



# Third International Symposium on Mangroves as Fish Habitat

**Kuala Lumpur • Malaysia • 12–14 November, 2018**



**Bulletin of  
Marine  
Science**  
bullmarsci.org



**“Connecting the Hemispheres”**

## **Symposium Organizing Committee**

**Joseph E. Serafy**

US National Marine Fisheries Service & University of Miami

**Rafael J. Araújo**

University of Miami

**Geoffrey S. Shideler**

University of Miami

**Amy Then**

University of Malaya

## **Conference Organizers**

**Spark It Communications**

[sparkitideas.com](http://sparkitideas.com)

## **Supporting Partners**

**International Fisheries Section of the American Fisheries Society**



International  
Fisheries  
Section of the  
American Fisheries Society



# Welcome to the Third International Symposium on Mangroves as Fish Habitat

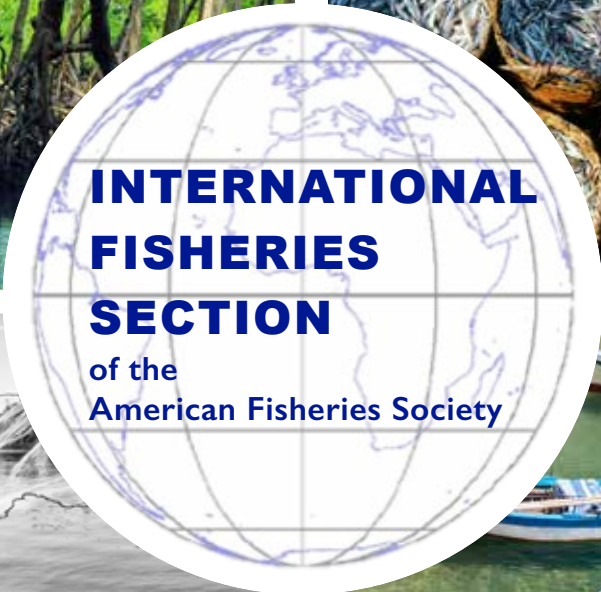
**W**e are pleased to welcome you to the Third International Symposium on Mangroves as Fish Habitat (MAFH), hosted by the *Bulletin of Marine Science*. While the *Bulletin* was involved with the two previous MAFH conferences, this MAFH3 is the first that our journal has organized. So, we are particularly excited that the call for abstracts captured the interest of such a diverse group of excellent scientists, educators, and resources managers. Clear from the abstracts is that we are in for a stimulating meeting that spans many fields of study from more than a dozen nations from around the world.

First and foremost, as a scientific publication, our goal is to produce high-quality proceedings that captures the state of the science for all things surrounding mangroves as fish habitat. We invite you to submit your work to be included in the “Proceedings of the Third International Symposium on Mangroves as Fish Habitat,” a dedicated, peer-reviewed, open-access special issue of the *Bulletin* that is scheduled for publication in early 2020. For this issue, the *Bulletin* will waive all publication charges for contributing authors from the symposium. We encourage you to go to our website and familiarize yourself with the author guidelines and submission procedures. The submission deadline for manuscripts is January 15, 2019. However, we encourage you to submit your work as soon as possible.



We hope you enjoy your stay in Kuala Lumpur, and that your science and your network of collaborators is enriched as a direct result of this meeting.

Joseph E. Serafy, Ph.D.  
Editor  
*Bulletin of Marine Science*



The **International Fisheries Section** provides a home for American Fisheries Society members that live, work, or have an interest in global fisheries science.



**Increase** the awareness of international fisheries research and management activities, contributions, and issues that occur internationally.



**Encourage** the involvement and cooperation of the American Fisheries Society and its members in international fisheries.



**Assist** the international community with networking and conference opportunities.



**Provide** the exchange of information and technical assistance among fishery workers of all nations.

## LEARN MORE ABOUT IFS

Website: <https://units.fisheries.org/ifs/>

Facebook: [facebook.com/InternationalAFS/](https://www.facebook.com/InternationalAFS/)

Twitter: @IFS\_AFS

Email: [IFSoFAFS@gmail.com](mailto:IFSoFAFS@gmail.com)



**President: Abigail Lynch**

*National Climate Adaptation  
Science Center*

*We welcome new members! Please  
contact us via email to join.*



# “Connecting the Hemispheres”

Six decades after it originated, and one decade after the concept of “mangroves as fish habitat” was formalized with the first scientific meeting of its kind, research linking mangroves and fishes continues to grow and expand into new and exciting disciplines. The First International Symposium on Mangroves as Fish Habitat in Miami, USA (2006), revealed the thematic diversity that researchers around the world were exploring when studying fish and their relationships with mangrove ecosystems. Nursery and trophic function, community ecology and connectivity, mangrove-fisheries linkages, and conservation and management were being studied with an array of techniques that included traditional fish capture methods and literature surveys, but also visual surveys, acoustic telemetry, stable isotopes, and otolith chemistry analyses. The first meeting also revealed a growing interest in disturbance and habitat restoration to enhance nearshore fish biomass.



The Second International Symposium on Mangroves as Fish Habitat in Mazatlán, Mexico (2014), took the core scientific concepts of the first symposium and expanded them into a global exploration of mangrove-fishery values, emphasizing the need to quantify and monetize mangrove-associated fisheries, as well as analyses of geographically extensive data sets to establish the dependence on mangroves of several fish species at regional scales. The second symposium included studies using camera systems to examine fish behavior, habitat complexity and habitat use, while others addressed carbon storage in mangrove systems and the potential effects of global climate change and other disturbances on mangroves and associated fish assemblages.

The goal of the Third International Symposium on Mangroves as Fish Habitat, Kuala Lumpur, Malaysia (2018), is to bring together scientists, researchers, industry professionals, economists, educators, and government officials, with the goal of “Connecting the Hemispheres.” Decades of research on the function of mangroves as fish habitat suggest there may be differing processes occurring in the Eastern and Western hemispheres. Whether it be driven by differences in tides, evolutionary histories, or differing species life-histories, there is uncertainty about the global role that mangroves play as critical habitat in the new versus old worlds. This symposium aims to examine the relationships between fishes and mangroves in each hemisphere, to identify gaps in our knowledge, and to chart a course for future global research on mangroves as fish habitat.



**Clear from the abstracts is that we are in for a stimulating meeting that spans many fields of study from more than a dozen nations from around the world.**



# Welcome to Kuala Lumpur

**G**reetings and *Selamat datang ke Malaysia!* We warmly welcome all our MAFH3 participants to the land of hot, humid tropical climate conducive for all things “exotic,” including our highly biodiverse Indo-Malayan mangroves! The organizing team has been working hard to arrange an exciting program featuring equally diverse presentations that will bring together updated mangrove knowledge from both the Eastern and Western hemispheres. We trust that collectively, MAFH3 will inspire new ideas, as well as chart the future course for mangrove-fish studies that will matter in the decades to come.

Amy Then, Ph.D.  
University of Malaya

## Table of Contents

Agenda at a Glance .....	7
Conference Program	
Monday, November 12 .....	13
Tuesday, November 13 .....	31
Wednesday, November 14 .....	56

## About the Sessions

The first two symposia took place in the United States and in Mexico, two countries dominated by just a few genera of mangroves. Most mangrove species in the Western Hemisphere have common names that relate to the color of the bark. In English, they are red, white, and black mangroves. Similarly in Spanish, Portuguese, and French, the same colors are used to identify some of the species. In contrast to the Western Hemisphere, Southeast Asia is home to dozens of mangrove species. The common names of many of the species are local words, such as Api-api (in Malay, meaning fire), or Bakau Minyak (meaning oil mangrove). To celebrate the Third International Symposium on Mangroves as Fish Habitat taking place in a region of the world with incredible mangrove diversity, we have named each of the sessions after the common names of some mangrove species in Malay. We hope you have the opportunity to see many mangrove species for yourself either on the field trip excursion, or on your own.



The Third International Symposium on  
Mangroves as Fish Habitat is presented by:

The *Bulletin of Marine Science* is a hybrid open access journal dedicated to the dissemination of research dealing with the waters of the world's oceans. All aspects of marine science are treated by the *Bulletin of Marine Science*, including papers in marine biology, biological oceanography, fisheries, marine policy, applied marine physics, marine geology and geophysics, marine and atmospheric chemistry, meteorology, and physical oceanography.



# Bulletin of Marine Science

For more information,  
visit [bullmarsci.org](http://bullmarsci.org)



# Monday, November 12

**09:00**

Welcoming Remarks

## Keynote Address

**09:20-10:00**

**Philine zu Ermgassen**

Modelling and Mapping the Mangrove Fisheries Value Globally

**10:00-10:20**

Coffee and Tea Break

## Session 1 (Api-api)

**10:20-10:40**

**S Kanno**

Stationary Video Transect Reveals Differences in Habitat Use and Movement Pattern Between Two Stingray Species

**10:40-11:00**

**M D'Elia**

Evaluation of an Imaging Sonar System (DIDSON) as a Fisheries Monitoring Tool for Complex Habitats

**11:00-11:20**

**MO Aljahdali**

Investigation on the Changes of Mangrove Trees in Rabigh Lagoon Swamps Using Remote Sensing and Geographic Information System (GIS) Techniques

**11:20-11:40**

**GA Castellanos-Galindo**

Synthesis of Knowledge on Mangrove-Associated Fishes in the Colombian Pacific Coast

**11:40-12:00**

**JA Payán-Alcacio**

Fish Community Structure of an Arid Mangrove Region in the Northwest of México

**12:00-13:00**

Lunch

## Session 2 (Nipah)

**13:00-13:20**

**MDE Hoq**

Does Sundarbans Mangrove Support Growing Mud Crab Farming Industry in Bangladesh Coast?

**13:20-13:40**

**SG Salmo III**

Nekton Assemblages in Mangroves-Seagrass-Coral Reefs Disturbed by Bleaching Event: the Role of Interconnected Coastal Ecosystems in Post-Disturbance Recovery

**13:40-14:00**

**MK Abu Hena**

Community Composition and Diversity of Phytoplankton in Relation to Environmental Variables and Seasonality in a Tropical Mangrove Estuary, Malaysia

# Monday, November 12

**14:00-14:20**

**MS Islam**

The Mud Crab Fishery of the South-Western Mangrove of Bangladesh: Biological Traits to Manage the Resources to Ensure Continuous Livelihood

**14:20-14:40**

**MA Rahman**

Fisheries and Aquaculture Adaptation To Climate Change in Coastal Areas of Bangladesh

**14:40-15:00**

**JA Payán-Alcacio**

Functional Structure of the Mangrove Fish Community in the American Continent

**15:00-15:20**

Coffee and Tea Break

## Session 3 (Bakau Minyak)

**15:20-15:40**

**QD Le**

Trophic Behavior of Juvenile Reef Fishes Inhabiting a Tropical Mangrove-Seagrass Continuum Along a Shallow-Water Coastal Lagoon

**15:40-16:00**

**QM Dinh**

Spatiotemporal Variation in Diet Composition of the Freshwater Mudskipper *Periophthalmodon septemradiatus* (Hamilton, 1822) at Different Fish Sizes

**16:00-16:20**

**SMN Amin**

Feeding Habits of Five Dominant Fish Species from Matang Mangrove Estuaries, Malaysia, Based on Stomach Content and Stable Isotope Analyses

**16:20-16:40**

**W Severi**

Spatial Segregation and Diet of Gerreidae in a Tropical Coastal Ecosystem

**16:40-17:00**

**AY-H Then**

Stable Isotopes Track Macrobenthic Food Web Changes in a Chronosequence of Replanted Tropical Mangrove Stands

**17:00-17:20**

**V Lheknim**

Patterns of Infestation of the Epizoic Barnacle, *Octolasmis angulata*, on the Swimming Crab, *Portunus pelagicus*, from Thale Sap Songkhla and Adjacent Coastal Area, South Thailand

**17:20**

Dismissal

**18:00-20:00**

Rooftop Welcome Social and Networking Event

# Tuesday, November 13

**09:00–09:20**

Welcoming Remarks

## Keynote Address

**09:20–10:00**

**Harinder Rai Singh**

Replanted Mangroves – Biodiversity and Livelihoods Generators?

**10:00–10:20**

Coffee and Tea Break

## Session 4 (Bakau Pasir)

**10:20–10:40**

**RA Mackenzie**

Do Restored Mangroves Function Similar to Intact Ones? Carbon Storage, Sedimentation, and More!

**10:40–11:00**

**AA Aldrie**

The Causes and Consequences of Mangrove Habitat Loss in Peninsular Malaysia

**11:00–11:20**

**A Quarto**

Reversing the Damage to Mangrove Wetlands To Restore Fish Habitat – A Global Perspective

**11:20–11:40**

**EK D'Alessandro**

Disturbance and Recovery in a Highly Dynamic Mangrove Fish Community



**11:40–12:00**

**S Sharma**

Blue Carbon Stocks of Pristine and Restored Mangroves in Asian Countries

**12:00–13:00**

Lunch

## Session 5 (Pedada)

**13:00–13:20**

**SM Carstenn**

Do Novel, Non-Native Mangrove Ecosystems Provide Fish Habitat in Hawai'i?

**13:20–13:40**

**AKS Wee**

The Delineation of Marine Protected Areas: Perspectives from Comparative Phylogeography of Mangrove Trees

# Tuesday, November 13



**13:40-14:00**

**DCJ Wodehouse**

Lessons for Fisheries Management: Constructive Engagement between Government Agencies and Village Leadership Leads to Better Mangrove Management than Simply Focusing on Villager Participation

**14:00-14:20**

**CM Beitzl**

Integrative and Ethnographic Methods for Understanding the Ecology of Fishing Decisions and Feedback in Mangrove Social-Ecological Systems

**14:20-14:40**

**N Rajendran**

Peoples' Perception on Declining Fish Resources in Mangroves of Southeast Coast of India

**14:40-15:00**

**MA Rahman**

Fishing Activities of Artisanal Fishers and Their Socioeconomic Features in the Sundarbans Mangrove Forest of Bangladesh

**15:00-15:20**

Coffee and Tea Break

## Session 6 (Berus)

**15:20-15:40**

**B Satyanarayana**

Genetic Diversity of *Carcinoscorpius rotundicauda* in Peninsular Malaysia

**15:40-16:00**

**V Lheknim**

Temporal and Spatial Distribution Patterns of Mysidacea, *Acetes*, and *Lucifer* in Songkhla Lagoon System, South Thailand

**16:00-16:20**

**R Ara**

Spatiotemporal Variation of Larval Fishes at Matang Mangrove Ecosystem, Perak, Malaysia

# Tuesday, November 13

## Lightening Talks

**16:20-16:25**

**W Severi**

Size Distribution of Early Stages of *Ctenogobius boleosoma* (Actinopterygii, Gobiidae) in a Coastal Complex in Northeastern Brazil

**16:25-16:30**

**W Filfilan**

Physiological Alterations Induced by Phenanthrene (Crude Oil Derivative) on Marine Cultured Tilapia Fish *Oreochromis spilurus* in Saudi Arabia

**16:30-16:35**

**P Siraprapha**

Simulating the Effects of Shrimp Harvesting on Target Fishes for Thai Mangrove Fisheries Scenarios

**16:35-16:40**

**LA Sandoval**

Relationship Between Fish Catch and Environmental Variables Reveals the Importance of Mangroves to Small-Scale Fishery in Urabá Gulf, Colombian Caribbean

**16:40-16:45**

**W Severi**

Structure of the Fish Assemblage and Functional Guilds in the Estuary of Maracaípe, Northeast Coast of Brazil

**16:45-16:50**

**SMN Amin**

Diversity and Population Dynamics of Fishes in the Mangrove Estuary of Marudu Bay, Malaysia

**16:50-16:55**

**CR Kaur**

The Significance of Particularly Sensitive Sea Areas (PSSA) for Protection of the Ramsar Sites in Johor, Malaysia

**16:55-17:00**

**LD Vorsatz**

The Role of Mangrove Microhabitats: An Invertebrate and Fish Larval Perspective

**17:00-17:05**

**G Malla**

Perceptions and Preferences of Local Fishers around a Protected Mangrove Forest in Eastern India

**17:05-17:10**

**P Ray**

Assemblage Patterns of Fishes in Mangrove and Non-Mangrove Habitats of an Estuary in Eastern Coast of India

**17:10**

Dismissal



# Wednesday, November 14

**09:00-09:20**

Welcoming Remarks

## Keynote Address

**09:20-10:00**

**Ivan Nagelkerken**

Connecting the Hemispheres: Global Patterns of Mangroves as Fish Habitat

**10:00-10:20**

Coffee And Tea Break

## Session 7 (Teruntum Putih)

**10:20-10:40**

**LE Stuthmann**

The Functional Ecology of Mangrove Fishes at the Isthmus of Panama

**10:40-11:00**

**S McGregor**

The Extent of Mangrove-Use by Small Fishes in Warm Temperate South African Estuaries

**11:00-11:20**

**R Seary**

Defining Mangrove-Fisheries: Case Studies of Indonesia and Cambodia



**11:20-12:00**

**Panel Discussion**

Amy Then, Philine zu Ermgassen, Harinder Rai Singh, Ivan Nagelkerken, Joseph E Serafy

**12:00**

Dismissal

# Keynote Address

Monday, November 12 — 09:20

## Modelling and Mapping the Mangrove Fisheries Value Globally

### PHILINE ZU ERMGASSEN

School of Geosciences  
University of Edinburgh  
Edinburgh, United Kingdom  
Email: Philine.Zu.Ermgassen@ed.ac.uk

Understanding the ecosystem service values of threatened habitats is key to communication with both stakeholders and policymakers. Here, I present the results from a broad collaboration of experts who have developed a model of the global distribution of mangrove fisheries values. The presentation will cover four key and distinct processes in developing the global model. Firstly, the quantitative assessment of field data to derive a list of mangrove-dependent fish and invertebrate species. Secondly, the development of a global GIS layer identifying the geomorphology of mangrove areas. Thirdly, the identification through a Delphi process of key biotic and abiotic variables driving mangrove fish abundance and the fitting of a quantitative model to field-derived density data. Fourthly, the identification of key drivers of fishing pressure within mangrove regions through a Delphi process and the development of a representative GIS layer. Finally, I will describe how all of these efforts come together in the development of a global mangrove fisheries model and present the resulting map.



### Biography

Coastal habitats are critical for fish and fisheries, yet their value is still poorly quantified. Philine works with a broad range of collaborators across academia and conservation to quantify the importance of threatened coastal habitats to fish. Her aim is to provide insights into the spatial distribution of these values to inform fisheries and conservation policy agendas. Her present research seeks to develop a model of the distribution of fish production from mangroves globally. This work relies on a large network of collaborators bringing their expert regional knowledge to the table, both on fish ecology and on the human use of mangrove dependent-fisheries species. The project draws on many experiences working with mangrove fish and fisheries from around the world through the Delphi technique, and uses the resulting assessment to inform the interpretation of quantitative data. She is also currently developing regional US models for fish production from oyster reefs, seagrasses, and saltmarshes.

Philine received her PhD from the University of Cambridge and is currently a postdoctoral researcher in the Changing Oceans Group at the University of Edinburgh, where she works in close collaboration with colleagues in The Nature Conservancy.

# Session 1 (Api-api)

Monday, November 12 — 10:20

## Stationary Video Transect Reveals Differences in Habitat Use and Movement Pattern Between Two Stingray Species

**KANNO S**, Heupel M, Simpfendorfer C

James Cook University

1 James Cook Drive, Building 34-133

James Cook University QLD 4811

Australia

Email: shiori.kanno@my.jcu.edu.au

Mangroves are highly productive habitats offering abundant food resources and physical refuge against predators to elasmobranch species, particularly, juveniles. However, habitat use and behavioral pattern of stingrays are poorly understood within mangrove habitats and the direct utilization of mangroves remains unclear. Stationary video transects were used to investigate fine-spatial scale use of mangroves by juveniles of two stingray species—mangrove whiprays, *Urogymnus granulatus*, and cowtail stingrays, *Pastinachus ater*—in a mangrove-fringed intertidal area at Pioneer Bay, Orpheus Island, Australia. Transects compared abundance, residence time, and behavior of stingrays among three different habitats (inside-mangrove, mangrove-edge, and sandflat) between summer (February) and winter (August). The abundance of *U. granulatus* was not significantly different between seasons, while *P. ater* was significantly more abundant in summer than in winter, suggesting a seasonal habitat shift by *P. ater*. *Urogymnus granulatus* exhibited tide-associated movement, where they occupied mangroves during flooding tide and moved to sandflats at ebb tide. As *U. granulatus* were frequently observed feeding and refuging among the root structures, they likely gain feeding opportunities and predator avoidance from occupying mangrove habitats. *Pastinachus ater* predominantly occurred on sandflats regardless of tidal height, confirming the possible importance of sandflats for feeding by this species. Juveniles of these two co-occurring stingrays consistently utilized a mangrove-fringed nearshore bay, highlighting that this may be critical habitat for early life stages, and that loss of mangroves may have significant negative effects on populations.





PRESENTATION

# Session 1 (Api-api)

**Monday, November 12 — 10:40**

## **Evaluation of An Imaging Sonar System (DIDSON) as a Fisheries Monitoring Tool for Complex Habitats**

**D'ELIA M**, Campo R, Garcia R, Boswell K, Rehage J, Crowl T  
Institute of Water and Environment and Department of Biological Sciences  
Florida International University  
Biscayne Bay Campus  
3000 NE 151st St., North Miami, FL  
USA  
Email: [madelia@fiu.edu](mailto:madelia@fiu.edu)

Accurate assessment of fish size and spatial distributions in mangrove habitats is fundamental to assess the role of these systems as nursery habitat and to understand how fish distributional patterns affect ecological processes and services. Imaging sonars are considered to be the most advantageous and non-invasive tools to monitor fish, especially in shallow, low visibility water. However, to obtain accurate target detections in complex habitats (mangroves), it is imperative to determine the extent to which the complex

structure mediates the acoustic signal. The strong acoustic return produced by hard and complex underwater structure could mask the echoes of targets of interest, introducing inherent bias in detection and tracking processes. In this study, we developed an experimental design in a controlled setting to determine the efficiency of acoustic methods for estimating fish size and abundance within simulated mangrove root structures. Fish were collected adjacent to mangroves in South Florida and put into a mesocosm with simulated mangrove root masses. Simultaneous video and DIDSON data were compared to match the acoustic signal of targeted fish with visual identification of the fish individuals. In addition to examining the detection probability in the

complex habitats, we also developed an algorithm for automated target detection and tracking, and explored how signal detection threshold, distance of the sonar from the mangrove structure, and beam shape mediate the accuracy of fish abundance estimates. Results of this experiment will help to evaluate the use of imaging sonars as a fisheries monitoring tool in natural mangrove systems.



# Session 1 (Api-api)

**Monday, November 12 — 11:00**

## **Investigation on the Changes of Mangrove Trees in Rabigh Lagoon Swamps Using Remote Sensing and Geographic Information System (GIS) Techniques**

### **AIJAHDALI MO**

Department of Biological Sciences, Faculty of Science  
King Abdulaziz University  
P.O. Box 80203, Jeddah 21589  
Saudi Arabia  
Email: moaljhdali@kau.edu.sa

Due to changes caused by anthropogenic catastrophes on the hydrology of Rabigh lagoon system, approximately 49.35% of the originally 490 hectares of mangrove forests have been destroyed between 1987 and 2012. However, during 2013 to 2017, some healthy mangrove trees remained along the lagoon with 30% of enhancement comparing to those in past seasons. The main objective of this study was to detect the changes of mangrove forests canopy in Rabigh lagoon using remote sensing and GIS imaginary. To fulfill this objective, Landsat images acquired between 1987 and 2015 were used for analysis. The images were accurately calibrated, smoothly filtered, and radiometrically corrected, and then human constructions, normalized difference vegetation index (NDVI), mangroves distribution, and changes between 1990 and 2017 were estimated. Data indicated that the degradation of mangrove cover started in 1988 when the lagoon was mostly enclosed by a passageway. This was partly modified in 1990, when the mangrove forests linked again with the open system of Red Sea through narrow streams. The recharged water in the swamp was low until 2012 when the lagoon was mostly liberated. Mangrove forests were severely degraded between 1990s and 2000, especially in the islands and the northern parts of the lagoon. The total area of mangrove forests decreased from 490.4 ha in 1990 to 286 ha in 2000, and to its lowest amount of 248.8 ha in 2012. In contrast, the mangroves area gradually recovered and increased to 342.8 and 380 ha in 2014 and 2017, respectively.



PRESENTATION

# Session 1 (Api-api)

**Monday, November 12 — 11:20**

## **Synthesis of Knowledge on Mangrove-Associated Fishes in the Colombian Pacific Coast**

**CASTELLANOS-GALINDO GA**, Baos R, Zapata LA  
Leibniz Centre for Tropical Marine Research (ZMT)  
Fahrenheitstrasse 6  
28359 Bremen  
Germany  
Email: gustavoa80@yahoo.com

More than 50% of the Colombian Pacific coastline in the eastern Pacific (EP) Ocean contains mangroves and estuaries. The dominance of alluvial plains and large deltas, macro and meso-tides, and heavy rainfall ( $>3000$  mm yr<sup>-1</sup>) contribute to the development of extensive mangrove forests in this coast. Fishes inhabiting the mangrove-estuary mosaic in the Colombian Pacific play a fundamental ecological role and are the basis for sustaining large parts of the small-scale fishery of this region. Given the historical isolation of this coast, research on the mangrove ichthyofauna has been concentrated in areas close to



Buenaventura City, the main shipping port. More recently, remote localities in the southern coast (Nariño province) have been sampled, helping to synthesize the ecological knowledge about these fish communities. Approximately 230 fish species can be found in the mangrove-estuary mosaic of the Colombian Pacific. This represents one quarter of the total marine fish richness in the Colombian Pacific. However, only around 80 fish species ( $<10\%$  of marine fish richness in this coast) regularly enter mangroves and used them as feeding or shelter sites. The dominant fish families, i.e., Clupeidae, Engraulidae, Centropomidae, Lutjanidae, Sciaenidae, Tetraodontidae, and Ariidae, correspond

to those dominant in mangroves of EP region, being many of these important to the local fishery. Knowledge gaps persist both in geographic coverage and in the understanding of the ecological role of fish within the mangrove-estuary mosaic of this region. Filling in these gaps will be critical to preserve mangrove habitats and ecosystem services in this under-develop coast.

# Session 1 (Api-api)

**Monday, November 12 — 11:40**

## Fish Community Structure of an Arid Mangrove Region in the Northwest of México

**PAYÁN-ALCACIO JA**, Amezcua F, De la Cruz G, Moncayo-Estrada R  
IPN-CICIMAR

Avenida Instituto Politecnico Nacional SN  
Playa Palo de Santa Rita  
23096 La Paz, B.C.S.  
Mexico  
Email: japayanalcacio@gmail.com

Among the different types of mangroves, those in arid climates are recognizable. The high rates of evaporation, low rainfall (<200 mm yr<sup>-1</sup>), and the absence of continental water supplies lead to antiestuarine conditions. Ichthyological studies in this type of environment are scarce, and the structure of their fish communities is poorly understood. Based on nine factors, we investigated the structure of fish communities associated with the mangroves of Bahía de La Paz (BP) and Bahía Almejas (BA) in Baja California Sur; Las Guásimas (LG) in Sonora and Navachiste, Reforma, Urias and Huizache in Sinaloa (Si). In total, we encountered almost 300 species in the arid mangroves inside the Gulf of California peninsula of Baja California; the most important families were Haemulidae, Gerreidae, and Paralichthyidae. In BP, the distribution of the abundance and dominance of the species varied significantly throughout the year. In contrast, the abundance of the species in BA did not change significantly, likely due to the stable, cooler temperature. In LG, we found higher complexity during the summer and autumn season (Sinaloa is work in progress). The functional analysis detected nine groups. The most important groups were “generalists,” which constituted almost 50% of all species in the analysis, followed by a benthonic group consisting of flatfish and gobids (with 23% of species), and finally a pelagic group with 14% of the species richness. The structure of the community reflects a regional longitudinal tendency tinged by local factors.



PRESENTATION

## Session 2 (Nipah)

Monday, November 12 — 13:00

### Does Sundarbans Mangrove Support Growing Mud Crab Farming Industry In Bangladesh Coast?

**HOQ MDE**, Islam MDL, Mahmud Y  
Research Management Division  
Bangladesh Fisheries Research Institute  
Mymensingh 2201  
Bangladesh  
Email: hoq\_me@yahoo.com, hoqmenoman@gmail.com

Mud crab (*Scylla* spp.) occur abundantly in the estuaries, Sundarbans mangrove water, and coastal ghers of Bangladesh, and can be identified as a significant fisheries product for its contribution in export earnings of the country. While more than 0.30 million people are involved in the crab fishery in and around the Sundarbans, a significant portion adopt crab fishing and fattening as their livelihood. Crab larvae are most numerous, making up to 25.6% of the total shellfish larval abundance in Sundarbans water. High demand triggered the crab fishers to harvest all size groups of mud crab for trade and culture. The catch per



unit effort of artisanal capture fisheries in Sundarbans indicated higher availability of crab seed in the lower Sundarbans. On the other hand, present mud crab aquaculture on the Bangladesh coast is solely dependent on wild seed collection. The uncontrolled fishing of undersized crabs for fattening has led to recruitment overfishing in the Sundarbans. We succeeded on mud crab breeding since 2014, although the survival rate of mud crab larvae in hatchery conditions was low (0.87%–1.05%). To support the mud crab population in the Sundarbans, protection of their primary habitat is crucial and regular monitoring of stocks is needed to guard against their overfishing. In this context, size-specific fattening practices may lead to precise production of

crabs even in the reduction of cost of fattening. Moreover, an ecosystem-based management approach may also be applied, through which part of the crab population can be conserved by maintaining closed seasons or protected areas during breeding season in the Sundarbans.

## Session 2 (Nipah)

Monday, November 12 — 13:20

### Nekton Assemblages in Mangroves-Seagrass-Coral Reefs Disturbed by Bleaching Event: The Role of Interconnected Coastal Ecosystems in Post-Disturbance Recovery

**SALMO SG III**, Altomonte JC

3F Manila Observatory Bldg.  
Ateneo de Manila University  
Loyola Heights, Quezon City  
1108 Philippines  
Email: ssalmo@ateneo.edu

The occurrence of coral bleaching affects the ecosystem health of coral reefs and reduces the habitat for reef-dependent fishes. These reef fishes will have to find habitat for food and shelter, but may be constrained if a suitable habitat is absent or far from the bleached corals. While the effects of bleaching event on coral reefs are relatively well studied, reports on the impacts of such disturbance on reef-dependent fauna, including its movements to other habitats, are rare. In this study, the changes in nekton assemblages (composed of fishes, crabs, and shrimps) in coral reefs that were disturbed by a bleaching event (in June 2016) were evaluated. The study was conducted in relatively undisturbed coast in Busuanga, Calamianes Island, Palawan, Philippines with coral reefs, seagrass meadows, and mangroves forests that are located adjacent to each other (<500 m distance between habitats). Using a triangular trap net (2 m height; area = 12.5 m<sup>2</sup>), nekton samples were collected before, during, and after spring tide at 1-mo pre-bleaching and at 1-mo, 4-mo and 7-mo post-bleaching. The nekton assemblages were evaluated and compared between and among habitats across time. Results showed 80 % reduction in nekton diversity, density, and biomass in coral reefs, but a sudden increase in mangroves. The species composition was changed and the dominant species shifted in both coral reefs and mangroves, but not in seagrass. Such changes persist until 4-month post-bleaching, but appeared to return to pre-bleaching level at 7-month post-bleaching, indicating a possible recovery.



## Session 2 (Nipah)

Monday, November 12 — 13:40

### Community Composition and Diversity of Phytoplankton in Relation to Environmental Variables and Seasonality in a Tropical Mangrove Estuary, Malaysia

**ABU HENA MK**, Saifullah ASM, Idris MH, Rajaee AH, Rahman MM

UPM Campus Bintulu

Faculty of Agriculture and Food Sciences

Universiti Putra Malaysia Campus Bintulu Sarawak

97008 Bintulu, Sarawak

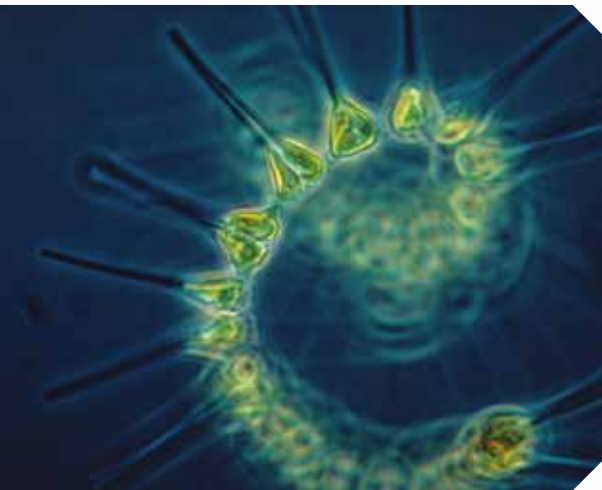
Malaysia

Email: hena71@yahoo.com

Phytoplankton are the base of aquatic food chain from which the energy is transferred to higher organisms. The community and abundance of phytoplankton in a tropical mangrove estuary were examined in Sarawak. Monthly-collected data from January 2013 to December 2013 was pooled into seasons to examine the influence of seasonality. The estuary was

relatively species-rich and a total of 102 species under 43 genera were recorded, comprising: 6 species of Cyanophyceae; 4 species of Chlorophyceae; 63 species of Bacillariophyceae; and 29 species of Dinophyceae. The mean abundance (cells L<sup>-1</sup>) of phytoplankton was found in an order of Bacillariophyceae > Dinophyceae > Cyanophyceae > Chlorophyceae. Mean abundance of phytoplankton ranged from 5694 to 88,890 cells L<sup>-1</sup> over the study period, with a higher value in the dry season. Species recorded from the estuary were dominated by *Pleurosigma normanii*, *Coscinodiscus sp.*, *Coscinodiscus centralis*, *Coscinodiscus granii*, *Dinophysis caudata*, *Ceratium carriense*, *Ceratium fusus*, and *Ceratium lineatum*. Abundance of phytoplankton is positively

influenced by chlorophyll a ( $r = 0.69$ ), ammonium ( $r = 0.64$ ), and silica ( $r = 0.64$ ). Significant differences (ANOSIM and nMDS) were observed in the species community structure between intermediate and wet season. The species assemblages were positively correlated with surface water temperature, salinity, pH, ammonium, and nitrate in the intermediate and dry season toward larger species composition in the respective seasons, whereas silica influenced on the species assemblage in the wet season. The findings suggest that the mangrove estuary in Sarawak is productive in terms of the diversified fishery resources like phytoplankton, which are influenced by the hydrobiological factors.



PRESENTATION

## Session 2 (Nipah)

Monday, November 12 — 14:00

### The Mud Crab Fishery of the South-Western Mangrove of Bangladesh: Biological Traits to Manage the Resources to Ensure Continuous Livelihood

#### ISLAM MS

Department of Fisheries & Marine Bioscience  
Jessore University of Science & Technology, Jessore-7408  
Bangladesh  
Email: [tuhinkk@yahoo.com](mailto:tuhinkk@yahoo.com)

This study describes the present status of engagement of coastal communities to the mud crab fishery, its economical values, and the biological traits, such as size-class distribution, size at maturity, breeding periodicity, etc., to propose a suitable management guideline to secure vulnerable coastal livelihoods. The disease outbreak in shrimp farming and recent catastrophic disasters have changed the coastal habitat and the livelihood patterns. Mud crab is now one of the leading fisheries and ranked third among exported fishery commodities of Bangladesh. The country earns about US\$45 million by exporting about 10,000 tons of live mud crab each year. There are about 300,000 people directly and indirectly connected with mud crab farming activities.

Among the exported crabs, 60% is coming from the mangrove forest of the Sundarbans. The deceptive declines in abundance, total catch, and size from the study area and hence biological traits of female mud crab were investigated to determine the population status in the region. Sampled individuals were mostly under the size-class 80–90 mm internal carapace width (ICW), and very small number of individuals were >100 mm ICW. Most individuals were mature (>70%) as determined by their ovarian stages. Earlier maturation was noticed in the area, with 50% of the specimens reaching maturity at the size range of 75–78 mm ICW. Though the species breeds round the year, the peak breeding period occurred during winter. A size and season restriction could be imposed to manage the resources and hence to ensure continuous or better livelihoods.





PRESENTATION

## Session 2 (Nipah)

Monday, November 12 — 14:20

### Fisheries and Aquaculture Adaptation to Climate Change in Coastal Areas of Bangladesh

**RAHMAN MA,** Parvez MS, Lee S-G, Billah MM, Molla MHR

Pukyong National University  
World Fisheries University Pilot Programme  
Pukyong National University (PKNU)  
45 Yongso-ro, Nam-gu  
Busan 48513, South Korea  
E-mail: aminur1963@gmail.com, aminur2017@pknu.ac.kr

The impacts of climate change, owing to their potentially vast reach and scale, embody a critical challenge for fisheries and aquaculture, and the livelihood of many coastal countries, including Bangladesh, most specifically the fishing communities living close to these resources. The fisheries and aquaculture sector in the coastal areas of Bangladesh is subjugated by export-oriented saltwater shrimp and freshwater prawn farming. However,

different variables, including drought, cyclone, flood, salinity, rainfall, sea level rise, and sea surface temperature, have profound antagonistic effects on shrimp and prawn production. Fishery resources are also highly sensitive to variations in climate-forcing biophysical processes, such as ocean currents, river flows and lake-level fluctuations, and related changes in ocean, coastal, and floodplain productivity. With such a high exposure to climate-related risks, adaptation to climate change is becoming a key concern for fisheries organizations. Although fisheries have always had to cope with variable production and unpredictable changes in weather, future climate change will bring shifts in climatic means and in the frequency and severity of extreme events that are beyond the coping capacity of even the more flexible, adapted fishery systems. Considering vulnerability in fishery production systems to the effects of climate change on coastal

aquaculture, it is still worth investing in building the capacity of fishery production systems to adapt to future climate change scenarios. The main reason is that most options for building adaptive capacity are also required to manage fish stocks effectively and to reduce the poverty and vulnerability of fishing-dependent people to a greater extent.



PRESENTATION

## Session 2 (Nipah)

Monday, November 12 — 14:40

### Functional Structure of the Mangrove Fish Community in the American Continent

**PAYÁN-ALCACIO JA**, Moncayo-Estrada R, De la Cruz-Agüero J,  
De la Cruz-Agüero G  
IPN-CICIMAR  
Departamento de Pesquerías y Biología Marina  
Mexico  
Email: japayanalcacio@gmail.com

Because mangroves have similar environmental functions that fish exploit around the world (feeding, reproduction, and refuge sites), we believe that taxonomic and functional structure of each fish community should have similarities at different sites. Through the analysis of scientific publications, we evaluated the genus composition of fish and their relationship with biotic and environmental variables (average rainfall, type of substrate, mangrove species present, and freshwater contributions). Relationships were identified using multivariate techniques (canonical correlations and hierarchical grouping). Thus far, we have identified 334 species in 175 genera and 67 families in the Atlantic Ocean (15 locations) and 192 species in 107 genera and 49 families in Pacific Ocean (15 localities). Globally, the most diverse families were Cichlidae and Gobiidae (10 genera each); in the Atlantic Ocean, Scianidae (8); and in the Pacific ocean, Ariidae and Carangidae (6 genera each). Results so far have identified similar groups according to the ecoregions and provinces proposed in the continent by Spalding: the Gulf of California region with antiestuarine mangrove conditions; the Gulf of Mexico region given the richness of mangrove species and fish genera related to soft substrates; the Brazilian region defined by the endemisms of the Amazon River; the Region of Islands with fish genera related to reef substrates; and the Mexico-Panamic region. No similarity was found in the taxonomic community structure, rather the assemblages were related to local characteristics. However, it is expected that functional diversity analysis might be more sensitive to create a new regionalization proposals based on the performance of the species in the environment.



## Session 3 (Bakau Minyak)

Monday, November 12 — 15:20

### Trophic Behavior of Juvenile Reef Fishes Inhabiting a Tropical Mangrove–Seagrass Continuum Along a Shallow-Water Coastal Lagoon

LE QD, Siau YF, Tanaka K, Suratman S, Sano Y, Shirai K

Institute of Oceanography and Environment  
Universiti Malaysia Terengganu, T145, 21300  
Malaysia  
Email: lqdungimer@gmail.com

We conducted stable isotope ( $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$ ) and gut content analyses to elucidate the size-related feeding habits of reef-associated juvenile fish species (*Lethrinus lentjan*, *Lutjanus russellii*, and *Epinephelus coioides*) in habitats at different distances along a mangrove–seagrass continuum in Setiu Lagoon, Malaysia. Gut content analysis showed that although the fish preyed on a broad range of food items, they mainly ingested benthic invertebrates (penaeid shrimps, crabs, and polychaetes) and some other fish (juveniles). Stable isotope

analyses showed a significant difference in potential prey items between seagrasses and mangroves, indicating that this type of analysis is useful to trace fish foraging habitats and behaviors. The juvenile fish relied mainly on seagrass food sources; however, increasing proportions of mangrove or fish prey sources were observed in large juvenile fish, particularly *L. lentjan* and *E. coioides*. Spatial distance from mangroves to adjacent seagrasses and hydrologic features may be major factors profoundly influencing size-related feeding behaviors and strategies in these fish species. The large juvenile species, *L. lentjan* and *E. coioides*, foraged broadly in interlinked seagrasses and nearby mangroves during flood tides from the central lagoon, whereas all juvenile fish preyed primarily in seagrasses near the lagoon inlet, implying prey–predator trade-off and dietary flexibility. These findings suggest the importance of targeted fishery restoration efforts to protect

interconnected habitat mosaics as critical nursery habitats for commercial reef fish during their juvenile periods in Setiu Lagoon.



## Session 3 (Bakau Minyak)

Monday, November 12 — 15:40

### Spatiotemporal Variation in Diet Composition of the Freshwater Mudskipper *Periophthalmodon septemradiatus* (Hamilton, 1822) at Different Fish Sizes

**DINH QM**, Tran LT, Tran TTM, To DK, Nguyen TTK

Can Tho University  
3/2 Street, Xuan Khanh Ward  
Ninh Kieu District  
Can Tho 900000  
Vietnam  
Email: dmquang@ctu.edu.vn

*Periophthalmodon septemradiatus* is an amphibious fish and widely distributed in Asian regions. Unlike other mudskippers, this species can live from estuary to upstream in Mekong Delta river systems. This mudskipper population has recently decreased because of urbanization and environmental pollution; however, the existing knowledge of biological characteristics of this species is not sufficient to build efficient conservation strategies. This study contributed to the knowledge of diet and feeding ecology of this species based on investigation on a collection of 1360 individuals' stomach contents in Hau River flowing across several provinces in the south of Vietnam. Specimens were monthly collected by



fishing rods at the mudflat in tributaries of Hau River from August 2017 to July 2018. Data analysis showed that this mudskipper is a carnivorous fish and displayed a high trophic level of 3.01 (SE 0.39). Six food item categories consisting of small fishes, *Acetes* spp., *Uca* spp., mollusks, *Dolichoderus* sp., and detritus were found in stomach content. Costello graphical analysis indicated that the species was a generalist feeder. Both males and females at different sizes, seasons, and sites ingested primarily *Dolichoderus* sp., secondarily detritus, and rarely other preys. The diet composition did not vary in gender, but in fish size, season, and site. *Uca* spp., *Dolichoderus* sp., and detritus contributed to intraspecific and seasonal variation of diet composition. The spatial variation of food composition was regulated by *Dolichoderus* sp. and detritus. These findings contribute to the understanding of fish adaption and building an appropriate fish conservation and management strategy.

## Session 3 (Bakau Minyak)

Monday, November 12 — 16:00

### Feeding Habits of Five Dominant Fish Species from Matang Mangrove Estuaries, Malaysia, Based on Stomach Content and Stable Isotope Analyses

**MOHD AZIM MK**, Amin Smn, Mazumder D, Arshad A, Yusoff FM

Department of Aquaculture, Faculty of Agriculture

Universiti Putra Malaysia

43400 Serdang, Selangor

Malaysia

Email: smnabd@gmail.com

Feeding habits of five dominant fish species (*Thryssa hamiltonii*, *Ambassis nalua*, *Escualosa thoracata*, *Stolephorus tri*, and *Johnius belangerii*) were investigated in the Matang Mangrove ecosystem, Perak in dry (May to September 2015) and wet (November 2015 to February 2016) seasons. Two sampling stations were selected namely St 1 (Undisturbed, Sungai Tiram Laut) and St 2 (Disturbed, Sungai Sepetang). Fish samples were collected by push net. Stomach contents of fish species comprised of phytoplankton, algae and plant leaves, zooplankton, fish and crustacean parts, debris, and unidentified fish parts. According to the simple resultant index (%Rs), plant (phytoplankton, algae and plant leave) and animal (zooplankton, unidentified fish parts, fish and crustacean parts) based diets contained

51.01% and 38.24% for *T. hamiltoni*, 50.35% and 37.99% for *A. nalua*, 42.09% and 44.4% for *E. thorakata*, 38.17% and 46.55% for *S. tri*, 25.35% and 58.86 for *J. belangerri*.

Therefore, all observed five fish species can be considered as omnivorous. There was a significant variation of different diets wet and dry seasons for the five fish species.

Stable  $\delta^{15}\text{N}$  values (except *Johnius belangerii*) were enriched for four species. Stable  $\delta^{13}\text{C}$  values indicate no significant changes between dry and wet for dietary carbon.

It is probably that, in dry conditions, these four species accessed higher trophic order

fish than in wet conditions, an indication of higher predation and competition. Therefore, we conclude that disturbed mangrove areas and seasons might have significant effects on diet contents of dominant fish species in the Matang Mangrove estuaries.



## Session 3 (Bakau Minyak)

Monday, November 12 — 16:20

### Spatial Segregation and Diet of Gerreidae in a Tropical Coastal Ecosystem

Araújo IMS, Barreto TMS, Brainer M, Lira AL, **SEVERI W**  
 Laboratório de Ictiologia, Departamento de Pesca e Aquicultura  
 Universidade Federal Rural de Pernambuco  
 Rua Dom Manoel de Medeiros - s/n, Dois Irmãos, Recife, PE  
 CEP 52171-900  
 Brazil  
 Email: wseveri@gmail.com

Gerreidae are abundant fishes in coastal tropical and subtropical areas around the world. The present study analyzed the distribution and abundance of gerreids between different coastal environments and evaluated the diet of the most abundant species as a proxy for their distribution. Samples were taken through beach seine trawls in a coastal area located in northeastern Brazil between March 2012 and February 2013. A total of 5078 individuals were collected from eight species: *Ulaema lefroyi* (3511), *Eucinostomus argenteus* (902), *E. melanopterus* (425), *E. gula* (80), *E. havana* (61), *Diapterus auratus* (45), *Eugerres brasilianus* (30), and *D. rhombeus* (24). The most important items were Copepoda Calanoida for *U. lefroyi*, Decapoda for *E. melanopterus*, and Polychaeta for *E. argenteus*. These results seem to be related to species size, as larger-sized *E. argenteus* ingested larger preys, and larger individuals of all species ingested polychaetes. Species distribution and abundance or food items did not clearly correlate with environmental variables, their distribution between environments being directly related to food availability. The abundance of individuals within the estuary reflected species food preference, since the most abundant places were those where species presented the most diversified diet. The strategy of competition and exploitation of available resources in each environment can justify diet variations among habitats. All studied species presented diet ontogenetic variation, with larger individuals consuming mainly polychaetes. The gerreids studied here segregated spatially in relation to the volume of preys ingested, and differences in food preference can be a strategy for their coexistence between the environments.



## Session 3 (Bakau Minyak)

Monday, November 12 — 16:40

### Stable Isotopes Track Macrobenthic Food Web Changes in a Chronosequence of Replanted Tropical Mangrove Stands

**THEN AY-H**, Adame MF, Fry B, Chong V-C, Zakaria RM, Lee SY

Institute of Biological Sciences

University of Malaya

Kuala Lumpur

Malaysia, 50603

Email: amy\_then@um.edu.my

Assessment of mangrove replanting success remains an important but understudied area of research, especially from a faunal standpoint. Stable isotopes have conventionally been used as tracers of organic carbon in mangrove food webs, but little work has been done to apply this technique to assess native faunal food web changes in replanted mangrove forests. We used stable isotope (C, H, N) analyses to assess changes in macrobenthic invertebrate food web in a chronosequence (0, 4, 15, 30, 40 yrs after planting, and 70+ year-old virgin forest)

of mangrove stands in the tropical Matang Mangrove Forest Reserve, Peninsular Malaysia. By comparing isotopic measurements relative to the virgin reserve as reference site, our study showed distinct benthic food web differences between young (ages 0 to 5 post replanting) and older forest stands (15 yrs and older). The isotopic shift can be attributed to shift in contribution of primary producers from benthic microalgae in the younger forests to mangrove sources in the intermediate and mature forests. Crabs and gastropods appeared to be useful benthic faunal indicators for mangrove forest recovery. Stable isotope measurements are shown to be useful indicators of mangrove-associated faunal food web functioning to track success of mangrove recovery.



## Session 3 (Bakau Minyak)

Monday, November 12 — 17:00

### Patterns of Infestation of the Epizoic Barnacle, *Octolasmis angulata*, on the Swimming Crab, *Portunus pelagicus*, from Thale Sap Songkhla and Adjacent Coastal Area, South Thailand

**LHEKNIM V**, Leelawathanagoon P, Thanakorn N  
 Department of Biology, Prince of Songkla University  
 15 Karnjanavanich Road  
 PO Box 3 Ko Hong  
 Songkhla 90112  
 Thailand  
 Email: vachira.l@psu.ac.th

Thale Sap Songkhla is the southern end of the Songkhla Lagoon system, a large shallow water body located on the east coast of southern Thailand and connected to the Gulf of Thailand, salinity ranges from 0 to 34. The shores of the Songkhla Lagoon system comprise a mixture of urban areas, fishing villages, shrimp ponds, and mangrove forests. One hundred specimens of the swimming crab, *Portunus pelagicus*, from Thale Sap Songkhla and an adjacent coastal area were examined for epizoic barnacles in the branchial chambers and their carapaces. *Octolasmis angulata* was the dominant epizoic barnacle in both areas. Of the 50 crabs examined from each area, around 50% and nearly 100% of the specimens from Thale Sap Songkhla and coastal samples were infested with *O. angulata*, respectively. The prevalence of *O. angulata* infestation for coastal trawls was significantly higher than that for Thale Sap Songkhla. There was no significant difference in infection rate between male and female crabs. There was a significant positive correlation between the carapace width of *P. pelagicus* and *O. angulata* density for coastal trawl samples, while no correlation was observed in those from Thale Sap Songkhla. *Octolasmis angulata* was predominately attached on the proximal and medial positions of the hypobranchial side of the gill of *P. pelagicus*. Variations in prevalent rate of *O. angulata* on *P. pelagicus* from Thale Sap Songkhla and an adjacent coastal area were possibly due to the differential salinities of the two sampled habitats and associated behavior of the crabs.





# Keynote Address

Tuesday, November 13 — 9:20

## Replanted Mangroves – Biodiversity and Livelihoods Generators?

### HARINDER RAI SINGH

Biology Department  
Faculty of Applied Sciences  
Universiti Teknologi Mara  
40450 Shah Alam  
Malaysia  
Email: harinderrai.singh@gmail.com



Mangrove forests cover approximately 81,500 km<sup>2</sup> across the tropics and subtropics, and provide myriad ecosystem services (raw materials and food, coastal protection, erosion control, water purification, fisheries maintenance, carbon sequestration, tourism and recreation, education and research) to human communities. Notwithstanding these benefits, there is much mangrove loss globally due to anthropogenic stressors, primarily conversion to large scale agriculture and aquaculture, wood extraction, infrastructure development, pollution, and small scale subsistence use. The 2004 tsunami jolted countries bordering not only the Indian Ocean, but also the Pacific Rim, and brought about revitalized or speed mangrove replanting and rehabilitation programs. Malaysia embarked on its mangrove replanting programs in 2005 and from 2005 to 2016, 5,962,493 mangrove trees (*Rhizophora apiculata* and *R. mucronata*) were replanted covering an area approximately 2,104 hectares. From 2000 to 2012, however, the country lost 15,809 hectares (2.83%) of mangroves mostly to oil palm, aquaculture, urban development, and other categories. There is much literature on the biodiversity and functions of natural mangrove forests that comprises diverse tree species, but the contribution of replanted mangroves, which are mostly monospecific stands toward enhancing biodiversity and livelihoods, needs elaboration and consolidation. Here I attempt to quantify some aspects of the biodiversity (for example fish, crustacean, and molluscs) and livelihoods enhancement from replanted and rehabilitated mangroves through global literature surveys, as well as cite some studies that have been conducted in Malaysia.

### Biography

Mangrove forests are important not only for coastal erosion prevention, carbon sequestration, and nutrient filtering, but also as habitats for coastal fauna and flora. Harinder's research interests focus on anthropogenic disturbances as it relates to mangroves and their macrobenthic communities, as well as mangrove restoration and replanting and their effects on faunal recruitment. He is interested in the age at which mangroves, especially those that have been restored or replanted, become significant habitats for fishes and macrobenthos. As mangrove forests grow, there is an increase in secondary producer abundance, which serves as contribution to the diets of resident and migratory fishes, and this in the long term affects the livelihoods of coastal inhabitants. Harinder is also actively involved in research related to marine & coastal habitat connectivity and biodiversity management.

Harinder received his PhD from the University of Malaya and currently holds the position of a Senior Lecturer at Universiti Teknologi MARA in Malaysia.

## Session 4 (Bakau Pasir)

**Tuesday, November 13 — 10:20**

### **Do Restored Mangroves Function Similar to Intact Ones? Carbon Storage, Sedimentation, and More!**

**MACKENZIE RA**, Sharma S, Blate G, Resanond A, Tulyasuwan N, Tieng T, Wachirapunyanont R, Nam VN, Sasmito SD, Murdiyarso D, Purbopuspito J, Castillo A, Ranes L, Salvatierra B, Bandibas M, Bhomia R

USDA Forest Service  
60 Nowelo St., Hilo, HI  
USA

Email: [rmackenzie@fs.fed.us](mailto:rmackenzie@fs.fed.us)

Mangrove forests are being rapidly degraded as demand for economic development grows. In recognition of the multiple benefits of mangrove forests, rehabilitation of degraded and deforested forests is being carried out in many regions through the creation of mono-specific mangrove plantations. While many of these plantations fail, it remains to be determined if successful plantations are effective at providing similar levels of ecosystem services as intact mangrove forests. This study used the SWAMP protocol to assess the potential for different aged restored and intact mangrove forests in Asia to remove and store carbon. Ecosystem carbon stock (ECS) data were collected from India (5 yrs), Philippines (5, 10, and 25 yrs), Cambodia (17 yrs) and Vietnam (35 yrs), which increased with age from 102, 537, 695, 617, 923, to 867 Mg C ha<sup>-1</sup>, respectively. Results suggest that it takes approximately 25 yrs for aboveground C of mangrove plantation to be equivalent to intact mangrove forests; belowground C stocks appear to be equivalent after 10 years. While conservation of intact mangroves is the most effective way to protect ecosystem services, it appears that mangrove plantations may be effective at storing similar levels of C over time. Additional research is needed to compare other ecosystem services of planted and intact mangroves.



## Session 4 (Bakau Pasir)

**Tuesday, November 13 – 10:40**

### **The Causes and Consequences of Mangrove Habitat Loss in Peninsular Malaysia**

**ALDRIE AA**, Khirotdin RPK, Helfer V, Zimmer M  
Institute for Environment & Development (LESTARI)  
Universiti Kebangsaan Malaysia  
43600 Bangi, Selangor  
Malaysia  
Email: [aldrie@ukm.edu.my](mailto:aldrie@ukm.edu.my)

As Malaysia progresses to become a high-income economy, human development continues to grow at the expense of natural resources and the environment. Mangroves are one particular down-stream habitat, especially in Malaysia and in the southeast Asia region, to bear witness and to have suffered first-hand impacts of land-use change for socioeconomic development. Due to various reasons, mangrove area has dwindled significantly, especially in the final quarter of the past century, related to the period when the country's growth was

most rapid. This presentation showcases significant spatiotemporal changes in iconic mangrove habitats of Peninsular Malaysia. This study quantifies the extent and explains the causes of these changes, and describes how these changes actually correspond to local, national, and regional development since Malaysia's independence until present day. This study critically discusses the implications of mangrove loss on their connectivity with the adjacent habitats, namely: (A) mudflats; (B) seagrass beds; (C) coral reefs; (D) islands, bays, and lagoons; (E) rivers, estuaries, and deltas; and (F) inland hinterland.



## Session 4 (Bakau Pasir)

**Tuesday, November 13 — 11:00**

### **Reversing the Damage to Mangrove Wetlands to Restore Fish Habitat – A Global Perspective**

#### **QUARTO A**

Mangrove Action Project  
PO Box 1854  
Port Angeles, WA 98362-0279  
USA  
Email: mangroveap@olympus.net

Mangroves are the rain forests by the sea, fringing large stretches of subtropical and tropical coastlines. Now, less than 15 million ha remain—less than half the original area. Today there is growing urgency to recognize the importance of conserving and restoring protective mangrove greenbelts to lessen dangers from future catastrophes, because as oceans warm and sea levels rise, so will the frequency and intensity of hurricanes and storm surges. Mangroves can buffer against the fury of such destructive storms and waves, protecting those settlements located behind a healthy mangrove fringe. Because nearly half of humankind today lives along the now vulnerable coasts and many industries, such as aquaculture, are situated along these same coasts, climate change and consequent sea level rise cannot be ignored. Shrimp aquaculture, which plays a significant role in the so-called “Blue Revolution” is one of the greatest threats to mangroves. With the threat of climate change looming over our planet, the ongoing clearing of mangroves for shrimp farm production, or for other reasons, must now be perceived in an entirely new light. Here I also discuss the great need to involve local communities to equitably participate in this “blue revolution,” where it is important to adapt small-scale aquaculture to address local food security issues in “Developing Nations,” while bringing into clearer focus environmental implications of industrial aquaculture, with particular reference to loss of marine habitat, such as mangroves and related wetlands that play vital roles in wild fisheries, combating climate change, and related sea level rise.



## Session 4 (Bakau Pasir)

**Tuesday, November 13 — 11:20**

### **Disturbance and Recovery in a Highly Dynamic Mangrove Fish Community**

**D'ALESSANDRO EK**

University of Miami, RSMAS  
4600 Rickenbacker Causeway  
Miami, Florida 33149  
USA  
Email: edalessa@rsmas.miami.edu

Mangrove shoreline habitats are inherently variable by nature, blurring the line between terrestrial and aquatic systems. This is especially true in subtropical south Florida, where mangroves often exist at the interface between fresh and salt water, and urban development and open water. Many fish species occupying these mangrove habitats are well adapted to the inherent variability in both physical and biological factors, with many able to tolerate wide ranges in salinity, temperature, dissolved O<sub>2</sub> etc. What is much less understood is how

these fish assemblages and their component taxa respond to major disturbances, either natural or human induced, that cause conditions well outside the normal range of variability. Using data gathered as part of a long-term mangrove-fish survey (i.e., >15 consecutive years), I examined for mangrove fish assemblage responses to several different major disturbances, including hurricanes, algal blooms, anomalous temperature and salinity events, and golden tides. For some of these disturbances, assemblage- and species-specific recovery rates are estimated. Given that the frequency and intensity of disturbances are projected to increase as the planet warms, knowledge of the response

of fish communities is important for effective conservation and management of habitats, especially those that serve as important nursery and feeding grounds.



## Session 4 (Bakau Pasir)

**Tuesday, November 13 – 11:40**

### Blue Carbon Stocks of Pristine and Restored Mangroves in Asian Countries

**SHARMA S**, Mackenzie RA, Kangkuso A, Bhomia RK, Tieng T, Litton CM, Castilo JA, Bandibas M

Institute of Ocean and Earth Sciences  
C308, Institute of Postgraduates Studies Building  
University of Malaya  
50603 Kuala Lumpur  
Malaysia  
Email: ssharma@um.edu.my

“Blue carbon” refers to carbon sequestered in vegetated coastal ecosystems, especially mangrove forests, seagrass beds, and salt marshes. Rapid degradation of mangrove forests had reduced the capacity of blue carbon sinks to remove carbon from the atmosphere. Such loss of mangroves makes coastal communities more vulnerable to erosion and reduces overall resilience. In Southeast Asian countries, ecosystem-based coastal defenses by restoration and protection of mangroves is an accepted option to increase coastal resilience and provide livelihood avenues for coastal communities. However, it is unclear how restored mangroves function as a blue carbon reservoir in comparison to pristine mangrove forests. Our study used the SWAMP (Sustainable Wetland Adaptation Mitigation Program) protocol to assess the blue carbon sequestration potential of pristine and restored mangrove forests in Asia (Cambodia, Thailand, Vietnam, Indonesia, India). Blue carbon stocks in pristine mangroves ranged from 650 to 997 Mg C ha<sup>-1</sup>. Blue carbon stocks in restored mangroves from India (5 yrs), Philippines (5, 10, and 25 yrs), Cambodia (17 yrs), and Vietnam (35 yrs) have 102, 537, 695, 617, 923, and 867 Mg C ha<sup>-1</sup>, respectively. Earlier reported ecosystem carbon stock for Indo-pacific region were 1023 Mg C ha<sup>-1</sup>. Results suggest that blue carbon stocks in restored mangroves increased with age, and can help in climate change mitigation. Economically, conservation of intact mangroves is more effective rather than restoration of degraded mangroves. Such outcomes may contribute to determine strategies, scenarios, and mechanisms that will reduce CO<sub>2</sub> emissions and improve the health of coastal ecosystems through regional actions.



## Session 5 (Pedada)

**Tuesday, November 13 – 13:00**

### **Do Novel, Non-Native Mangrove Ecosystems Provide Fish Habitat In Hawai'i?**

**CARSTENN SM**, Goecke-Marcoux S, Mallette S

Hawaii Pacific University  
41-020 Kaulu Street  
Waimanalo, Hawaii 96795  
USA  
Email: scarstenn@hpu.edu

*Rhizophora mangle* (red mangrove) was introduced to Hawai'i in 1907 and subsequently resulted in novel ecosystems along Hawai'i's low energy coastlines. Mangroves provide fish habitat and receive protection globally. In Hawai'i, where mangroves are non-native, mangroves are believed to diminish rather than enhance fish habitat resulting in mangrove removal projects. Phase 1 of our study of stream mouth estuary (SME) fish communities found a positive correlation between abundance of *Kuhlia xenura* and *Mugil cephalus*

and percent mangrove cover, particularly for juveniles. Phase 2 addressed changes in fish community structure associated with mangrove removal projects in He'eia National Estuarine Research Reserve (NERR). Differences in fish abundance and length were noted, but it was not clear if changes were a function of mangrove removal or seasonal variation. The third phase assessed temporal variation in the He'eia NERR fish community and reaffirmed species abundance did not differ among seasons, but length of the three most-abundant species (*M. cephalus*, *Valamugil engeli*, *K. xenura*) did. Phase 2 and 3 studies were somewhat compromised by inadequate quantification of mangrove cover during sampling as a result of three ongoing mangrove removal projects. The final phase of this study, a meta-analysis, used historical and

current images of He'eia NERR to estimate extent of mangrove cover on each sampling date. Mangrove cover was added to a non-metric multidimensional scaling analysis using all data collected during the three studies. No evidence was found supporting a negative impact of mangroves on fish habitat.



## Session 5 (Pedada)

**Tuesday, November 13 – 13:20**

### **The Delineation of Marine Protected Areas: Perspectives from Comparative Phylogeography of Mangrove Trees**

#### **WEE AKS**

College of Forestry, Guangxi University  
No. 100 Daxuedonglu  
530005 Nanning Guangxi  
P.R. China  
Email: alisonwks@gxu.edu.cn

The establishment of marine protected areas (MPAs) is a common policy tool to conserve fisheries species and their habitat at a global scale. However, challenges associated with estimating the dispersal of pelagic fishes and their larvae reduce our ability to provide biological justification for the delineation of MPAs. Here, I propose using the phylogeography of mangrove trees to facilitate the detection of barriers to connectivity in coastal fauna that are strongly associated with the mangrove habitat. Since mangrove trees have propagules that are also passively dispersed by sea, phylogeographic data provide important insights on the biogeographic barriers and dispersal patterns under the influence of prevailing ocean currents. Phylogeography data from more than 20 studies on mangrove trees in both the Atlantic-East Pacific and the Indo-West Pacific regions revealed genetic breaks across several well-known biogeographic barriers, suggesting the universality of physical factors in dictating the dispersal and population structure of coastal and marine species. However, the detection of several cryptic oceanic barriers indicated that ocean circulation patterns could play a crucial role in restricting habitat connectivity. Ultimately, this demonstrates the practicality of using comparative phylogeography across taxa to achieve an ecologically meaningful delimitation of reserve networks.





## Session 5 (Pedada)

**Tuesday, November 13 – 13:40**

### **Lessons for Fisheries Management: Constructive Engagement between Government Agencies and Village Leadership Leads to Better Mangrove Management than Simply Focusing on Villager Participation**

**WODEHOUSE DCJ**, Rayment MB

School of Environment, Natural Resources and Geography

Bangor University

Thoday Building, Deiniol Road

Bangor, Wales LL57 2UW

United Kingdom

Email: [d.wodehouse@bangor.ac.uk](mailto:d.wodehouse@bangor.ac.uk)

Despite near-universal awareness of the link between mangrove health and fisheries productivity, many villagers want to extract mangrove wood, e.g., for house repairs/charcoal production. Although mangroves are typically protected by national law, the government



agencies responsible for natural resources (NR), such as mangroves or fisheries, often have limited budgets, staff, capacity, and time to police overexploitation and inappropriate local management. Effective management therefore requires the negotiation of community rules governing extraction limits, patrols, credible sanctions, and their enforcement. This study examined villager participation in mangrove management/rule-making via 118 semi-structured interviews and many informal interviews with villagers and village leaders from eight mangrove villages across Thailand and the Philippines. 42% described fishing as their primary livelihood and 29% as a secondary occupation. Of the

general populace, 30% felt they could participate in rules development and 46% reported being invited to these meetings. However, village meetings were less participative than they appeared. Many villagers joined meetings primarily to collect incentives offered. Three-quarters of all villagers understood that the rules came initially from the government. Only 13% of villagers believed the debates were genuine and in good faith, and villagers who disagreed rarely said anything due to a lack of confidence, not wanting to identify as mangrove cutters and not wishing to publicly disagree with their social “betters.” We recommend that village leaders collect public opinion in specific, small, or one-to-one meetings. NR agencies should facilitate the establishment and capacity strengthening of leadership.

## Session 5 (Pedada)

**Tuesday, November 13 – 14:00**

### **Integrative and Ethnographic Methods for Understanding the Ecology of Fishing Decisions and Feedback in Mangrove Social-Ecological Systems**

**BEITL CM**, Leslie HM, Rahimzadeh-Bajgiran P

University of Maine  
5773 S. Stevens Hall  
University of Maine  
Orono, ME 04469  
USA

Email: [christine.beitl@maine.edu](mailto:christine.beitl@maine.edu)

Despite their role as critical habitat for diverse species of mollusks, crustaceans, and fish, coastal mangroves confront significant challenges of habitat destruction, harvesting pressures, and climate change uncertainty. Data on small-scale fisheries is often scarce, which necessitates the development of innovative methods and interdisciplinary research to generate knowledge about habitat-fishery linkages, fisheries productivity, and social-ecological system dynamics. Here we describe how cooperative research and ethnographic approaches can be used to gather data on fish species assemblages and catch rates. Ethnographic research provides fine-scale understanding of human-environment interactions. Cooperative research in fisheries is a collaborative methodology that integrates

fishers' knowledge with scientific knowledge to produce a more holistic understanding of the socioecological dimensions of fisheries. Cooperative research has been increasingly recognized in fisheries science as a tool to advance knowledge and inform policies that are most appropriate for the ecological and social context. This approach can produce new biological information about the species and improve communication and trust between fishers and regulatory institutions. Preliminary findings reveal implications for understanding strategies employed by fishers to target selected fish species in a fragmented habitat. We further discuss the ways in which integrative methods can be used to study how species distributions correspond with mangrove conditions and fragmented mangrove landscapes. We conclude with some recommendations and lessons to address data deficiencies in small-scale fisheries.



## Session 5 (Pedada)

**Tuesday, November 13 — 14:20**

### Peoples' Perception on Declining Fish Resources in Mangroves of Southeast Coast of India

**RAJENDRAN N**, Kathiresan K  
 Government Arts College  
 C. Mutlur  
 Chidambaram, Tamil Nadu  
 India  
 Email: rajkaniskaa@gmail.com

Mangroves support fish resources as nursery, feeding, and breeding grounds. Any loss in mangroves is likely to affect the fish resources. In this regard, it is crucial to understand peoples' perception on present status of the fish resources. Hence, a survey was made with 100 people actively involved in fishing in the mangrove waters of southeast coast of India. They are of the opinion that fish resources are declining due to five reasons in descending



order: (1) closure of estuarine mouth not freely allowing the fish migration for breeding (80%);(2) pollution of fish habitats with untreated aquaculture waste discharges (65%); (3) loss of vegetated coastal areas of mangroves, seaweed, and seagrass beds that serve as nursery ground for juveniles (35%);(4) shallow coastal environment as a result of sedimentation, especially after a tsunami (40%); and (5) reduced input of fresh water to coastal water bodies due to poor rainfall, and improper water management (50%). Even the most abundant species (*Scylla serrata* and *Penaeus monodon*) are significantly reduced in population. In contrast to the past, 17 fish species are now less frequently distributed in the

mangrove waters. Hence, continuous monitoring of fishes is a matter of necessity for better management of mangrove as fish habitats.



## Session 5 (Pedada)

**Tuesday, November 13 – 14:40**

### **Fishing Activities of Artisanal Fishers and their Socioeconomic Features in the Sundarbans Mangrove Forest of Bangladesh**

**RAHMAN MA**, Lee S-G, Parvez MS

World Fisheries University Pilot Programme

Pukyong National University (PKNU)

45 Yongso-ro, Nam-gu

Busan 48513

South Korea

E-mail: aminur1963@gmail.com, aminur2017@pknu.ac.kr

The Sundarbans is one of the largest mangrove forests of the world, located in the delta of rivers Padma, Brahmaputra, and Meghna on the Bay of Bengal. It has varied natural resources comprising of unique flora and fauna. However, this potential ecosystem is yet to be fully explored, assessed, managed and utilized in Bangladesh. In view of this, we investigated the socioeconomic features and fishing activities of the artisanal fishers in the mangrove forest of the Sundarbans. Despite the immense importance of mangroves to the livelihood of artisanal fishers in the Sundarbans, deforestation continues due to illegal logging and deterioration of habitat as a result of climate change, increased salinity, natural disasters, shrimp farming, etc. These natural and anthropogenic hazards are not only causing havoc to the mangrove biodiversity, but also depleting fishery resources, changes in fishers' key occupations, and affecting their livelihood status. The present investigation also elicited several risks to the livelihood of fishers, viz., the attack by dacoits, ransom, hostage, and attack by tigers, river, and coastal erosion, and natural disasters. Nevertheless, the artisanal fishers applied different strategies to cope with the changing situations by forming associations, violating the fisheries rules and regulations, migrating, distributing, sharing responsibilities with the household members, and transmitting local ecological, environmental, and conservational knowledge. This investigation revealed that there is an urgent need to upgrade the existing policies and management strategies toward the sustainable extraction and utilization of the mangrove resources for the livelihood improvement of artisanal fishermen in the Sundarbans.



PRESENTATION

## Session 6 (Berus)

**Tuesday, November 13 – 15:20**

### **Genetic Diversity of *Carcinoscorpius rotundicauda* in Peninsular Malaysia**

Fairuz-Fozi N, **SATYANARAYANA B**, Zauki NAM, Kaben AM, Muslim AM, Nelson BR, Ludwig Triest, Dahdouh-Guebas F  
Institute of Oceanography and Environment (INOS)  
Higher Institution Centre of Excellence (HICoE) in Marine Sciences  
Universiti Malaysia Terengganu - UMT  
21030 Kuala Terengganu  
Terengganu Darul Iman  
Malaysia  
Email: satyam2149@gmail.com

The mangrove horseshoe crab, *Carcinoscorpius rotundicauda*, has a restricted distribution throughout Asia. The present study analyzed its genetic diversity (CO1 sequencing) at Pahang (on the east), Perak (on the west), and Johor (in southern) states in Peninsular Malaysia. The freshly deposited eggs (6–8 nos.) and adult crab blood (0.5 ml) samples were



collected every month (Jan 2016–Jan 2017). Due to no observed nesting activity at Perak, only blood samples, from the crabs found as bycatch by local fishers, were considered. The isolated data were analyzed using GenBank® of the NCBI, and similarities were found with the DNA sequences of *C. rotundicauda* from India, Thailand, and Vietnam. From the phylogenetic tree of resemblance between samples, it was possible to distinguish two major clades separating West and East Malay Peninsula. While the West Malay Peninsula with Perak (Straits of Malacca) population has a lineage of Odisha (Bay of Bengal) and Phuket (Andaman Sea), the East Malay Peninsula with the Pahang (South China Sea) population has a lineage of Bac Lieu (South China Sea)

and Bang Pu (Gulf of Thailand). The southernmost Johor (Straits of Johor) population was found to be a subclade of the East Malay Peninsula and suggests a historical connectivity with the South China Sea, but separated from the direct influence. Overall, *C. rotundicauda* populations on the west and the east coasts of Peninsular Malaysia are distinctly separate for which local topography on the south (as land barrier) along with sea surface currents could be responsible.

PRESENTATION

## Session 6 (Berus)

**Tuesday, November 13 – 15:40**

### **Temporal and Spatial Distribution Patterns of Mysidacea, *Acetes*, and *Lucifer* In Songkhla Lagoon System, South Thailand**

**LHEKNIM V**, Yolanda R

Department of Biology, Prince of Songkla Universit  
15 Karnjanavanich Road  
PO Box 3 Ko Hong  
Songkhla 90112  
Thailand  
Email: vachira.l@psu.ac.th

The Songkhla Lagoon system is a large shallow water body located off the east coast of Thai's Peninsula in southern Thailand. The lagoon system comprises four distinct parts: Thale Noi, Thale Luang, Thale Sap, and Thale Sap Songkhla, and exhibits three water regimes with fringing mangroves: fresh, brackish, and salt water arranged from north to south, salinity ranges from 0 to 34, respectively, with the southern end connected to the Gulf of Thailand. We studied the variability in abundance of *Metapenaeus* spp. recruitment in Thale Sap Songkhla by using modified Riley Push Nets with 500 microns mesh size over the surface sediments of Thale Sap and Thale Sap Songkhla between June 2017 and May 2018. A lot of Mysidacea and small decapods crustacean were collected with juvenile prawns, and information of such organisms in the Songkhla Lagoon system is limited. This study found significant interactions between sampling sites and sampling trips in the abundance of Mysidacea, *Lucifer*, and *Acetes*. *Nanomysid siamensis* was the most dominant group, among other Mysidacea, throughout the estuary. These analyses suggest that the occurrence pattern was a continuum that was more or less dependent on their ability to tolerate different physicochemical conditions. There were also significant temporal variations; seasonal trends for abundance were observed for other Mysidacea, *Lucifer*, and *Acetes*. The relative distributions indicated that monthly variation was more considerable at the Thale Sap Songkhla, while the higher seasonal stability of the salinity gradient was predominant in Thale Sap.



PRESENTATION

## Session 6 (Berus)

**Tuesday, November 13 – 16:00**

### **Spatiotemporal Variation of Larval Fishes at Matang Mangrove Ecosystem, Perak, Malaysia**

**ARA R**, Hishamudin M, Amin SMN, Yusoff FM, Arshad A  
Department of Aquaculture  
Faculty of Agriculture  
Universiti Putra Malaysia  
43400 Serdang, Selangor  
Malaysia  
Email: smnabd@gmail.com

Spatiotemporal variations of larval fishes were investigated in the Matang Mangrove ecosystem, Perak, in the dry season (May–July 2015) and wet season (November 2015–January 2016). Three sampling stations were selected: St 1 (Least disturbed, Sungai Tiram Laut), St 2 (Moderate disturbed, Sungai Tinggi), and St 3 (Most disturbed, Sungai Sepetang). Samples were collected by using Bongo net equipped with a flow meter. The mean values of temperature, dissolved oxygen, salinity, pH and total dissolved solid in the investigated areas were: 29.64 ± 0.26 (°C), 3.92 ± 0.29; 19.72 ± 2.12 (mg L<sup>-1</sup>); 7.12 ± 2.12 (ppt); 7.12 ± 0.07; 21.03 ± 2.01 (mg L<sup>-1</sup>). There were significant variations in salinity and total dissolved solid among the investigated areas. However, no significant variations were observed in temperature, dissolved oxygen, and pH among the investigated areas. There were significant variations in salinity, temperature, and total dissolved solid among months during the study period. However, no significant variations were observed in dissolved oxygen and pH among the different months. In total, more than 4711 larval fishes were sorted and checked and 15 families were identified from the investigated areas. Among them, nine families were observed in wet season and 13 in dry season. Overall, 4 families (Gobiidae, Engraulidae, Blenniidae, and Ambassidae) were dominant in the investigated areas. For spatial diversity, the mean density of larval fishes was found to be 8.42, 47.23, and 194.18 individuals 100 m<sup>-3</sup> in stations St1, St2, and St3, respectively. While, for the seasonal diversity, the mean density of larval fishes was found to be 139.17 and 27.38 individuals 100 m<sup>-3</sup> in wet and dry seasons respectively. However, all diversity indices were highest in the dry season. Only family richness showed significant variation among the stations. None of the diversity indices differed significantly between wet and dry season.



LIGHTNING TALKS  
Session 6 (Berus)

Tuesday, November 13 — 16:20

## Size Distribution of Early Stages of *Ctenogobius boleosoma* (Actinopterygii, Gobiidae) in a Coastal Complex in Northeastern Brazil

**SEVERI W**, Araújo IMS, Santos NCL, Santana HS, Barreto TMS, Silva RG  
Laboratório de Ictiologia, Departamento de Pesca e Aquicultura  
Universidade Federal Rural de Pernambuco  
Rua Dom Manoel de Medeiros - s/n, Dois Irmãos, Recife, PE  
CEP 52171-900  
Brazil  
Email: wseveri@gmail.com

The dynamics of ontogenetic occupation by *Ctenogobius boleosoma* in different coastal environments—bay, surfzone, reef, and estuary—on the northeastern coast of Brazil was analyzed through the distribution and abundance of early size classes. Monthly samplings between March 2012 and February 2013 were undertaken with a plankton net for larvae and a beach seine for juveniles. We analyzed 903 individuals, 330 in the larval (standard length (SL) = 6.0–14.8 mm) and 573 in the juvenile (SL = 15–39.8 mm) phases. Differences in fish distribution related to environmental variables were detected between sampling locations and seasons, but their interaction was not significant. The analysis of variance evidenced that SL varied significantly according to the interactions local\*period and local\*season for larvae, and local\*period for juveniles. Individuals in the larval phase were found in all environments, with a lower occurrence in the reef, whereas juveniles presented a preference for inner portions of the estuary. Based on larvae and juvenile distribution among the studied environments, *C. boleosoma* was classified as estuarine resident. Simultaneous sampling of larvae and juveniles at different nearby coastal environments has proven essential for a better understanding of coastal fish ecology and functional use guild classification.





# LIGHTNING TALKS

## Session 6 (Berus)

**Tuesday, November 13 – 16:25**

### **Physiological Alterations Induced by Phenanthrene (Crude Oil Derivative) on Marine Cultured Tilapia Fish *Oreochromis spilurus* in Saudi Arabia**

**FILFILAN W**, Aljahdali M  
King Abdulaziz University  
Biological Sciences Department  
P.O Box 80203  
Jeddah 21589  
Saudi Arabia  
Email: wfilfilan@stu.kau.edu.sa

Oil production, transportation, and petrochemical industries have massive influence on marine ecosystem and habitat. Saudi Arabia as an oil production and refining country has huge oil transport overseas every day. The marine habitats and wildlife are thus subjected to oil pollution and may cause intensive disruption in the biological system, affecting the biodiversity and biota in marine habitat. In this study, we investigated the physiological alterations in marine cultured tilapia fish exposed to phenanthrene, a poly aromatic



hydrocarbon, in laboratory conditions. Alterations including structural, functional, and genetic changes were studied. The fluorescent emissions were very helpful to investigate how pollutant's particles were recorded in the biological systems. Our cultured tilapia marine fish were exposed to different concentrations of Phenanthrene (10, 25, and 50 ppm) for different lengths of time (2, 4, and 8 wks). It was observed that fish exposed to phenanthrene over time had significant changes in the level of fluorescent measurement in fish oil and tissues compared to control fish. The higher doses of Phenanthrene and differing lengths of time were both significant. These results suggest

that the long exposure to phenanthrene, even at minimum doses, may have impacts on marine habitats and decrease the activities of marine resources as a result of environmental contamination. There is also concern about human consumption of contaminated fish, which may result in genetic mutations and cancer, as has been reported by previous studies.

# LIGHTNING TALKS

## Session 6 (Berus)

**Tuesday, November 13 — 16:30**

### **Simulating the Effects of Shrimp Harvesting on Target Fishes for Thai Mangrove Fisheries Scenarios**

**SIRAPRAPHA P**

Kasetsart University  
Department of Science  
Faculty of Liberal Arts and Science  
Thailand  
Email: faassrp@ku.ac.th

A biomass-based dynamic model of Mae Klong estuary was constructed using Ecopath to explore the effects of harvesting on shrimp groups on the biomasses of some target fishes within the system, as an example of the potential responses of tropical mangrove coastal ecosystems in the inner Gulf of Thailand to commercial fishing. After simulation, removing shrimps over an extensive range of biomasses (25%, 50%, and 75%) at 5, 10, 15, and 20 yrs had similar impacts on the biomasses of other fish species; threadfin, anchovy, and catfish all increased slightly and then began to decline again, whereas mullet and croaker responded quite differently, continuing to increase at least for 20 yrs. The present analysis has revealed effects of shrimp harvesting, which would not have been easily accounted for in advance, especially the changes in mullet and croaker, due to the ways in which direct and indirect competitive and trophic interactions spread through food webs like the Mae Klong when the system is perturbed, in this case by the harvesting of shrimps. The results of this study not only reveal the power of Ecopath to highlight possible unforeseen changes in multispecies fisheries, but also serve as a lesson for fisheries managers to manage their ecosystems in a multispecies way and to be cautious about the predictions of single species approaches, which would not have revealed the complex interactions suggested here.



# LIGHTNING TALKS

## Session 6 (Berus)

Tuesday, November 13 — 16:35

### Relationship between Fish Catch and Environmental Variables Reveals the Importance of Mangroves to Small-Scale Fishery in Urabá Gulf, Colombian Caribbean

**SANDOVAL LA**, Leal-Flórez J, Blanco-Libreros JF

Corporación Académica Ambiental  
Universidad de Antioquia, Medellín  
Colombia  
Email: sandovalejo@gmail.com

Mangroves provide a range of valuable ecosystem services, for instance: fish production, coastal protection, carbon storage, and sediment trapping. We studied linkages between environmental variables and catch per unit effort (CPUE) of key fish species in Urabá Gulf (ecodistrit). We included mangrove parameters (area, perimeter, and carbon accumulation in aerial biomass) and pelagic environment (salinity, total dissolved solids) and productivity (chlorophyll *a*, seston and zooplankton biovolumes) variables. Finer-scale analyzes were done using experimental fishing data and high-resolution image photographs. Spearman correlations and stepwise multiple regression analyses were used to investigate which environmental variables best explained and predicted CPUE species-specific. Positive correlations (Spearman) showed that mangrove variables (area and perimeter) explained the CPUEs of four key species: *Ariopsis canteri*, *Mugil incilis*, *Oligoplites sauros*, *Cetengraulis edentulous*. Stepwise multiple linear regressions revealed that mangroves rather than pelagic characteristics were important to predict CPUE of three key species: *A. canteri* ( $r^2 = 0.49$ ), suggesting that it is a mangrove-associated species with a strong mangrove dependency; *M. incilis* ( $r^2 = 0.40$ ), suggesting that it is a mangrove-associated species; and *Scomberomorus brasiliensis* ( $r^2 = -0.52$ ), suggesting that is a marine straggler species with no dependence on mangroves. Pelagic environmental and productivity variables predicted the capture of seven species: *Centropomus pectinatus*, *Oligoplites saliens*, and *Cetengraulis edentulous* by total dissolved solids; *Oligoplites sauros* by salinity; *Bagre marinus*, *Caranx hippos*, *Bagre bagre* by chlorophyll *a*. The results of this study can be useful for the management of fishery resources and the conservation of the mangrove ecosystems of the Gulf of Urabá.



# LIGHTNING TALKS

## Session 6 (Berus)

**Tuesday, November 13 – 16:40**

### **Structure of the Fish Assemblage and Functional Guilds in the Estuary of Maracaípe, Northeast Coast of Brazil**

Favero FLT, Araujo IMS, **SEVERI W**  
Fisheries and Aquaculture Department  
Federal Rural University of Pernambuco  
Rua Dom Manoel de Medeiros, s/n  
Recife, Pernambuco  
Brazil  
Email: wseveri@gmail.com

The assemblage and functional structure of the fish fauna of the Maracaípe River, municipality of Ipojuca – PE, was characterized by monthly beach trawls carried out from March 2012 to February 2013. A beach trawl net (picaré) was used at three different points of the estuary during day and night trawls. The captured specimens were measured and weighed in the laboratory, identified, and separated into use and trophic guilds using appropriate literature. In one year of collection, 11,513 specimens were captured, belonging to 92 species, 38 families, and 15 orders. Gerreidae, Atherinopsidae, Clupeidae, Gobiidae, and Hemiramphidae were responsible for 82.9% of the total abundance. The estuary of the Maracaípe River presents a rich ichthyofauna, but with the quantitative predominance of seven species (*Atherinella brasiliensis*, *Eucinostomus argenteus*, *E. melanopterus*, *Ulaema lefroyi*, *Lile piquitinga*, *Ctenogobius boleosoma*, and *Hyporhamphus unifasciatus*). In the estuary, six species classified as vulnerable on the IUCN Endangered Species List were reported. The estuary presents a high diversity of species, most of them marine, carnivorous, and opportunistic, showing the high resilience of this environment. The predominance of small fishes underscores the importance of the Maracaípe River estuary for the maintenance of population stocks of coastal species, demonstrating the urgent demand of management of this environment.



# LIGHTNING TALKS

## Session 6 (Berus)

Tuesday, November 13 – 16:45

### Diversity and Population Dynamics of Fishes in the Mangrove Estuary of Marudu Bay, Malaysia

Mohd Azim MK, **AMIN SMN**, Arshad A  
Laboratory of Fisheries Biology and Aquatic Ecology  
Department of Aquaculture, Faculty of Agriculture  
Universiti Putra Malaysia  
43400 Serdang, Selangor  
Malaysia  
Email: smnabd@gmail.com

Habitat ecology and population dynamics parameters were determined by analyzing fish samples collected from the mangrove estuarine area of Marudu Bay, Sabah, Malaysia between October 2012 and September 2013. There were five sampling stations for the study. Each sampling station was approximately 1 km apart from each other. Fish samples

were collected by using gill nets. In total, 40 species of fish belonging to 29 families were identified from the mangrove estuarine waters of Marudu Bay, Sabah, Malaysia. The abundance of 40 species was found to be correlated (positive or negative) with the water parameters. The highest and significant regression coefficient was observed for *Pseudorhombus cinnamoneus*, which indicated that 29% of their abundance was influenced by the major water parameters and the remaining 71% by other factors. The growth, mortality, recruitment, and relative yield per recruit of the five selected dominant fish species (*R. kanagurta*, *G. oyena*,



*A. mate*, *S. sihama*, and *S. melanura*) from Marudu Bay were investigated based on monthly length-frequency data, using FiSAT software. In terms of length-weight relationships, *G. oyena*, *S. sihama*, and *S. melanura* showed a negative allometric nature of growth, while *R. kanagurta* and *A. mate* showed a positive allometric nature of growth in Marudu Bay. Only *G. oyena* had a continuous recruitment pattern with only one major cohort produced per year, while the four other species (*R. kanagurta*, *A. mate*, *S. sihama*, and *S. melanura*) showed two major recruitment events per year, indicating two cohorts were produced in a year. Results from the analysis of the exploitation rate (E) based on the fishing mortality estimates indicate that the fishery of the selected five dominant fish species in Marudu Bay were slightly below the optimum level of exploitation. This implies that the fish stocks in Marudu Bay are still abundant, but any further unrestrained increase in fishing effort in the future might drive the fish stocks down and lead to economic losses.

# LIGHTNING TALKS

## Session 6 (Berus)

**Tuesday, November 13 – 16:50**

### **The Significance of Particularly Sensitive Sea Areas (PSSA) for Protection of the Ramsar Sites in Johor, Malaysia**

#### **KAUR CR**

Maritime Institute of Malaysia (MIMA)  
Unit B-6-8 Megan Avenue II  
12 Jalan Yap Kwan Seng  
50450 Kuala Lumpur  
Malaysia  
Email: cheryl\_rk@mima.gov.my

A particularly sensitive sea area (PSSA) is defined as an ecologically, economically, and scientifically significant area that could be negatively affected by shipping and which requires protection through the action of the International Maritime Organisation (IMO). The concept of the PSSA was originally discussed between 1986 and 1991, with the guidelines for its designation adopted in 1991. This was subsequently revised in 2005. The guidelines specify the process, procedures, and criteria for designating a PSSA, stipulate possible vulnerabilities to international shipping, and propose measures to protect the area from the impact of shipping. This study describes the procedures and criteria for designating a PSSA, analyses some of the related issues, and informs on Malaysia's initiatives on identifying and designating a PSSA in the Straits of Malacca and Singapore under the framework cooperation agreement between IMO and the Norwegian Agency for Development Cooperation (Norad) for the prevention of pollution from ships through the adoption of PSSAs within the region. The areas identified include Pulau Kukup (Kukup Island) and Tanjung Piai (Cape Piai) RAMSAR sites at the southern tip of Peninsular Malaysia. An overview of the environmental significance and the need for added protection for the area through the establishment of a PSSA are further outlined.



LIGHTNING TALKS  
Session 6 (Berus)

Tuesday, November 13 – 16:55

## The Role of Mangrove Microhabitats: An Invertebrate and Fish Larval Perspective

**VORSATZ LD**, Patrick P, Porri F  
South African Institute for Aquatic Biodiversity  
Somerset street  
Grahamstown, Eastern Cape  
South Africa  
Email: lylevorsatz@gmail.com

Mangrove systems are among the most productive and biologically-important ecosystems in the world, and are generally regarded as nursery areas for many marine and coastal species. Despite the critical role mangroves play in coastal and marine environments, and their contribution to society, they are considered to be increasingly under threat through natural and anthropogenic disturbances. This research aims to evaluate the fine scale role microhabitats play in the larval stages of fish and invertebrates that use mangroves as

nurseries. These microhabitats, created by complex mangrove root systems, burrowing taxa, seagrass beds, and tidal creeks, can provide a food resource and refuge from predation in the early life history stages of commercially important marine species, as well as species that are essential to the ecosystem health of mangroves and estuaries that they occur in. Here, light traps were used to sample invertebrate and fish larval assemblages in tidal creeks, pencil roots of *Avicennia marina*, knee roots of *Bruguiera gymnorhiza*, prop roots of *Rhizophora mucronata*, and in seagrass beds (where available) in South African mangrove



forests from two different bioregions: warm temperate (Mngazana) and subtropical (Mlalazi). Preliminary results indicate: assemblages of invertebrate and fish larvae vary spatially (among microhabitats and between sites) and temporally during the reproductive season. This patchiness in occurrence and distribution highlights the inconsistent yet distinct nursery function mangrove microhabitats provide to a range of larval taxa and hence underlines the increase ecological risk many marine and estuarine populations are subjected to when some structural habitats become unavailable.



# LIGHTNING TALKS

## Session 6 (Berus)

**Tuesday, November 13 – 17:00**

### **Perceptions and Preferences of Local Fishers around a Protected Mangrove Forest in Eastern India**

**MALLA G**, Ray P, Sivakumar K, Johnson JA

Wildlife Institute of India

P.O. Box. 18

Chandrabani, Dehradun 248001

Uttarakhand

India

Email: mallagiridhar@gmail.com

Among the various services provided by mangrove forests, fisheries have direct implications for the local communities. Coringa Wildlife Sanctuary is a protected mangrove forest lying at the confluence of Godavari River with Bay of Bengal on the eastern coast of India. The artisanal fishery practiced inside the sanctuary and surrounding mangroves provides livelihood to 44 fishing villages in the region. A semi-structured questionnaire survey was conducted from September to December 2016 in 383 households across 13 villages located just outside the boundary of the sanctuary. The main objective was to estimate the non-use value attached by local fishers through their stated preference for willingness-to-pay a yearly amount to protect and restore the mangroves in the region. During the survey, 92.7% of the respondents agreed to pay. The best-approximating probit model revealed that a person with higher number of years of education, a lower household income, and an awareness of climate change is more willing than others to pay for mangrove protection. Nearly every respondent noticed an increase in ambient temperatures and rise in sea level in past 10 years, but only 41.7% of the respondents were aware of the concept of “climate change” and its impacts on coastal areas. Results of this study reveal the positive importance attached by local communities to mangrove forests. However, raising awareness about their vulnerability to drivers of climate change is an essential step to help them in adopting to the future changes.





LIGHTNING TALKS  
Session 6 (Berus)

Tuesday, November 13 – 17:05

## Assemblage Patterns of Fishes in Mangrove and Non-Mangrove Habitats of an Estuary in Eastern Coast of India

RAY P, Malla G, Sivakumar K, Johnson JA

Wildlife Institute of India  
36, Navkranti Apartments  
75, I.P. Extension, Patparganj, Delhi-110092  
India  
Email: paromitaray20@gmail.com

The confluence of Godavari River (second longest river in India) with Bay of Bengal gives rise to an extensive riverine estuary characterized by one of the largest patches of mangroves on the east coast of India. Different habitats, including mangrove-lined creeks, a river mouth, and bay were surveyed between December 2014 and November 2016 using

locally-available trammel nets.

A total of 115 species were recorded during the study, out of which *Leiognathus equulus*, *Mystus gulio*, *Dichotomyctere fluviatilis*, and *Dendrophysa russelii* were the most abundant species, contributing >50% of total fish abundance.

Multivariate analysis revealed salinity to be an important factor that segregated the fish community into habitats with lower salinity and habitats with higher salinity. The oligohaline

mangrove creeks were dominated by *M. gulio* (predominantly a freshwater species), while habitats with higher salinity were dominated by *L. equulus* and *D. russelii*. Overall, the non-mangrove habitats had higher species diversity than the mangrove-lined creeks. The fish composition of Godavari Estuary was also compared and found to be similar to other estuaries in the eastern coast of India. Results of this study will assist in monitoring the changes in fish community of the estuary as a result of freshwater flow regulation by a large dam, which will become operational in few years.



# Keynote Address

**Wednesday, November 14 — 09:20**

## **Connecting the Hemispheres: Global Patterns of Mangroves as Fish Habitat**

### **IVAN NAGELKERKEN**

Southern Seas Ecology Laboratories  
School of Biological Sciences and The Environment Institute  
DX 650 418  
The University of Adelaide  
Adelaide, SA 5005  
Australia  
Email: [ivan.nagelkerken@adelaide.edu.au](mailto:ivan.nagelkerken@adelaide.edu.au)

Mangroves are globally valued for the important ecosystem services they provide to mankind. One of these services is their fisheries production, which covers a wide variety of finfish and shellfish species. Mangrove estuaries can be highly productive fisheries areas, but they also support offshore fisheries through their nursery function. There has been a long-standing debate about whether the habitat function of mangroves for fishes differs between the western Atlantic and Indo-Pacific oceans. This debate may have been driven by the studies available a few decades ago, but with recent studies on mangroves as fish habitat from other locations across the globe, we are now gaining better insights into regional differences, while there has been a focus toward better understanding the underlying processes that drive such differences. Globally, mangrove forests exist in very different contexts based on their positioning in the intertidal, tidal regime, salinity levels, latitude, biogeographic regions, spatial setting within the seascape, habitat architecture, fish community structures, and so on. We are now starting to understand that these context-dependencies are major driving forces of how fishes use mangroves and structure their communities. In this presentation, I will use several existing examples of studies that have addressed such drivers to contemplate whether differential habitat use of mangroves by fishes in the western and eastern hemispheres is a dogma based on earlier studies, or their use might be similar when un-confounded by context-dependency.



## Biography

Ivan Nagelkerken has worked on temperate and tropical coastal ecosystems, with a special focus on fishes. Over the past decade, he has examined how ecosystem connectivity affects the functioning and resilience of coastal ecosystems, including coral reefs, seagrasses, and mangroves. He has done most of his work in the Caribbean Sea, Eastern Africa, and Australia. He also focuses on the effects of climate change on coastal marine ecosystems and fishes. He has done a lot of work on how fishes utilize coastal habitats throughout their life cycle, and how fish movements and trophic interactions connect neighboring ecosystems and affect the functioning of donor and recipient systems. Studying the nursery function of vegetated habitats for commercially- and ecologically-important juveniles of coral reef fishes has formed a core area of his research.

He has used techniques such as tagging, telemetry, and stable isotope analysis of fish otoliths and tissues to track fish movement and dispersal. Using aquaria, large mesocosms, and natural laboratories he also studies how climate change alters

fish diversity, community structure, trophic interactions, behavior, and habitat use. This knowledge is used to answer questions about the effects of ecosystem connectivity and climate change on marine ecosystem functioning, population dynamics of reef fishes, food web productivity, and resilience of coastal systems.

Ivan received his PhD from Radboud University Nijmegen and is presently a Professor at The University of Adelaide in Australia.



## Session 7 (Teruntum Putih)

Wednesday, November 14 — 10:20

### The Functional Ecology of Mangrove Fishes at the Isthmus of Panama

**STUTHMANN LE**, Castellanos-Galindo GA  
 Leibniz Centre for Tropical Marine Research (ZMT)  
 Langemarckstraße 155  
 28199 Bremen  
 Germany  
 Email: lara-stuthmann@web.de

Mangroves occur over a variety of environmental settings that affect the way these ecosystems function. This can also influence the functional ecology of communities that live within mangroves including nekton, but recent evidence suggests that biogeography affects the taxonomic composition of mangrove fish assemblages, but not their functional characteristics. Here we examine the functional characteristics of mangrove fish communities at both sides of the Isthmus of Panama (eastern Pacific Ocean vs Caribbean Sea). These areas were connected before the Miocene-Pliocene, but are now isolated and subject to different environmental controls, i.e., different tidal, salinity, and productivity regimes. Samples of mangrove fish communities of the Pacific (Gulf of Montijo) and Caribbean (Bocas del Toro) coasts of Panama were used to compare their functional (trait) and isotopic diversity. We found functional trait differences in the fish assemblages from these areas. Fish assemblages in the Pacific coast were dominated by brackish species, whereas in the Caribbean region, marine species were the most dominant. Body sizes were generally larger off the Pacific coast. Isotopic ( $\delta^{15}\text{N}$ ,  $\delta^{13}\text{C}$ ) diversity metrics, i.e., isotopic richness and uniqueness, in eastern Pacific mangrove fish assemblages were considerably lower than those of the Caribbean Sea, indicating that mangrove fish assemblages in the Pacific have a lower variety of food sources and a higher species redundancy in contrast to the Caribbean counterparts. Our results suggest that functional characteristics of mangrove fish assemblages do vary across biogeographical realms and that this variation is strongly linked to the environmental controls prevailing in each region.



## Session 7 (Teruntum Putih)

Wednesday, November 14 — 10:40

### The Extent of Mangrove Use by Small Fishes in Warm Temperate South African Estuaries

**MCGREGOR S**, Strydom NA  
 Nelson Mandela University  
 Department of Zoology, Nelson Mandela University  
 Summerstrand Campus South  
 P.O. Box 77000  
 Port Elizabeth  
 6031  
 South Africa  
 Email: s214045560@mandela.ac.za

The importance of mangroves for early stage fishes as crucial nursery and feeding areas in tropical and subtropical regions is well known. However, their warm temperate counterparts remain unstudied in terms of the advantages they provide as fish nurseries. The study aimed to assess whether the presence of mangroves in warm temperate South African estuaries resulted in changes in abundance, diversity, and distribution of small fishes. Two estuaries



with mangroves (Nahoon and Xhora estuaries) and two without mangroves (Gonubie and Qora estuaries) were sampled in the same biogeographic region over three summer seasons using a 50 × 2 m seine net with 12 mm mesh. There was little variation in fish abundance and diversity among estuaries, despite mangrove presence. Warm temperate estuaries lie on the edge of mangrove distribution and offer alternative habitats that offer similar feeding opportunities and nursery functions to mangroves. It appears that the temperate ichthyofauna dominating warm temperate estuaries have not yet evolved a dependence on mangrove systems and their associated ecological services. Additionally, in seasonally mediated systems, food is

the limiting factor, which makes specialist niche use a constraint in larger foraging regimes exhibited by many marine fishes utilizing estuaries as nursery areas.

## Session 7 (Teruntum Putih)

Wednesday, November 14 — 11:00

### Defining Mangrove-Fisheries: Case Studies of Indonesia and Cambodia

**SEARY R**, Spencer T, Bithell M, McOwen C

Department of Geography  
University of Cambridge  
Downing Place  
Cambridge  
UK CB2 3EN  
Email: rs864@cam.ac.uk

Mangroves provide vital economic, ecological, and societal benefits to coastal communities through their role in fisheries enhancement. However, mangrove forest extent worldwide continues to decline due to land conversion for aquaculture, agriculture, coastal development, and unsustainable fishing activities. Declines are particularly prevalent in SE Asia. Mangrove-fisheries rarely feature as a management target and one explanation may be that no ubiquitous definition for what constitutes a mangrove-fishery currently exists. There is a confusing dialog in the literature regarding what

constitutes mangrove-fishing, from traditional fishers collecting directly from the mangrove for subsistence, to studies that limit measures to mangrove-associates caught offshore. This risks groups of fishers being absent from management plans where their connection to mangroves is overlooked. Further, quantitative mangrove valuations, which have focused on a single sector, target species, gear, or season, are likely to provide underestimates of the overall mangrove value to fishing in a particular location. Research in Bali, Indonesia, has therefore developed a framework to describe the characteristics of mangrove-fisheries in a local context, confirming that mangrove-fisheries are multidimensional and variable even in close proximity. Following this framework, measurements of mangrove-fishery production are conducted for Koh Kong Province, Cambodia. Given that undervaluation of mangroves to people is one of the leading causes of mangrove conversion for other uses, this study encourages mangrove research that seeks to provide the full value of mangroves to fishing.





## Panel Discussion

**Wednesday, November 14 — 11:20-12:00**

**Host:**

Amy Then

**Panelists:**

Philine zu Ermgassen

Harinder Rai Singh

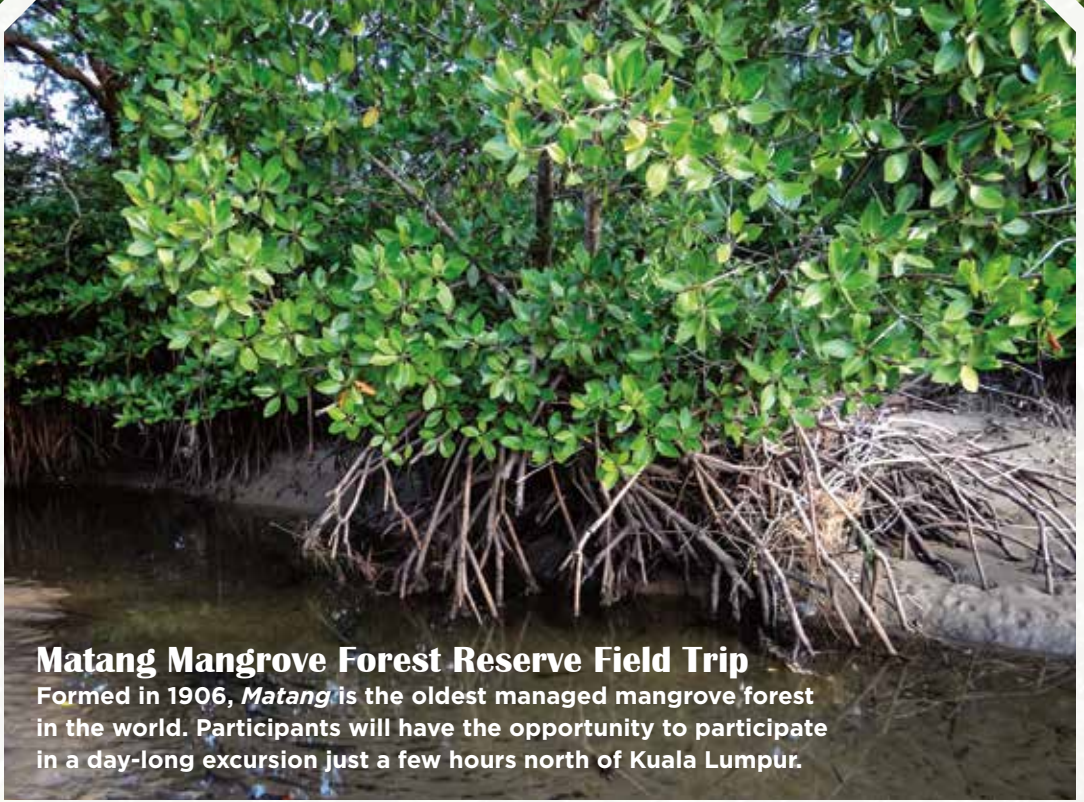
Ivan Nagelkerken

Joseph E. Serafy

After three days of presentations from differing mangrove regions, we invite all participants to join us for a stimulating panel discussion. The panel will be hosted by symposium co-convener Amy Then, and will feature all symposium keynote speakers plus Joseph E. Serafy, co-convener of the first and third symposia.

We invite you to join in the discussion by asking questions of the panel, and by sharing your experiences and ideas. Ultimately, we aim for this session to synthesize the current state of science regarding mangroves as fish habitat, and to chart the future research needs for the field.





### **Matang Mangrove Forest Reserve Field Trip**

Formed in 1906, *Matang* is the oldest managed mangrove forest in the world. Participants will have the opportunity to participate in a day-long excursion just a few hours north of Kuala Lumpur.

## **Thank You for Attending**

