abstract

This paper explores the conditions and relations of production and processing of a distinct small pelagic fish species, golden anchovies, on the Kutch coast of the western Indian state of Gujarat. Gujarat accounts for about 10 per cent of the total landing of anchovies in India since the mid-2000s. In the Kutch fisheries, the species forms an important catch next only to the famed Bombay Duck. Golden anchovies are known to be nutrition-dense, the consumption of which could enhance the overall quality of protein and micronutrient content of human diet. However, there is far less emphasis in contemporary times on these values as fishing, processing and trading have come to be governed increasingly by competitive business concerns. Challenges posed by climate variations and a largely apathetic state have deepened this neglect.

The paper draws on the findings of a survey conducted in June 2021 among a purposively selected sample of fishers, processors and traders in three coastal villages of Kutch. The socio-economic characteristics of small fish producers/ processors, production and market conditions, and the relationship between different value chain players are the core themes of the paper.

The Kutch coast is an interesting site in that it has witnessed tumultuous changes over the last decade due to the conflict between the aggressive port-linked industrialisation strategy of the provincial government and the desperate fight to protect their livelihood by the local fisherfolk, mostly belonging to the Muslim community. In order to sustain the lifeforce of this resistance, the fisherfolk have adopted innovative strategies such as setting up a producers' collective that extends finance and marketing support to the members. The paper would critically review the impact of the collective with a view to derive some implications for such struggles elsewhere in the country.

Value stream analysis and middlemen impact on smoothbelly sardinella dried fish value chain on the Northwest coast of Sri Lanka

Shalika Wickrama*, D.N. Koralagama

¹Department of Agricultural Economics, Faculty of Agriculture, Dried Fish Matters University of Ruhuna, Matara, Sri Lanka

*** Correspondence:**

Wickrama PSSL

shalikalaksan@gmail.com

Abstract

Small-pelagic dried fish varieties are consumed in several dishes in Sri Lankan cuisine and provide essential nutrition, irrespective of people's income levels. Smoothbelly sardinella (*Amblygaster cluepeoides*) is a major dried fish variety with high consumption in Sri Lanka. Prices, value creation, processing and handling practices are important in determining the profitability and market margin at each node of the value chain. Value Stream Analysis (VSA) is an effective tool to assess the process path activities including value addition, which leads to fair prices and profit shares. Thus, this study aims to conduct a VSA and middlemen impact assessment for the smoothbelly sardinella value chain on the Northwest coast of Sri Lanka in order to support an effective pricing mechanism. A simple random sampling technique was employed to select processors and traders (25 from each). Qualitative data collection methods including in-depth interviews and key informant interviews were employed in collecting primary data. Descriptive statistical methods were used for the analysis. Results revealed 11 Value Added Activities (VA), 05 Necessary Non Value Added (NNVA) and 03 Non Value Added (NVA) activities from processor to retailer. Processors engage with 72% VA, 40% NNVA and 33% NVA, spending 109 hours on average for producing 200Kg smoothbelly sardinella. The contribution of wholesalers is 18% (VA), 40% (NNVA) and 33% (NVA) activities, spending 54 hours, while that of retailers is 9% (VA), 33% (NNVA) and 20% (VA), spending 98 hours. The profit shares of processors, wholesalers and retailers are 11%, 17% and 14% respectively. The market margin is 31% for the value chain. This reveals inequitable profit sharing and price distribution, as well as poor value addition along the smooth-belly sardinella value chain. Fair pricing and profit margins through an effective pricing mechanism related to value addition contributed at each node are recommended.

Dried fish for nutrition: Change in consumption patterns and preferences, and implications towards nutrition security

Sami Farook^{1,*}, B. Belton², K. Pendakur³, D. Johnson⁴, E. Haque⁵, S.Thilsted⁶

¹PhD student, Natural Resources Institute, University of Manitoba, Winnipeg, Canada

²Senior Scientist, Value Chain and Nutrition, WorldFish Center, Penang, Malaysia

³Professor, Department of Economics, Simon Fraser University, Burnaby, Canada

⁴Professor, Anthropology, University of Manitoba, Winnipeg, Canada

⁵Professor, Natural Resources Institute, University of Manitoba, Winnipeg, Canada

⁶Research Program Leader, Value Chains and Nutrition, WorldFish Center, Penang, Malaysia

*** Correspondence:**

Sami Farook

farooks@myumanitoba.ca

saminaimfarook@gmail.com

Abstract

Fish are a major part of diet in South and South-East Asia. It counts for 56% of total protein intake in Bangladesh and 13% in India. A good share of fish catch in such developing countries is processed by sun drying, fermentation, smoking and salting. Drying the fish results in weight reduction, dehydration and concentration of nutrients. Dried fish are mostly made of small and medium sized from capture fisheries, micronutrient content of which are rich and much higher than usually found in cultured fish. Small dried fishes are usually low in price, easily divisible and can be stored and transported for accessibility by the poorest and most vulnerable communities. Dried fish can therefore play a vital role in nutrition security, particularly for the poor and vulnerable during times of stress (natural disasters, economic shocks, etc.) Though DFM countries in the Global South have made good progress in hunger reduction in recent decades, nutrition security still remains a pressing issue. Despite the importance of dried fish for nutrition security, global literature in this subject is limited.

This paper explores how consumption pattern of dried fish are changing over time across Bangladesh in different regions, among socioeconomic groups (poor vs. non-poor), compared to other animal source food (fresh fish and meat). We also want to empirically estimate how preference of dried fish are changing over time across the poor and non-poor consumers, compared to other animal source food, controlling for age, sex and education of household members. This work is done with secondary data analysis. Four (Years 2000, 2005, 2010 and 2016) rounds of National Household Income and Expenditure Surveys (HIES) conducted by Bangladesh Bureau of Statistics (BBS) periodically (every five years) is considered. Preliminary results reveal that over time there has been a persistent fall in dried fish consumption with a rise in consumption for chicken and fresh cultured fishes. Such fall is greater among poor consumers compared to the non-poor. Empirical estimations indicate that preference may be shifting away from dried fish and towards poultry meat over time, with a rise in income of consumers.

Towards a social economy of dried small fish in South Asia

Nikita Gopal^{1,*}, Amalendu Jyotishi², Emdad Haque³, Ramachandra Bhatta⁴, Holly Hapke⁵

¹ICAR-Central Institute of Fisheries Technology, Kerala, India

²School of Development, Azim Premji University, Bangalore, India

³Natural Resources Institute, University of Manitoba, Winnipeg, Canada

⁴Snehakunja Trust (Regd.) Kasarkod, Karnataka, India

⁵University of California, Irvine, USA

*** Correspondence:**

Nikita Gopal
nikiajith@gmail.com

Abstract

Drying has been one of the oldest practices for preservation of fish extensively used in several countries including in South Asia. The ensuing product is a source of income and also contributes to food and nutritional security of households. The definition of 'dried' fish has expanded to include other forms of preserved fish like salted, fermented, smoked, pickled etc. in various local and regional contexts. This presentation is a brief synthesis of findings from the scoping phase of the Dried Fish Matters project that is looking at various dimensions of the social economy of dried fish, and focuses on findings from three South Asian countries, Bangladesh, India and Sri Lanka. We examine the changes in the availability of small marine fish for drying focusing on changes in fishing practices and regulations; processing and trading from a value chain perspective. In the process, we understand the factors explaining changes in procurement, processing & trading and vulnerability of the people engaged in the sector especially women. We also examine the implications of such changes and vulnerability on nutrition, quality and safety impacting food security. The overarching goal thus is, to understand how these aspects may influence long term sustainability of dried fish value chains especially in South Asian context.

Marine spatial planning evaluation: An Ecological Vulnerability Index perspective

Qinhua Fang^{1,2,*}, Jiafang He²

¹Fujian Provincial Key Laboratory for Coastal Ecology and Environmental Studies, Xiamen University, Xiamen, China

²Coastal and Ocean Management Institute, Xiamen University, Xiamen, China

*** Correspondence:**

Qinhua Fang
qhfang@xmu.edu.cn

Abstract

Marine spatial planning has become a key to balance protection and development all around the world. In this study, 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 was proposed. The current marine spatial plan (Scenario 0) and 2 designed scenarios, namely Scenario 1 (protection priority, expanding the area of marine protection areas and promoting the construction of coastal trunk protection forests) and Scenario 2 (development priority, increasing the development intensity of the sea areas) were analyzed. The main findings are as follows: (1) The Ecological Vulnerability Index (EVI) of the main island of Pingtan and its surrounding waters is 0.58, which is in a middle-low vulnerability state; (2) The EVIs of Scenario 1 and Scenario 2 are 0.55 and 0.60 respectively. Together with the further discussion, the evaluation contributes to improve the MPS of study site in the future.

Temporal and spatial evolution and influencing factors of land-sea social-ecological system

Jiangyun Li¹, Mingbao Chen^{2,3}

¹Institute of Sustainable Development, Macau University of Science and Technology, Macao SAR, China

²Marine Development Center, Macau University of Science and Technology, Macao SAR, China

³Southern Marine Science and Engineering Guangdong Laboratory, China

Abstract

Ocean and Coastal is the most significant area of land-sea interaction, and it is also the high-frequency area of high-intensity interaction between human activities and marine ecological environment, which constitutes a complex social-ecological system. Understanding the temporal and spatial evolution process of social-ecological system under complex land-sea interaction, evaluating the performance of land-sea social-ecological system vulnerability and revealing its impact mechanism are conducive to the sustainable economic and social development of coastal areas. The Great Bay area of Guangdong, Hong Kong and Macao is close to the South China Sea and located in the Pearl River delta plain. Its economic and social development depends on the ocean and coastal. It is a typical area of complex social-ecological system under the interaction of land and sea. For a long time, with the economic and social development and the utilization of coastal marine resources and ecology in the Great Bay area of Guangdong, Hong Kong and Macao, it has led to the over utilization of marine resources and serious ecosystem degradation, and the ecological vulnerability is becoming more and more obvious. Although good progress has been made in ecological construction and environmental governance in recent years, the demand for social and economic development will further lead to tension between people and sea. Therefore, based on the relevant data of 11 cities in the Great Bay area from 2009 to 2019, this paper selects indicators from the three aspects of exposure, sensitivity and adaptability to build an evaluation index system of land and sea social ecosystem for social system vulnerability, economic system vulnerability and ecosystem vulnerability, The temporal and spatial evolution characteristics of land and sea social ecosystem vulnerability in the Great Bay area were analyzed. From the perspective of society, economy and ecosystem, 12 influencing factors such as population density, per capita marine GDP, dependence on marine resources and marine industry diversification index are selected to explore their impact mechanism on the vulnerability of land and sea social ecosystem in the Great Bay area. In order to build a good land and sea ecological environment management system, improve the Great Bay area, improve the efficiency of land and sea resource allocation, and promote the coordinated and sustainable development of economy, society and ecological environment in the bay area.

Creating space for expression of knowledges when managing for cumulative effects in coasts and oceans

Andrew Allison^{1,*}, Carolyn Lundquist¹, Stephen FitzHerbert¹

¹National Institute of Water and Atmospheric Research (NIWA), Hamilton, New Zealand

*** Correspondence:**

Andrew Allison

andrew.allison@niwa.co.nz

Abstract

Cumulative effects in coasts and oceans are poorly understood and poorly managed. 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. Current management structures, where the focus is on a single institution or sector find it difficult to cope with the cumulative effects of multiple interacting stressors. Such a single sector approach carries the risk of inappropriate management that can make conditions worse. While stressor management often seeks to avoid an 'environmental bottom line', this bottom line is socially constructed and constantly shifting. Avoidance of environmental bottom lines can, however, be used to move toward avoiding ecological bottom lines through management of multiple stressors. To address cumulative effects, a shift is required toward governance regimes that balance power dynamics, types of knowledge, sectors, and impacts. Balancing the diverse rights and values at play requires compromise, collaboration and co-learning between multiple parties interacting within social, cultural, economic, and ecological spaces; diverse approaches and multiple knowledge systems need to productively thrive at the decision-making table. Representation of different types of knowledge (scientific, local, indigenous, etc.) is not enough. Different types of knowledge need to be freely expressed and mutually respected, not challenged based on western science principles. 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.

The indigenous traditional knowledge and sustainability: A case study from the Kerala Coast of India

K. Dhanya, K.S. Anoop Das

Abstract

Indigenous Traditional knowledge (ITK) refers to the knowledge, innovations and practices of indigenous and local communities around the world. Developed from experience gained over the centuries and adapted to the local culture and environment, traditional knowledge is transmitted orally from generation to generation. This paper explores and analyses how local ecological knowledge as a component of culture facilitates sustainable resource management practices among fishing communities in Kerala, India. The paper is based on a comparative ethnographic analysis among three different geographically separated districts. Key observations from analysis show that various groups of fishermen give emphasis to different knowledge spheres based on the nature of the resources and how they are getting benefitted out of the ITK in different means.

Indigenous Traditional Knowledge in marine fisheries sector of Kerala was documented with the following objectives such as what are the main ITKs adapted by marine fisheries sector of Kerala? How far the scientific basis of selected ITKs are correct and functional? What can be the methods that Developing suitable output to disseminate the ITKs in the society? How far the loss of ITK has happened among the fisher folks?

The data were collected through various methods like personal interviews, in depth surveys, focus group discussion and several group discussions. A total of 245 fishermen were interviewed from the three Districts of Kerala. Local knowledge among the fishing communities plays a crucial role in the sustainable management of fishery resources. However, this local knowledge serves the purpose of sustainable resource management only when it is supplemented by the other components of culture. It was observed that, local knowledge among the fishing communities plays a crucial role in the sustainable management of fishery resources. However, this local knowledge serves the purpose of sustainable resource management only when it is supplemented by the other components of culture.

Livelihood diversification among the fisherfolks of Kerala Coast of India

Dhanya Kandarattil

Abstract

The recent climatic events and catastrophes coupled with a global reduction of fish resources have made the already deprived fishermen into poverty. This situation permitted them to think on the alternative livelihood options to get relief from the murky socio-economic condition. This paper explores and analyses how the livelihood diversification has affected the traditional fisheries in Kerala, India. In the context of fisheries, diversification is promoted as a means for reducing dependence on the resource. This often interprets diversification as a change of occupation (to discontinue fishing, do something different for living) rather than adding other activities to a revenue-portfolio. With the inclination for increasing pressure on fishery resources, it becomes ever more necessary to address in a coherent way diversification and its links with both poverty reduction and responsible fisheries. The paper is based on a comparative ethnographic analysis among three different geographically separated districts.

The data were collected through various methods like personal interviews, in depth surveys, focus group discussion and several group discussions. A total of 474 fishermen ie. 158 each from the three Districts of Kerala were interviewed. There have been reports of the livelihood diversification in all the three districts. However, the numbers of the proportion of the diversified individuals were observed in the fields of daily wage workers. The following were the three factors of livelihood diversification 1) Risk related diversification 2) Economic related diversification 3) Psychological related diversification.

The present study showed enough shreds of evidence for the livelihood diversification. Due to the risk related factor, the fishers who opt for the secondary livelihood appears to be more. The lack of sufficient income to meet their expenses can be the sole reason for the livelihood diversification. The livelihood diversification was observed more in those who are employed in marine fisheries. Another observation made is that the livelihood diversification was high in the fishers those who are engaged in motorised 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 increased level of attainment of education in the youngsters also provides them with multiple opening in the professional avenue. This context is making the elder professionals in the fishing field keep their next generation away from the fishing field

Responsible consumption and production embedded in the Thai marine shrimp farming certification programs

Kanongdate, Kamalaporn, Satumanatpan, Suvaluck

Faculty of Environment and Resource Studies, Mahidol University, Nakhon Pathom, Thailand

Abstract

To achieve credibility and competitiveness in the international markets, Thailand has given considerable attention to the production and trade of safe and responsibly produced marine shrimp cultured products. This study 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. Priorities of certification, both required and volunteered will be described.

According to the SDG 12, the concept of sustainable consumption and production (SCP) is embedded in the National Economic and Social Development Plan (NESDP 2017-2021) and deployed to the Action Plan: the so-called Strategic Plans for Fishery and Aquaculture in Thailand (2017-2021). While the increase in inland marine shrimp farming may lead to uncertainty in environmental degradation, certification schemes have become an important tool for environmentally friendly practice for farmers. Several global shrimp certifications have been introduced in Thailand, including the Global Aquaculture Alliance (GAA), Aquaculture Certification Council (ACC), Best Aquaculture Practices (BAP), Organic Certification and the Global Partnership for Good Aquaculture Practices (GLOBAL G. A. P.), Aquaculture Stewardship Council (ASC), ISO 22000, ISO 9001/14001, Thai quality shrimp GAP, and Code of Conduct (CoC) certified Thai shrimp. These certifications have different focus content and are therefore applied for different purposes by farm owners.

The ASC and CoC certification for Thai shrimp are mainly concerned with sustainable farming/aquaculture that assist consumers to track the quality of each product from the farms. These certificates play an important role to also ensure the sustainability of fishing/farming by having sustainable fish stocks and marine environment as well as guarantee the availability of jobs for workers. In accordance, Thailand established the Best Aquaculture Partners (BAP) for farming applications, which becomes the first ASC-certified for farming in Thailand. This is a significant step towards responsible aquaculture in the country.

Making a case for community-based artificial reefs management for the sustainability of coastal fisheries resources and livelihoods

Jarina Mohd Jani¹

¹Faculty of Science and Marine Environment, University Malaysia Terengganu, Kuala Nerus, Malaysia

*** Correspondence:**

Jarina Mohd Jani
jarina@umt.edu.my

Abstract

For the sustainability of coastal livelihoods, the management of resources in marginal seas has to be inclusive beyond “engagement and awareness raising”. The promise of community-based fisheries management (CBFM) that has long remained “on paper” must now be fulfilled. Furthermore, the CBFM that is put in practice must optimally tap on the local (ecological) fisheries knowledge of local fishers and establish participatory management frameworks that enable them to be the main actors in the sustainable management of the marine resources that their livelihood depends on. This paper makes a case for establishing such a framework via artificial reefs – a familiar, traditional gone high-tech fishery concept among coastal fishers. Using in depth interviews, ethnography and participatory fieldwork, the role of artificial reefs in the lives of small scale coastal fisherfolks in Terengganu, Malaysia using the Sustainable Livelihoods Approach was studied. More concerned with the ways that artificial reefs – both traditional and modern versions- fit into the local fishery, the findings of this study suggest that 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 and even talk about the same things, albeit in different ways.

Fishery-based adaption to climate change: The case of migratory species grey mullet in Taiwan Strait, Northwestern Pacific

Ming-An Lee^{1,2,*}, Sheng-Yuan Teng¹, Ailong Lin³

¹Department of Environmental Biology Fisheries Science, National Taiwan Ocean University, Taiwan, China

²Center of Excellence for Oceans, National Taiwan Ocean University, Taiwan, China

³Taiwan Ocean Conservation and Fisheries Sustainability Foundation, Taiwan, China

Abstract

We analysed 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. A wavelet analysis revealed that variations in climatic indices, namely the PDO, NPGO, NPI, and sea surface temperatures anomalies (SSTAs) might have affected the winter abundance and migration behaviour of grey mullet in the TS.

Due to the subsequent decreased catch, the types of fleet with fishing methods in the coastal waters of Taiwan were changed from the purse seiner with two boats before 1986, to the gill net and trawl net as the abundance was at the low level between 1989 to 2010. The fishing method was significantly changed with the catch variation. It was dominated for gill net with the low cost expense as the mullet abundance increased since 2013. And the Taiwanese purse seiner with the higher fishery efficiency was also appeared again. 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.

Tracking the ecological health of a mangrove ecosystem from the Northern Indian Ocean - Applicability of benthic foraminifera as bioproxy

A. Mandal¹, P. Bhadury^{1,*}

¹Integrative Taxonomy and Microbial Ecology Research Group, Department of Biological Sciences, Indian Institute of Science Education and Research Kolkata (IISER Kolkata), Nadia, India

***Corresponding**

pbbhadury@iiserkol.ac.in

Abstract

Mangrove ecosystems serve a range of ecological and socio-economic functions and drive coastal blue economy. Sundarbans represents the world's largest contiguous mangrove ecosystem which is a UNESCO World Heritage and Ramsar Site, located at the Ganga-Brahmaputra-Meghna delta. This mangrove ecosystem is diurnally influenced by coastal water entering from the Bay of Bengal of the Northern Indian Ocean. Sundarbans is home to rich biodiversity and strongly influenced by riverine freshwater flow and groundwater seepage. In recent years, Sundarbans has become increasingly vulnerable to anthropogenic forcing. In the present study, seasonal monitoring of 112 (June 2019) and 100 (November 2019) sites using benthic foraminifera, an organismal group known to be sensitive to environmental changes, was evaluated as a biological proxy to track the ecological health of Sundarbans. Benthic foraminifera abundance ranged between 5-130 individuals/10 cc in pre-monsoon (2019) to 5-215 individuals/10 cc in post-monsoon (2019). Based on the observed foraminifera abundance trends from the above sites, 10 sites were monitored intensively in post-monsoon (November, 2020) and observed benthic foraminifera abundance ranged between 15-140 individuals/10 cc. Overall, observed diversity was low. The calcareous taxa *Ammonia*, *Quinqueloculina*, *Nonionella* and agglutinated taxa *Jadammina macrescens*, *Textularia* were frequently encountered. *Jadammina macrescens* were low in abundance and less frequent across sites, indicating deteriorating ecological health of Sundarbans. Incidentally, live:dead ratio in 2020 was also low (2:17), although in pre-monsoon and post-monsoon the ratio was less. The dominance of populations of stress-tolerant taxa *Ammonia* spp. across studied sites highlighted adverse effects of increased anthropogenic forcing on this ecosystem. Presence of a higher number of degraded tests in post-monsoon of 2019 (200 individuals/10 cc) compared to 2020 (90 individuals/10 cc) highlighted taphonomic alteration in the study area and increasing stress. Overall, this study has provided much needed baseline information on changing ecological health and influences of anthropogenic forcing in Sundarbans mangroves of the Northern Indian Ocean.

Status and perspectives on mariculture spatial planning and implementation

Øivind Strand¹, Hui Liu², Joao G Ferreira³, Jon Grant⁴, Ellen Sofie Grefsrud¹, Pia Kupka Hansen¹, Qianwen Sun⁵, Jenny Weitzman⁶

¹Institute of Marine Research, Norway

²Yellow Sea Fisheries Research Institute, Chinese Academy of Fishery Sciences, China

³Longline Environment Ltd., London, UK. and NOVA – FCT Portugal, Portugal

⁴Department of Oceanography, Dalhousie University, Canada

⁵Second Institute of Oceanology, Ministry of Natural Resources, China

⁶Marine Affairs Program, Life Sciences Centre, Dalhousie University, Canada

Abstract

The policy and legal frameworks that regulate expansion of mariculture differs worldwide, and specifically between some of the major players in mariculture development, China, EU, Norway and Canada. In China, marine functional zoning (MFZ) is the legal framework regulating use of marine space, while maritime spatial planning (MSP) is the alike. This report provides an account of how mariculture is implemented and the processes experienced for MFZ 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. The report aims to set a background for better exchange of information, to allow further discussions and analysis to provide perspectives and recommendations for governance and management to promote sustainable development of mariculture.

China, EU, Norway and Canada all have governmental visions and objectives to develop their mariculture industries. They have established, though highly diverse among them, institutional frameworks for managing aquaculture planning, where a general concern and condition for further development and growth is how the culture affects the environment.

In the prospects of future increase in competition for space and resources in the oceans and consequently the need for efficient governance, the apparent weak or receding position of mariculture in MFZ and MSP processes should be of considerable concern if the endeavors of providing more ocean food using mariculture is promoted. As mariculture is regarded as the most promising route to realize a substantial increase in provision of food from the oceans, the information compiled in our report may contribute to highlight the need for improving the position of mariculture and its implementation in maritime spatial planning frameworks like MFZ and MSP. We have also encouraged recognition of the relationship between food security, intensification of culture and environmental sustainability, hopefully leading towards better understanding of how mariculture can be developed to secure sustainability for the oceans.

Ecosystem modelling to support decision making for the coastal South-West Pacific (Eastern Australia)

R. C. Subramaniam^{1,*}, H. T. Schilling^{1,2}, I. M. Suthers^{1,2}

¹Sydney Institute of Marine Science, Mosman, Australia

²School of Biological Earth and Environmental Science, University of New South Wales, Sydney, Australia

*** Correspondence:**

Roshni Subramaniam

roshni.subramaniam@sims.org.au

Abstract

The East Australian Current (EAC) in the south-west Pacific Ocean is warming and extending further south along the east Australian coastline. As a result, the New South Wales (NSW) coast has been identified as a global warming hotspot. Rapidly warming waters from the EAC is tropicalising our Great Southern Reef, extending species' ranges and altering habitats. This is impacting ecosystem structure and function and ecosystem services. We need to understand how this complex coastal ecosystem is changing to plan effective mitigation and adaption strategies. However, this baseline understanding is currently lacking.

Ecosystem models integrate available ecological knowledge and data, from phytoplankton to whales, to explore ecosystems and multi-model approaches can enhance confidence in modelled outcomes or, indicate where more targeted information is needed. In this study, we developed a qualitative and quantitative (Ecopath) ecosystem model to i) overcome uncertainties relating to data availability and model structure, ii) provide an understanding of current ecosystem structure and function, and iii) explore ecosystem responses under different perturbation scenarios and changes in biomass. Simulations from the qualitative model were compared with output from the Ecopath model to identify changes the NSW coastal ecosystem has undergone and may undergo in the future, including indicator groups that may signify ecosystem change. We present results from both models and the implications of these results for managing the coastal NSW ecosystem.

Our multidisciplinary study capitalises on the expertise of world renown ecosystem modellers at CSIRO Hobart and biologists at Sydney Institute of Marine Science to address essential knowledge gaps in ocean ecosystem understanding for coastal ecosystems in Australia.

Review of Fukushima nuclear contaminated water discharge event: International law analysis and stakeholders' response

Kailei Zhu¹, Jiayu Bai^{2,*}

¹School of Law, Ocean University of China, Qingdao, China

²School of Law, Nankai University, Tianjin, China

*** Correspondence:**

Bai, J.

gracefulgl@hotmail.com

Abstract

The Fukushima Daiichi nuclear power plant accident in 2011 is one of the most serious nuclear accidents in the world after the Chernobyl nuclear power plant accident on April 26, 1986. The disposal of the accident is still in progress. Japan's treatment of the nuclear wastewater stored during the accident treatment aroused controversy in the international community, especially after Japan approved a plan to release more than one million tons of contaminated water from the destroyed Fukushima nuclear plant into the sea in 2021. A state's disposal of radioactive waste shall comply with international law of the management of radioactive substances. Japan's recent intention to discharge nuclear waste water into the sea is a major challenge to today's international law and violates relevant obligations under international law, including the United Nations Convention on the law of the sea, the Convention on Early Notification of a Nuclear Accident, Convention on Nuclear Safety such as radiation protection obligations, reporting and consultation obligations, etc. In order to protect the domestic marine ecological environment and national health of stakeholders, including China, it is necessary to analyze the illegality of Japan's treatment of Fukushima nuclear wastewater from the timeline of the Fukushima nuclear accident, and summarize the response measures proposed by current stakeholders from three aspects of politics, law and culture. By summarizing these response measures, this paper expects the handler to fulfill their obligations, make information public, protect the right of stakeholders and consult with them to deal with the aftermath of the Fukushima nuclear accident to proceed smoothly and prevent irreversible marine ecological damage.

Study of morphodynamic changes along the lagoon of Oualidia (Morocco) using bathymetric data

Mohammed Bouchkara^{1*}, Bendahhou Zourarah¹, Khalid El Khalidi¹, Aïssa Benazzouz², Nouhaila Erraji Chahid¹, Imane Joudar¹

¹Marine Geosciences and Soil Science Laboratory (URAC-45), Earth Sciences Department, Faculty of Sciences, Chouaib Doukkali University, EL Jadida, Morocco

²Higher Institute of Maritime Studies, Casablanca, Morocco

*** Correspondence:**

Mohammed Bouchkara

m.bouchkara@yahoo.[com](mailto:m.bouchkara@yahoo.com)

Abstract

Changes in morphodynamics and sedimentation in the Oualidia lagoon were studied using bathymetric data surveys and a 3D GIS analysis tool. This lagoon has been classified as a RAMSAR site since 2005, providing great ecological and socio-economic value for the local population. However, in recent decades, the Oualidia lagoon has suffered many types of degradation, including the phenomenon of water and sediment containment. This paper evaluates the evolution of the morphodynamics and sediment budget of this lagoon on a 6-year time scale using bathymetric data from 2006 and 2012. Thus, an average height of +0.65 m was gained by the lagoon, while the average evolution of the eroded areas was estimated at -0.42 m. In addition, the eroded area in the lagoon was estimated to be about 1,513,800 m² with an erosion volume of 633,383 m³, while an accumulation of 1,765,866 m³ was observed over an area of 2,699,396 m². These remarkable changes are mainly related to natural (hydrodynamics, waves, currents...) and anthropogenic (dikes, sediment traps...) factors. This study provides a useful model to support effective decision-making regarding lagoon management in all contexts.

Community structure and rearing experiments of the Shrimp *Lucensosergia lucens* Hansen 1922 (Crustacea, Decapoda, Sergestidae) (Sakura-ebi) in Suruga Bay

Beatriz E. Casareto^{1,2,*}, Toshiyuki Suzuki¹, Keita Toyoda², Jun-ichi Miyahara³, Yoshimi Suzuki²

¹Sustainability Center, Shizuoka University, Shizuoka, Japan

²Graduate School of Science and Technology, Shizuoka University (GSST-SU), Shizuoka, Japan

³Yui Fisherman's Association, Shizuoka, Japan

*** Correspondence:**

Beatriz E. Casareto

Email: becasar@shizuoka.ac.jp

Abstract

The shrimp *Lucensosergia lucens*, well known as Sakura-ebi, was commercially fished in Suruga Bay for more than 100 years, but since 2018 fishery experienced an unprecedented decline which is about one-fourth of the average catch in 2010. In order to clarify changes in the ecology of the Sakura-ebi and the causes of this drastic decline field studies at the most frequent spawning area near Yui port, are being conducted. Rare experiments of Sakura-ebi are been conducted in order to assess larvae growth, mortality rates and food preferences.

Water sampling using Niskin bottles (2, 20, and 50 m depth) to assess nutrients, organic matters (POM and DOM) and chlorophyll concentrations, phyto and zooplankton collection using NORPAC net (100 µm mesh) to assess diversity and abundance, and light and temperature measurements using in-situ loggers, are been conducted since May 2020 by our biogeochemistry laboratory (GSST-SU) in cooperation with the Yui Fisherman's Association. Moreover, the weight to size ratio, female to male ratio and the percentage of gravid individuals landed in the autumn 2020 and the spring 2021 were registered.

Diatoms dominated phytoplankton assemblages showing clear seasonal variations in cell size, composition and abundance. Heterotrophic dinoflagellates (*Noctiluca* spp., *Protoperidinium* spp.) were important competitors for phytoplankton food during the Sakura-ebi larval growth season. The individual size of Sakura-ebi was the same or slightly larger when compared with past literature (since 1964). Gravid females were reared in aquarium with sub-surface pre-filtered (GF/F, 0.45µm) seawater from Suruga Bay at 20°C and a natural light illumination. The hatched larvae were fed with selected phytoplankton (first larval stages) and a mixture of phyto and zooplankton (later larval stages) and juvenile stages were successfully reached. We were able to determine the suitable rearing conditions and food combinations for growing the shrimps to juveniles in a laboratory aquarium. Subsequently we aim to establish an appropriate technology for rearing conditions with lower mortality for a sustainable shrimp culture.

Evaluation of marine ecosystem services in China based on meta-analysis

Kai Chen

Abstract

China has the third largest ocean area in the world, with 18,000 kilometers of coastline on its eastern and southern continents, 4.7 million square kilometers of inland and border waters, 7600 large and small islands, and rich marine ecosystems. Rich marine ecosystems create great value through different forms of services. In order to study the influencing factors of marine ecosystem service value, this paper collects the articles related to marine ecosystem service value in China since 2000, extracts the key indicators such as ecological type, service type, evaluation method and service value, and establishes a data base. Based on the database information, OLS and MLM are used for meta-analysis respectively. The results are as follows: (1) the significance of the provinces and cities in the study area is generally high, and the significance levels of Guangdong Province and Fujian Province are the highest; (2) The area and population density of the study area are significantly negatively correlated with the value level; (3) Compared with ecosystem services, the significance of evaluation methods is low; (4) MLM is better than OLS and so on. The validity of the model is tested, and the transfer error is within a reasonable range, which shows that the result is reliable. This paper will effectively reveal the key indicators affecting the value of marine ecosystem, provide reference for the in-depth study of marine ecosystem services, help people realize the inseparable relationship between human society and marine ecosystem, and provide an important reference basis for strengthening marine ecological protection and promoting the high-quality development of marine economy.

Seasonal variations of nutrient concentrations and their ratios in the central Bohai Sea

Xiaokun Ding^{1,2}, Xinyu Guo^{1,2,*}, Huiwang Gao^{1,3}, Jie Gao², Jie Shi^{1,3}, Xiaojie Yu¹, Zhaosen Wu¹

¹Key Laboratory of Marine Environment and Ecology, Ministry of Education of China, Ocean University of China, Qingdao, China

²Center for Marine Environmental Studies, Ehime University, Matsuyama, Japan

³Laboratory for Marine Ecology and Environmental Sciences, Qingdao National Laboratory for Marine Science and Technology, Qingdao, China

*** Correspondence:**

Xinyu Guo

guoxinyu@sci.ehime-u.ac.jp

Abstract

The Bohai Sea is a typical semi-enclosed sea in the northwest Pacific, which is subject to serious eutrophication due to human activities. Similar to hydrographic variables such as water temperature and salinity, the nutrient concentrations and ratios in the Bohai Sea also exhibit seasonal variations. However, the effects of external inputs, biological processes, and benthic processes on these seasonal variations have not been quantified to date. To address this issue, a physical–biological coupled model was developed to capture the seasonal nutrient cycling in the central Bohai Sea. The simulation results revealed apparent seasonal variations in the concentrations of dissolved inorganic nitrogen (DIN), dissolved inorganic phosphorus (DIP), and dissolved silicate (DSi). The N/P ratio (as the molar ratio of DIN/DIP) also exhibited an apparent seasonal variation, with the maximum and minimum values in surface water occurring in summer (> 100) and winter (< 30), respectively. The Si/N ratio (as the molar ratio of DSi/DIN) was slightly higher in summer than in other seasons. The budget for three types of nutrient indicated that the biological processes determined the seasonal variations in nutrient concentrations and the N/P ratio. The external inputs of nutrients via river input, atmospheric deposition, and sediment release were probably important in summer when they could alleviate the reduced nutrient concentrations due to biological processes. To maintain a reasonable nitrogen budget, it was necessary to include benthic nitrogen loss, which removed a large amount of inorganic nitrogen in summer and autumn. In addition, the variation of N/P ratio of phytoplankton uptake can reduce the ratio of DIN to DIP in surface water by ~ 20 in summer as compared to the calculation with a fixed N/P ratio (16:1) in phytoplankton uptake.

Hydrodynamic and morpho-sedimentary modelling of the Moulay Bouselham lagoon and their impact on the socio-environment: Application to the study of "Fishing" and "Agricole" practices.

Nouhaila Erraji Chahid¹, Bendahhou Zourarah¹, Aïssa Benazzouz², Khalid El Khalidi¹, Mohammed Bouchkara¹, Imane Joudar¹.

¹Marine Geosciences and Soil Science Laboratory (URAC-45), Earth Sciences department, Faculty of Sciences, Chouaib Doukkali University, EL Jadida, Morocco

²Higher Institute of Maritime Studies, Casablanca, Morocco

Abstract

Lagoon ecosystems are among the most vulnerable ecosystems, often subject to multiple stresses, including a number of disturbances to the balance of the lagoon ecosystem in terms of hydro- sedimentary dynamics. The Moulay Bouselham lagoon is one of the ecosystems that are directly affected by such factors. This site is also home to a number of human activities and is the site of tourism and artisanal fishing.

Currently, this lagoon is experiencing a problem of silting which has resulted in the creation of a spit that has developed to the southern limit of the pass:

Deterioration of water exchanges with the sea and the confinement of the lagoon;

The reduction of fishermen's working hours (movement only possible in the open sea);

A considerable increase in the risks associated with fishermen's navigation conditions (two incidents have been recorded recently);

Risk of closure of the channel.

The subject of my thesis is part of the problem of developing an environmental model useful to identify and understand the mechanisms of functioning of the various morpho-sedimentary and hydrodynamic processes in this lagoon environment.

The methodology which will be based: Firstly, on the numerical modelling of the wave propagation to calculate the sediment transport and simulate the evolution of the coastline; using the MIKE 21 FLOW MODEL HD FM. Secondly, a questionnaire is carried out to analyse the variability of the impact of fishermen's activities; and to be able to calibrate the interactions between activities-climate-regulation.

This multidisciplinary methodology will also 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, all the more so as the rise in sea level threatens activities and populations, which will call for Integrated Coastal Zone Management.

The results that will be obtained relate to the impact of the developments from a hydrodynamic point of view and the location of the sectors subject to erosion and the sectors subject to accretion. For the long term, the evolution of the lagoon can be determined.

Integration of the socioeconomic status into MSP-theoretical aspects and recommendations for Moheshkhali Island

Mohammad Saydul Islam Sarkar

Assistant Professor

Department of Oceanography, University of Chittagong, Chittagong, Bangladesh

Email: saydul76@gmail.com

Abstract

The complex nature of the Marine Spatial Planning (MSP) requires the integration, relation and consideration of multiple elements, ranging from the ecological and environmental to the socio-economic status of the people as well as the social, political, regional, institutional, religious or cultural. By applying an empirical approach, this paper presented a framework to evaluate the direct economic impacts linked to the development and implementation of the MSP process. The methodological procedure was sequenced by the identification of the sectors involved, respondent's questionnaire data collection, and construction of counterfactual scenarios and estimate of impacts after consulting the respondents/stakeholders. Research findings could serve as the basis for further estimations of indirect and induced impacts of the implementation of spatial management policies in a blue economy context. Socioeconomic status (SES) is consistently associated with people's performance outcomes, yet little was known about the psychosocial and behavioral mechanisms that might explain this association. Researchers usually couldn't control socioeconomic status rather than examine it. When it was studied, all levels of peoples including the effects of lower, poverty-level socioeconomic status were generally examined. Due to the interdependency that exists between the ecosystem resources and its users, successful development and implementation of MSP depends on the identification and understanding of different stakeholders, their practices, expectations and interests. This article focused on the various types and stages of people's participation in a marine spatial planning process, and would illustrate how to conduct a respondent analysis that allows the involvement of people's in an adequate way that would be sustainable over time. Now a day's oceanographers, scientists and resource experts agreed that the involvement of people's is a key factor for a successful management regime of MSP process for the sustainable ocean governance (SOG).

Increased transfer of trace metals and *Vibrio* sp. from biodegradable microplastics to catfish *Clarias gariepinus*

Faddrine Holt Jang^{1,*}, Changi Wong¹, Jenny Choo¹, Edwin Sien Aun Sia¹, Aazani Mujahid², Moritz Müller¹

¹Faculty of Engineering, Computing and Science, Swinburne University of Technology Sarawak, 93350 Kuching, Sarawak, Malaysia

²Faculty of Resource Science and Technology, Universiti Malaysia Sarawak, Kota Samarahan, Malaysia

*** Correspondence:**

Faddrine Holt Jang
faddrineholt@gmail.com

Abstract

Microplastic ingestion has been documented in various aquatic species. While causing physical damage, contaminated microplastics also transfer attached pollutants and microbial pathogens to ingesting organisms. Continued metal accumulation can lead to toxicity and adverse health effects; whereas attached microbial pathogens can cause dysbiosis - which lowers host immunity and promotes infections. Catfish are a major food source in Southeast Asia, a hotspot of plastic pollution. This study aimed to quantify the transfer of trace metals copper (Cu) and lead (Pb) - at environmentally relevant concentrations - from microplastics (polyamide 12, PA12, and polylactic acid, PLA) to catfish, *Clarias gariepinus*. Fish were reared for three months and exposed to seven different combinations of feed, supplemented with plastics and metals. At monthly intervals, fish gills, gut, liver, and edible muscles were analysed for Cu and Pb concentrations using ICP-OES, and the gut content assessed for *Vibrio* sp.. Our results surprisingly showed that biodegradable PLA transferred higher amounts of metals to catfish and also led to increased *Vibrio* counts in the gut compared to PA12. Trace metal accumulation was significantly different in varying tissues, with highest concentrations observed in the gills, followed by liver, guts, and lastly edible muscles. Results of this study further support that microplastics act as efficient shuttles to concentrate and transfer metals. They also indicate that their uptake can cause dysbiosis (increased numbers of *Vibrio* sp.). Most importantly, however, our study highlights that biodegradable polymers, such as PLA, could actually pose a greater environmental threat when ingested compared to the more common polymers such as PA12.

Caspian Sea: Isolated, yet mutually engaged

Yerkenaz Karibayeva¹

¹Wuhan University, School of Political Science and Public Administration, Wuhan, China

*** Correspondence:**

Yerkenaz Karibayeva

2018171150003@whu.edu.cn

Abstract

By looking back around 50 – 60 million years ago, our history evolves the fact that the Caspian Sea is a remnant of the ancient Paratethys Sea, part of the Tethys Ocean, which was connected to the Atlantic and Pacific oceans. Nowadays, the Caspian Sea, as the largest inland body of water in the world, is shared by multiple coastlines of Azerbaijan, Iran, Kazakhstan, Russia, and Turkmenistan.

Over the past decade, countries have made great efforts to protect the region's most valuable areas, both on land and in the marine environment. But, this very isolation determines the sensitivity of the Caspian Sea's ecosystem to climate. On the other hand, uncontrolled or unauthorized waste disposal is also a problem in the region, leading to the pollution of ecosystems.

In accordance to the Protocol for the Protection of the Caspian Sea priorities for action 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. Moreover, one of the UN SDGs (Goal 14: Life Below Water) aims to sustainably manage and protect coastal ecosystems from pollution.

Current ecosystem imbalances and social inter-dependance among Caspian neighboring countries, require regional and national partnerships, institutional and legal frameworks, research cooperation and knowledge management mechanisms in the Caspian Region for adaptation of evidence-based strategies. In addition, social and political interaction can provide a platform for implementation of sustainable ecosystems management approaches. It is therefore crucial to determine whether there are any environmental risks related to economic activities in coastal marine areas, that may harm or affect biodiversity or jeopardize the conservation of ecosystems.

Social awareness is needed to be evolved by adapting particular techniques with technological advances, changes in scientific knowledge, economic and social factors in mind.

Fish biodiversity survey in Korean waters using environmental DNA analysis

Ah Ran Kim², Ji-hyun Lee¹, Chang-Keun Kang³, Hyun-Woo Kim^{1,2,*}

¹Department of Marine Biology, Pukyong National University, Busan, Republic of Korea

²Marine Integrated Biomedical Technology Center, The National Key Research Institutes in Universities, Pukyong National University, Busan, Republic of Korea

³School of Earth Sciences and Environmental Engineering, Gwangju Institute of Science and Technology, Gwangju, South Korea

Abstract

Fish biodiversity surveys using environmental DNA (eDNA) metabarcoding analysis are now widely used as an alternative approach at lower cost and efforts compared with the traditional methods. We here established a pipeline for fish diversity survey using eDNA metabarcoding in Korean waters. As a result of one year of survey using the seawater samples collected from Gamak Bay in each month, 2018, a total of 630 fish haplotypes were obtained which cover 15 orders, 60 families, 128 species. Metabarcoding analysis clearly demonstrated seasonal and regional differences in fish assemblage within the Gamak Bay. Compared those by the traditional previous researches, 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. However, several issues should be resolved before its nation-wide applications for fish diversity analysis, which includes the supplement of regional reference sequences, a standard eDNA analysis pipeline, and the compatibility of quantitative values. The consistent and long-term eDNA metabarcoding would provide a valuable information for scientific management and conservation of fish resources in Korean waters.

A community-based qualitative vulnerability assessment tools for rivers in developing participatory response to land-use changes

E. C. D. Lambat^{1,*}, A. Mujahid¹, M. Müller²

¹Faculty of Resource Science and Technology, University Malaysia Sarawak, Kota Samarahan, Malaysia

²Faculty of Engineering, Computing and Science, Swinburne University of Technology, Kuching, Malaysia

*** Correspondence:**

Corresponding author: Elsa Cordelia Durie Lambat
Contact email: elsacordelia23@gmail.com

Abstract

Over the years, global land cover has been altered by land-use changes and poor land management. Consequently, this affects the environmental conditions especially the aquatic environment. Although changes in land use can benefit the community in terms of improving livelihood and generally raising socio-economic status, these changes have risks and place aquatic habitats at stake. Assessing river vulnerability to changing land use is vital to determine how the communities along rivers are responding to these changes. Currently, there are a few existing assessing frameworks for rivers using top-down approaches which require a large pool of data and highly trained experts. The present river vulnerability tool created comprises a total of 23 criteria, with rubrics to enable self-assessment of the river environment, economic and social factors affected by land-use change. This semi-qualitative tool is developed using information obtained from various methods including satellite images, preliminary site assessment, site surveys, structured questionnaires and informal interviews. This tool was tested in two river systems in Sarawak which are the pristine Maludam river and the anthropogenically-influenced Simunjan river. Results of this vulnerability assessment will be able to highlight areas that require proper adaptive measures to mitigate the effects of changing land use. The verbal and visual data needed for assessment such as types of erosion, water condition and perception on river condition enable the community to assess their own rivers thus opening opportunities to application of citizen science. With little training, it is hoped that the present tool may be adapted for use by stakeholders to empower communities in assessing their own river vulnerability.

Source, composition and reactivity of particulate organic matter along the salinity gradient in the Changjiang Estuary and its adjacent sea

Shanshan Li^{1,2}, Shengkang Liang^{1,2,*}, Jinqiang Guo³

¹Key Laboratory of Marine Chemistry Theory and Technology, Ministry of Education, Ocean University of China, Qingdao, China

²College of Chemistry and Chemical Engineering, Ocean University of China, Qingdao, China

³Key Laboratory of Marine Ecology and Environmental Sciences, Institute of Oceanology, Chinese Academy of Sciences, Qingdao, China

*** Correspondence:**

Shengkang Liang
liangsk@ouc.edu.cn

Abstract

The distribution and fate of particulate organic matter (POM) in the estuaries with high-intensive human activities is dynamic and complex due to its multiple sources and intricate biogeochemical features. In order to obtain information on source, transformation and fate of POM in the Changjiang Estuary and its adjacent sea (CJEAS), POM samples were collected along different salinity gradients in February and May 2017. Concentrations of particulate organic carbon (POC), nitrogen (PN), $\delta^{13}\text{C}$ and major biochemical (total particulate amino acids, TPAA) were measured. Overall, the distribution of POC and PN showed a decreasing trend from the river mouth to sea. POC and PN concentrations were significantly negative correlation with salinity while obviously positive correlation with chlorophyll (Chl-*a*), indicating that variations of POM were mainly controlled by both terrigenous input and phytoplankton production in situ. $\delta^{13}\text{C}$ and C/N showed a trend of gradual increase from the river mouth to the outer estuary in both winter and spring, reflecting the transition from seriously degrading terrestrial POM to phytoplankton-derived fresh POM with increasing salinity gradient. Major biochemical indicator of TPAA/POC(%) showed a gradual shift towards more bioactive POM with increasing salinity, however, the low values TPAA/POC(%) appeared within the turbidity maxima zone. The bioavailability of POM in spring were higher than that in winter. The contents of glycine, asparagine, glutamine, alanine and serine were higher in the proportions of TPAA, indicating that POM had suffered serious biodegradation. The calculation by the two end-member mixing model showed that the contribution of terrigenous of POM in winter ($54.38 \pm 21.68\%$) was prominently higher than in spring ($38.18 \pm 14.96\%$), indicating that the phytoplankton-derived POM dominated the sources in the CJEAS associated with the increase of phytoplankton biomass from winter to spring. These results illustrate that the distributions of POM vary distinctively in space and time leading to a significant variability in its composition and reactivity.

Identification jurisdiction responsibility and land-sea synergistic regulation for coastal total nitrogen based on water quality target in Laizhou Bay, China

Yanqun Yang^{1,2,3}, Shengkang Liang^{1,2,3,*}, Keqiang Li^{1,2,3}, Yang Liu^{1,2,3}, Haoran Lv^{1,2,3}, Yanbin Li^{1,2,3}, Xiulin Wang^{1,2,3}

¹Frontiers Science Center for Deep Ocean Multispheres and Earth System, Qingdao, China

²Key Laboratory of Marine Chemistry Theory and Technology, Ministry of Education, College of Chemistry and Chemical Engineering, Ocean University of China, Qingdao, China

³College of Chemistry and Chemical Engineering, Ocean University of China, Qingdao, China

*** Correspondence:**

Shengkang Liang
liangsk@ouc.edu.cn

Abstract

Globally, many bays near human habitats have subjected to water quality deterioration and eutrophication, due to excessive discharge of terrigenous pollutants derived from high-intensive production and other human activities. To implement an effective pollutant management scheme meeting a bay's water quality, it is essential for each pollutant source region (PSR) to identify apportionment for the polluted segments and reduce pollutant load equally and properly. In this study, the polluted segments of Laizhou Bay (LZB), located south of the Bohai Sea, China, were discerned through land-sea synchronous investigation. The apportionment for the polluted segments of each jurisdiction was quantified, and "precise discharge reduction" indicators throughout the land-based pollutant entire migration pathway were also established by a simulation-optimization approach. The nitrogen polluted segments located at the bottom of LZB account for up to 70% of the whole bay's area. Due to the heterogeneity of the land-based total nitrogen (TN) load and the total maximum allocated load of the 13 justifications in the the basin, the distribution of apportionment rate for the nitrogen polluted segments showed an obviously spatial disparity, the city of Weifang with the highest value of 32%, followed by Zibo with 28%, Ji'nan with 20%, and the other 10 jurisdictions with 19%. Accordingly, the land-based TN management indicators showed a significant difference among the 13 justifications. TN load reduction rate varied from 1% to 99%, with an average of 62%. The average values for reduction rate of TN generation, increase rate of TN removal amount by wastewater factory treatment, increase rate of soil retention amount, and increase rate of river retention amount were 44% (21-69%), 53% (0-88%), 31% (0-61%), and 63% (15-84%), respectively. Simulating results from the water quality model showed that the deadline for achieving the water quality standard through the scheme of the "differentiated percent reduction" was six years earlier than that through the "equal percent reduction" in each justification. These results should help policymakers determine the location, time and manner for implementing management measures to control pollution on the basis of land-sea synergistic regulation.

Effect of iron on the preservation of organic carbon in marine sediments

Deju Lin^{1,2}, **Nan Wang**³, **Jingyu Liu**^{1,2}, **Yangli Che**^{1,2}, **Cuimei Xia**^{1,2}, **Weifeng Wu**^{1,2}, **Rui Bao**^{1,2,*}

¹Frontiers Science Center for Deep Ocean Multispheres and Earth System, Key Lab of Marine Chemistry Theory and Technology, MOE and College of Marine Geosciences, Ocean University of China, Qingdao, China

²Laboratory for Marine Mineral Resources, Qingdao National Laboratory for Marine Science and Technology, Qingdao, China

³Frontiers Science Center for Deep Ocean Multispheres and Earth System, Key Lab of Submarine Geosciences and Prospecting Techniques, MOE and College of Marine Geosciences, Ocean University of China, Qingdao, China

*** Correspondence:**

Rui Bao

baorui@ouc.edu.cn

Abstract

Understanding the fate of sedimentary organic carbon (OC) in ocean is critical to deciphering the biogeochemical processes related to the global carbon cycles and its response to climate change. Previous studies demonstrated that metal elements could promote the burial of OC. However, it remains hitherto unclear about the deep-going mechanism of the effect of metal elements on the preservation of OC in marine sediments. Here we analyze the geochemical parameters such as total organic carbon (TOC), stable carbon isotope ($\delta^{13}\text{C}$), radiocarbon ($\Delta^{14}\text{C}$), surface area (SA) and metal elements iron (Fe), aluminum (Al) in the surface sediments of China Marginal Seas, and discuss the linkages between Fe protection and preservation of ancient/modern OC, in order to reveal the influence of Fe on OC burial systematically. Our results show that both contents of Fe and TOC appear negative correlation with sediments particle size, suggesting Fe maybe relate to the preservation of OC in coarse-grained sediments, together controlling the fate of OC with clay minerals in fine-grained sediments. Meanwhile, Al contents express generally good linear correlations with Fe, marine OC and terrestrial OC, implying that terrestrial aluminosilicate minerals may influence the interactions between Fe and OC. Additionally, we also collect the global data including reactive Fe and TOC contents from different regions to further understand the adsorption/coprecipitation mechanism of concomitants between Fe and OC. Furthermore, a concept model about the concomitants in different particle sizes and environments is tentatively described. To sum up, our findings provide a means of thinking to explore the mechanism about the preservation of OC in sediments.

Sediment Quality in Halmahera Sea waters, North of Maluku

Edward & Helfinalis, Marsya Jaqualine Rugebregt

Research Centre for Oceanography, Indonesian Institute of Sciences, Jakarta, Indonesia

ekewe07@mail.com

Abstract

Halmahera Waters located in North of Maluku, it has panoramic coastal waters and marine natural beautiful view, and rich in fishery resources, so potential to be developed as a location for beach and marine tourism and fisheries industries. For that development need a lot of data base, one of the data base is heavy metals. Heavy metals comes from various human activities, both on land and at sea. Heavy metals in the low levels needed by aquatic organisms for the growth and development of its life, but high levels are toxic. Measurement of levels of heavy metals Pb, Cd, Cu, Zn, Ni, and Cr in the sediment in the waters of Halmahera was conducted in September 2005. Sediment samples is taken using gravity cores at 8 research stations. The levels of heavy metals were measured using Atomic Absorption Spectrophotometer (AAS). The purpose of this study was to assess sediment quality in relation to the interests of marine life. The results of this study show overall, based on the value of the geoaccumulation (I_{geo}) and pollution load indeces (PLI), sediment in this water is include to unpolluted category and is still safe for marine life ($I_{geo} < 0$ and $PLI < 1$).

Long-term shoreline analysis of Brunei coast: an application of Digital Shoreline Analysis System (DSAS)

A. J. Osanyintuyi^{1,*}, C. I. Addey², R. B. Adesina^{3,4}

¹College of Marine Geosciences, Ocean University of China, Qingdao, China

²Department of Marine Science, Ocean College, Zhejiang University, Zhoushan, China

³Institute of Port, Coastal and Offshore Engineering, Ocean College, Zhejiang University, Zhoushan, China

⁴Department of Marine Science and Technology, Federal University of Technology, Akure, Nigeria

*** Correspondence:**

Osanyintuyi, A. J.

osanyintuyi.abiola@yahoo.com

Abstract:

Coastal environments are dynamic, consequential to their constant interaction with human and hydroclimatic processes. In contemporary times, concomitant to climate change, sea-level rise, and flooding, coastal erosion is one of the hazards faced by coastal communities around the world. These risks are exacerbated along low-lying coasts. Understanding the shoreline behavior of the coast is a prerequisite for creating sustainable coastal planning and management plans. In this paper, we use multispectral satellite images from 1972, 1994, 2005, 2011, and 2021, to identify the shoreline behavior of the Brunei coastline exposed to the South China Sea. To elucidate the accretion and erosion threshold of the study area, we utilized the End Point Ratio (EPR) method of the Digital Shoreline Analysis System (DSAS). The real-time shoreline changes were identified through a water index and object-oriented approach by identifying and extracting the dynamic changes of sediment deposition between the seawater and the beach. Categorizing the rate of accretion and erosion, the result of the analysis revealed that up to 77% of the study area experienced erosion at an average rate of 1.32 m/yr, and 23% of the coast accreted at an average rate of 0.88m/yr during the 49 years study period. Erosion dominates despite several coastal engineering modifications including groynes and breakwaters put in place to protect the coastline of Brunei. The outcome of this study is suitable for private and public institutions involved in coastal planning, development and disaster management along Brunei coast.

On the bliss of nature: Leveraging Nature based Solutions (NbS) for coastal management

T. Perera*, H.D. Dahanayake, L. Prematilaka, D. Wickramasinghe

Department of Zoology and Environment Sciences, Faculty of Science, University of Colombo, Colombo, Sri Lanka

* **Correspondence:**

thisaruanjana@gmail.com

Abstract

Across the global south, coasts represent areas with a mixture of different environmental, socio-economic and political issues. Among these, impacts of natural disasters and climate change are at the forefront of the challenges that coastal areas confront in the 21st century. Policy makers and practitioners often seek practical solutions to handle the deleterious impacts with involvements of a myriad of stakeholders, multiple policies and strategies and yet, very often face bottlenecks.

In recent years, use of alternative and novel methods in the practice of coastal socio-economic management have expanded rapidly. Although the concept of Nature-based Solutions (NbS) is not new, it has been gaining increased attention in the recent past. The NbS are the actions that could be taken to conserve, manage and restore natural ecosystems to support healthy functioning of the environment and to achieve social wellbeing effectively and adaptively. The NbS could be a successful strategy to address multifaceted issues that the climate change and natural disasters generate in the coast affecting communities.

Nevertheless, the socio-economic implications in managing natural resources and habitats to strengthen the NbS they offer, remain largely unexplored and overlooked. Recognizing these challenges, we will first examine the NbS provided by coastal habitats. A special attention will be paid to mangroves, sand dunes and coastal wetlands to highlight their contributions to climate change adaptations and reduce disaster risk. Secondly, using a few case studies from the South Asian region, we will describe a set of transformative perceptions which are essential in successful environmental conservation and management. In particular, we will introduce a new policy framework to upscale natural infrastructure entwined with inclusive community participation.

Impacts of human activities on Arsenic transport in the Huanghe (Yellow River)

Jing-Ling Ren, Jia-Qi Li, Guo-Dong Song, Su-Mei Liu

Frontiers Science Center for Deep Ocean Multispheres and Earth System, and Key Laboratory of Marine Chemistry Theory and Technology, Ministry of Education, Ocean University of China, Qingdao, China

Abstract

Under the influences of human activities (dam construction, Water-Sediment Regulation Schemes (WSRSs), etc.) and climate change, the biogeochemical cycles of trace elements in the Huanghe have undergone tremendous changes. Samples were collected in the middle and lower reaches of the Yellow River during Dec 2017 and Sep 2018 at three different seasons, with intensive sampling in the Xiaolangdi Reservoir in which WSRSs should be implemented in summer to flush trapped sediments from the upstream watercourse and reservoirs of the river. Regular monthly investigations were also carried out at Kenli (the lower reach of the Huanghe) to monitor the seasonal variations of dissolved As. The concentrations of total dissolved inorganic arsenic (TDIAs) ranged in 9.9-30.4 nM in spring, 15.6-31.7 nM in autumn and 15.7-31.6 nM in winter in the middle and lower reaches of Huanghe, respectively, with similar average concentration but distinguish distribution patterns during different seasons. TDIAs concentrations increased significantly in the Xiaolangdi Reservoir in winter and spring, indicating the human impacts on the behavior of TDIAs in the Huanghe. TDIAs concentrations decreased gradually from Xiaolangdi Reservoir to the Huanghe estuary in winter and spring, but with relatively high concentrations in autumn due to the effects of WSRSs carried out in august and flushing of watersheds by rainfall. Major influence factors on the behavior of TDIAs in the Huanghe and fluxes to the marginal sea of western Pacific are evaluated.

The potential value of establishing Oyster Shell Recycling (OSR) programmes.

Matthew Roberts

The University of Hong Kong, Hong Kong SAR, China

Correspondence:

Matthew Roberts

mattroberts07@msn.com

Abstract

Worldwide, Oyster Shell Recycling (OSR) is the process of recovering waste shell material and OSR programmes have been used as a successful mechanism for procuring otherwise lost oyster shells that are crucial to restoring oyster populations. Oyster shells are considered waste in Hong Kong and currently there is no active Oyster Shell Recycling programme. Hong Kong generated an estimated 3671 tonnes of shell material in 2020; therefore the opportunity to create circularity through recycling is feasible. Oyster populations in Hong Kong have the potential to generate considerable ecological and economic value. Oysters have been harvested extensively for their shells to make by-products for at least 700 years and combined with the continued decline of the oyster aquaculture industry, face extinction without immediate restorative action. Unfortunately, restoration efforts face shortages in shell material that is used as a hard substrate for oyster spat (larvae), on which they are dependent for settlement and survival. As the global shell deficit continues alternative materials in restoration are being explored. The study undertook the following process; first, experimentally validated shell as a preferred substrate for oyster spat and secondly, identified the extent of oyster shell available in Hong Kong to evaluate the cost-benefit and feasibility of implementing an OSR programme. The study offers a context under which OSR programmes can contribute efforts to mitigating waste issues in Hong Kong, by repurposing “waste” shells for the restoration of oyster populations, therefore enhancing the ecosystem services they provide.

China's coastal ecological restoration policies: Evolution, problems, and proposals

Xiao-qin Yu¹, Hui-ying Sun¹, Jing Yu^{1,2,*}

¹College of Oceanic and Atmospheric Sciences, Ocean University of China, Qingdao, China

²Institute of Marine Development of Ocean University of China, Qingdao, China

*** Correspondence:**

Jing Yu

by6801@ouc.edu.cn

Abstract

Coastal ecological restoration is the key means for improving functions of coastal ecological service and marine ecological environment. This paper 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. By analyzing the development of China's coastal ecological restoration and show that, both support funds and programs exhibit a remarkable growing trend since 2010. Large numbers of environment renovation programs contribute to coastal ecological restoration. A holistic restoration approach, fundamental research of coastal ecosystems, and the construction of coastal zone management system, are concluded as the main features. Because of the issues of marine government system, and some other challenges, such as the poor understanding of ecology and systematic idea, the quality of ecological restoration needs to be improved. Based on the current situations, some suggestions like implementing systematical restoration, and innovating restoration methods are proposed, which could underpin the coastal ecological restoration greatly.

Elucidation of incentive structures for researchers to focus on coastal ecological conservation activities and promotion of industrial use of the ocean

Chika Suzuki^{1,*}, Takeshi Yoshimochi², Hiriyuki Ukeda³, Akihiro Takemura⁴, Kazuhiro Nishikawa⁵, Kiyohi Fujikawa⁶, Takuro Matsumoto⁷, Takashi Nakagawa⁸, Shinichi Yukutake⁹, Minoru Ishida¹

¹Center for Science, Technology and Innovation Policy Studies, Kyushu University, Fukuoka, Japan

²Center for Regional Sustainability and Innovation, Kochi University, Kochi, Japan

³Headquarts, Kochi University, Kochi, Japan

⁴Faculty of Science Department of Sea Natural Science, University of the Ryukyus, Okinawa, Japan

⁵Kii Peninsula Institute of Regional Innovation, Wakayama University, Wakayama, Japan

⁶Faculty of Economics. Department of Economics, Aichi Gakuin University, Nagoya, Japan

⁷National Research Institute for Earth Science and Disaster Resilience, Tsukuba, Japan

⁸Ministry of Education, Culture, Sports, Science and Technology, Tokyo, Japan

⁹Kozo Keikaku Engineering Inc., Tokyo, Japan

*** Correspondence:**

Chika Suzuki

mdp.chika@nifty.com (suzuki@sti.kyushu-u.ac.jp)

Abstract

The Third Basic Plan on Ocean Policy positions "the challenge of realizing a new oceanic state" as a policy direction, and the basic policy for measures included "promotion of industrial use of the ocean". The purpose of this study was to elucidate the incentive structure for researchers who are actively engaged in industry-academia and regional collaboration activities in the fields of agriculture, forestry, and fisheries, including the use of deep sea water, tourism, and food.

First, the research questions (RQs) were formulated.

RQ1) What is the incentive structure for researchers who are actively engaged in industry-academia and regional collaboration activities?

RQ2) Are there any organizational or environmental influences?

The specific items and methods to be implemented in clarifying RQs are as follows.

(1) Selection of cases for analysis through web-based questionnaires

(2) Study of policy issues related to construction of an evaluation system based on statistical analysis

The data obtained from the above were subjected to (1) Stokes' four quadrants and (2) multiple regression analysis, while comparing them with the items of the previous evaluation projects. The data were enhanced based on interviews with researchers in the field of fisheries oceanography.

SESSION 4: ECOSYSTEM-SOCIAL INTERACTIONS IN THE COASTAL SEA

The results and discussion are as follows.

(1) In Stokes' four quadrants, it was confirmed that the majority of researchers recognize the high importance of both "pursuing fundamental principles" and "solving concrete real-world issues".

(2) The results of the statistical analysis based on multiple regression analysis found, as a point worthy of special mention, effective results for providing incentives in the future to promote collaborative activities. In the case of universities that use the region's marine resources as their research strength, we were able to identify issues and propose concrete measures for "promoting industrial use of the ocean" by reinforcing the results through interview surveys that included the management level.

Effects of integrated multi-trophic aquaculture on the nutrients and phytoplankton size structure in Sanggou Bay

Wenqi Xu¹, Sumei Liu^{1,2,3,*}, Xiaoyan Ning², Guoling Zhang¹

¹Key Laboratory of Marine Chemistry Theory and Technology, Ministry of Education, Ocean University of China, Qingdao, China

²Frontiers Science Center for Deep Ocean Multispheres and Earth System, Ocean University of China, Qingdao, China

³Laboratory for Marine Ecology and Environmental Science, Qingdao National Laboratory for Marine Science and Technology, Qingdao, China

*** Correspondence:**

Wenqi Xu

xuwenqi@ouc.edu.cn

Abstract

Field observations were made in October of 2014, May of 2015 at an integrated multi-trophic aquaculture (IMTA) site in Sanggou Bay (SGB), China, to assess the effects of aquaculture on nutrients and phytoplankton size structure in the bay. Dissolved nutrient and particulate phosphorus were measured in SGB. Nutrient concentrations showed considerable variation in spring and autumn, with higher concentrations in autumn. Besides tidal exchange and fluvial input, kelp culture at the mouth of the bay in spring and large-scale shellfish culture in the bay in autumn were also important factors affecting nutrient structure in the bay. Based on size-fractionated phytoplankton biomass (chlorophyll *a*), the effects of nutrient and aquaculture activities on the phytoplankton size structure in SGB were described. Phytoplankton biomass in autumn was significantly higher than that in spring, mainly affected by higher concentration of nutrients and higher temperature. Under the influence of large-scale kelp cultivation in the bay mouth in spring, chlorophyll *a* had the same distribution trend (higher in inner bay than in outer bay) as autumn even though the nutrient concentrations in the bay mouth were higher. Nanophytoplankton was the dominance of community, then the picophytoplankton and the microphytoplankton. Size fraction of phytoplankton from outer bay to inner bay gradually became smaller in both spring and autumn. From long term trends, nutrients in SGB had been affected combined by natural processes and aquaculture activities, and the size of phytoplankton might tend to miniaturize influenced by nutrients and aquaculture.

Changes in the community structuring of bacteria and archaea in a mariculture-impacted area

Erika Grace Gernato¹, DFL. Onda¹, AT VII. Bautista³, RB. Lloren^{4,5}, N. Dubois^{4,5}, and CMB. Jaraula^{2,*}

¹Microbial Oceanography Laboratory, The Marine Science Institute, University of the Philippines, Diliman, Quezon City, Philippines

²Organic and Stable Isotope Geochemistry Laboratory, The Marine Science Institute, University of the Philippines, Diliman, Quezon City, Philippines

³NATAS Lab, Philippine Nuclear Research Institute, Diliman, Quezon City, Philippines

⁴Department of Earth Sciences, ETH Zürich, Zürich, Switzerland

⁵Department of Surface Waters Research and Management, Eawag, Dübendorf, Switzerland

*** Correspondence:**

Caroline Marie B. Jaraula

cjaraula@msi.upd.edu.ph

Abstract

Mariculture is an essential industry in sustaining food security globally, and its increasing popularity in the latter decades led to emerging environmental concerns. In the Philippines, Bolinao is a site of intensive and extensive mariculture activity and its continued expansion resulted in fish kills with huge economic losses. Mariculture sediments are characterized by high organic matter (OM) content, and we hypothesized that mariculture pressure significantly affected benthic processes through time. To test this, a 140-cm sediment core adjacent to a fish cage was collected and analyzed for microbial community composition and structure with depth-for-time substitution. Results showed that bacterial communities mainly clustered with depth, hence time, consistent with clustering of physico-chemical characteristics of the sediments, hence the sections: BOT, MID, TOP, but only two clusters for archaea. Succession of microbes among sections was observed, and OM, phosphate, and oxygenation were the main drivers of structuring. Most indicator taxa per section corresponded to reconstructed environmental conditions upon deposition. Ultimately, changes in community structuring were likely from differences in OM content and composition and the resulting environmental conditions following TOC accumulation e.g., hypoxia. This study affirms the influence of mariculture to the benthos. This current period of changing climate coupled with long-term effects of pollution, where we observed significant changes since its inception, might spell disaster to the ecosystem.

Molecular and phylogenetic analysis of *Sardinella lemuru* at fishing ground Prigi-Trenggalek inferred d-loop mutations of mtDNA

Aida Sartimbul^{1,2,1}, Winata, Adi. Victor¹, Kasitowati, Dyah. Rarasrum^{1,3}, Feni. Iranawati^{1,2}, Pranowo, Setiyo. Widodo^{4,5}

¹Department of Marine Science, Faculty of Fisheries and Marine Science, Universitas Brawijaya, East Java, Indonesia

²Marine Resources Exploration and Management (MEXMA) Research Group, Universitas Brawijaya, East Java, Indonesia

⁴Marine & Coastal Data Laboratory, Marine Research Center, Ministry of Marine Affairs & Fisheries, Jakarta, Indonesia

⁵Department of Hydrography, Indonesian Naval Postgraduate School (STTAL), Jakarta, Indonesia

Abstract

Sardinella lemuru population trend is declining in Bali Strait. However, fish landings increase unexpectedly in the end of 2019 at Prigi fishing ground. However, the prior-conventional kinship assessments need genetically to be confirmed. These research objectives encompass both molecular identification and the genetic relationship of Prigi_SL with others. Similar morphological samples had collected five individuals in both 2017 and 2019. Chelex 10% was used for genomic DNA extraction, CRK-CRE primer had applied for amplification with Hotstart-50 PCR thermal profile. 1% agarose electrophoresis and Sanger sequencing had examined for both quantity and quality of D-loop amplicon. Identification using the algorithm of BLASTn. Phylogenetic tree analysis uses the neighbor-joining method. The genetic identities of 10 D-loop Prigi_SL are high (97.7%-98.7%) as Philippine_SL (MK579741.1-MK579742.1). The phylogenetic significantly shows low barrier inter-waters from low to moderate genetic distance. Even though two clades separate with different mutation rates, the kinship both Prigi_SL2019 and Philipine_SL2021 are the most closely genetic as well as Prigi_SL2017 and Prigi_SL2019, but there is one unique sample of Prigi_SL2017 in another clade. These study results provide needed information that its populations translocate to another secondary fishing ground with ITF, its dispersal connection

Keywords: *Sardinella lemuru*, DNA, ITF, Prigi, Indonesia

Multi-scale ocean dynamical processes in the Indo-Pacific Convergence Zone and their climatic and ecological effects

Yan Du^{1,2,3,*}, **Fan Wang**^{4, 2,*}, **Tianyu Wang**^{1,3}, **Weiwei Liu**^{1,3}, **Linlin Liang**³, **Ying Zhang**^{1,3}, **Yunfan Chen**^{1,2}, **Jiaxing Liu**^{1,3}, **Wei Wu**^{1,2}, **Kefu Yu**⁵, **Jing Zhang**⁶

¹State Key Laboratory of Tropical Oceanography & Key Laboratory of Science and Technology on Operational Oceanography, South China Sea Institute of Oceanology, Chinese Academy of Sciences, Guangzhou, China

²University of Chinese Academy of Sciences, Beijing, China

³Southern Marine Science and Engineering Guangdong Laboratory, Guangzhou, China

⁴Key Laboratory of Ocean Circulation and Waves, Institute of Oceanology, Chinese Academy of Sciences, Qingdao, China

⁵Coral Reef Research Center, School of Marine Sciences, Guangxi University, Nanning, China

⁶State Key Laboratory of Estuarine and Coastal Research, East China Normal University, Shanghai, China

*** Correspondence:**

Yan Du
duyan@scsio.ac.cn
Fan Wang
fwang@qdio.ac.cn

Abstract

The Indo-Pacific Convergence Zone (IPCZ) has a complex ocean dynamical system. The IPCZ closely links five basin-scale circulations in the Indo-Pacific Ocean. The ocean circulation and planetary waves are complicated and variable, conveying the mass and energy exchanges across basins. Numerous straits in the Indonesian Seas act as oceanic channels for planetary waves that propagate from the tropical Pacific to the southeast Indian Ocean, or vice versa. In a large scale, the inter-basin transports and planetary waves change the ocean thermal structure, triggering strong air-sea interactions, further regulating the regional and global climate. Both ocean dynamics and climate variabilities have direct impacts on the ecological system in the IPCZ. With exceptional marine biodiversity in the IPCZ, investigation of the ecological evolution could provide scientific supports for marine biodiversity and environmental protection, the sustainable use of marine biological resources, and the healthy development of the marine economy under global climate change. This work overviews a series of researches focusing on the multi-scale dynamical and environmental processes in the IPCZ, including the climatic signatures in coral records and the ecological response.

Getting To Know The Underwater Gardener: Sea Urchin Community Distribution in Peninsular Malaysia

Man Ying Mok^{1,*}, Amri Affendi Yang¹, Jillian Ooi Lean Sim^{2,1}

¹Institute of Ocean and Earth Sciences, Universiti Malaya, 50603 Kuala Lumpur, Malaysia

²Department of Geography, Faculty of Arts and Social Sciences, Universiti Malaya, Kuala Lumpur, Malaysia

*** Correspondence:**

Mok Man Ying

mokmanyong@um.edu.my

Abstract

Sea urchins are recognized as keystone herbivore species in coral reefs as they control algae and promote coral dominance in the Caribbean. However, there is a large knowledge gaps in our understanding of sea urchins in Indo-Pacific despite it's high biodiversity of coral reef species and depleted herbivorous fish populations caused by overfishing. There is uncertainty as to whether sea urchins in Indo-Pacific fulfil a similar functional role as their Caribbean counterparts. To fill this knowledge gap, this study aims to examine the distribution of sea urchins of Peninsular Malaysia (The Sunda Shelf and Malacca Strait Marine Ecoregion), as the first step to understand their role in these marine ecosystems. Geographical information on the density, diversity, and distribution of sea urchins in Peninsular Malaysia's waters were collated using three types of approaches which were literature, questionnaire and field surveys. From the field surveys, a total of 7 species from 5 families with a mean density of 41.6 ± 52.98 S.D. individuals/100m² were documented. When combined with the literature and questionnaire surveys, 10 species from 6 families can be found within Peninsular Malaysia's waters. In addition, a first record of *Prionocidaris bispinosa* for Malaysia was documented at the intertidal seagrass meadow in Tanjung Kupang, Johor. Data collected from field surveys indicated that sea urchin diversity, richness and density between marine ecoregions were similar. However, sea urchin species composition were significantly different between coral and seagrass habitats (Wilcoxon rank sum test, $p < 0.05$). By using the spatial data gathered, this study revealed the location of sea urchin density, species richness and diversity hotspots. The spatial data can be used to improve the knowledge of the present distributions of sea urchin in Peninsular Malaysia waters and would serve as valuable information in the planning and management of natural habitats for biodiversity and conservation in Malaysia's marine ecosystem.

Ocean Acidification from Below in the Tropical Pacific

Masao Ishii¹, K. B. Rodgers^{3,4}, H. Y. Inoue⁵, K. Toyama¹, D. Sasano¹, N. Kosugi¹, H. Ono¹, K. Enyo², T. Nakano², D. Iudicone⁶, B. Blanke⁷, O. Aumont⁸, R. A. Feely⁹

¹Meteorological Research Institute, JMA, Tsukuba, Japan

²Global Environment and Marine Department, JMA, Tokyo, Japan

³Center for Climate Physics, Institute for Basic Science, Busan, South Korea

⁴Pusan National University, Busan, South Korea

⁵Graduate School of Environmental Earth Sciences, Hokkaido University, Sapporo, Japan

⁶Department of Integrated Marine Ecology, Stazione Zoologica Anton Dohrn, Naples, Italy

⁷Laboratoire d'Océanographie Physique et Spatiale, UMR 6523 CNRS-Ifremer-IRD-UBO, Institut Universitaire Européen de la Mer, Brest, France

⁸LOCEAN, Centre IRD de Bretagne, Plouzané, France

⁹Pacific Marine Environmental Laboratory, NOAA, Seattle, Washington, USA

*** Correspondence:**

Ishii, Masao

mishii@mri-jma.go.jp

Abstract

Identifying ocean acidification and its controlling mechanisms is an important priority within the broader question of understanding how sustained anthropogenic CO₂ emissions are harming the health of the ocean. Through extensive analysis of observational data products for ocean inorganic carbon, here we quantify the rate at which acidification is proceeding in the western tropical Pacific Warm Pool, revealing $-0.0013 \pm 0.0001 \text{ yr}^{-1}$ for pH and $-0.0083 \pm 0.0007 \text{ yr}^{-1}$ for the saturation index of aragonite for the years 1985-2016. However, the mean rate of total dissolved inorganic carbon increase ($+0.81 \pm 0.06 \mu\text{mol kg}^{-1} \text{ yr}^{-1}$) sustaining acidification was ~20% slower than what would be expected if it were simply controlled by the rate of atmospheric CO₂ increase and transmitted through local air-sea CO₂ equilibration. Joint Lagrangian and Eulerian model diagnostics indicate that the acidification of the Warm Pool occurs primarily through the anthropogenic CO₂ that invades the ocean in the extra-tropics, is transported to the tropics through the thermocline shallow overturning circulation, and then re-emerges into surface waters within the tropics through the Equatorial Undercurrent from below. An interior residence time of several years to decades, acting in conjunction with the accelerating CO₂ growth in the atmosphere, can be expected to contribute to modulating the rate of Warm Pool acidification.

Understanding the fate of dissolved organic carbon from tropical peatlands in Southeast Asia's shelf sea

Patrick Martin^{1,*}, Yongli Zhou¹, Robert S. Nichols¹, Nivedita Sanwlani¹, Moritz Müller², Yuan Chen¹, Kristy Y.W. Chang¹, Elizabeth W.S. Wong³, Joel M.C. Wong³, Soo Chin Liew³, Nikita Kaushal¹, Nagur Cherukuru⁴, Christopher D. Evans⁵

¹Asian School of the Environment, Nanyang Technological University, Singapore

²Swinburne University of Science and Technology, Kuching, Malaysia

³Centre for Remote Imaging, Sensing, and Processing, National University of Singapore, Singapore

⁴CSIRO Oceans and Atmosphere, Canberra, Australia

⁵UK Centre for Ecology and Hydrology, Bangor, UK

*** Correspondence:**

Patrick Martin

pmartin@ntu.edu.sg

Abstract

Southeast Asia's tropical peatlands deliver ~10% of the global land–ocean dissolved organic carbon (DOC) flux to the Sunda Shelf Sea, and land-use change is believed to have increased this flux considerably above pre-anthropogenic levels. However, we still have a limited understanding of the biogeochemical fate and impacts of this DOC. I will present an overview of our work in Sarawak (northwest Borneo) and Singapore to constrain the fate and impacts of peatland DOC in coastal waters. Our data from Sarawak confirm that peatland DOC typically mixes conservatively across estuaries, which means that there is little biogeochemical processing until the DOC reaches coastal waters. Using satellite remote sensing, we also found that DOC concentrations in coastal waters of Sarawak have increased since the early 2000s, suggesting that land-use change has indeed increased DOC fluxes. Incubation experiments revealed that peatland DOC is quite refractory to microbial remineralization, but that it is labile to photochemical oxidation. To quantify the remineralisation of peatland DOC at sea, we collected time-series data in the Singapore Strait, where the monsoon-driven reversal of ocean currents leads to a seasonal input of peatland DOC. Mass balance calculations based on the stable carbon isotope composition ($\delta^{13}\text{C}$) of DOC and of dissolved inorganic carbon (DIC) show that at least 60–70% of peatland DOC is remineralised within the shelf sea. Our data further reveal that the remineralisation of the DOC to CO_2 acidifies coastal water to a degree that may cause ecological impacts. Conversely, undecomposed peatland DOC absorbs sunlight and significantly reduces the depth of the euphotic zone. Overall, our results demonstrate that peatland DOC affects coastal water quality in Southeast Asia, and that sustainable land management is important for the health of marine ecosystems in this region.

Biogeography of marine planktonic cyanobacterial communities from coastal oceans- what can we learn from ‘omics’ based approaches?

Punyasloke Bhadury, Anwesha Ghosh¹

¹Integrative Taxonomy and Microbial Ecology Research Group, Department of Biological Sciences, Indian Institute of Science Education and Research Kolkata, Nadia, India

Abstract

Mangroves represent a unique ecotone between land and ocean boundary systems. Marine planktonic cyanobacterial communities are known to influence rates and fluxes of carbon and nitrogen cycling in coastal oceans globally including in the Northern Indian Ocean. However, their structure, in particular biogeographic patterns, are not very well elucidated from mangrove ecosystems and other coastal biotopes. Biogeographic patterns of marine planktonic cyanobacterial (MPC) assemblages were elucidated from four coastal habitats namely, Baltic Sea (BL), Monterey Bay (MB), South China Sea (SCS) and Sundarbans (SB) mangrove of Northern Indian Ocean based on deep phylogeny of 16S rRNA sequences generated using Sanger and Next-generation sequencing approaches. Based on 16S rRNA phylogeny, four major taxonomic orders of marine planktonic cyanobacteria were recovered in varying proportions with several novel 16S rRNA sequences in each of the four targeted habitats. Members of the order Synechococcales were dominant in all the habitats (~94% sequences) while the orders Chroococcales and Oscillatoriales were only detected in SB and SCS, respectively. In the phylogenetic tree, Synechococcus-like sequences showed overwhelming dominance in SB and they were found in three other habitats. Prochlorococcus-like sequences were found in sizeable number in MB and SCS but were absent in SB and coastal BL. Synechococcus-like sequences were represented by three major marine clusters (5.1, 5.2, and 5.3). Three novel clades as part of Synechococcus cluster were detected only in SB and one novel clade in BL. These clades could have potential significance in carbon and nitrogen cycling. Besides, across small geographical gradients of the Northern Indian Ocean covering Bay of Bengal it was also found that MPC communities also exhibit local environmental gradients including role of sediment and coastal hypoxia. Interestingly, cultured based approaches also revealed a new species of Synechococcus, *S. moorigangaii* from SB which can grow in presence of urea and also possess adaptive genes linked to urea metabolism as well as motility apparatus in genome. The study reflected potential unexplored functional diversity of marine planktonic cyanobacteria in coastal habitats including in mangroves and are vital to health of coastal oceans of the Northern Indian Ocean and beyond including regional carbon pump.

Diagnostic of critical health status for an estuarine mangrove ecosystem

S. M. Mustafizur Rahman^{1,*}, Md. Alamgir Hossain¹, Sheikh Fahim Faysal Sowrav¹, Nafis Intiaj Hossain¹, Kashafad Bin Hafiz¹, Md. Masud-UI-Alam^{1,2}, Chung Il Lee³, Md. Nazrul Islam⁴

¹Dept. of Oceanography and Hydrography, Bangabandhu Sheikh Mujibur Rahman Maritime University, Dhaka, Bangladesh

²Skidway Institute of Oceanography, The University of Georgia, Savannah, USA

³Department of Marine Bioscience, Gangneung-Wonju National University, Gangneung, Republic of Korea

⁴Department of Geography and Environment, Jahangirnagar University, Savar, Bangladesh

*** Correspondence:**

Dept. of Oceanography and Hydrography, Bangabandhu Sheikh Mujibur Rahman Maritime University, Dhaka, Bangladesh
mustafizur.ocn@bsmrmu.edu.bd

Abstract

Sundarbans Mangrove Forest (SMF) is the world largest single block of tidal halophytic mangroves, comprise around 10,000 km². The strong tidal influence and confluence of freshwater from upstream river flow make it highly productive; however, all the hydrological and physio-chemical parameters fluctuate very frequently and in such, shape the productivity of this unique ecosystem. The spatial water dynamics of this ecosystem help to understand the Water Quality Index (WQI) of this area. Results suggest that upper part of the Pashur River got highest concentration of total chlorophyll (53.0917µgm/L) whereas the western estuary contains a significant amount of total chlorophyll and shows east to westward increasing trend; 33.15567 and 51.4259 µgm/L respectively. The increasing trend of nutrient concentration shifted from river to estuary 0.18 – 0.062, 0.4 – 0.675, 0.286-0.252, 1.32-1.96 mg/L for Phosphate, Nitrate, Ammonia and Silica respectively. Also, an increasing trend of Chemical Oxygen Demand (COD) level was observed in the seaward direction, 9.03 mg/L in the Central estuary. Surface temperatures were relatively stable and uniformly static (averages are 22.35 °C, 22.67 °C, 23.72 °C, 25.32 °C and 25.47 °C in the area of Pashur River Upper part, Pashur River middle part, Central estuary, western estuary and eastern estuary respectively whereas density have a direct proportional relation with salinity showing the average values of sigma-t 3.75, 10.75, 15, 16.8 and 14.11 respectively. The upper part of Pashur River got less Dissolved Oxygen (DO) than the lower reaches, 3.63 and 4.65 mg/L respectively. Electro-conductivity has a strong correlation with surface salinity and density (Average EC for A: 13.9567 (mS/cm), SSS: 8.07 PSU, SST: 22.35, Density: 3.744125 TDS: 7.219, TSS: 19.6333) whereas TSS has a completely opposite relationship. Freshwater flux and TDS (6.401 ppt-20.55 ppt) concentration are inversely related. Establishing the WQI for SMF is very essential to understand the ecological health status.

Monsoonal shifts in taxonomic and functional diversity of picoeukaryotic microbial communities in a tropical coastal environment

Maria Anna Michaela De La Cruz¹, BW. Hingpit¹, DFL. Onda^{1,*}

¹Microbial Oceanography Laboratory, The Marine Science Institute, University of the Philippines, Diliman, Quezon City, Philippines

*** Correspondence:**

Deo Florence L. Onda
dfonda@msi.upd.edu.ph

Abstract

Picoeukaryotes are key components in marine ecosystems that play crucial roles in food webs and biogeochemical cycles. Despite their significance, many aspects of their community ecology and diversity remain understudied. Here, our goal was to investigate the taxonomic and functional diversity of picoeukaryotic communities particularly in response to monsoonal patterns characterizing tropical coastal regions. To do this, water samples were collected monthly at a single location in a tropical coastal area covering the late northeast (NE) and southwest (SW) monsoons. We then performed high-throughput amplicon sequencing of the V4 region of the 18S rRNA gene to generate taxonomic profiles of the communities across time. Results showed a clear shift in community structures coinciding with the monsoonal shifts NE (January to mid-June) to SW monsoon (late June to October), implying that changes in community patterns were possibly associated with changes in monsoonal periods. Further, NE monsoon samples exhibited greater diversity, with smaller taxa such as Syndiniales, Prymnesiophyceae, Picozoa, Cercozoa, Stramenopiles and Chlorophytes being the most abundant groups present. In contrast, SW monsoon samples have lower diversity and have become generally dominated by large-celled taxa mostly diatoms. Canonical correlation analysis (CCA) and multiple linear regression both revealed nitrate as the strongest environmental driver of the picoeukaryotic communities. A look at the functional diversity patterns of these communities using shotgun metagenomic sequencing of representative samples from each monsoon period also revealed differently abundant functional genes, indicating possible adaptation to the changing conditions. Our observations could help provide insights on the potential trajectory of microbial communities under environmental stresses which are important in understanding the implications of emerging threats such as coastal eutrophication and climate change.

Seasonal Dynamics of Surface Dissolved Organic Matter in the South China Sea and the Straits of Malacca: Implications for Biogeochemical Province Delineation of Marginal Seas

Yixue Zhang, Ying Wu, Jing Zhang, Jie Jin, Jian Li, Zhenqiu Zhang

Abstract:

Biogeochemical provinces are an important aid to identify homogeneous biogeochemical characteristics and underlying ecosystem dynamics in the open ocean. This macroscale approach, however, does not appear to be applicable to marginal seas for disregarding various small scale changes. Here, we adopted two observation schemes throughout the typical marginal seas, the South China Sea (SCS) and Straits of Malacca (MS), with continuous surface-water sampling during March and May 2018. Spatial and seasonal heterogeneity of hydrological and dissolved organic matter (DOM) properties was investigated. With a novel combination of chromophoric DOM index and classical biogeochemical parameters (temperature, salinity, chlorophyll-*a*, and bathymetry), we delineated five biogeochemical provinces in each season to integrate DOM pools and investigate region-specific and season-dependent biogeochemical processes. The results showed that the SCS basin was seasonally modulated by biological activities and photodegradation, resulting in the biologically active DOM pools. The western SCS seasonally received terrestrial DOM, subjected to the western boundary current under monsoon regulation. The MS was found to serve as an efficient carbon source of terrestrial substances, which exported to the northern Indian Ocean during the Northeast Monsoon. The delineation favored the simplification of complex biogeochemistry and allowed us to predict future trends in this dynamic system. Chromophoric DOM index was proven applicable to the delineation of marginal seas, that shed the light on the potential applications in biogeochemical provinces in dynamic systems.

Nutrient Dynamics in the River Systems of The Sundarban Mangrove, Bangladesh

Ashraful Azam Khan¹

¹Department of Fisheries, University of Chittagong, Chittagong, Bangladesh

aakimscu@yahoo.com

Abstract:

The study revealed that nutrient concentrations were influenced by seasonal changes. Mean nutrient levels during post-monsoon, winter and monsoon seasons, respectively, were in the following ranges: nitrate (0.05–0.35, 0.04–0.31 and 0.11–0.33 mg/L); phosphate (0.09–0.12, 0.05–0.36 and 0.11–0.15 mg/L) and ammonia (0.02–0.06, 0.02–0.04 and 0.31–0.41 mg/L). Increased levels of PO₄-P and NH₃-N and lower DO and salinity were recorded during the monsoon period. Most of the experimental sites showed higher NO₃-N content during monsoon, whereas few elevated concentrations were observed during post-monsoon and winter periods. High and low tidal waters contained mean nutrient levels in the following ranges: nitrate (0.05–0.46 and 0.04–0.40 mg/L); phosphate (0.05–0.42 and 0.07–0.18 mg/L) and ammonia (0.02–0.38 and 0.02–0.37 mg/L) without following any distinct fluctuation patterns. The western part of the Sundarbans receives less freshwater input during the monsoon season than other areas of the ecosystem, which reduces the variability of nutrient levels and water quality components.

Diversity distribution, driving factors and assembly mechanisms of free-living and particle-associated bacterial communities at a subtropical marginal sea

Huatao Yuan¹, Tangcheng Li¹, Hongfei Li¹, Cong Wang¹, Ling Li¹, Xin Lin¹, Senjie Lin^{1,2,*}

¹State Key Laboratory of Marine Environmental Science and College of Ocean and Marine Biodiversity and Global Change Research Center, Xiamen University, Xiamen, China

²Department of Marine Sciences, University of Connecticut, Groton, United States of America

***Correspondence:**

Dr. Senjie Lin

senjie.lin@uconn.edu

Abstract

In the ocean, free-living (FL) and particle-associated (PA) bacterioplankton communities play critical roles in biogeochemical cycles. However, their community composition, assembly process, and functions in the continental shelf and slope regions are poorly understood. Here, based on 16S rRNA gene amplicon sequencing, we investigated the driving factors, assembly processes and functional potentials of bacterial communities in a subtropical shelf and slope region in northern South China Sea. The bacterioplankton community showed specific distribution patterns with respect to lifestyle (free-living vs. particle-associated), habitat (slope vs. shelf), and depth (surface vs. the deep chlorophyll maximum and bottom). Moreover, physical environmental properties and nutrient concentrations were both influential factors. Salinity and water temperature were the key factors modulating turnover in the FL bacterioplankton community, whereas nitrite, silicate and phosphate were the key factors for the PA community. Model analyses revealed that stochastic processes outweighed deterministic processes in general bacterioplankton community assembly, and had stronger influences on PA than FL. Homogeneous selection (Hos) was more responsible for the assembly and turnover of FL, while drift and dispersal limitation contributed more to the assembly of PA. Importantly, the major contributor to Hos in PA was Gammaproteobacteria:Others, whereas that in FL was Cyanobacteria:Bin6. Additionally, the major contributors to drift and dispersal limitation in both PA and FL were Gammaproteobacteria:Bin91 and Gammaproteobacteria:Others, respectively. Finally, the predicted metagenomic analysis (PICRUSt2) indicated that the metabolism of carbohydrates, cofactors, amino acids, terpenoids, polyketides, and lipids, the biosynthesis of other secondary metabolites, and antibiotic resistance were markedly enriched in PA than FL. These findings expand the current understanding of the ecological mechanisms controlling microbial community assembly and differentiating the FL and PA communities in the continental shelf and slope regions.

Keywords: Marine bacterioplankton; Spatial variability; Particle-associated; Community assembly; iCAMP-based null model; Neutral community model

Exploring environmental dynamics of Sundarbans mangrove of the Northern Indian Ocean- the importance of time series monitoring

Yash Yash, Bhadury Punyasloke¹

¹Integrative Taxonomy and Microbial Ecology Research Group, Department of Biological Sciences, Indian Institute of Science Education and Research Kolkata (IISER Kolkata), Nadia, India

* **Correspondence:**
yshcu5@gmail.com

Abstract

Mangroves represent a key feature of coastal ocean in the tropics and sub-tropics; serves a range of ecological and socio-economic functions including driver of coastal blue economy such as in the Northern Indian Ocean. Sundarbans represents the world's largest contiguous mangrove ecosystem and strongly influenced by freshwater flow from the three major riverine systems Ganga-Brahmaputra-Meghna as well as from the coastal water of Bay of Bengal diurnally. The broad objective of this study is to track environmental dynamics of Sundarbans by sustained monitoring of Sundarbans Biological Observatory Time Series (SBOTS). Based on weekly and monthly sampling approaches of SBOTS, the decadal dataset (2010-2020) provides a mechanistic understanding of key environmental parameters including surface water temperature (SWT), salinity, dissolved oxygen, pH and dissolved forms of nutrients representing N, P and Si. The SWT trends vary between 19-34°C while salinity show 0-25 although with a gradual increase towards marine conditions. The dissolved oxygen concentration varies between 3-9.3 mg/L with evidences of seasonal hypoxia, in particular during pre-monsoon every year. The pH trends (6.9-8.5) reflect the strong influence of seasonal precipitation and freshwater flow in the region. The values of inorganic nitrogen (nitrate), phosphate and silicate varying from 30-180, 0.5-4.5, and 3-60 μM respectively indicating the influence of anthropogenic inputs and resulting implications on biological communities including evidences of genome plasticity in Sundarbans. Overall, time series program such as SBOTS of the Northern Indian Ocean can be crucial towards linking the critical roles of environmental variables in shaping biological complexity in coastal oceans.

Probing air-sea exchange with radiocarbon in the maritime air and sea surface water of the West Pacific

Yongqi Liang^{1,*}, Liping Zhou^{1,2}, Yongrui An¹, Na Qian¹

¹Department of Geography, Peking University, Beijing, China

² Institute of Ocean Research, Peking University, Beijing, China

*** Correspondence:**

Liang, Yongqi

liangyq@pku.edu.cn

Abstract

The West Pacific is one of the most active areas of atmospheric movement and ocean current. Radiocarbon (^{14}C) generated by the thermonuclear tests in the 1950s to early 1960s is known as bomb radiocarbon. The distribution of the bomb ^{14}C has provided a tracer for studying natural carbon dynamics in all compartments of the global carbon cycle, and for tracing air-sea exchange. Here we present ^{14}C in atmospheric CO_2 of the maritime air collected over the West Pacific at 7°N to 36°N in 2019, along with the ^{14}C of the dissolved inorganic carbon (DIC) in the sea surface water at the same locations. The $\Delta^{14}\text{C}$ values of the atmospheric CO_2 ($\Delta^{14}\text{CO}_2$) and the seawater DIC (DI^{14}C) vary in the range of -41.5 ± 1.8 -- $11.4 \pm 2.3\text{‰}$ and -11.8 ± 1.9 -- $25.3 \pm 2.1\text{‰}$, respectively. The average value of sea surface DI^{14}C is 27.6‰ higher than that of the maritime air $^{14}\text{CO}_2$, confirming the transfer of bomb ^{14}C from the upper ocean back into the atmosphere. The $\Delta^{14}\text{CO}_2$ decreases gradually with latitude, while less changes in DI^{14}C are observed. This gives rise to an increasing $\Delta^{14}\text{C}$ gradient towards the north, indicating that the air-sea exchange in the West Pacific is influenced by factors such as ocean CO_2 solubility pump and fossil fuel emission from the continent. Combined with the DI^{14}C data of adjacent sea area, the ocean circulation and mixing process are also discussed.

Transport and dilution of fluvial antibiotic in the Upper Gulf of Thailand

Aobo Wang¹, **Xinyu Guo**^{2,*}, **Akihiko Morimoto**², **Kana Maetani**¹, **Rumi Tanoue**², **Siraporn Tong-U-Dom**³, **Anukul Buranapratheprat**³

¹Graduate School of Science and Engineering, Ehime University, Matsuyama, Japan

²Center for Marine Environmental Studies (CMES), Ehime University, Matsuyama, Japan

³Department of Aquatic Science, Faculty of Science, Burapha University, Chonburi, Thailand

*** Correspondence:**

Xinyu Guo

guoxinyu@sci.ehime-u.ac.jp

Abstract

A three-dimensional hydrodynamic-antibiotic model is developed to investigate the transport and dilution of sulfamethoxazole (SMX) in the Upper Gulf of Thailand (UGoT). The simulation produced a spatially averaged annual mean SMX concentration of $0.58 \mu\text{g m}^{-3}$, which varied slightly between seasons assuming a temporally constant river SMX loading observed in August. In contrast, the horizontal distribution of SMX concentrations strongly varied with season because of the changing residual currents. In addition, SMX is diluted to concentrations lower than 10% of those in river waters a short distance offshore of the estuaries. To better understand this behavior, we examined the relationship between salinity and SMX concentrations in the UGoT. The annual budget demonstrates that 98% of SMX in the UGoT is removed by natural decomposition. As the concentrations of fluvial pollutants in the UGoT depend on their river loading and decomposition rates, functions were derived to predict pollutant concentrations and flushing times based on the river input flux and half-life.

Peer inside the deepest blue hole: diel vertical dynamics of plankton in Yongle Blue Hole, South China Sea

Tianying Chen^{1,2}, J. Zhu^{1,2}, Y. Zhuang^{1,2,*}, H. Chen^{1,2}, C. Chen^{1,2}, R. Ge^{1,2}, L. Fu³, Z. Yang⁴, N. Bi⁵, G. Liu^{1,2}

¹Key Laboratory of Marine Environment Science and Ecology, Ministry of Education, Qingdao, China

²Laboratory for Marine Ecology and Environmental Science, National Laboratory for Marine Science and Technology, Qingdao, China

³Sansha Trackline Institute of Coral Reef Environment Protection, Sansha, China

⁴College of Marine Geosciences, Ocean University of China, Qingdao, China

⁵Key Laboratory of Submarine Geosciences and Prospecting Techniques, MOE, Ocean University of China, Qingdao, China

* **Correspondence:**

Zhuang Yunyun

yunyun.zhuang@ouc.edu.cn

Abstract

The Yongle blue hole (YLBH) in South China Sea is the deepest blue hole in the world and exhibits unique environmental characteristics. Based on rRNA, rDNA and metatranscriptomic analysis, we investigated the diel vertical dynamics of plankton community, and the in situ gene expression of mesoplankton of YLBH in spring 2017. The results showed that the composition of plankton community in YLBH was significantly different from that in the lagoon and the outer reef slope, and depth-dependent and diurnal variation was observed. For pico-, nano- and micro-plankton, Proteobacteria and Actinomycetes, Annelida and Dinophyceae were the dominant prokaryotes and eukaryotes, respectively. Malacostraca, Actinopterygii, Copepoda and Annelida were most abundant in mesoplankton rRNA libraries. The neutral model showed that the stochastic processes had greater impact on eukaryotes plankton community than prokaryotic ones. Dispersal limitation was the most important ecological process shaping the eukaryotic plankton communities. The contribution of homogenous selection and heterogenous selection to prokaryotic community variation was higher than that to eukaryotic communities. Depth and salinity are environmental factors most significantly affecting eukaryotic and prokaryotic plankton communities, respectively. A group of Malacostraca juvenile was found in the net-tow samples, which was inferred to be a new species of genus *Sadayoshia* in family *Munididae* based on phylogeny of COI gene. Metatranscriptomes revealed the metabolic variations of mesoplankton communities with depth and diurnal cycle. Significant decrease of transcript richness in the 60-90 m community of nighttime suggests that depth or hypoxia may depress the metabolic activity of mesoplankton community. Our preliminary results shed light on the biodiversity and community assembly mechanism of plankton in YLBH, and provided a basis for further exploring the adaptation and evolution of organisms in YLBH.

Organic matter as an active component of biogeochemical cycles in tropical waters

Christian Lønborg^{1,*}, Xosé Antón Álvarez-Salgado², Cátia Carreira³

¹Department of Ecoscience, Aarhus University, Roskilde, Denmark

²CSIC, Instituto de Investigaciones Mariñas, Vigo, Spain

³Department of Environmental Science, Aarhus University, Roskilde, Denmark

*** Correspondence:**

Christian Lønborg

c.lonborg@ecos.au.dk

Abstract

In tropical waters, a dominant part of carbon and nutrients is entangled in a complex mixture of organic compounds. Due to difficulties in quantifying the bioavailability of organic forms, these are not normally considered as active components of biogeochemical cycles.

In this presentation, we will use data collected in tropical coastal waters as a case study to demonstrate that organic matter is an active component of the carbon and nutrients cycles, which also needs to be considered in future studies in the Indo-Pacific region.

Distribution patterns of ciliate diversity in the South China Sea

Weiwei Liu^{1,2}, **Yehui Tan**^{1,2,*}

¹Key Laboratory of Tropical Marine Bio-resources and Ecology, South China Sea Institute of Oceanology, Chinese Academy of Science, Guangzhou, 510301, China

²Southern Marine Science and Engineering Guangdong Laboratory (Guangzhou), Guangzhou, 511458, China

*** Correspondence:**

Yehui Tan
tanyh@scsio.ac.cn

Abstract

Ciliates are abundant microplankton that are widely distributed in the ocean. In this study, the distribution patterns of ciliate diversity in the South China Sea (SCS) were analyzed by compiling community data from previous publications. Based on morphological identification, a total of 592 ciliate species have been recorded in the SCS. The ciliate communities in intertidal, neritic and oceanic water areas were compared in terms of taxonomy, motility and feeding habit composition, respectively. Significant community variation was revealed among the three areas, but the difference between the intertidal area and the other two areas was more significant than that between neritic and oceanic areas. The distributions of ciliates within each of the three areas were also analyzed. In the intertidal water, the community was not significantly different among sites but did differ among habitat types. In neritic and oceanic areas, the spatial variation of communities among different sites was clearly observed. Comparison of communities by taxonomic and ecological traits (motility and feeding habit) indicated that these traits similarly revealed the geographical pattern of ciliates on a large scale in the SCS, but to distinguish the community variation on a local scale, taxonomic traits has higher resolution than ecological traits. In addition, we assessed the relative influences of environmental and spatial factors on assembly of ciliate communities in the SCS and found that environmental selection is the major process structuring the taxonomic composition in intertidal water, while spatial processes played significant roles in influencing the taxonomic composition in neritic and oceanic water. Among ecological traits, environmental selection had the most important impact on distributions.

Seasonal mesozooplankton dynamics and its predictive future: need of freshwater in marine dominated estuaries of Indian Sundarban

Chayan Chakrabarty, Sandip Kumar Mukhopadhyay

Department of Marine Science, University of Calcutta, Kolkata, India

Abstract

Does monsoon drive seasonal mesozooplankton dynamics of tropical mangrove estuaries? To answer that a seasonal study was conducted between 2012 to 2017 in the Saptamukhi, Thakuran and Matla estuaries of central Indian Sundarban (part of the largest deltaic mangrove forest of the world). All these estuaries were freshwater starved and maintained polyhaline state except in monsoon season when oligohalinity was observed. Spatial variability of physical-chemical parameters including nutrients was not significant which suggested spatial homogeneity of environment. That homogeneity however brakes down with the arrival and departure of monsoon which increase habitat variability possibly by introducing variable volumes of freshwater in otherwise marine dominated estuaries. Mesozooplankton diversity and abundance decreased significantly in monsoon than pre and post-monsoon. Each estuary had its own set of dominant population(s) that succeeded seasonally. Mesozooplankton community was dominated by warm water calanoid copepods *Pseudodiaptomus serricaudatus*, *Paracalanus parvus*, *Bestiolina similis*, *Acacia spinicauda*, and *Chaetognath Sagiata bedoti*. Lack of freshwater, irregular monsoon, sea-level rise (6.1 24 mm/year) of the Northern Bay of Bengal, mangrove destruction may lead central Indian Sundarban towards a homogenous hypersaline environment. If that happens in decadal scale, mesozooplankton diversity and distribution of Indian Sundarban would be strained so are the predators (Fish, Prawns, Crabs) on which the economic sustainability of the region rests. Recommendations include long-term monitoring of salinization effects on plankton and its predators, and bringing back freshwater into the central Indian Sundarban from the Ganges River either by river engineering or by cooperation between India and Bangladesh or by both.

Dynamics of pelagic fisheries and their relation to the water temperature, chlorophyll-a and Indian Ocean Dipole: Case study of Prigi Water, Indonesia

Aida Sartimbul^{1,2}, Hideaki. Nakata³, Nurin. Hidayati^{1,2}, Zulfan. Khaidar¹, Widodo Setiyo. Pramono^{4,5}

¹Department of Marine Science, Faculty of Fisheries and Marine Science, Universitas Brawijaya, Malang, Indonesia

²Marine Resources Exploration and Management (MEXMA) Research Group, Universitas Brawijaya, Malang, Indonesia

³Faculty of Fisheries, Nagasaki University, Nagasaki, Japan

⁴Marine & Coastal Data Laboratory, Marine Research Center, Ministry of Marine Affairs & Fisheries, Jakarta, Indonesia

⁵Department of Hydrography, Indonesian Naval Postgraduate School (STTAL), Jakarta, Indonesia

Abstract

Purse seine fishing gear is a common fishing gear used to catch pelagic fishes in the Java and Bali Straits, including Prigi Waters. Recently, the catch has been declining. Various factors allegedly affect the dynamics of fishing in Prigi waters, one of which is the impact of climate change. The limited information about fishing and climatic phenomena in Prigi waters encourages this research to be carried out. The purpose of this study was to determine the relationship between oceanographic parameters (temperature and Chl-a) and climate index on the dynamics of pelagic fishing in Prigi Waters. Daily interval of six-month in situ tidbit water temperature data (Jun-Dec 2012) were used to test their correlation with satellite sea surface temperature data. (2004-2014). The result demonstrated the highly correlation between two data series and non-parametric analysis Sakaronov-Smirnov showed no different between both data series. Thus, satellite sea surface temperature data can substitute the lack of longer period of tidbit water temperature data series. Eleven (2003-2014) years data SST and Chlorophyll-a derived from Satellite MODIS were analysis together with the fisheries catch data and climatic index (Indian Ocean Dipole). Factor loading of Principal Component Analysis showed that fisheries catch was driven by Satellite Sea Surface Temperature, Chlorophyll-a, and Indian Ocean Dipole (PC1). Satellite sea surface temperature, Chlorophyll-a, and Indian Ocean Dipole contributed 16.2, 22.3, 17.0 % of total variables, respectively. Furthermore, fisheries catch composition, such as Bali Sardine, Mackerel Tuna and Skipjack Tuna contributed 19.0, 11.9, and 9.1 % respectively, while Indian Scads contributed only 4.5 % of the total variables. This study provides good information for government to manage sustainable pelagic fisheries in Prigi Water and its adjacent sea.

Key words: pelagic, fisheries, SST, Chlorophyll-a, Prigi

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

Riza Yuliratno Setiawan^{1,*}, R. Dwi Susanto², Anindya Wirasatriya^{3,4}, Inovasita Alifdini⁵, Ardiansyah Desmont Puryajati³

¹Department of Fisheries, Faculty of Agriculture, Universitas Gadjah Mada, Yogyakarta, Indonesia

²Department of Atmospheric and Oceanic Science, University of Maryland, College Park, MD, USA

³Department of Oceanography, Faculty of Fisheries and Marine Science, Diponegoro University, Semarang, Indonesia

⁴Coastal and Ocean Remote Sensing Laboratory, Center for Coastal Rehabilitation and Disaster Mitigation Studies, Diponegoro University, Semarang, Indonesia

⁵Institute of Meteorology and Climate Research, Karlsruhe Institute of Technology, Karlsruhe, Germany

*** Correspondence:**

Riza Yuliratno Setiawan
riza.y.setiawan@ugm.ac.id

Abstract

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

Impacts of Fluvial Flood on Physical and Biogeochemical Environments in Estuary–Shelf Continuum in the East China Sea

Jianzhong Ge^{1,2}, Jingsi Zhang¹, Changsheng Chen³, Pingxing Ding^{1,2}

¹State Key Laboratory of Estuarine and Coastal Research, East China Normal University, Shanghai, China

²Institute of Eco-Chongming (IEC), Shanghai, China

³School for Marine Science and Technology, University of Massachusetts-Dartmouth, New Bedford, United States

Abstract

Land-ocean interaction plays an essential role in the transport fate of terrestrial matters in the coastal and shelf regions. Flood discharge from a mega river, containing massive water, sediment, and nutrient loads, could result in substantial and complex impacts on the physical and biogeochemical dynamics of coastal systems. In this study, field campaigns were conducted in a region from the Changjiang River Estuary to the East China Sea (ECS) before and after a significant flood. The impacts of the flood on physical and biogeochemical environments were assessed. The results revealed that the fluvial flood enhanced the offshore expansion of the low-salinity river plume and associated sediment/nutrient fronts. However, the area of elevated chlorophyll-a at the river mouth did not expand noticeably. A numerical model was applied to quantify the contribution of the Three Gorges Dam (TGD) to the spatial intensity and temporal duration of fluvial flood effects on estuary–shelf continuum. The results predicted a maximum of 2° latitudinal offshore displacement of the shelf water. Salinity and nitrate exhibited conservative expansions, with a longer relaxation time (~ 2 months) than chlorophyll-a and phosphate. After the TGD-regulated flow event ceased, salinity and nitrate effects persisted, but phosphate and chlorophyll-a recovered rapidly. The flood decreased the dissolved oxygen (DO) concentration around the river mouth and the offshore region, but not in the nearshore transient area. In contrast, the non-TGD regulation increased the regional DO concentration, which reduced the hypoxia risk. The TGD has become a crucial anthropogenic driver of environmental changes in the Changjiang Estuary-ECS continuum.

Local drivers of extreme upper ocean marine heatwaves assessed using a global ocean circulation model

Maxime Marin^{1,2,3}, Ming Feng³, Nathaniel L. Bindoff^{1,2,4,5}, Helen E. Phillips^{1,2,4}

¹Institute for Marine and Antarctic Studies, University of Tasmania, Hobart, Australia

²ARC Centre of Excellence for Climate Extremes, Hobart, Australia

³CSIRO Oceans and Atmosphere, Indian Ocean Marine Research Centre, Crawley, Australia

⁴Australian Antarctic Program Partnership, Hobart, Australia

⁵CSIRO Oceans and Atmosphere, Hobart, Australia

Abstract

The growing threat of Marine Heatwaves (MHWs) to marine ecosystems and their respective industry demands that we better understand their local physical drivers. This information can be used to improve the performance of ocean models in simulating major events so more appropriate management policies can be taken. Here, we perform a global upper ocean heat budget analysis, using outputs from the OFAM3 ocean general circulation model, to quantify the relative contributions of oceanic and atmospheric processes to the onset and decay of the most extreme upper ocean MHWs. Results show that, unlike surface MHWs, in 78% of cases, horizontal heat convergence was the main driver of MHW onsets. In contrast, air-sea heat fluxes dominated the formation of MHWs through anomalies of latent heat flux or solar radiations, mostly in the tropical regions associated with shallow mixed layer depths. The domination of heat advection in explaining MHW decays decreased to 31% of pixels analysed. In 43% of pixels, both advection and air-sea flux anomalies acted together to dissipate the extreme heat. The air-sea heat flux cooling contribution is explained by an increased latent heat loss feedback response to upper ocean temperature anomalies. The expression of extreme upper ocean MHWs were consistent at the surface, although the increased variability from atmospheric influences resulted in more and weaker events. Our analysis provides valuable insights on the local physical processes controlling extreme MHWs evolution in an oceanic model.

Long-lasting marine heatwaves instigated by ocean planetary waves in the tropical Indian Ocean

Ying Zhang^{1,2}, **Ruisi Qi**^{1,3}, **Yan Du**^{1,2,3,*}, **Ming Feng**^{4,5}, **Shijian Hu**⁶

¹State Key Laboratory of Tropical Oceanography, South China Sea Institute of Oceanology, Chinese Academy of Sciences, Guangzhou, China

²Southern Marine Science and Engineering Guangdong Laboratory, Guangzhou, China

³University of Chinese Academy of Sciences, Beijing, China

⁴CSIRO Oceans and Atmosphere, Crawley, Australia

⁵Centre for Southern Hemisphere Oceans Research, Hobart, Australia

⁶CAS Key Laboratory of Ocean Circulation and Waves, Institute of Oceanology, Chinese Academy of Sciences, Qingdao, China

*** Correspondence:**

Yan Du

duyan@scsio.ac.cn

Abstract

Marine heatwaves (MHWs) are extreme weather-climate events in the ocean, with sustained sea surface warming from several days to months. MHWs can have devastating and long-lasting impacts on the marine ecosystem and socio-economy. MHWs in the tropical Indian Ocean (TIO) showed remarkable increases in duration and frequency during the satellite observing era, responding to rising sea surface temperature. Long-lasting MHWs were found in three major upwelling regions of the TIO in 2015-2016 and 2019-2020, closely related to by persistent downwelling oceanic planetary waves. In 2015, a prolonged MHW (149 days) in the western TIO was mainly instigated by the downwelling Rossby waves associated with the co-occurring super El Niño and positive IOD events. In the following year, the negative IOD sustained the longest MHW (372 days) in the southeastern TIO, dynamically attributed to the eastward-propagating equatorial Kelvin waves. In 2019-2020, the MHWs (424 days) in the southwestern TIO were the most long-lasting events on records, maintained by the downwelling Rossby waves associated with the 2019 extreme IOD.

The interannual variation and long-term trend of MHWs in the western TIO have been further investigated in this study. Significant interannual variability of MHWs in the western TIO were closely linked to the downwelling Rossby waves associated with IOD and ENSO. The downwelling Rossby waves deepen the thermocline and cause subsurface warming, affecting surface temperature by suppressing upwelling/entrainment of subsurface cold water and convergent Ekman transport of upper-ocean warm water. The total MHW days in the western TIO showed a significant increasing trend, which was dominated by rising sea surface temperature due to the impact of global warming.

The role of ocean–atmosphere coupling in the 2017 extreme coastal El Niño

Dongxiao Wang^{1,*}, Qihua Peng², Shangping Xie^{2,*}, Xiaotong Zheng³, Hong Zhang⁴

¹Guangdong Provincial Key Laboratory of Marine Resources and Coastal Engineering, and School of Marine Science, Sun Yat-Sen University, Guangzhou, China

²Scripps Institution of Oceanography, University of California San Diego, La Jolla, USA

³Physical Oceanography Laboratory, Ocean University of China, and Qingdao National Laboratory for Marine Science and Technology, Qingdao, China

⁴Joint Institute for Regional Earth System Science and Engineering, University of California, Los Angeles, USA

*** Correspondence:**

Dongxiao Wang

dxwang@mail.sysu.edu.cn

Shang-Ping Xie

sxie@ucsd.edu

Abstract

During February–April 2017, sea surface temperatures off Peru and Ecuador rose above 28 °C, causing torrential rains and floods with severe socioeconomic hardships.

In contrast to the 1983 and 1998 extreme coastal warming formed after the basin-wide warming, the 2017 warming event was confined to the coast region and preceded by a moderate La Niña. Our study utilizes a wide range of observations as well as comprehensive oceanic and atmospheric general circulation models to reveal the ocean–atmosphere dynamics underlying this highly unusual extreme event. Results show that both the downwelling Kelvin waves caused by strong westerly wind events over the equatorial Pacific and anomalous northerly coastal winds off Peru are crucial in the development of the 2017 extreme event. Atmospheric general circulation model experiments further reveal a positive ocean–atmosphere coupling in the coastal region, between coastal warming, atmospheric deep convection, and alongshore winds. These coupled processes provide predictability at monthly leads. Indeed, initialized on as early as 1 February 2017, seasonal prediction models captured the extreme rainfall event. Climate model projections indicate that the frequency of extreme coastal El Niño will increase under global warming due to an enhanced SST increase in the southeastern Pacific compared to the tropical mean warming.

Predicting marine heatwaves over seasonal timescales in the Pacific

Grant Smith^{1,*}, **Claire Spillman**¹, **Alistair Hobday**², **Jason Hartog**²

¹Bureau of Meteorology, Melbourne, Australia

²CSIRO Oceans and Atmosphere, Hobart, Australia

*** Correspondence:**

Grant Smith

grant.smith@bom.gov.au

Abstract

Above average ocean temperatures leading to marine heatwaves have implications for many marine ecosystems and industries. The impacts felt include mass coral bleaching and mortality, altered aquaculture yields and changes in wild fish migration patterns. For example, the Coral Triangle, including regions of Indonesia, PNG, Philippines, and Solomon Islands, experienced marine heatwaves and coral bleaching in 2021. Seasonal forecasts of marine heatwave risk from dynamical ocean-atmosphere models of marine heatwaves can be very useful tools for marine managers, businesses and researchers. The Australian Bureau of Meteorology's seasonal forecast model ACCESS-S1 currently produces operational real-time forecasts of sea surface temperatures. Experimental products based on marine heatwave metrics using daily forecasts and probabilities of exceeding the 90th percentile are currently being developed and assessed. These new products will complement existing operational accumulated thermal stress forecast products developed for coral bleaching to improve both the understanding and the management of these events, as well as the complex interactions that lead to them, particularly in a changing climate.

Statistical prediction of marine heatwaves via machine learning

Fabio Boschetti¹, Ming Feng¹, Xuebin Zhang², Jason Hartog², Alistair Hobday²

¹CSIRO Oceans & Atmosphere, Perth, Australia

²CSIRO Oceans & Atmosphere, Hobart, Australia

Abstract

Predicting future environmental events can be advanced by expert knowledge, statistical patterns, and dynamical models. In an uncertain future, where an increase in extreme events is forecast, these multiple methods offer mutual benefits. In the case of marine heatwaves, oceanographic and atmospheric expert knowledge can refine the search for causal links and mechanisms, which can inform both statistical and dynamical models. Statistical forecast models bring the power of historical patterns across various spatiotemporal scales, without needing full mechanistic understanding or system linkages. They can also identify the most predictive patterns and the conditions under which these patterns are predictive, leading to improved oceanographic knowledge. Dynamic models can respond to novel conditions and are expected to perform better in out-of-sample prediction.

We use sea surface temperature and upper ocean heat content anomalies from the historical runs of a subset of the Coupled Model Intercomparison Project (CMIP) models, which reasonably capture the broadscale and regional dynamics and a marine heatwave index purposely defined for a set of select regions around Australia. A Convolutional Neural Network is trained on these datasets, and next reanalysed and evaluated on Simple Ocean Data Assimilation (SODA) and Global Ocean Data Assimilation System (GODAS) data sets, respectively.

We test the Convolutional Neural Network forecast system on the predictions from a number of sites around Australia, and will present results from hindcast predictions as well as for predictions for the upcoming boreal summer, made in November 2021, for the period Jan-Mar 2022.

Use of Species Distribution Models to Extend the Capabilities of Ecological Risk Assessments to Quantify the Vulnerability of Sharks to Fishing Impacts Under a Changing Climate

Simon. Nicol, Naiten Bradley. Phillip Jr, Valerie. Allain, Shane. Griffiths, Joanne Potts, Cassandra. Rigby

Abstract

Ecological risk assessment methods have been developed and routinely applied in the western Pacific since the early 2000s as a cost-effective and rapid means to assess the vulnerability of species to the impacts of fishing, particularly in data-limited settings. The assumed spatial domain of the stock is an important variable for these methods since it influences the proportion of the stock that is exposed to the 'footprint' of a fishery. Using the EASI-Fish methodology we explore the impact of differing assumed stock distributions of oceanic sharks on their vulnerability status. Moreover, by developing species distribution models (SDMs) coupled to earth system models we demonstrate an approach to assess how vulnerability of these species may vary with the impacts of future climate and subsequent changes in patterns of fishing. We use an SDM developed for tuna as a proxy to forecast potential changes in the distribution of fishing effort in response to climate change and an SDM developed for each shark species to forecast potential changes in their distribution. The change in overlap between the forecasted distributions provides a proxy for how fishing mortalities may evolve with climate. The approach extends the application of ecological risk assessment to consider the cumulative effects of fishing and climate on data-limited non-target species.

Ocean response to Super-Typhoon Haiyan

Tolulope Emmanuel Oqinni¹, Shuang Li^{1,*}, Hailun He^{2,*}, Hongwei Yang³, Zheng Ling⁴

¹Ocean College, Zhejiang University, Zhoushan, China

²State Key Laboratory of Satellite Ocean Environment Dynamics, Second Institute of Oceanography, Ministry of Natural Resources, Hangzhou, China

³College of Mathematics and Systems Science, Shandong University of Science and Technology, Qingdao, China

⁴College of Ocean and Meteorology, Guangdong Ocean University, Zhanjiang, China

*** Correspondence:**

lshuang@zju.edu.cn

hehailun@sio.org.cn

Abstract

Present paper studies the ocean response to super-typhoon Haiyan based on satellite and Argo float data. First, we show the satellite-based surface wind and sea surface temperature during super-typhoon Haiyan, and evaluate the widely-used atmospheric and oceanic analysis or reanalysis datasets. Second, we investigate the signals of Argo float, and find the daily sampling. Argo floats capture the phenomena of both vertical-mixing-induced mixed-layer extension and nonlocal subsurface upwelling. Accordingly, the comparisons between Argo float and ocean reanalyses reveal that, the typhoon-induced upwelling in the ocean reanalysis needs to be further improved, meanwhile, the salinity profiles prior to typhoon arrival are obviously biased.

Monitoring marine heatwaves and impacts using an ocean observing system

Ming Feng^{1,*}, Miaoju Chen¹

¹CSIRO Oceans and Atmosphere, Crawley, Australia

*** Correspondence:**

Ming Feng

ming.feng@csiro.au

Abstract

Ocean temperature monitoring programs are crucial for the identification and categorization of marine heatwaves. Satellite measurements provide high-resolution sea surface temperature (SST) in the global ocean, which has been used to detect and characterize marine heatwaves at the ocean surface over the past four decades. Subsurface marine heatwaves can only be informed with in situ measurements, such as Argo floats, moorings, and gliders. In situ observations can be used to validate marine heatwave and cold spell predictions. In this presentation, we review some recent progresses of marine heatwave research using data streams from the Australia's Integrated Marine Observing System (IMOS). The extreme 2011-13 Western Australian marine heatwave, the subsequent marine cold spells, and the recent 2020-21 marine heatwave are detected from sustained mooring observation on the continental shelf. An attempt to capture the marine heatwaves using glider surveys also yield some success. Monthly chlorophyll samplings from a national reference station show significant reduction of water column chlorophyll concentration during marine heatwaves, while enhanced concentration during the marine cold spells. Recent research also show that marine heatwaves have significant effects on the zooplankton biomass and fisheries recruitment in the region. IMOS has sustained observations around Australia over the past 10 years. Ocean observing systems are crucial to detect marine heatwaves, which along with marine heatwave predictions can provide early warning to marine ecosystem and fisheries managements to mitigate their impacts.

Application of swan and swash models to the marine submersion hazard on the Moroccan coast: Case of El Jadida bay.

Imane Joudar^{1,*}, Erraji Chahid Nouhaila¹, Bouchkara Mohammed¹, Benazzouz Aïssa², El Khalidi Khalid¹, SALHI Fouad¹, Zourarah Bendahhou¹, Mehdi Khalid¹

¹Marine Geosciences and Soil Science Laboratory (URAC-45), Earth Sciences department, Faculty Sciences, Chouaib doukkali University, EL Jadida, Morocco

²Higher Institute of Maritime Studies, Casablanca, Morocco

*** Correspondence:**

Joudar imane
imanejoudar1@gmail.com

Abstract

Our work focuses on the coast of El Jadida, highly vulnerable to natural hazards. The study area is located on the Atlantic coast of Morocco constitutes a large sandy system (beaches, dunes, estuary ...) it has a parabolic shape oriented NW-SE, asymmetrical. The beach of El Jadida is often flooded by high tides, storms and wave breaking are clearly visible in the bay so a numerical simulation of the marine submersion phenomenon is realized.

The objective of the present work aims to focus on the modelling of the hydrodynamic processes causing marine submersion by applying numerical calculation codes on a coastal zone strongly exposed to the risks of submergence. These processes vary considerably in time and space, so our work consists in numerical simulation, from the marine forcing conditions in El Jadida Bay the transformation of the waves by the SWAN (Simulating Waves Nearshore) model in addition to the estimation of water volumes flooding the coast with the SWASH (Simulating Waves till Shore) model.

Finally, results of a significant height of 11.6 m, direction and temporal elevation are obtained using the storm forcing conditions of 2017, these conditions being very close to the shoreline (bathymetry, direction and height) are very different from the open sea because they are subject to many transformations when they interact with the bottom these conditions vary considerably from one point to another in the surf zone that's why the knowledge of the wave conditions on the coast is an essential element to understand and predict extreme coastal phenomena in order to help the planners to better plan the coastlines for the realization of coastal projects.

Understanding the impact of monsoon, El Niño and Indian ocean dipole events on oily sardine (*Sardinella lemuru*) production using ocean color data in the Bali Strait, Indonesia

Jonson Lumban-Gaol^{1,*}, K. Mahapatra², C. Wilson³, E. Siswanto⁴, I.W. Nurjaya¹, R.E. Arhatin¹, A. W. Rudiastuti⁵

¹ Department of Marine Science and Technology, Faculty of Fisheries and Marine Science, IPB University, Bogor, Indonesia

² School of Marine Science and Technology, Tokai University, Shimizu, Japan

³ Environmental Research Division, Southwest Fisheries Science Center, National Marine Fisheries Service, NOAA, Pacific Grove, USA

⁴ Research and Development Center for Global Change Japan Agency for Marine-Earth Science and Technology 3173-25, Yokohama, Japan

⁵ Geospatial Information Agency, Cibinong, Indonesia

*** Correspondence:**

Lumban-Gaol, J.

jonsonlumban@apps.ipb.ac.id

Abstract

To understand the impacts of the climate variabilities on *Sardinella lemuru* production in the Bali Strait of Indonesia, we analyzed the monthly fish production and chlorophyll-a (chl-a) concentration derived ocean color data from September, 1997 to December, 2019. The wavelet analysis results provided the annual and interannual variability of chl-a concentration and *Sardinella lemuru* production. The South East Monsoon triggers upwelling along the South coast of Java and Bali Islands and the upwelling intensity increases during El Niño Southern Oscillation (ENSO) and Indian Ocean Dipole (IOD) (+) years. Our results indicate a robust relationship between *Sardinella lemuru* production and the IOD index. Chl-a concentration significantly increases under the influence of IOD (+) due to intense upwelling, than that of the El Niño years. The high magnitude of chl-a concentration, followed by higher *Sardinella lemuru* production rates, was also more distinctly noticed in the IOD (+) years than the El Niño years. There is a time lag of 3 months for the sardine production to respond to increased Chl-a concentration. Given the ability of ocean color data to explain the variability of *Sardinella lemuru* production it could be developed as a tool for sustainable management of the *Sardinella lemuru* fishery in the Bali Strait.

Characteristics and Drivers of Summer Marine heatwaves in the Kuroshio-Oyashio Extension Region

Yanzhen Du^{1,2}, **Ming Feng**^{3,4,*}, **Zhenhua Xu**^{1,5,6,7}, **Baoshu Yin**^{1,5,6,7}, **Alistair Hobday**⁸

¹CAS Key Laboratory of Ocean Circulation and Waves, Institute of Oceanology, Chinese Academy of Sciences, Qingdao, China

²University of Chinese Academy of Sciences, Beijing, China

³CSIRO Oceans and Atmosphere, Crawley, Australia

⁴Centre for Southern Hemisphere Ocean Research, Hobart, Australia

⁵Pilot National Laboratory for Marine Science and Technology, Qingdao, China

⁶Center for Ocean Mega-Science, Chinese Academy of Sciences, Qingdao, China

⁷CAS Engineering Laboratory for Marine Ranching, Institute of Oceanology, Chinese Academy of Sciences, Qingdao, China

⁸CSIRO Oceans and Atmosphere, Hobart, Australia

*** Correspondence:**

Ming Feng

ming.feng@csiro.au

Zhenhua Xu

xuzhenhua@qdio.ac.cn

Abstract

During 1982-2019, the highest summer sea surface temperature (SST) warming trend in the North Pacific occurred in the Kuroshio-Oyashio Extension (KOE) region, resulting in more frequent and more intense marine heatwaves (MHWs) in recent years. In this study, we used satellite observations, oceanic and atmospheric reanalyses data, to explore the characteristics, evolution, and drivers of MHWs in the KOE, and their connections to large-scale climate modes. Strong summer MHWs in the KOE started to develop in early spring, with SST anomalies rising sharply from March to July, reaching peak intensity in August-September. Based on a mixed layer temperature budget analysis, strong summer MHWs were primarily formed by enhanced shortwave radiation, reduced latent heat loss, with anomalous shallow mixed layer depth providing positive feedback to trap more heat in the surface mixed layer. The air-sea heat flux anomalies were influenced by the westward shift of the North Pacific High-pressure system, which reduced cloud cover and increased surface specific humidity in the KOE. The summer MHWs in the KOE appeared to be associated with large-scale climate modes, such as the Pacific Decadal Oscillation and North Pacific Gyre Oscillation, as well as the long-term warming trend. This understanding of MHW variability and the underlying mechanisms will help manage marine ecosystems in the KOE in a changing climate.

Deep-Learning Model for Sea Surface Temperature Prediction near the Korea Peninsular

Hey-Min Choi^{1,2}, **Min-Kyu Kim**^{1,2}, **Hyun Yang**^{1,2,*}

¹Korea Ocean Satellite Center, Korea Institute of Ocean Science & Technology, Busan, Korea

²Ocean Science and Technology School, Korea Maritime and Ocean University, Busan, Korea

*** Correspondence:**

Hyun Yang

yanghyun@kiost.ac.kr

Abstract

Recently, the sea surface temperature(SST) near the Korea peninsular has been increased rapidly due to the global warming, and these phenomena can cause the high water temperature and extensive damage to Korea fish farms. In order to reduce the damage caused by the high water temperature events, it is necessary to predict the events in advance. In this study, therefore, we propose a method for predicting the high water temperature phenomenon in advance to prevent the high water temperature damage. The SST have time-series data characteristics, and the long short-term memory(LSTM) network specialized for time-series data prediction among artificial neural network models is used. First, using the SST prediction model to predict the SST. And if the predicted SST is over 28°C, which is the Korean government standard for issuing the high water temperature warning, it is judged as high water temperature. In here, European Centre for Medium-Range Weather Forecasts(ECMWF) ERA5 sea surface temperature data near the Korea peninsular were used. To evaluate the SST prediction accuracy of the prediction model, the 1-day to 7-day prediction model was evaluated using the R^2 , root mean square error (RMSE) and mean absolute percentage error (MAPE) evaluation indicators were used. In the 1-day prediction SST model achieved results of 0.993°C, 0.12°C and 0.35%, R^2 , RMSE and MAPE, respectively. The 7-day prediction SST model was 0.917°C, 0.422°C and 1.24%. We also performed F1 score to evaluate the high water temperature classification accuracy. The F1 score for the 1-day and 7-day SST prediction models were 0.965 and 0.882.

Capturing the impact of extreme weather events on the survival of endangered New Zealand sea lions.

Dahlia Foo^{1,*}, L. Boren², MA. Lea¹

¹Institute for Marine and Antarctic Studies, University of Tasmania, Battery Point, Australia

²Department of Conservation, Te Papa Atawhai, New Zealand Government, Wellington, New Zealand

*** Correspondence:**

Dahlia Foo

dahlia.foo@utas.edu.au

Abstract

Increasing frequency and severity of weather events are impacts of ongoing climate change. Discrete extreme weather events can lead to catastrophic mass mortalities of young animals, which can greatly influence the health of endangered species. However, the impact of such events is seldom studied due to their rare and opportunistic nature. We quantified the effect of inclement weather (wind chill and rainfall) on early pup mortality of New Zealand sea lions (*Phocarctos hookeri*) at Campbell Island during the austral summer breeding season using daily dead pup count data from three breeding seasons (2018–2020). Linear mixed effect models showed that days with lower wind chill temperatures and higher rainfall was associated with greater proportions of pups dying. Our findings highlight the importance of taking extreme weather into consideration when studying population dynamics and in conservation management.

Marine Pollution in Bangladesh: A Critical Analysis of the Legal and Institutional Regimes for the Sustainable Ocean Governance

Abu Hena Muhammad Yousuf^{1,2,*}

¹Department of Oceanography, Faculty of Earth & Environmental Sciences, University of Dhaka, Dhaka, Bangladesh

²International Centre for Ocean Governance (ICOG), School of Law, Western Sydney University, Sydney, Australia

*** Correspondence:**

yousuf.ocn@du.ac.bd

yousuf.ocn@westernsydney.edu.au

Abstract

The conventional outlook of regulating coastal contamination normally emphasises on the collaboration within government and the polluters. But in the suggested method, the obligation for applying different effluence managing features is shared between various investors. Achievement of controlling and managing effluence mainly relies upon the proper arrangement of institutional and supervisory methods which is maintained by sufficient observing and a greater capability of the related institutions. A comprehensive manner relating to domestic, regional, and global legislative documents can guide an original and profitable procedure for protecting marine contamination specially from industrial sources. Through presenting this comprehensive manner, the proposed effluence controlling method will not only monitor release points and implementing guidelines and principles by the regulatory agencies, but can also accept an alternative method, like the public observing and sharing. This non-traditional method will offer additional adaptability, proficiency, and profitability to control marine contamination. But several plan initiatives need to undertake by the government for applying the offered comprehensive manner practically. These include bringing necessary changes in legislation; strengthening organisational capacity; providing economic incentives for pollution emitters; involving local community to monitor river water quality; and incorporating disclosure of information.

Keywords: Marine Pollution; Legal Framework; Institutional Arrangements; Ocean Governance

The change in oceanic transports of the early stage of fish by the shifts of climate mode? : Investigating egg and larval transport of Antarctic Toothfish (*Dissostichus mawsoni*) in the Indian sector of the Southern Ocean under extreme SAM event.

Mori, Mao, Mizobata, Kohei, Kusahara, Kazuya

Abstract

Antarctic Toothfish (*Dissostichus mawsoni*) is one of the largest fishes living over continental slope-shelf, banks and sea mountains in the Southern Ocean (SO). *D.mawsoni* is a valuable fishery target and important prey for top predators such as Weddell seals, sperm whales, and killer whales. While multiple historical fishery investigations have been developing information about the distribution and ecology of mature fish, the knowledge of the early stage of fish is still limited due to the difficulty of sampling. The distributions of the early stage of fish (egg – larval stage) are strongly affected by ocean currents. Recent studies indicate climate modes affect ocean currents, temperature and sea ice extent with monthly to decadal timescale. Southern Annual Mode (SAM) is one of the key modes causing variability of ocean circulation system in the SO and the increase in the positive trend of SAM was observed in the last decades. We investigated eggs and larval transport pathways of *D.mawsoni* under extreme SAM events in the continental slope-shelf regions of the Indian sector of the SO using a particle tracking model. Ocean currents datasets were calculated using a coupled sea-ice-ocean model “COCO” with an ice-shelf component. Model simulation results indicated transport pathways of particles released from the east side slopes were different in extreme positive and negative SAM phases. We believe understanding the change in transport pathway of fish under extreme climate modes is essential to develop our knowledge about their predator behaviors and the response of the whole SO ecosystem to the climate modes.

Climate influences on female survival in a declining population of southern elephant seals (*Mirounga leonina*)

S. Volzke^{1,*}, C.R. McMahon^{1,2}, M.A. Hindell^{1,3}, H.R. Burton⁴, S.J. Wotherspoon^{1,4}

¹Institute for Marine & Antarctic Studies, University of Tasmania, Hobart, Australia

²IMOS Animal Tagging, Sydney Institute of Marine Science, Mosman, Australia

³Antarctic Climate and Ecosystems Cooperative Research Centre, University of Tasmania, Hobart, Australia

⁴Australian Antarctic Division, Department of Agriculture, Water and the Environment, Kingston, Australia

*** Correspondence:**

Sophia Volzke

sophia.volzke@utas.edu.au

Abstract

The Southern Ocean has been disproportionately affected by climate change and is therefore an ideal place to study the influence of changing environmental conditions on ecosystems. Changes in the demography of predator populations are indicators of broader shifts in food-web structure, but long-term data are required to study these effects. Southern elephant seals (*Mirounga leonina*) from Macquarie Island have consistently decreased in population size while all other major populations across the Southern Ocean have recently stabilised or are increasing. Two long-term mark-recapture studies (1956-1967 and 1993-2009) have monitored this population, which provides an opportunity to investigate demographic performance over a range of climatic conditions. Using a 9-state matrix population model, we estimated climate influences on female survival by incorporating two major climatic indices into our model: The Southern Annular Mode (SAM) and the Southern Oscillation Index (SOI). Our best model included a one year lagged effect of SAM and an unlagged SOI as covariates. A positive relationship with SAM1 (lagged), related the previous year's SAM with juvenile survival, potentially due to changes in local prey availability surrounding Macquarie Island. The unlagged SOI had a negative effect on both juvenile and adult seals, indicating that sea-ice dynamics and access to foraging grounds on the East Antarctic continental shelf could explain the different contributions of ENSO events on the survival of females in this population.

Variations in the spatiotemporal distribution of yellowfin tuna (*Thunnus albacares*) in the eastern Pacific Ocean

Peng Lian

University of Chinese Academy of Sciences, Beijing, China

Abstract

Yellowfin tuna (YFT), *Thunnus albacares*, is a commercially important species in the Pacific with a global total catch of more than 400,000 metric tons. YFT has an active high catch status inversely with other kinds of tunas and brings a potential shift to the climate variability with its catch displaying homogeneous high frequency fluctuations on the ENSO transitional phases. The environmental processes associated with ENSO that drive variability in YFT are significant for fisheries management, however, they are poorly understood. In order to detect the characteristics of the catch variations of YFT in the eastern Pacific at different spatiotemporal scales, datasets from Argos to remote sensing data was integrated with the fishery data of 1° spatial grid for the period of 1994~2012 in the eastern Pacific (19.5°S~33.5°N, 71.5°W~149.5°W) to explore how environmental factors (SST, SSH, Chl-a) impacted the spatiotemporal distribution of YFT. The Morlet wavelet analysis and Empirical Orthogonal Function (EOF) analysis were carried out respectively to identify and extract the cycles and the spatiotemporal modes, and generalized additive models (GAMs) were applied to investigate the relationship between catch rates and environmental factors for predicting future patterns of YFT spatiotemporal distribution. Results showed that there were oscillations with a gradually reduced period between 48 and 72 months (2-6 years) in the time series of YFT catch while the first two EOFs and distribution maps indicated that the spatiotemporal distribution of YFT was largely related to the seasonal variation signal (especially from June to August and from December to February), which led to fragmentation. These findings were incorporated into a risk assessment index model of YFT to give an additional insight into resource prediction and management.

The missing link: pelagic prey field prediction for Southern Ocean predators

David Green^{1,2}, Sophie Bestley¹, Rowan Trebilco^{2,3}, Stuart Corney¹, Olivier Titaud⁴, Patrick Lehodey⁵, Clive McMahon⁶, Azwianewi Makhado^{7,8}, Christophe Guinet⁹, Mark Hindell¹

¹Institute for Marine and Antarctic Studies, University of Tasmania, Hobart, Australia

²CSIRO Oceans & Atmosphere, Hobart, Australia

³Centre for Marine Socioecology, University of Tasmania, Hobart, Australia

⁴Collecte Localisation Satellites, Ramonville St Agne, France

⁵Oceanic Fisheries Programme, Pacific Community, Noumea, New Caledonia

⁶IMOS Animal Satellite Tagging, Sydney Inst. of Marine Science, Mosman, Australia

⁷FitzPatrick Institute of African Ornithology, DST-NRF Centre of Excellence, University of Cape Town, Rondebosch, South Africa

⁸Oceans and Coasts, Department of Environment, Agriculture and Fisheries, Cape Town, South Africa

⁹Centre d'Etudes Biologiques de Chizé, UMR 7372 CNRS-La Rochelle Univ., Villiers en Bois, France

Abstract:

There is a growing need to better understand how the rapidly changing Southern Ocean will affect ecosystems and the marine predators within them. A key knowledge gap highlighted by the recent Marine Ecosystem Assessment for the Southern Ocean (MEASO) is how predator populations will respond to shifts in prey availability. Bridging this gap requires reliable quantification of prey responses to underlying conditions. Obtaining prey information directly is challenging because observations of prey biomass remain sparse, particularly at scales relevant to predator foraging. Models offer a useful alternative by using bioenergetics to mechanistically extend ocean circulation and biogeochemistry to mid-trophic levels. These models are now capable of generating reasonable approximations of the distribution and dynamics of micronekton prey.

Here we demonstrate that one such prey model, a Spatial Ecosystem and Population Dynamics Model (SEAPODYM), can be useful in forecasting marine predator responses to changing environments. We present results from recent work where we use modelled prey field dynamics to predict southern elephant seal distribution and spatial variability in diving behaviour. We then consider how interannual changes in modelled prey biomass can be linked with population-level fitness consequences for predators. In so doing, we show that trends in arrival mass of macaroni penguins, following their non-breeding migration, reflect changing prey biomass within their winter foraging range.

Following this, we describe a workflow for extending the existing SEAPODYM framework to model the life history requirements of a key Southern Ocean prey species, Antarctic krill (krill). The ability to represent the spatial dynamics of krill biomass will become increasingly necessary given its sensitivity to climate-related change, the potential pressure it faces from an expanding fishery, and its disproportionate importance within numerous food webs. We present initial findings from this work and discuss possible applications for the West Pacific and the Southern Ocean more broadly.

Using a dynamic energy budget IBM to assess the drivers of decreasing elephant seal population at Macquarie Island

Stuart Corney, Merel Goedegebuure, Jessica Melbourne-Thomas, Clive McMahon, Mark Hindell

Abstract

Southern elephant seals are predatory, capital breeding, marine mammals with a circumpolar distribution. The population on Macquarie Island has been a part of longitudinal studies since 1949 and is in decline at an average rate of -1.46% per year. The exact drivers behind the population decline are unknown. Migration has been discounted as a driver behind this decline, however a number of competing hypotheses exist.

We investigate if a DEB-IBM can be used to evaluate four hypotheses regarding the observed population decline on Macquarie Island through implementing scenarios of i) climate variability ii) reduction of yearling survival iii) reduction in the fecundity of mothers, and iv) density dependence in the model. The modelled population trajectory for all scenarios (except a reduction in fecundity of mothers) closely followed the observed trend in the decline of southern elephant seals at Macquarie Island. The climate scenario showed that yearling survival was particularly affected by resource availability. The scenario for yearling survival created unrealistic transition ages between sexual and physical maturity stages and also affected the fecundity of mothers. The population trajectory of the fecundity scenario did not follow the observed trend at Macquarie Island. This simulation showed that the cost of reproduction at a young age is high, and consequently more pregnancies occurred for older mothers. In the density dependence scenario, the population trajectory closely matched that of Macquarie Island.

An overall weakness in the model was a poor representation of interannual variability, as compared to the observations. Thus, although the model produced interesting emergent behaviour of individuals and the overall population, none of the scenarios in isolation could explain the driver behind the observed population decline. We conclude that it is likely that a combination of drivers has resulted in population change at Macquarie Island.

Feeding ecology of 3 species of pacific tuna: an alternative stomach fullness metric.

Pauline Machful^{1,*}, Annie Portal¹, Jed Macdonald¹, Valerie Allain¹, Joe Scutt Phillips¹, Simon Nicol¹

¹Oceanic Fisheries Programme, The Pacific Community, Nouméa, New Caledonia

*** Correspondence:**
paulinem@spc.int

Abstract

Tropical tunas are important from commercial, biological and ecological standpoints. As top predators in the food chain and key target species for fisheries worldwide, understanding tuna diet and the processes that underpin it can provide valuable information on the dynamics of pelagic ecosystems and their capacity to adapt to future climatic and human-induced stressors.

The Pacific Marine Specimen Bank, housed at the Pacific Community in New Caledonia, contains data on 15,928 stomachs of skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*) and bigeye tuna (*T. Obesus*) collected from across the Western and Central Pacific Ocean (WCPO). To date, 8,089 of these stomachs' contents have been examined, with prey taxa identified, and qualitative metrics of stomach fullness derived. Such metrics are useful for studies of trophic interactions in the pelagic realm, but are problematic for a number of reasons: there may be biases in the description and capture of these data that may be more or less subjective than others.

Building on the analyses of tuna stomach contents from Pacific Marine Specimen Bank holdings, we propose an alternative stomach fullness metric. Our initial findings indicate that incorporating conditioning variables (e.g. species, fish length) into the metric will allow for improved estimation of the effects of ecological covariates of interest (e.g. foraging behaviour, environment, etc) in downstream analyses. Moreover, the framework proposed integrates stomach fullness onto a continuous scale, allowing for optimal use of the information derived from stomach contents analyses. Applications for such a metric include studies to identify the circumstances where foraging is more efficient, and the role of oceanographic regimes and prey availability on the diet and trophic positions of oceanic predators, and we demonstrate its use for Pacific tuna in this context.

Diet of marine predators as an indicator of Southern Ocean ecosystem health: design and implementation of an effective genetic monitoring approach in the Subantarctic.

J.C. McInnes^{1,3,*}, B.E. Deagle², A. Polanowski³, B. Raymond^{3,1}, S. Thalmann⁴, R. Trebilco², B. Wienecke³, M.A. Lea¹.

¹Institute for Marine and Antarctic Studies, University of Tasmania, Hobart, Australia

²Commonwealth Scientific and Industrial Research Organisation, Hobart, Australia

³Australian Antarctic Division, Kingston, Australia

⁴Department of Primary Industries, Parks, Water and Environment, Hobart, Australia

*** Correspondence:**

Julie McInnes

Julie.mcinnnes@utas.edu.au

Abstract

Ecosystem monitoring programs that aim to support the maintenance of biodiversity and ecosystem function require a sound knowledge of species composition and food web linkages. This information provides a foundation for assessing ecosystem changes and can allow causal links to be clarified (e.g. interactions between marine predators and fishery resources). By simultaneously studying the diet of a range of predators on Macquarie Island, we investigate food web linkages and species interactions in the region. Through the collection of baseline dietary data and new robust dietary information, we will provide a sound foundation for future monitoring programs to measure changes in species diversity and identify species that may be at risk from inter-species resource competition and fishery engagement. We aim to develop a marine ecosystem monitoring framework using top predator scat DNA to assess species biodiversity in the Subantarctic.

Ecology, Reproduction and Adaptation for a climate change sentinel: monitoring the Adélie penguin population in mid Victoria Land, Ross Sea.

Silvia Olmastroni^{1,2}

¹Dipartimento di Scienze Fisiche della Terra e dell'Ambiente, Università degli Studi di Siena, Siena, Italia

²Museo Nazionale dell'Antartide F. Ippolito, Siena, Italia

Correspondence:

silvia.olmastroni@unisi.it

Abstract

During 2017-20 the Italian project PenguinERA investigated the ecological role of a marine mesopredator, the Adélie penguin, through the study of its distribution and behavior in relation to the quality of habitat, colony size, evolution and adaptation at the scales of the ecological and climatic processes. The study area involved three Adélie penguin colonies nearby Terra Nova Bay and the Wood Bay (Ross Sea, Antarctica). The existing long-term monitoring program was improved with the measurement of a series of genetic and physiological parameters. Breeding biology showed similar trends at the different sites. Summer satellite tracking of adults breeding highlighted that penguins foraged near fast ice and pack ice in the vicinity of Terra Nova and Wood Bay, potentially minimising the cost to benefit ratio. Prey availability nearby the breeding colony may help breeding adults to cope with time constraint and the reproductive output. Genetic investigation on breeding Adélie penguin indicated meta-population dynamics and possibly relationships with habitat quality. A generally low genetic diversity was observed within each colony, in contrast to significant genetic heterogeneity among colonies indicating that populations were genetically structured. Proxies of penguin's health status (i.e. erythrocytes nuclear abnormalities and leukocytic profile) were also considered to establish a baseline against which future ecosystem changes, e.g. as a consequence of environmental stressors, can be detected. Since changes in habitat quality is likely to induce effects on wildlife physiology, long term monitoring programs together with useful proxies - which in turn can provide an early alert on changes on individuals - are highly recommended.

Foraging behaviors of Adélie penguins confronting a sudden appearance of large drift ice

Seongseop Park¹, Jeong-Hoon Kim¹, Hosung Chung¹, Won Young Lee^{1,*}

¹Division of Polar Life Sciences, Korea Polar Research Institute, Incheon, Republic of Korea

*** Correspondence:**

Won Young Lee

wonyounglee@kopri.re.kr

Abstract

Recent rapid environmental changes in Antarctica often produce a sudden barrier to the marine animals. Adélie penguins, one of top-predators in the Antarctic ecosystem, are reported to confront the changes near the habitats by appearance of large icebergs or drift ice. We tracked the foraging trips of Adélie penguins with GPS and time-depth recorders during the chick-rearing period in December 2018, at Adélie Cove in the Ross Sea, Antarctica, when 240 km² of dense pack ice was approaching near the foraging areas. Here we aimed to investigate how Adélie penguins respond to such natural obstacles. Our results showed that, among the 21 penguins, 7 individuals bypassed and 14 individuals crossed the drift ice. When compared to a neighboring population at Inexpressible Island in the same period, trip durations and total movement distances were larger in our penguin individuals at Adélie Cove. Our results suggest that the large dense pack ice prevented the foraging paths and penguins bypassed or crossed the ice to reach their foraging areas by spending more energy and time. Even if it may be a short-term effect, the penguins could have negative results from the sudden changes.

Keywords: Drift ice, Ross Sea, Antarctica, GPS, time-depth recorders

Investigating habitat use by East Antarctic seabirds in the context of historical, contemporary, and forthcoming environmental shifts.

Benjamin Viola

Abstract

Marine predators are widely accepted as sentinels of ecosystem health. Knowledge of their behaviour and foraging success can grant insights towards the ecosystem dynamics of lower trophic levels. Hereby, understanding marine predator habitat use and suitability in a changing climate is paramount to marine conservation and planning. For my PhD, I am using machine learning methods on geolocator tracking data, and shipboard observation data, to investigate how East Antarctic predators – specifically, seabirds – interact with their winter, and summer environments. Resultant outputs will then be used to model habitat suitability under different climate scenarios.

My current focus is detailing the winter habitat use of Snow Petrels (*Pagodroma nivea*): Ice-obligate fulmarine petrels that reside in Antarctica throughout their lifecycle. From January 2011 until December 2012, 38 geolocators were deployed on adult birds from two breeding colonies at Filla and Béchervaise islands, East Antarctica. Twenty-seven devices provided reliable data that were used to investigate winter activity patterns, at-sea distribution, habitat use, and overlap between the two breeding populations. Preliminary results show tracked Snow Petrels displayed various migratory behaviours, both within, and between colonies. Twenty birds used overlapping winter areas and remained within ~2,500 kilometres of their colonies. The remaining seven individuals travelled up to 5,268 kilometres from their breeding location, with some birds reaching the Scotia Arc and the Antarctic Peninsula. One individual performed a complete Antarctic circumnavigation. Total distances travelled ranged from 24,867 to 49,328 kilometres. Filla birds predominantly utilised winter habitat closer to their breeding site than the Béchervaise birds, but there was a clear overlap in the winter area of each colony. Daily activity patterns were related to day length, and peak activity occurred near dusk and dawn. Nocturnal activity increased from March until August/September.

Herring shark seasonal distribution in Northwest Pacific

Denis Kurnosov, Anna Kurnosova

Abstract

The Pacific herring shark *Lamna ditropis* is widespread in the North Pacific Ocean pelagic waters. We analyzed the trawl catches of scientific and fishing expeditions by Pacific branch of the VNIRO («TINRO») in the Sea of Japan, Okhotsk, Bering Seas and the North Pacific Ocean from 1970 to 2021. We combined the data for different years by seasons. Herring shark were registered from the Sea of Japan and the northern Bering Sea (64° N), the western Pacific Ocean, to the Gulf of Alaska and lower California in the east. The occurrence limit was 28° N in the open waters. A total of 2027 sharks were recorded. There were measured 1149 sharks, the minimum size was 40 cm, the maximum size was 278 cm. It was revealed that individuals less than 140 cm were found in the coastal area of the Kuroshio Current. It is likely that young sharks are born and fed in this area. Adult sharks have an annual migration cycle. In winter, herring sharks concentrate in the Pacific waters of the Honshu island within 38 ° -35 ° N where they reproduce. In the spring, sharks begin to migrate northward. In summer, the sharks occurrence in temperate waters increases, sharks migrate to the Sea of Japan and Okhotsk Sea, and also concentrate in the Gulf of Alaska. In the fall, there is a reverse migration from north to south. The seasonal distribution of the herring shark is strongly influenced by *Sardinops melanostictus*, which is known for its ability to fluctuate significantly. The frequency of occurrence of the herring shark in recent years has increased several times with the outbreak of sardines in the Pacific waters of the southern Kuril Islands. Generally, such concentrations of apex predator affect the balance of the food chain in the Pacific Northwest.

Continuous monitoring and future projection of ocean warming, acidification, and deoxygenation on the subarctic coast of Hokkaido, Japan

Masahiko Fujii^{1,2}, Shintaro Takao³, Takuto Yamaka², Tomoo Akamatsu², Yamato Fujita², Masahide Wakita⁴, Akitomo Yamamoto⁵, Tsuneo Ono⁶

¹Faculty of Environmental Earth Science, Hokkaido University, Sapporo, Japan

²Graduate School of Environmental Science, Hokkaido University, Sapporo, Japan

³Center for Global Environmental Research, National Institute for Environmental Studies, Tsukuba, Japan

⁴Mutsu Institute for Oceanography, Japan Agency for Marine-Earth Science and Technology, Mutsu, Japan

⁵Japan Agency for Marine-Earth Science and Technology, Yokohama, Japan

⁶National Research Institute of Far Seas Fisheries, Fisheries Research Agency, Yokohama, Japan

*** Correspondence:**

Masahiko Fujii

m Fujii@ees.hokudai.ac.jp

Abstract

As the ocean absorbs excessive anthropogenic CO₂ and ocean acidification proceeds, it is thought to be harder for marine calcifying organisms, such as shellfish, to form their skeletons and shells made of calcium carbonate. Recent studies have suggested that various marine organisms, both calcifiers and non-calcifiers, will be affected adversely by ocean warming and deoxygenation. However, regardless of their effects on calcifiers, the spatiotemporal variability of parameters affecting ocean acidification and deoxygenation has not been elucidated in the subarctic coasts of Japan. This study conducted the first continuous monitoring and future projection of physical and biogeochemical parameters of the subarctic coast of Hokkaido, Japan. Our results show that the seasonal change in biogeochemical parameters, with higher pH and dissolved oxygen (DO) concentration in winter than in summer, was primarily regulated by water temperature. The daily fluctuations, which were higher in the daytime than at night, were mainly affected by daytime photosynthesis by primary producers and respiration by marine organisms at night. Our projected results suggest that, without ambitious commitment to reducing CO₂ and other greenhouse gas emissions, such as by following the Paris Agreement, the impact of ocean warming and acidification on calcifiers along subarctic coasts will become serious, exceeding the critical level of high temperature for three months in summer and being close to the critical level of low saturation state of calcium carbonate for two months in mid-winter, respectively, by the end of this century. The impact of deoxygenation might often be prominent assuming that the daily fluctuation in DO concentration in the future is similar to that at present. The results also suggest the importance of adaptation strategies by local coastal industries, especially fisheries, such as modifying aquaculture styles.

Spatiotemporal variability in surface ocean pCO₂ and sea-air CO₂ flux across the Northwest Pacific Ocean

Charles Addey^{1,2,*}, Rasheed Adesina^{3,4}

¹State Key Laboratory of Marine Environmental Science, Xiamen University, Xiamen, China

²College of Ocean and Earth Sciences, Xiamen University, Xiamen, China

³Institute of Port, Coastal and Offshore Engineering, Ocean College, Zhejiang University, Zhoushan, China

⁴Department of Marine Science and Technology, Federal University of Technology, Akure, Nigeria

*** Correspondence:**

Addey Charles Izuma
charlesaddey@yahoo.com

Abstract

Surface water pCO₂ over a 1° latitude × 1° longitude grid in 2019 was calculated from satellite observation using sea surface temperature, salinity, and chlorophyll-a concentration data in the Northwest Pacific Ocean. The data was analyzed for pCO₂ and sea-air CO₂ flux temporal (monthly to seasonal) and spatial (latitudinal) variability. Due to the unique environmental features, the study area was divided into three sub-regions based on latitudinal difference: (Region A = 25-39N, B = 40-44N, and C = 45-60N). The seasonal pCO₂ variations in region A was dominantly controlled by temperature changes, acting as a sink for atmospheric CO₂ in winter and a weak source of CO₂ to the atmosphere in late summer/early august, with an overall annual estimated pCO₂ of 370.7 μatm and CO₂ uptake of -2.31 mol m⁻² yr⁻¹. While pCO₂ seasonal variability in regions B and C had a similar trend of winter-spring maxima associated with entrainment of subsurface water and summer-autumn minima generated from biological drawdown. The annual surface pCO₂ in region C (403 μatm) was typically greater than those in region B (373.6 μatm), especially during the winter owing to increased CO₂ solubility (due to lower SST) and enhanced vertical mixing intensity at higher latitudes. Region C acted as a CO₂ source to the atmosphere, with an annual emission of 0.32 mol m⁻² yr⁻¹, while region B was a sink of -2.57 mol m⁻² yr⁻¹. On average the entire region acted as an annual sink of -1.52 mol m⁻² yr⁻¹. The observed differences are most likely the result of the combined impacts of numerous dynamical processes such as Kuroshio Current, lateral and vertical mixing, surface wind, and typhoons. This study adds to the current knowledge of the Northwest Pacific Ocean and also strengthens our understanding of the physical and biological controlling mechanisms in the regions.

Flexible Carbon-to-Phosphorus Stoichiometric Ratio of Exported Marine Organic Matter and a Potential Feedback on Climate Change

Young Eun Kwon^{1,2,*}, **Holzer, Mark**³, **Timmermann, Axel**^{1,2}, **Primeau, Francois**⁴, **M.G., Sreeush**^{1,2}, **Lee, Sun-Seon**^{1,2}

¹Center for Climate Physics, Institute for Basic Science, Busan, South Korea

²Pusan National University, Busan, South Korea

³Department of Applied Mathematics, School of Mathematics and Statistics, University of New South Wales, Sydney, Australia

⁴Earth System Sciences, University of California, Irvine, USA

Abstract

The stoichiometric carbon (C) to phosphorus (P) ratios in suspended particulate organic matter (POM) are generally inversely correlated with surface phosphate (PO_4) concentration, with elevated values of 200-300 in oligotrophic gyres and lower values of 70-90 in eutrophic regions. The large spatial variations in organic matter C:P ratios as well as their temporal variations can influence the oceanic carbon cycle and its responses to and feedbacks on climate change.

In the first part of our presentation, we explore whether previously suggested relationships between C:P ratios ($r_{\text{C:P}}$) and PO_4 are appropriate for the vertical export flux of organic matter. Using a global steady-state inverse ocean biogeochemistry model and annual-mean observed tracers (independent from previous approaches), we estimate optimal parameters for both linear and power law representations of $r_{\text{P:C}}$ ($=1/r_{\text{C:P}}$), and find $r_{\text{P:C}} = (6.6 \pm 1.8) \times [\text{PO}_4] + (5.3 \pm 1.0)$ and $r_{\text{P:C}} = (11.2 \pm 1.8) \times [\text{PO}_4]^{(0.36 \pm 0.07)}$, respectively, where $[\text{PO}_4]$ is in μM . Both parameterizations allow us to fit global tracer observations equally well, but the power law model implies an up to 50% larger phytoplankton C:P ratios in oligotrophic gyres. For both formulations, the POM export C:P ratios from the euphotic zone is slightly less than the phytoplankton C:P ratios, while the dissolved organic matter export C:P ratios are up to two times larger than the phytoplankton C:P ratios.

In the second part of our presentation, we implement the simple empirical relationships between the phytoplankton C:P ratios and PO_4 concentrations in an Earth System Model to explore the role of flexible C:P ratios in the carbon cycle responses to climate change. Our results show that flexible C:P ratios can buffer the oceanic productivity responses to ocean warming and stratification. In other words, the plasticity in the organic matter elemental compositions allows the oligotrophic regions to remain more productive than would otherwise be by requiring less P while still fixing higher C per a unit of P consumption. The buffer effects are especially pronounced in the Western Pacific subtropical gyre where the 21st century projected net primary productivity from the flexible $r_{\text{C:P}}$ setup is nearly 100% greater than the projected net primary productivity from the fixed $r_{\text{C:P}}$ setup. We will end our presentation by providing implications of flexible C:P ratios on the marine ecosystems and the oceanic uptake of atmospheric CO_2 concentrations.

Compound-specific radiocarbon reveals sources and land–sea transport of polycyclic aromatic hydrocarbons in an urban estuary

Miaolei Ya^{1,2}, Yuling Wu¹, Li Xu³, Yongyu Li¹, Hanzhe Chen¹, Xinhong Wang^{1,*}

¹State Key Laboratory of Marine Environmental Science, Xiamen University, Xiamen, China

²School of Environmental and Biological Engineering, Nanjing University of Science and Technology, Nanjing, China

³National Ocean Sciences Accelerator Mass Spectrometry Facility, Department of Geology and Geophysics, Woods Hole Oceanographic Institution, Woods Hole, United States

*** Correspondence:**

Xinhong Wang
xhwang@xmu.edu.cn

Abstract

As typical chemical indicators of the Anthropocene, polycyclic aromatic hydrocarbons (PAHs) and their environmental behavior in urban estuaries can reveal the influence of anthropogenic activities on coastal zones worldwide. In contrast to conventional approaches based on concentration datasets, we provide a compound-specific radiocarbon (¹⁴C) perspective to quantitatively evaluate the sources and land–sea transport of PAHs in an estuarine–coastal surficial sedimentary system impacted by anthropogenic activities and coastal currents. Compound-specific ¹⁴C of PAHs and their ¹⁴C end-member mixing models showed that 67–73% of fluoranthene and pyrene and 76–80% of five- and six-ring PAHs in the Jiulong River Estuary (JRE, China) originated from fossil fuels (e.g., coal, oil spill, and petroleum-related emissions). In the adjacent Western Taiwan Strait (WTS), the contributions of fossil fuel to these PAH groups were higher at 74–79% and 84–87%, respectively. Furthermore, as a significant biomarker for source allocation of terrigenous organic matter, perylene, a typical five-ring PAH, and its land–sea transport from the basin through the JRE and finally to the WTS was quantitatively evaluated based on the ¹⁴C transport models. In the JRE, fluvial erosions and anthropogenic emissions affected the ¹⁴C signature of perylene ($\Delta^{14}\text{C}_{\text{perylene}}$, $-535 \pm 5\text{‰}$) with contributions of $> 38\%$ and $< 62\%$, respectively. From the JRE to the WTS, the decreased $\Delta^{14}\text{C}_{\text{perylene}}$ ($-735 \pm 4\text{‰}$) could be attributed to the long–range transport of “ocean current-driven” perylene ($-919 \pm 53\text{‰}$) with a contribution of $53 \pm 8\%$. This compound-specific ¹⁴C approach and PAH transport model help provide a valuable reference for accurately quantifying land–sea transport and burial of organic pollutants in estuarine–coastal sedimentary systems.

Fluorescence tracking of dissolved and particulate organic matter in a coastal ocean

Chia-Jung Lu*, H. Fukuda, H. Ogawa

Atmosphere and Ocean Research Institute, The University of Tokyo, Kashiwa, Japan

*** Correspondence:**

C.-J., Lu

lucj@aori.u-tokyo.ac.jp

Abstract

Dynamic exchanges between dissolved (DOM) and particulate (POM) organic matter play a key role in organic matter cycling. However, knowledge of the optical property of POM and linkage between DOM and POM are rare. In this study, fluorescence measurements of DOM and POM were carried out in a river-influenced coastal area to investigate the optical property and dynamics of organic matter in the natural environment.

DOM and POM samples for optical analysis included bulk waters and suspended particle organic matter in Otsuchi Bay, Japan. Suspended particle organic matter in riverine and seawater was extracted using base-extracted (AMix-POM) and hot-water-extracted (HW-POM) methods to identify refractory and bio-labile organic matter, respectively. Our results of excitation-emission matrix and parallel factor analysis (EEM-PARAFAC) revealed the terrigenous organic matter loading from river input in surface waters and the in-situ biological processes in seawater. The riverine waters had a high abundance of the terrestrial and marine humic-like components, and this characteristic declined at the bay mouth station. On the contrary, a protein tryptophan-like component was more evident at the bay mouth station. These three remarkable components were observed in AMix-POM, HW-POM, and bulk dissolved samples. The high fraction of these two humic-like components were found in July 2020 corresponded to rainy periods. In addition, a pigment-like component only emerged after HW-POM extraction, which indicated the contribution of phytoplankton-derived organic matter in Otsuchi Bay. The distribution of the pigment-like component implied the seasonal developments of phytoplankton blooms. Our study pointed out the optical characteristics of POM and DOM in the ocean and provided further information on the dynamics of organic matter.

Effects of dual fronts on the spatial pattern of Chlorophyll-a concentrations in and off the Changjiang River Estuary

Weiqi Li¹, Jianzhong Ge^{1,*}, Pingxing Ding¹, Jianfei Ma¹, Patricia M. Glibert², Dongyan Liu^{1,*}

¹State Key Laboratory of Estuarine and Coastal Research, East China Normal University, Shanghai, China

²Horn Point Laboratory, University of Maryland Center for Environmental Science, Cambridge, USA

*** Correspondence:**

Jianzhong Ge

jzge@sklec.ecnu.edu.cn

Dongyan Liu

dylu@sklec.ecnu.edu.cn

Abstract

Estuarine fronts play a vital role in estuarine circulation, productivity, sediment dynamics, and water quality. However, there are limited studies on the joint ecological effects of sediment front and plume front, caused by tidal mixing and a low-salinity plume in the Changjiang River Estuary (CRE) and its adjacent inner shelf water. Here, based on observational data in the CRE and its adjacent waters from the summers of 1988–2016, we analyzed the spatial correlations of environmental factors and Chlorophyll-a (Chl-a) concentrations along the two frontal boundaries. Three water masses in and off the CRE were classified according to the effects of a sediment front and a plume front. The water mass that is shoreward side of the sediment front was characterized by the highest total suspended matter (TSM) and nutrients concentration; extensive light limitation caused by TSM concentrations led to the lowest Chl-a concentrations. The water mass between the sediment front and plume front displayed much lower TSM and nutrients concentration but the highest Chl-a concentrations, which benefited from increased light availability due to the rapid deposition of TSM led by sediment front, and higher nutrients contributed by the plume and coastal upwelling. The shelf water mass beyond the plume front showed the lowest TSM and nutrients concentrations. The reduced nutrient transport led by the plume front was a key factor limiting phytoplankton productivity on the shelf. The spatial pattern of summer phytoplankton biomass tended to be a result of the balance of light and nutrients constructed by the two fronts and coastal upwelling off the CRE.

Changes in the phytoplankton community structure at the subsurface chlorophyll maximum in the Philippine Sea : mechanisms and possible temperature influence

Kristina S.A. Cordero-Bailey^{1,2}, de Leon, Jose¹, David, Laura T.¹, Yñiguez, Aletta T.¹

¹Marine Science Institute, University of the Philippines Diliman, Quezon City, Philippines

²Dept. of Community and Environmental Resources, College of Human Ecology, University of the Philippines Los Banos, Los Banos, Philippines

*** Correspondence:**

kscordero@up.edu.ph

Abstract

Our study simulated a size-structured phytoplankton community in the Philippine Sea to determine the contributing factors that regulate the vertical phytoplankton distribution using a one-dimensional coupled physical-biological individual-based model. The model was developed within the Virtual Ecosystem Workbench (VEW) which adheres to Langrangian Ensemble modelling. Initial physical conditions were based on in-situ data retrieved from the BGC-Argo float #2902573 and nutrient data collected in-situ in 2011. Three phytoplankton classes were based on estimated spherical distance (ESD) for picophytoplankton (0-2µm), nanophytoplankton (2-20µm) and microphytoplankton (>20µm) and are governed by size-specific metabolic and reproductive rates. The phytoplankton were grazed on by copepods which in turn were controlled by carnivorous zooplankton. We identified three plausible processes that regulate the establishment of the SCM: (1) new production with the initial formation; (2) regenerated production under low nutrient or mixing conditions; and (3) copepod grazing at depth. Two event scenarios to predict phytoplankton responses following an increase in temperature (+1.0°C and +2.0°C) showed varying results. Both scenarios predicted the SCM would develop deeper than the original simulation and a significant increase in the abundance of the dominant phytoplankton at the SCM. The first scenario predicted a shift to the larger microphytoplankton accompanied the deepening of the SCM and copepod prey preference for smaller phytoplankton while the second scenario saw a threefold magnitude increase in picophytoplankton sustained by recycled nutrients. Such simulations foresee drastic biological changes in the system that could affect higher trophic levels in the Philippine Sea and in the greater Western Pacific. Although the VEW software has been useful for investigations on plankton dynamics of global and specific regions, our study finds that the physical dynamics of the software is not attuned to simulate the highly variable Philippine Sea setting and needs restructuring to be more useful in such areas.

Elucidate the Roles of Tsushima Warm Current on the Southwest East/Japan Sea Primary Productivity Using a High-resolution Physical-biogeochemical Coupled Model

Zhixuan Feng^{1,*}, Rubao Ji^{2,*}, Dongyoung Kim³, Yun-ho Kang³, Chang-Keun Kang³

¹State Key Laboratory of Estuarine and Coastal Research, East China Normal University, Shanghai, China

²Department of Biology, Woods Hole Oceanographic Institution, Woods Hole, USA

³School of Environmental Science and Engineering, Gwangju Institute of Science and Technology, Gwangju, Republic of Korea

*** Correspondence:**

Zhixuan Feng
zxfeng@sklec.ecnu.edu.cn

Abstract

The southwest East/Japan Sea (EJS) along the Korean coast is a critical fishing ground, which is thought to be more productive than other regions of the EJS. Various hypotheses have been proposed to explain the relatively high productivity, such as wind-driven coastal upwelling, Ulleung warm eddy, subpolar frontal dynamics, and current-induced bottom Ekman transport. Those processes can be either attributed to or modulated by Tsushima Warm Current (TWC), a northeastward-flowing branch of the Kuroshio in the EJS. To elucidate the roles of TWC on ocean primary productivity, we develop a high-resolution physical-biogeochemical coupled model using the Coastal and Regional Ocean Community model (CROCO). Model results capture the general seasonality and spatial variability in satellite-derived chlorophyll-a, as well as observed phytoplankton biomass and size composition. Model results also suggest that the presence of East Korea Warm Current, the northward-flowing branch of TWC, causes nutricline tilting and facilitates upward nutrient supply on the Korean shelf. The relative contributions of multiple physical and biological processes in the euphotic-zone nutrient and phytoplankton budgets are further quantified. The modeling analyses are useful in elucidating the biophysical coupling that contributes to an elevated productivity in the southwest EJS and have important implications for managing essential fisheries resources.

Transient phytoplankton blooms and their formation mechanisms in oligotrophic subtropical and tropical oceans

Jiang Siyu^{1,*}, Hashihama Fuminori², Masumoto Yukio³, Liu Hongbin⁴, Ogawa Hiroshi¹, Saito Hiroaki¹

¹Atmosphere and Ocean Research Institute, The University of Tokyo, Kashiwa, Japan

²Department of Ocean Sciences, Tokyo University of Marine Science and Technology, Tokyo, Japan

³Graduate School of Science, The University of Tokyo, Tokyo, Japan

⁴Department of Ocean Science, Hong Kong University of Science and Technology, Hong Kong SAR, China

*** Correspondence:**

Jiang Siyu

jiangsiyu@aori.u-tokyo.ac.jp

Abstract

The oligotrophic subtropical and tropical oceans have been considered as unproductive ecosystems because of the low nutrient supply. Our two cruises in the subtropical North Pacific (NP, 137°E to 120°W, 21.5 to 23°N), and subtropical and tropical Eastern Indian Ocean (EIO, 88 °E, 16.5 °N to 20 °S) captured temporary phytoplankton blooms even under the DIN (dissolved inorganic nitrogen) depletion (< 60 nM). In the central NP, we encountered a pre-bloom condition, in which positive phytoplankton net growth ($0.42 \pm 0.11 \text{ d}^{-1}$, dilution experiments) with low ambient chlorophyll *a* ($\sim 68 \text{ ng L}^{-1}$) was observed. The following phytoplankton bloom was confirmed by the satellite-observed chlorophyll *a* increase ($\sim 138 \text{ ng L}^{-1}$). The observed high phytoplankton growth ($0.84 \pm 0.26 \text{ d}^{-1}$) was mostly contributed by the dominant prokaryotic *Prochlorococcus*. The *Prochlorococcus* growth ($1.14 \pm 0.55 \text{ d}^{-1}$) showed a negative or weak response to the ammonium addition, indicating it was not limited by the ambient DIN but could be a result of utilizing the relatively abundant dissolved organic nitrogen. At the equatorial EIO, we also captured the surface phytoplankton bloom (chlorophyll *a* of 298 ng L^{-1}). In contrast to the NP, it was at the decay phase with low or negative phytoplankton net growth. Furthermore, the ammonium addition enhanced the phytoplankton growth rate (0.28 d^{-1}) by 3.3 times, indicating the phytoplankton bloom in the EIO was possibly initiated by nutrient enrichment and ceased by nutrient exhaustion. The shipboard acoustic Doppler current profiler and the satellite-observed sea surface current and chlorophyll *a* collectively indicated that the bloom was generated near the Maldives, possibly by island effect, and advected eastward by Wyrтки Jet to the study area. Our observations showed that phytoplankton blooms occurred in both oligotrophic NP and EIO which are traditionally considered as consistently unproductive, although the formation mechanisms were different.

Floating sargassum blooms in the ECS and YS based on the satellite images from GOCI and GOCI-II

Young-Je Park^{1,*}, Kwangseok Kim

Korea Ocean Satellite Center, Korea Institute of Ocean Science and Technology, Busan, Republic of Korea

*** Correspondence:**

Park, Young-Je
youngjepark@kiost.ac.kr

Abstract

Recently, a large scale of floating sargassum blooms have been observed in the East China Sea every year since 2015, and a large quantity of the seaweed mats washes up on shore of Jeju Island and the southwest coast of the Korean Peninsula, causing serious damage to local activities including tourism, aquaculture and fishery.

Ocean color sensors having visible-near-infrared channels with high signal-to-noise ratio and narrow bandwidth are suitable for observing the floating seaweed. In particular, GOCI, the first geostationary satellite sensor, and its successor GOCI-II acquire images over the East China Sea and Yellow Sea multiple times a day with ground sampling distance of 500 m and 250 m, respectively, so they are optimal for observing floating Sargassum in the area. Here we report on spatiotemporal variability of the floating sargassum abundance as observed in satellite images from GOCI and GOCI-II.

In the case of year 2015, as early as late December to January, the sargassum patches were observed at low density near the Yellow Sea and the northern East China Sea (including Jeju Island), and then spread southward or southeastward with the persistent northwesterly wind during winter to the near-shore and outer continental shelf. The floating algae density reaches maximum during March and April when the northwest wind weakens and the sunlight becomes stronger. In April-June, the patches move to the northern East China Sea and Yellow Sea due to the northward current, and begin to decline in June when the water temperature rises, and finally almost disappear in July. It is noted other year data show that the location, density, and timing of the floating algae appearance significantly vary from year to year.

We also present possible origins of these large sargassum blooms and directions of future studies.

Warmer winters advanced clam phenology in the temperate East Asian marginal sea coast

H.Y. Kang^{1,2}, **W.C. Lee**³, **C.K. Kang**^{2,*}

¹Department of Oceanography, Chonnam National University, Gwangju, Republic of Korea

²School of Earth Sciences and Environmental Engineering, Gwangju Institute of Science and Technology, Gwangju, Republic of Korea

³Marine Environment Research Division, National Institute of Fisheries Science, Busan, Republic of Korea

*** Correspondence:**

C.K. Kang
ckkang@gist.ac.kr

Abstract

As seasonally asymmetric warming of the sea is being projected by different trends among geographical regions, strong winter warming has been established as a unique trend in the East Asian marginal seas. Given that winter conditions can affect entire life-history stage of ectotherms, an understanding of current biological consequences of rising winter-sea temperatures remains one of the new challenges for more accurate predictions of the impacts of climate change. We combined existing data of long-term daily sea surface temperatures (1963–2018) and the period of spawning of native clams on the East Asian marginal sea coast to highlight winter warming-induced phenology changes. We show that an improved energetic balance in overwintering clams under physiologically favorable thermal conditions in warmer winters ensures the replenishment of nutrient reserves and the fast gamete development, consequently advancing the timing of spawning. Such phenological shifts disturb the evolved reproductive cycle to adjust spawning to summer phytoplankton bloom, preventing long-term success of recruitment. Our results reveal mechanistic species-level consequences of winter warming of the sea. Despite physiological benefits from warmer winter temperatures, the resulting phenological shifts may make the clam populations more vulnerable to collapse as a result of a mismatch with seasonal food availability.

Seasonal variation in trophic structure of fish community in the Southern Sea of Korea/Northern East China Sea

Goutam Kundu^{1,2}, C. Kim¹, C. K. Kang^{1,*}

¹Stable Isotope Ecology Laboratory, School of Earth Science and Environmental Engineering, Gwangju Institute of Science and Technology, Gwangju, Korea

²Department of Fisheries, University of Dhaka, Dhaka, Bangladesh

*** Correspondence:**

C.K. Kang
ckkang@gist.ac.kr

Abstract

We investigated the trophic structure of fish communities and the dynamics of benthic-pelagic linkage during the stratified and mixed structures of water column in the Southern Sea of Korea (Northern East China Sea). We analyzed the stable carbon and nitrogen stable isotope ratios ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$) of fish and other nekton species collected from the Tsushima Warm Current influenced areas off the coast of the Jeju Island. The fish communities displayed relatively narrow range of $\delta^{13}\text{C}$ (-19.4 to -14.9‰) and $\delta^{15}\text{N}$ (8.0 to 14.9‰) values. A Permutational Analysis of Variance revealed that $\delta^{15}\text{N}$ values were consistent over space and time but $\delta^{13}\text{C}$ values differed between the shallow western site and the deeper-warmer eastern site. In contrast, pelagic fish displayed higher $\delta^{13}\text{C}$ values than those of benthic fish. The isotopic niche showed a clear seasonal pattern between the stratified and mixed conditions during summer and spring, respectively. Our results showed that the effect of water-column condition are less prominent on fish trophic structures in the western sites of Jeju Island than that of the deeper eastern sites characterized by warmer and high saline water, suggesting an impact of the shallow water depth and low salinity water (e.g., Changjiang Diluted Water). The isotopic niche of fish grouped by their occupying water depth (i.e., habitat zone) clearly distinguished among the pelagic, benthic, and benthic-pelagic fish. Benthic fish demonstrated niche expansion on the $\delta^{13}\text{C}$ axis, indicating a prey diversification during the stratified water-column condition. The isotopic niche metrics characterized well seasonal variability of fish food web structure around the Tsushima Warm Current trajectory. Overall results will provide an important baseline information for predictive ecosystem models to evaluate the effects of climate-induced oceanographic changes on East Asian marginal sea ecosystems.

Ocean acidification in marginal seas of the western North Pacific

Yosuke Iida^{1,*}, **Masao Ishii**^{2,*}

¹Atmosphere and ocean department, Japan Meteorological Agency, Tokyo, Japan

²Meteorological Research Institute, Japan Meteorological Agency, Tsukuba, Japan

*** Correspondence:**

Yosuke Iida

iida-ysk@met.kishou.go.jp

Abstract

Ocean acidification has reduced values of ecosystem service of our ocean through its adverse impacts on chemistry and biology in the seawater. We investigated current ocean acidification rates in the seas around Japan including marginal seas based on surface ocean carbonate measurements, thereby providing science-based information of ocean vulnerability affected by progressive acidification. We reconstructed monthly pH fields in the seas around Japan by 0.25 degrees latitude and longitude by using a moving-window multiple linear regression (MW-MLR) method, in which sea surface temperature and salinity, sea surface dynamic height and chlorophyll-a concentrations were used as explanatory variables for estimating total alkalinity (TA) and total dissolved inorganic carbon (DIC) concentration. Observation data used in the learning process of the MW-MLR method were obtained from GLODAPv2.2020 and SOCATv2020, whose $f\text{CO}_2$ data were converted to DIC in combination with estimated TA. Uncertainties in estimating TA and DIC were $\sigma=5.4 \mu\text{mol/kg}$ and $\sigma=5.4 \mu\text{mol/kg}$, respectively, and total uncertainty in estimating pH was $\sigma=0.009$. The sea around Japan as a whole has decreased its pH value by $-0.021/\text{decade}$ during the period 1998-2020, which is similar to the acidification rate of the global ocean. The estimated rates of pH decreases have regional differences, $-0.026/\text{decade}$ in the Sea of Japan whereas $-0.017/\text{decade}$ in the sea around Hokkaido, and what controls the variations is to be investigated. We can obtain the fields of seawater $p\text{CO}_2$ as well from the same method as used in reconstructing pH fields, which potentially be 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. The method of reconstruction in this study can be applied to other marginal seas in the western North Pacific.

Paleoclimate interpretation by Clay mineral contents in the surface sediment of Cirebon waters, Indonesia

Yunia Witasari

Research Center for Oceanography - Indonesian Institute of Science, Ancol Timur,
Indonesia

irasatwain@yahoo.com

Abstract

Clay mineral assemblages in marine sediments have strong effects on local paleoclimatic fluctuations and they can be useful as indicators for paleoclimatic condition. The distribution of clay minerals in modern oceans seems to be controlled by contemporary climates. A study was conducted to investigate surface sediments in the Cirebon waters, Indonesia. Eight samples at 20 cm long were collected using phleger core from 4 point, and were analyzed for clay content and the sediment age by ^{210}Pb dating. The clay minerals were identified by X-ray diffraction analyzer and the non-clay minerals were identified by electron microscopy. In general, the clay fractions were dominated by kaolinite and kaolinite-montmorillonite, lesser amounts of illite and nacrite. Kaolinite and montmorillonite were deposited in the surface sediments (layer 0-13 cm) of 2.7 – 5.6 years in Cirebon waters and they are consistent with the characteristic of wet tropical climate condition. It was mainly because the major kaolinitic is still developing up to present. While the content of illite and nacrite in the 13-20cm layer reflected the cold climate, have the same patterns with the sediments were formed during the sea level rise period following the last Glaciation of the Sunda land. It was assumed that the sediments under the 20 cm layer is derived from the old sediment of Cirebon land.

Key words: clay minerals, surface sediments, paleoclimatic, Cirebon Waters

Biogeochemistry of selenium in Western Pacific, selenium isotope perspective

Yan Chang¹, Jing Zhang^{1,2}, Ying Wu¹, Jianguo Qu¹, Han Su¹

¹State Key Laboratory of Estuarine and Coastal Research, East China Normal University, Shanghai, China

²Institute of Oceanography, Shanghai Jiao Tong University, Shanghai, China

*** Correspondence:**

ychang@sklec.ecnu.edu.cn
86-15821060834

Abstract

Selenium (Se) is an essential micronutrient for microorganisms, whose cycling in the ocean is primarily controlled by uptake by phytoplankton and subsequent recycling to the water column. With multiple oxidation states and six stable isotopes, Se isotopes have the potential to trace the yield biogeochemical cycles of Se. For the present day no direct measurement of the Se isotopic composition has been reported for the open ocean. A hydride generator combined with a desolvation device with methane addition was coupled to multiple collector inductively coupled mass spectrometry (MC-ICP-MS) to measure dissolved inorganic selenium (DISe) isotopes precisely. To investigate the behaviors of selenium in the Western Pacific, samples were taken in October, 2017 by a research vessel “Kexue”. The dissolved inorganic selenium (DISe) concentration ranged from 0.05 nM to 2.8 nM, with average of 1 nM in the Western Pacific. At a station which affected by the Kuroshio Current, the dissolved inorganic selenium isotopic ($\delta^{82/76}\text{DISe}$) values were relatively constant with average values of 1.59 ± 0.06 ‰ from the surface to a depth of 130 m, suggesting phytoplankton preferentially accumulate the lighter Se isotopes, and then decreased linearly to a depth of 800 m; below 800 m, $\delta^{82/76}\text{DISe}$ values remained at a relatively stable value of 0.40 ± 0.05 ‰, suggesting homogenization by strong vertical mixing. The DISe isotopic composition in the seawater is fractionated greatly relative to the bulk Earth values, indicating that Se isotopes fractionate sufficiently to clarify the biogeochemical cycling of this element in the ocean. The physicochemical properties and abiotic and biotic processes are potential factors that influenced Se isotopic composition in the seawater.

Budget of Riverine Nitrogen over the East China Sea Shelf

Jing Zhang¹, Xinyu Guo^{2,*}, Liang Zhao¹

¹College of Marine and Environmental Sciences, Tianjin University of Science and Technology, Tianjin, China

²Center for Marine Environmental Studies, Ehime University, Matsuyama, Japan

*** Correspondence:**

Xinyu Guo

guoxinyu@sci.ehime-u.ac.jp

Abstract

Riverine nitrogen loading to the continental shelf sea is important for terrestrial–marine linkage and global nitrogen cycling and leads to serious marine environmental problems. The budget and cycle of riverine nitrogen over the continental shelf in the East China Sea (ECS) are unknown. Using the tracking technique within a physical–biological coupled model, we quantified the nitrogen budgets of riverine dissolved inorganic nitrogen (DIN) and particulate organic nitrogen (PON) over seasonal to annual scales in the ECS, especially from the Changjiang River, which plays a dominant role in riverine nitrogen input. The horizontal distributions of the Changjiang DIN and PON generally followed the Changjiang diluted water and coastal currents and were affected by stratification in the vertical direction. Their inventory variations were dominated by biological fluxes and modulated by physical ones, and changed most dramatically in the inner shelf among three subregions. Less than half of DIN were converted to PON with most of the rest leaving the ECS through lateral transport pathways, among which the flux through the Tsushima Strait was dominant. With the increasing loading of the Changjiang DIN flux from the 1980s to 2010s, lateral transports rather than PON production increased due to limited primary production. Approximately 60% of the produced PON exported to the sediment and 34% went to the Tsushima Strait. According to the export production, the DIN from the Changjiang River contributed 12–42% to the ECS carbon sequestration.

Responses of size-fractionated phytoplankton to environmental variables in Gwangyang Bay focusing on the role of small phytoplankton

Yoonja Kang^{1,*}, Sang-Duk Choi², Young-Kyun Kim³, Yun-Ho Kang³, Chang-Keun Kang³

¹Department of Ocean Integrated Science, Chonnam National University, Yeosu, Republic of Korea

²Department of Aquaculture, Chonnam National University, Yeosu, Republic of Korea

³School of Earth Sciences and Environmental Engineering, Gwangju Institute of Science and Technology, Gwangju, Republic of Korea

*** Correspondence:**

yoonyakang@chonnam.ac.kr

Abstract

Responses of size-fractionated phytoplankton to environmental variables, particularly, temperature and ammonium, were investigated in Gwangyang Bay to identify the phytoplankton group, responsible for the estuarine blooms. Carbon-transformed biomass explicitly showed the dominance of nanoplankton in the summer and that of microplankton in the winter. A combination of microscopy and flow cytometry analysis revealed that cryptophytes dominated in a summer bloom and diatoms dominated in a winter bloom. Our polynomial regression models illustrated that the diatom-dominated microplankton biomass sharply declined with increasing temperature and ammonium, while cryptophyte-dominated nanoplankton and cyanobacteria-dominated picoplankton biomass increased with a temperature increase. This indicates the substantial role of small phytoplankton (nanoplankton and picoplankton) in the bay ecosystem, in which concerns regarding declining water quality and reduced nitrate are ongoing.

Inter-annual and inter-decadal variabilities of Chlorophyll over the East China Sea and southern Yellow Sea

Yi Xu^{1,*}, Ying Wu¹, Jing Zhang^{1,2}

¹State Key Laboratory of Estuarine and Coastal Research, East China Normal University, Shanghai, China

²School of Oceanography, Shanghai Jiao Tong University, Shanghai, China

*** Correspondence:**

Yi Xu

xuyi@sklec.ecnu.edu.cn

Abstract

The inter-annual and inter-decadal variabilities of Chlorophyll (Chl) over the East China Sea (ECS) and southern Yellow Sea are examined using satellite imagery acquired from 1998 to 2019. Empirical orthogonal function (EOF) analysis is performed with nonseasonal Chl signals to examine the dominant spatial and temporal pattern changes, and linear trends are quantified. The ECS explains most of the inter-annual variances of Chl, Photosynthetically Available Radiation (PAR), and physical fields (i.e., wind, net heat flux (NHF)), suggesting dynamic processes in this region determine the property and transport of water mass, thus play a substantial role in regulating phytoplankton bloom. 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 opposite with the PAR and NHF trends, but 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. The long-term satellite Chl data set, together with information of physical environments enables further studies to elucidate the causes of phytoplankton variability in this Western Pacific marginal sea.

Planktonic food web dynamics along the western area from North Pacific to Bering Sea in summer

Kailin Liu¹, Jun Nishioka², Koji Suzuki³, Bingzhang Chen^{4,5}, Shunyan Cheung¹, Huijun Wu¹, Yanhong Lu¹, Hongbin Liu^{1,5,*}

¹Department of Ocean Science, Hong Kong University of Science and Technology, Hong Kong SAR, China

²Pan-Okhotsk Research Center, Institute of Low Temperature Science, Hokkaido University, Sapporo, Japan

³Faculty of Environmental Earth Science, Hokkaido University, Sapporo, Japan

⁴Department of Mathematics and Statistics, University of Strathclyde, Glasgow, United Kingdom

⁵Hong Kong Branch of Southern Marine Science and Engineering Guangdong Laboratory (Guangzhou), Guangzhou, China

*** Correspondence:**

liuhb@ust.hk_ Tel: +852-23587341, Fax: +852-23581559.

Abstract

Phytoplankton growth and microzooplankton grazing rates were estimated by dilution technique along the western area from the subarctic North Pacific to the Bering Sea in the late summer of 2018. The phytoplankton growth in the study regions was under strong bottom-up control of nutrient availability and temperature. In the Kamchatka Basin characterized by high macronutrient, low chlorophyll, and low Fe concentration similar with the subarctic Pacific, the phytoplankton growth was not limited by macronutrient, but could be limited by Fe availability. By contrast, the phytoplankton growth both in the Gulf of Anadyr located in the northwest Bering Sea and the Kamchatka Strait was strongly limited by the macronutrient that had been exhausted by the summer blooms initiated by Fe supply via freshwater input. During this period, the phytoplankton community shifts the dominance from large diatoms towards small flagellates. Overall, the microzooplankton grazing rate in the study regions was determined by the prey (i.e., phytoplankton) concentration and affected by temperature. The close coupling between phytoplankton growth and microzooplankton grazing rates were observed in the Gulf of Anadyr and the western North Pacific, indicating a strong top-down control on phytoplankton dynamics and a relatively active microbial food web with high turnover rates. While the microzooplankton grazing impact on phytoplankton in the Kamchatka Basin was small, which may due to the influence of trophic cascade and the presence of mixotrophs. Such results and comparisons with other regions suggest a longer and more complicated protistan predatory chains in the Fe-limited Kamchatka Basin, which may affect the pathway and fate of organic carbon in the food web. Here, our results revealed the magnitude of phytoplankton growth and microzooplankton grazing rates and their regulating factors in the less-explored western Bering Sea, highlighting the importance of microzooplankton as a trophic link and the different food web structures in the area with or without Fe input.

High-throughput sequencing of 18S rDNA and rRNA reveals the diel vertical dynamics of mesoplankton assemblages at continental shelf and slope sites in northern South China Sea

Yixuan Li^{1,2}, **Y. Zhuang**^{1,2,*}, **H. Chen**^{1,2}, **H. Zhang**^{1,3}, **G Liu**^{1,2}

¹Key Laboratory of Marine Environment Science and Ecology, Ministry of Education, Qingdao, China

²Laboratory for Marine Ecology and Environmental Science, National Laboratory for Marine Science and Technology, Qingdao, China

³Department of Marine Sciences, University of Connecticut, Connecticut, U.S.A.

*** Correspondence:**

Y. Zhuang

yunyun.zhuang@ouc.edu.cn

Abstract

Assessing the biodiversity and metabolic activity of mesoplankton is crucial for understanding their roles in marine food web and biogeochemical cycles. Here, we exploited 18S rDNA and rRNA profiling to study the diel vertical dynamics of mesoplankton at continental shelf (C6 station) and slope sites (C9 station) in the northern South China Sea. Mesoplankton were collected in August of 2016 by vertical tow (mesh size 200 μ m) from different depths over a diel cycle. The contents of the cod ends were filtered, community DNA and RNA were extracted for 18S rDNA and rRNA high-throughput sequencing, respectively. Community compositions between two sites were significantly different (similarity < 42%) with higher diversity observed in continental slope. Copepoda was the most abundant group (relative abundance 77.4~84.8%) at both sites, followed with Tunicata (6.8%) and Hydrozoa (19.1%) respectively in continental shelf and slope. Significant variation in diel vertical distribution of mesoplankton communities indicates the diel vertical migration (DVM), of which the pattern differed between two sites. Potential DVM of Tunicata occurred in the surface layer (0-30 m) of the continental shelf, but less notable at the continental slope. rRNA profiles were significantly distinct from rDNA, with Copepoda (34.9%), Acantharia (36.2%) and Tunicata (14.3%) dominant at continental shelf, and Copepoda (40.4%) and Hydrozoa (24.6%) dominant at 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. As the first attempt, the combined analysis of rDNA and rRNA shed light on the contrasting diversity and dynamics of mesoplankton assemblages between continental shelf and slope in northern South China Sea.

Population dynamics of the ‘Golden Tides’ seaweed, *Sargassum horneri*, on the southwestern coast of Korea: The degree and formation of golden tides

Sang Rul Park

Estuarine and Coastal Ecology Laboratory, Department of Marine Life Sciences, Jeju National University, Jeju, Republic of Korea

Abstract

Since 2015, excessive masses of floating *Sargassum horneri* have been introduced via ocean currents and winds to the southwestern coastline of Korea, including Jeju Island. These massive mats have caused considerable damage to the aquaculture industry, tourism, and the marine ecosystem. Most previous studies of *S. horneri* have highlighted cultivation, the development of gene markers, and photosynthetic activity. However, the available data on population dynamics of *S. horneri* is still insufficient. The aim of this study was to investigate the population dynamics of native *S. horneri* off the southwestern coast of Korea for predicting the extent and formation of golden tides. Populations at two sites had obligate annual life cycles. Thalli were recruited during the period September–November, grew during the period December–April, and senesced by July. This pattern reflected seasonal trends in water temperature. Specific growth rates and heights of the thalli at Munseom were significantly higher than those at Jindo. The greatest environmental difference between the two sites is probably the degree of exposure to wave action. Mortality density (thalli lost per unit area) in the Munseom population was highest during the period December–January (i.e., 2–3 months after recruitment) and in March. Most thalli in the Jindo population died off in July when water temperatures increased. The maximum average biomass of *S. horneri* thalli detaching from the substrata reached 1.6 kg fresh weight m⁻² during January and March. Thus, large-scale drifting mats were formed by *S. horneri* detachment from the substrata. Despite the differences in space and environment between China and Korea, our findings will enable quantitative assessments of the overall floating *Sargassum* biomass in the East China and Yellow Seas.

Temperature modulation of the gut and skin microbiota in the smolt of chum salmon (*Oncorhynchus keta*)

Subrata Kumar Ghosh¹, Marty Kwok-Shing Wong¹, Susumu Hyodo¹, Koji Hamasaki^{1,*}

¹Atmosphere and Ocean Research Institute, The University of Tokyo, Chiba, Japan

*** Correspondence:**

hamasaki@g.ecc.u-tokyo.ac.jp

Keywords: chum salmon, intestinal bacteria, temperature, gut, skin mucus, fish.

Abstract

Fish-associated microbiota possess a decisive role on the health of the host fish. Factors including host genetics and environmental changes are deemed critical for regulating the dynamics of fish microbiota. Migratory fishes draw special attention for studying how these factors affect their endogenous microbiota as they experience severe environmental perturbations throughout their migration. Here, we investigated on chum salmon (*Oncorhynchus keta*), an anadromous fish with the most extensive natural geographical distribution of any Pacific salmon species, to determine how the endogenous microbiota of fish respond when subjected to sub-optimal temperature stress. Over the course of two weeks, 30 specimens of chum salmon smolts were exposed to a high-temperature tank of 18°C and a low-temperature tank of 8°C, with feces, cutaneous mucus, and rearing water samples taken at 0, 7, and 14 days. The 16S rRNA gene hypervariable regions (V4-V5) of bacteria were sequenced. Taxonomic and diversity analysis data unambiguously suggested that the exposition of chum salmon to sub-optimum temperatures triggers significant changes in fecal and skin mucus microbiota. Especially we found high relative abundance of *Vibrio* and *Tenacibaculum* sequence variants which possibly included opportunistic pathogens and thus a sign of dysbiosis. Comparison of community structure among the skin mucus samples indicated intraspecies variation in the skin-associated bacterial consortia in response to temperature stress, which might highlight large variability of physiological capacity of individual fish to temperature stress. We also identified two potential stress-specific taxonomic microbial biomarkers: the class *Betaproteobacteria* and the genus *Flavobacterium* in both high and low temperatures. Our study implied the importance of environmental temperature for regulating the equilibrium in cutaneous and intestinal microbiota dedicated to maintaining homeostasis of migratory fishes.

Detection of fish community distribution by MiFish analysis and comparison of typical fish community assemblage with ocean frontal structure

**Ahmed Sk Istiaque¹, Ito Shin-ichi¹, Yu Zeshu¹, Wong Marty¹, Yoshizawa Susumu¹,
Inoue Jun¹, Itoh Sachihiko¹, Hyodo Susumu¹**

¹Atmosphere and Ocean Research Institute, The University of Tokyo, Tokyo, Japan

*** Correspondence:**

AHMED Sk Istiaque

iahmed@g.ecc.u-tokyo.ac.jp

Abstract

Environmental DNA (eDNA) is gaining immense popularity in understanding fish species distribution pattern and biodiversity monitoring in the ocean due to its non-invasive nature and convenience to use. The eDNA is derived from the genetic materials present in water and gleaned from various sources including skin cells, feces and mucous. MiFish metabarcoding technique is a modern hotcake in analyzing fish community distribution in larger waterbodies which capacitates detection of huge number of species at a short time provided with some precautions in sampling.

This study focuses on the distribution of fish species along the Kuroshio Extension front of the North Pacific and aspires to understand the effects of frontal structure on the fish community structure from the collected samples of a research vessel (KS-18-5) at 19 different stations (0 to 300m) with a view of the fish species richness and comprehending spatial variations. The samples were collected, filtered, and stored appropriately to extract the DNA and finally segregated in respective Operational Taxonomic Units (OTUs) by MiFish analysis.

A total of 111 species has been detected and they are assigned to their respective ratios. The samples were subjected to cluster analysis based on species composition using Ward method with Euclidean distance. Eventually, the samples have been cleaved into 6 clusters where the cluster 6 is the most dominant in space followed by cluster 2, 1, 4, 5 and 3. All the clusters are dominated by one or two species. However, the uniformly distributed cluster 6 is dominated by large number of species. Some of the clusters distributed a specific depth. In addition, several clusters showed close link to the Kuroshio Extension frontal structure. The study promulgates the feasibilities of using MiFish analysis for biodiversity study and creates passage of concocting the influence of frontal structure on fish assemblage.

The solutions to balance the coastal wind energy development and waterbird conservation along East China Coast

Ben Li^{1,*}, Xiuzhen Li², Tianhou Wang¹

¹School of Life Science, East China Normal University, Shanghai, China

²State Key Laboratory of Estuarine and Coastal Research, East China Normal University, Shanghai, China

*** Correspondence:**

Li Ben

bli@bio.ecnu.edu.cn

Abstract

Wind farms are a cleaner alternative to fossil fuels and may mitigate the effects of climate change. However, they have complex ecological consequences, especially their negative effects on birds. The East China coast is a key part of the East Asian-Australasian flyway (EAAF) for migratory waterbirds, and numerous wind farms have been or will be built in this region owing to high electricity demand and wind energy resources. However, little is known regarding the effects of large-scale wind farms of the East China coast on biodiversity conservation. The negative effects of wind farms on waterbirds that overwinter here could be reduced by understanding waterbird distribution and movement around wind turbines in these areas. From 2017 to 2019, we selected the Chongming Islands as our study area, which are one of the most important hot spots for migratory waterbirds of the East China coast and have sufficient wind generation potential to achieve energy sustainability, to study how to coordinate coastal wind farm development (existing and planned wind farms) and waterbird conservation (important waterbird habitats and buffer zone due to characteristic of waterbird activity). We identified four coastal natural wetlands of international importance for waterbirds according to 16 field surveys in 2017 to 2018. Additionally, with 4603 locations of 14 GPS/GSM tracked waterbirds (seven shorebirds and seven ducks) in Chongming Dongtan in 2018 to 2019, we further demonstrated that more than 60% of waterbird locations were within a distance of 800 to 1300 m from the dyke, and this distance could be defined as a buffer zone to protect waterbirds. Finally, we found that 67 existing wind turbines adjacent to four important coastal habitats on the Chongming Islands may influence waterbirds based on our finding of the buffer zone for waterbird conservation.

Feeding ecology of walleye pollock, *Gadus chalcogramma*, in the western East/Japan Sea revealed by stable isotope analyses

Hyun Je Park^{1,*}, Tae Hee Park¹, Dongyoung Kim², Chung-II Lee¹, Chang-Keun Kang²

¹Department of Marine Bioscience, Gangneung-Wonju National University, Gangneung, Republic of Korea

²School of Earth Sciences & Environmental Engineering, Gwangju Institute of Science and Technology, Gwangju, Republic of Korea

*** Correspondence:**

Hyun Je Park
phj13579@gwnu.ac.kr

Abstract

We determined the dietary composition and trophic position (TP) of walleye pollock in the western East/Japan Sea, based on the $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values of this species, sympatric dominant fish and invertebrates, and their putative food sources in winter 2016 and 2017. A broad range of the consumer $\delta^{13}\text{C}$ values reflected clear distinctions between benthic and pelagic feeders, differentiating benthic vs. pelagic trophic pathways. The intermediate $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values of walleye pollock fell between those of benthic and pelagic feeders, indicating their trophic links through both pathways. Increases of their isotopic values with increasing body length suggest an ontogenetic change in dominant diets from pelagic to benthic prey. Their ontogenetic pattern in resource utilization might be associated with deeper migration range with size caused by the vertical hydrographic conditions in this region, increasing TP during ontogeny. Overall, our results provide a clue to understanding the potential impacts of environmental changes on the demographic decline of the pollock stock in Korean water.

Land use land cover classification and oil palm detection in Sarawak using Landsat-8 and the Open Data Cube

ES. Richard¹, A. Mujahid², M. Müller³, M. Bhave^{1,*}

¹Swinburne University of Technology Sarawak, Faculty of Engineering, Computing and Science, Kuching, Malaysia

²Universiti Malaysia Sarawak, Faculty of Resource Science and Technology, Kota Samarahan, Malaysia

³Swinburne University of Technology, Department of Chemistry and Biotechnology, Victoria, Australia

*** Correspondence:**

Moritz Müller

mmueller@swinburne.edu.my

Abstract

Sarawak is undergoing land cover conversion to meet global palm oil demand. This is threatening its biodiversity, water-related ecosystem, and the role of its tropical forest in mitigating climate change. Despite the land use land cover (LULC) change of oil palm plantations reported, there is no database providing comprehensive data on oil palm expansion in Sarawak.

This study leveraged the computing and analysis power of the Singapore-Sarawak Open Data Cube (ODC) infrastructure through supervised machine learning (ML) techniques for LULC classification in Betong, Sarawak, with a specific focus on oil palm detection. We developed ML models from the random forest (RF), adaptive boosting (AdaBoost), and gradient boosting (GB) algorithms to classify Landsat-8 Surface Reflectance data from 2013 and 2018. The models were developed through feature selection and hyperparameter tuning optimisation techniques before being compared against its baseline models. The model evaluation indicated that the RF baseline model outperformed other models with minor misclassifications. The misclassifications can be attributed to the compromised satellite data quality.

The result from this study indicated that there are expansions of oil palm plantation in Betong from 2013 to 2018. Large number of oil palm plantations on peatlands, nearby protected areas boundaries and proximity to major rivers in Betong were detected in both years. This may impose severe impacts on the terrestrial and aquatic ecosystems. This study also indicated that more oil palm plantations in Betong than Borneo Atlas geoportal's mapped and reported data.

Based on the result, there is potential in applying the techniques and the data explored in this study for oil palm detection by using the Open Data Cube infrastructure to provide more comprehensive oil palm data in Sarawak. Hence, providing accurate linkage in between land use and environmental impacts.