UC San Diego –National Sun Yat-sen University

2019 Bilateral Research Symposium

Marine Science Breakout Session II

SATURDAY MORNING, MARCH 9, 2019

HUBBS HALL, RM 4500
SCRIPPS INSTITUTION OF OCEANOGRAPHY

9:30 - 11:30 Marine Science II (Chair: Hsien-Hua Lee)

- Andreas Andersson, Professor, Scripps Institution of Oceanography, UC San Diego
  "Taking the Metabolic Pulse of the Dongsha Atoll"
- Meng-Hsien Chen, Professor and Chair, Department of Oceanography, NSYSU
  "Climate Change Effects on Sakura Ebi Larvae in the Kaoping Submarine Canyon, Taiwan"
- Phil Hastings, Professor, Scripps Institution of Oceanography, UC San Diego
  "Journey to the west: Trans-Pacific historical biogeography of fringehead blennies of the genus *Neoclinus* (Teleostei: Blenniiformes)"
- Teyu Liao, Professor, Department of Oceanography, NSYSU
  "Currents shaped the Lineage Distributions of Tridentiger Barbatus along the Chinese Coast"
- Lindsey Bonito, Staff Scientist, SIO, UC San Diego
  "Describing the Diversity of Taiwanese Reef Communities: 100 Island Challenge"
- Hsiu-Chin Lin, Professor, Department of Marine Biotechnology and Resources, NSYSU
  "Impacts of South China Sea Internal Waves on Coral Barnacles at Dongsha Atoll"

ABSTRACTS

Taking the Metabolic Pulse of the Dongsha Atoll

Andreas J. Andersson[1], Wen-Chen Chou[2], Hui-Chuan Chu[2], Travis Courtney[1], Wei-Jen Huang[3], Samuel Kekuewa[1], Ariel Pezner[1], Rong-Wei Syu[2], Yi Wei[3], Keryea Soong[3]

[1]*Scripps Institution of Oceanography, University of California San Diego, La Jolla, California,USA; aandersson@ucsd.edu*

[2]*National Taiwan Ocean University, Taiwan*

[3]*National Sun Yat-sen University, Taiwan*

The most fundamental function of coral reefs is the construction of calcium carbonate ($CaCO_3$) reef structures. This function is the basic principle that allows reefs to provide a range of ecosystem services such as protection from storms and waves, beach replenishment, and a habitat for 25% of all marine species. As a result of climate change and ocean acidification, it is highly probable that reefs will gradually lose their ability to sustain complex $CaCO_3$ reef structures due to a reduction in rates of calcification and an increase in rates of bioerosion and $CaCO_3$ dissolution. However, we currently do not know where and when such changes are likely to be most serious and whether there are reefs that are more or less susceptible, and what dominant factors contribute to a reef's susceptibility or resistance to environmental change. The Dongsha Atoll offers an exceptional opportunity to evaluate the biogeochemical function of a unique reef environment, which due to its remote location in the South China Sea and exposure to large internal waves experiences different forcings than reefs in other areas. In this study, we measured carbonate chemistry and biogeochemical processes (i.e., net community calcification and net organic carbon production) across the entire Dongsha Atoll as well as in specific habitats such as seagrass meadows and patch reef environments to gain a better insight in terms of whether the Dongsha Atoll is net calcifying or dissolving, net autotrophic or heterotrophic, and how reef biogeochemical processes modify the local seawater carbonate chemistry.

Keywords: Dongsha Atoll, Coral reefs, Calcification, $CaCO_3$ dissolution, Metabolic pulse

Climate Change Effects on Sakura Ebi Larvae in the Kaoping Submarine Canyon, Taiwan

Meng-Hsien Chen, Hsu-Sen Chen

Department of Oceanography, National Sun Yat-sen University, Kaohsiung, Taiwan; mhchen@mail.nsysu.edu.tw

Sakura *Ebi*, *Lucensosergialucens* (= *Sergialucens*) is one of only two deep sea sergestid *shrimp* harvested in Kaoping Submarine Canyon, Taiwan and Suruga Submarine Canyon, Japan. They are planktonic shrimp that perform vertical migration. They live in canyons of 200-300m deep during the daytime and migrate up to 100-150m depth at night when the fishermen harvest them by deep sea trawling.

They are a high value macrozooplankton, with a market price of up to USD 40 per kilogram. The mean and 95% CI of total allowable catch are estimated at 910 (758-1119) tons annually. Therefore, sustainable use of this valuable shrimp is critical for supporting the local Tung-Kang fishing community. The fishermen have had their own society to regulate the harvest of the shrimp since 1993; however, this is a short-lived shrimp (less than 2 years), and so is sensitive to environmental fluctuation such as climate change. Even though there is a strategy to manage the total amount of harvest per day, limited to the period from November to May, this shrimp product may be affected by climate change or various hydrographic characteristics.

We conducted a survey from 2013 to 2018 at nine sampling sites set through the canyon from shallow to deep waters. Zooplankton trawling and water sampling were performed. From the zooplankton samples, we sorted out all the shrimp larvae and categorized them into 24 groups. Among them, sergestidprotozoea, zoea and mysis could be identified morphologically, and they were also further identified by barcoding to be *Lucensosergialucens*.

We found that, in the year of El Niño, 2014-2015, the larvae abundance of Sakura Ebi showed a significant drop compared with the larvae collected in 2013 and 2017. We also compared this result with the price of Sakura *Ebi* in Tung-Kung, which showed that in the year of 2014-2015, the price increased to its highest due to the low production of this shrimp. Since this shrimp is a deep cold water species, the sea water temperature rise in the El Niño year may affect their spawning and subsequent survival rate. To better understand this phenomenon so as to implement appropriate management strategies such as closing the fishing ground during the El Niño season, further study of their reproductive behavior and larvae survival rate subject to temperature change is urgently needed.

Keywords: El Niño; Macrozooplanton; Lucensosergia lucens; Submarine Canyon; Deep Sea shrimp

Journey to the west: Trans-Pacific historical biogeography of fringehead blennies of the genus Neoclinus (Teleostei: Blenniiformes)

Philip A. Hastings

Marine Biology Research Division, Scripps Institution of Oceanography, University of California San Diego, La Jolla, California; phastings@ucsd.edu

Several temperate marine taxa follow a trans-Pacific biogeographic track, most without representatives in the intervening boreal waters. Estimated times of divergence of these groups vary widely from recent Pleistocene events to as early as the late-Eocene/early Oligocene. Shelter-dwelling blennioform fishes of the genus Neoclinus exhibit this trans-Pacific distribution pattern: some members inhabit warm temperate waters along the northeastern Pacific coast of California, while others are found in warm-temperate to sub-tropical waters of the northwestern Pacific Ocean including Taiwan. We reconstructed the phylogeny of the Neocliniini using six genetic markers: four mitochondrial (COI, cytochrome b, 12S and 16S), and two nuclear genes (RAG-1, TMO-4C4). Ancestral state reconstruction and molecular clock dating were used to explore hypothetical ancestral distributions and dispersal routes, and to estimate divergent times within this group. The monophyly of the genus Neoclinus, and the reciprocal monophyly of the eastern Pacific and western Pacific lineages were supported. Estimated divergence time of the eastern and western Pacific clades was 24.14 million year ago, which falls during the Oligocene epoch. Available evidence supports an ancestral distribution of the Neocliniini in the temperate eastern Pacific with dispersal to the tropical eastern Pacific by their sister group, the monotypic Mccoskerichthys, and to the west across the north Pacific by the ancestor of the western Pacific clade.

Keywords: phylogeny, biogeography, blennioform fishes

Currents shaped the Lineage Distributions of Tridentiger Barbatus along the Chinese Coast

Teyu Liao

Department of Oceanography, National Sun Yat-sen University, Kaohsiung, Taiwan; tyliao@mail.nsysu.edu.tw

Complex coastal current system and Pleistocene Glacial Cycle are possible factors causing divergence of marine organisms. In this study, we explore the genetic structure and life history of a widely distributed benthic goby *Tridentiger barbatus* and its interrelationships with coastal currents. In total, 258 individuals of *T. barbatus* were collected from 14 sites along the Chinese coast and their fragments of cytb, Rh and RAG1 were sequenced. Bayesian trees and TCS networks revealed two deeply divided southern and northern lineages with an overlap through Shanghai (southern boundary of northern lineage) to Lianyungang (northern boundary of southern lineage). Lianyungang fits approximately with the circulation of Yellow Sea Coastal Current and Subei Coastal Current that probably constrain the northward dispersion of the southern lineage. The northward Taiwan Warm Current may play an important role in the restriction of southward dispersal of the northern lineage. Despite of shared common haplotypes and insignificant AMOVA among-groups differentiation in both lineages, numerous intra-group unique haplotypes were found across Fuding-Raoping, Changjiang River and Bohai Sea. The variation in haplotype composition was not reflected in AMOVA or genealogy analyses, which is probably due to the extremely low genetic divergence, providing limited phylogenetic information. This is further supported by post-glacial sudden expansion times of both lineages estimated by Bayesian skyline plot. However, their constrained distribution would reflect the influence of currents along the Chinese coast on the phylogeographic pattern of *T. barbatus*, an inshore species with relative short pelagic larval duration (20-30 days).

Keywords: Tridentiger barbatus; Current; Coastal China; Phylogeography; Population genetics

Impacts of South China Sea Internal Waves on Coral Barnacles at Dongsha Atoll

Hsiu-Chin Lin

Department of Marine Biotechnology and Resources, National Sun Yat-sen University, Kaohsiung, Taiwan; hsiuchinlin@mail.nsysu.edu.tw

South China Sea has the largest internal waves ever recorded. They originate from the Luzon Strait then propagate and steepen westward, eventually reach to the shallow water of Dongsha Plateau. The breaking of waves causes turbulence and strong vertical mixing thus redistribute sediments, heat and chemical substances in water column. For marine organisms, studies have shown internal wave packets can passively transport phytoplanktons and zooplanktons. In addition, large predators like pilot whales can be attracted by trapped preys thus actively swim toward the internal waves. However, there are many other marine organisms and no studies have been conducted on understanding their responses to internal waves. In this study, we used coral barnacles (Family Pyrgomatidae) as target organisms to study how internal waves affect sessile marine organisms at Dongsha Atoll coral reef ecosystem. We have sampling sites at the outer reefs of eastern, northern and southern Dongsha atoll where coral coverage is high. Environmental data including water depth, temperature, and habitat type (coral species); biological data of coral barnacles including species (identification was confirmed with DNA barcoding), density, growth rate (size as rostro-carinal basal diameter), and recruitment conditions were recorded seasonally. We expect to find the barnacle species that respond to internal waves and identify the areas and perspectives of impacts.

Keywords: Internal waves; Coral barnacles; Dongsha Atoll; Coral reef ecosystem