

The 9th Okinawa Marine Science Workshop Program

Date: November 22nd, 2024

9:40 – 10:00 **Registration**

10:00 – 10:15 **Opening greetings**

Prof. Satoshi Mitarai, Dean of Research, OIST

Morning Session

10:15 – 10:30 **Record Sea Surface Temperatures near Okinawa in Summer 2024**

Nobuyuki Kayaba, Okinawa Regional Headquarters, Japan Meteorological Agency, JP

10:30 – 10:45 **Assessing the effects on growth and survival of corals (*Acropora tenuis*) transplanted into habitats with different environmental stressors**

Sayaka Higa, Okinawa Prefectural Institute of Health and Environment, JP

10:45 – 11:00 **Using underwater drones and image detection AI to study the health of corals and fishes in Okinawa**

Kazuyo Toma & Miku Kakiyama, National Institute of Technology, Okinawa College, JP

11:00 – 11:15 **Long-term eDNA biomonitoring of the coral reef ecosystem of the Mermaid's Grotto – “Apogama”: the first year**

Ayşe Haruka Oshima Açıkbaş, OIST, JP

11:15 – 11:30 **Distinct soundscape characteristics across habitats within a coral reef revealed by snap rate analysis**

Lucas Yutaka Kimura, University of the Ryukyus, EN

11:30 – 12:15 **Lunch**

12:15 – 13:00 **Poster session**

Afternoon session1

13:00 – 13:15 **Assessment of the taxonomic status of nominal species of the Indo-Pacific Pellona (*Teleostei: Clupeiformes: Pristigasteridae*)**

Harutaka Hata, OIST, EN

- 13:15 – 13:30 **The Other Blue Zone: Trait diversity and biogeography of coral reef fishes across the Ryukyu Islands**
Chloe Nash, OIST, EN
- 13:30 – 13:45 **Identifying Important Shark and Ray Areas (ISRAs) in the Ryukyu Archipelago: a critical step for marine conservation**
Fabienne Ziadi-Künzli, OIST, EN
- 13:45 – 14:00 **Biocultural Ecologies**
Emanuela Borgnino, OIST, EN
- 14:00 – 14:15 **Japanese local city governments start to publish and utilize their own marine biodiversity data on BISMAL platform**
Takashi Hosono, Japan Agency for Marine-Earth Science and Technology, JP
- 14:15 – 14:30 **Tea break**

Afternoon session 2

- 14:30 – 14:45 **Investigation of the Presence of Parasites in Cephalopod Eggs and Available Treatment with Peracetic Acid**
Mehmet Arif Zoral, OIST, EN
- 14:45 – 15:00 **Research and development of seeding production of coral grouper (*Plectropomus leopardus*)**
Yuji Fujikura, Fisheries Technology Institute, Japan Fisheries Research and Education Agency, JP
- 15:00 – 15:15 **Selection of a superior strain of the brown seaweed *Cladosiphon okamuranus* (Okinawa mozuku) with high-temperature tolerance**
Yusuke Sudo, Okinawa Prefectural Fisheries Research and Extension Center, JP
- 15:15 – 15:30 **Identifying the cause of bleaching in *Caulerpa lentillifera* and considering countermeasures**
Kaoru Maeganeku, Okinawa Prefectural Fisheries Research and Extension Center, JP
- 15:30 – 15:45 **Development of an artificial seeding technique for *Monostroma nitidum* aquaculture**
Shiho Uchihara, Okinawa Prefectural Fisheries Research and Extension Center, JP

Closing remarks

List of poster presentations

Using underwater drones and image detection AI to study the health of corals and fishes in Okinawa

Kazuyo Toma & Miku Kakihara, National Institute of Technology, Okinawa College

The Expansion and Prospects of the Marine Science Program: The Future of Marine Human Resource Development through Diverse Approaches

Naoto Higa & Kenzaburo Sawano JAMSTEC GODAC

Differential feeding preferences of six obligate corallivore fishes during mass coral bleaching

Rickdane Gomez, University of the Ryukyus

Investigation of the source of White Spot Disease in Kuruma Shrimp on Miyako Island

Masaki Asato & Masatoki Tamaki, Okinawa Prefectural Fisheries Research and Extension Center

Understanding biodiversity information collecting activities through analog experiences - Development of marine education activities for elementary and junior high school students

Shuko Azuma, Shoko Matsuda, Ayana Fusho, Kinuyo Kobashigawa, Azusa Kishimoto, & Takashi Hosono, Marine Works Japan, LTD. & JAMSTEC GODAC

Detection of tridacnid giant clams from seawater

Hiroshi YAMASHITA, Fisheries Technology Institute, Japan Fisheries Research and Education Agency

Early life stage disappearance: A tiny predator (*Calanopia thompsoni*) during *Sarcophyton cf. elegans* (*Octocorallia*) spawning release in Okinawa Island, Japan

Agus A. Hakim^{1,2}, Emmeline A. Jamodiong¹, Geminne G. Manzano¹, Tracy D. Tabalanza³, Sota Komeda⁴, Daisuke Uyeno⁵, Takashi Nakamura^{3,6}, James D. Reimer^{1,6}

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Potential *Acropora* coral larvae

Oitsuki Ayumi, University of the Ryukyus

Temperature tolerance of *Porites cylindrica*, and its cryptic species

Kotaro Inoue, University of Ryukyus

Swimming in ancient fish: exploring the hydrodynamics of *Sacabambaspis*

Samuel Coatham, OIST

Regional distribution of the GC content in cephalopods and molluscs

Lucia Zifcakova, OIST

Morphological assessment of the Spotted garden eel (*Heteroconger hassi*) for prospective research ideas

Diala Joy Edde, OIST

Distribution and habitat characteristics of the juvenile mudskipper, *Periophthalmus modestus* on the Edogawa flood channel

Yijin Lee, OIST

Microplastic collection robot No.3

Reo Tanaka, National Institute of Technology, Okinawa College “Learning from the Churaumi, Training School for Future Leaders”, Ginoza Junior High School

The 9th Okinawa Marine Science Workshop Abstracts

Oral Presentations

Record Sea Surface Temperatures near Okinawa in Summer 2024

Nobuyuki Kayaba, Okinawa Regional Headquarters, Japan Meteorological Agency

The JMA observes atmospheric and oceanic conditions, furthermore, it accumulates observation data collected from related organizations in Japan and abroad over a long period of time, and analyzes and predicts actual conditions using a supercomputer.

In the summer of 2024, temperatures reached record highs nationwide, and sea surface temperatures (SSTs) were remarkably high in the seas around Japan, including around Okinawa. This was due to the persistent northward meandering of the subtropical jet stream near Japan, which resulted in continued high pressure and strong solar radiation. In addition to global warming, the El Niño phenomenon which continued until spring, is thought to have contributed to significantly higher temperatures in the mid-latitudes of the Northern Hemisphere.

In particular, the record high SSTs around Okinawa were related to the low number of typhoons that occurred from spring to the first half of summer.

In this paper, we focus on the record high SSTs in the sea area around Okinawa this summer and review the factors that contributed to the record high SSTs from the perspective of the interaction between the atmosphere and the ocean, based on the latest findings and the forecast information we provided at the time.

Assessing the effects on growth and survival of corals (*Acropora tenuis*) transplanted into habitats with different environmental stressors

Sayaka Higa, Okinawa Prefectural Institute of Health and Environment

Coral communities are being degraded by the combined effects of global stressors such as rising sea temperatures induced by climate change and local stressors such as soil influx from land areas. Therefore, reduction of local stressors has been focused on as a more realistic adaptation measure to climate change impacts on coral communities. In Okinawa Prefecture, land-induced red soils pollution caused by the influx of soil particles (red soils etc.) has been a long-lasting problem, and it is important to understand the effects of red soils on coral growth.

In this study, we selected two adjacent experimental sites with different levels of terrestrial loading under similar water temperatures as study sites to examine the effects of loading and reproductive history on adult coral colonies. We planted 50 colonies of *Acropora tenuis* at each site and monitored them for 1.5 years. Half of the 50 colonies were sexually reproduced, and the other half were asexually reproduced. We surveyed the colonies at four times between May 2022 and October 2023 to check survival to record colony size. Growth rates were calculated assuming that the colonies were elliptical cones and expressed as relative values to the initial size.

We found that the coral deaths were more frequent in the high than in the low loaded site and in sexually than in asexually reproduced colonies. Growth rates were lower in the high than in the low loaded site but did not differ by reproductive history. The results of this study and previous findings suggest that terrestrial loads decrease both the settlement of coral larvae and the survival and growth of adult corals.

Using underwater drones and image detection AI to study the health of corals and fishes in Okinawa

Kazuyo Toma & Miku Kakihara, National Institute of Technology, Okinawa College

2024 In Okinawa, the first large-scale coral bleaching event since recent decades is occurring, and countermeasures are urgently needed. In order to protect marine life, it is most important to first accurately understand its current status. Therefore, we propose a marine life survey system (name: Aquascope). This system uses AI to analyse underwater images acquired by underwater or marine drones to acquire and survey data on the habitat status of coral and the fish that live there, without manual intervention. The marine life information analysed by region and season by AquaScope will be used in efforts to conserve living organisms and improve the marine environment.

In the development of fish AI and coral AI, technology will be established to detect marine organisms by computer, rather than relying on human observation, from underwater images acquired from underwater or marine drone cameras. The target is 80 coral species and fish species, with a detection accuracy of at least 85%. A unique data set consisting of 9525 images is collected by data crawling from the internet and by snorkelling and aquarium photography. Next, a drone control scheme is developed to move the drone precisely along a set route in order to acquire underwater images at the right timing and location. The drone is detected in a rectangle from the images taken of the drone and the centre coordinates of the detected rectangle are used as the location information of the drone (x-coordinate and y-coordinate). In order to survey the entire survey area, the underwater drone is moved in a mesh pattern based on the drone's position information. Finally, the feasibility of the system is checked in an indoor experiment, followed by an outdoor experiment in a real marine field. The information obtained on the status of coral growth and bleaching in each area, as well as the types and numbers of fish, will be disclosed on a website where it can be viewed as a marine life map.

Long-term eDNA biomonitoring of the coral reef ecosystem of the Mermaid's Grotto – “Apogama”: the first year

Ayşe Haruka Oshima Açıkbaş, OIST

Global and local human activities are transforming biodiversity at unprecedented rates, with accelerated extinction and the spread of invasive species threatening the unique ecosystem functions and services linked to our wellbeing. Long-term and local biomonitoring datasets are crucial for tailored conservation practices, as trends in biodiversity richness and composition over time and space vary significantly across timescales and regions. We present here the findings from our ongoing environmental DNA (eDNA)

metabarcoding survey of the fish assemblage of a highly biodiverse coral reef ecosystem in Onna village, Okinawa. We characterize the dataset with regards to rare and commonly detected species, their life history traits and detection and richness over time and space. Finally, we discuss the potentials as well as limitations of the technique in comparison to traditional census methods and highlight the importance of integrating species-specific knowledge and expertise into biomonitoring projects to make the data and conclusions more impactful.

Distinct soundscape characteristics across habitats within a coral reef revealed by snap rate analysis

Lucas Yutaka Kimura, University of the Ryukyus

To effectively maintain and conserve coral reef ecosystems, monitoring methods that ensure both temporal continuity and spatial comprehensiveness are essential for early anomaly detection and intervention. However, traditional visual-based surveys are limited in spatial and temporal coverage. To overcome these limitations, Passive Acoustic Monitoring (PAM), which records and analyzes “soundscape” composed of biophonic, geophonic and anthropophonic sounds, provide a promising complement to conventional methods. While ecoacoustic indices have shown potential as robust indicators of coral reef ecological status, soundscape characteristics across different habitats within the same coral reef remain understudied. The aim of this study was to quantitatively compare the soundscape characteristics of habitats dominated by hermatypic corals versus habitats dominated by rubble and sand within the same coral reef system.

The survey was conducted in Kakinouchi, northern Okinawa Island, from February to July 2024. Three underwater recording stations were established at depths of 1–2 m, each spaced approximately 50 m apart at two distinct habitats: one dominated by branching and tabular *Acropora*, and the other dominated by sand and rubble. Based on the obtained underwater acoustic data, “snap rate”, defined as the number of snaps produced by snapping shrimps (Alpheidae) per minute was computed.

The results showed that the snap rate was significantly higher at the sand-rubble-dominated stations compared to the coral-dominated stations. Moreover, the snap rate exhibited clear diurnal variation, increasing after sunset and decreasing after sunrise. These findings provide the first strong evidence of clear differences in soundscape characteristics between habitats within the same coral reef. Furthermore, this highlights the effectiveness of the soundscape approach in providing a quantitative, non-invasive method for assessing the ecological status of coral reef habitats through the analysis of soniferous activities of organisms.

Assessment of the taxonomic status of nominal species of the Indo-Pacific *Pellona* (Teleostei: Clupeiformes: Pristigasteridae)

Harutaka Hata, OIST

The genus *Pellona* (Clupeiformes: Pristigasteridae), of which two species (*Pellona dayi* Wongratana, 1987 and *Pellona ditchela* Valenciennes, 1847) have been known to be distributed in the Indo-Pacific, is diagnosed by toothed hypomaxilla. In this study, *P. dayi*, previously known only from a few type specimens collected from the eastern coast of India, is confirmed to be widely distributed in the eastern Indian Ocean

from India to Java, Indonesia and characterized by lower count of gill rakers and elongated body. Furthermore, morphological examination and mitochondrial COI genetic data of specimens identified as *P. ditchela* obtained throughout its distribution, revealed that this species comprises at least two species, distributed in the Southeast Asia (western Pacific from Vietnam to Indonesia) and Africa, respectively (east coast of Africa and Madagascar). These two can be distinguished from each other by differences several morphological characters including fin-ray counts and form of grooves on scales, and some measurements. Based on the examinations of the type specimens, the Asian and African species are considered as to be treated as *Pellona hoevenii* Bleeker, 1852 and *Pellona natalensis* Gilchrist and Thompson, 1908, respectively. No specimens of these two species from India were observed, although the type locality of *P. ditchela* is Visakhapatnam (eastern coast of India). Based on the examination of the original description and numerous specimens, the nominal species is considered as to be applied for the species has been regarded as *Ilisha striatula* Wongratana, 1983, a species of another genus of *Pristigasteridae*.

The Other Blue Zone: Trait diversity and biogeography of coral reef fishes across the Ryukyu Islands

Chloe Nash, OIST

An investigation of community structuring can reveal the impact of historic and current biogeographical processes on the distribution and evolution of species. The Ryukyu Islands (also known as the Nansei Islands) are situated at the southernmost point of Japan and mark the northern border of the Coral Triangle. Spanning 1,200 km from Yakushima and Tanegashima Islands in the north to the Yaeyama Islands in the south, the islands within this archipelago vary in geological formation, age, and size, however they primarily formed as a result of a convergent plate boundary. Additionally, the islands were connected to the mainland of Asia during the last glacial maximum as a result of sea level drops. As a result, the Ryukyu Islands boast exceptionally rich marine biodiversity and are home to numerous endemic species. Given the variability in the scale of available biodiversity data, we aim to compare different taxonomic and geographic scales of species occurrence within Japan and the Ryukyu Islands. Additionally, we aim to examine the influence of benthic habitat availability on the variation in morphological, life history, and behavioral traits of coral reef fishes found across Okinawa. Using robust 2D/3D morphometrics data based on fish market specimens, static video surveys across various reef substrates, and a comprehensive trait database, we test hypotheses about community associations with benthic habitat and geographic patterns of trait variation. We hypothesize that there will be distinct fish communities associated with each substrate type and that more complex benthic habitats will maintain communities with more trait diversity. This project provides insight into the underlying patterns of biogeography within this archipelago, which will allow us to further test hypotheses about population connectivity and dispersal, the impacts of historic disturbances on community structuring, and the comparison with other islands globally.

Identifying Important Shark and Ray Areas (ISRAs) in the Ryukyu Archipelago: a critical step for marine conservation

Fabienne Ziadi-Künzli, OIST

Sharks and rays face an unprecedented extinction crisis, with approximately one-third of species threatened globally. In the Ryukyu Archipelago, a hot spot of marine biodiversity, targeted conservation actions remain limited despite the critical role these species play in marine ecosystems. This presentation introduces the Important Shark and Ray Areas (ISRAs) initiative, developed by the IUCN Species Survival Commission (SSC) Shark Specialist Group, to identify key habitats essential for the survival of sharks and rays.

As of 2024, seven ISRAs have been officially designated in the Okinawa Prefecture. These ISRAs are identified based on the best available scientific data, including life history, movement records, and observational data via citizen science. This presentation will introduce the ISRA concept and the designated areas, highlighting their significance in safeguarding local shark and ray populations. The ISRA process engages diverse stakeholders to create a robust framework for guiding conservation efforts and promoting sustainable management, ensuring the long-term health of these species and the marine ecosystems they support.

Biocultural Ecologies

Emanuela Borgnino, OIST

This project proposes to scientifically investigate and compare two leeward different quasi-protected marine areas, the Okinawa Kaigan Quasi-National Park, with the marine Indigenous Community Conserved Areas of Pokai Bay on the island of O'ahu, Hawaii, to study the production and implementation of ecological responsibility practices in areas where top-down and bottom-up marine protected areas are present. The expected impact of the project is to provide a different approach to environmental issues, in the form of a biocultural data chart a set of place-based parameters to evaluate and understand the ecological knowledge present and to assess the social, economic and cultural impact.

How do we measure environmental perception, knowledge, and practices?

Science has different tools to evaluate and quantify the well-being of an ecosystem, however, we often forget the human collective that is also part of the ecosystem. The bio-cultural framework used in this project will not help manage the sea or the reef; it will help manage people interacting with the sea using place-based local cultural perspective.

Japanese local city governments start to publish and utilize their own marine biodiversity data on BISMAL platform

Takashi Hosono, Japan Agency for Marine-Earth Science and Technology

Since 2009, the Global Oceanographic Data Center (GODAC) has developed a marine biodiversity information system, named Biological Information System for Marine Life (BISMAL), to integrate marine biodiversity data obtained from scientific activities around Japanese waters. BISMAL assumed that the main users of BISMAL would be people or institutes belonging to the scientific community. Recently, however, we have begun to work with some Japanese local governments in an attempt to reach out a new layer of users. In this presentation, we will introduce the two datasets created by local governments and published on the BISMAL platform: "Organisms in river and marine in Yokohama" by the Yokohama City Government, and "Endangered Species Listed in the Toba city Marine Red Data Book 2023" by the Toba City Government.

Investigation of the Presence of Parasites in Cephalopod Eggs and Available Treatment with Peracetic Acid

Mehmet Arif Zoral, OIST

Having been successfully bred in semi-intensive and intensive aquaculture systems, oval squid (*Sepioteuthis lessoniana*) and pharaoh cuttlefish (*Sepia pharaonis*) are emerging as promising candidates for research and industry. Nevertheless, information about pathogens and diseases that may affect squid and cuttlefish aquaculture remains sparse. This research highlights the discovery of a new species of copepod parasites, *ikanecator primus* and *Liburna oophaga* on squid and cuttlefish eggs using a combination of morphological and molecular diagnostic markers. Parasites on squid eggs were exposed to specific concentrations of PAA-product (70 mg/L PAA and 30 mg/L H₂O₂) and were eliminated resulting in improved survival of cephalopod embryos and increased the growth rate of cephalopod hatchlings. These findings suggest that PAA could be a potential inhibitor and controller of the parasitic infection and aid in overall health management in cephalopod culture.

Research and development of seeding production of coral grouper (*Plectropomus leopardus*)

Yuji Fujikura, Fisheries Technology Institute, Japan Fisheries Research and Education Agency

We research for seeding production and the development of aquaculture technology for coral grouper (*Plectropomus leopardus*), a typical Okinawan fish. Since coral grouper is popular not only in Okinawa but also in other Asian countries, especially in Greater China, we expect it to be a new target species for aquaculture in Japan. This presentation will provide an overview of breeding water temperatures, growth, recent problems and measures taken in seed production of this species. Research on this species began in the 1980s, and mass production technology for juveniles was developed in 2009. According to seeding production data from 2021 to 2023, the average breeding water temperature for each year was 27.6~28.6°C. The average number of days from the start of rearing to take-up (average total length 36-53 mm) was 59 days (54-64 days). The causes of mass die-offs during rearing include mortality from surfacing and settling. Floating mortality is prevented by adding oil to the water surface, and sinking mortality is prevented by generating water flow with a pump. Furthermore, there was a problem that many of the mass-produced fry had lordosis. This is due to the failure of the swim bladder to inflate during the early stages of seeding production. At 5 to 10 days after hatching, spraying seawater on the surface of the water increased swim bladder inflation rate and subsequently decreased the rate of morphological anomalies. This has made it possible in recent years to secure large quantities of healthy juveniles.

Selection of a superior strain of the brown seaweed *Cladosiphon okamuranus* (Okinawa mozuku) with high-temperature tolerance

Yusuke Sudo, Okinawa Prefectural Fisheries Research and Extension Center

Cladosiphon okamuranus (Standard Japanese name: Okinawa mozuku) is an edible seaweed predominantly distributed in the Okinawa Islands, playing an important role in Okinawa aquaculture industry. The aquaculture production of this species is suggested to become unstable due to high water temperatures during the early stages of cultivation process, prompting the need for strains adapted to such environmental conditions. In this study, we selected a potential strain adapted to high water

temperatures under laboratory conditions using strain groups subcultured at the Okinawa Prefectural Fisheries Research and Extension Center, and conducted aquaculture experiments to investigate the unit yield and quality of the selected strain in marine environments.

Laboratory experiments examining growth rates under high-temperature conditions revealed that the strain collected from Miyako Island (MK) exhibited significantly higher growth compared to the standard strain (CH) widely used in the prefecture. Thus, MK strain was selected as a candidate with high-temperature tolerance. Further aquaculture experiment using these strains demonstrated that in ocean areas with persistently high water temperatures, the MK strain achieved a greater unit yield than the CH strain. Additionally, parameters related to processing quality, such as thickness and firmness, were higher in the MK strain. These results indicate that the MK strain is a potentially superior strain for future aquaculture operations.

Identifying the cause of bleaching in *Caulerpa lentillifera* and considering countermeasures

Kaoru Maeganeku, Okinawa Prefectural Fisheries Research and Extension Center

Caulerpa lentillifera, commonly known as “Umi-budo (sea grapes)”, is widely cultivated in Okinawa, with an aquaculture production value reaching approximately 600 million yen (FY 2021), making it the third most important species after *Cladosiphon okamuranus* (Okinawa-mozuku) and *Marsupenaeus japonicus* (Kuruma-prawn). However, during cultivation, the fronds bleach and subsequently dissolve, leading to their loss— a phenomenon observed throughout the prefecture, which significantly impacts the management of aquaculture producers. In response, we are conducting research aimed at identifying the cause of the bleaching and dissolution phenomena and developing countermeasures to ensure stable production of this species.

Field surveys with aquaculture producers in major production areas revealed that a net-like pattern was observed on the surface of the fronds in many areas before bleaching and dissolution occurred. It has been reported that the protoplasm of the genus *Caulerpa* aggregates in a net-like pattern upon maturation, suggesting that maturation of the fronds may be a factor of bleaching and dissolution. However, basic knowledge about the factors inducing maturation in this species remains limited. In future research, we aim to clarify the conditions that lead to these phenomena through laboratory experiments and establish effective countermeasures for bleaching and dissolution.

Development of an artificial seeding technique for *Monostroma nitidum* aquaculture

Shiho Uchihara, Okinawa Prefectural Fisheries Research and Extension Center

Monostroma nitidum (Local name: Ahsa), an important aquaculture species in Okinawa Prefecture, is cultivated using a natural seeding method in which zoospores released into ocean areas attach to aquaculture nets. However, with such natural seeding, the success of seeding is greatly influenced by annual variations in weather conditions, resulting in unstable production. Therefore, we have been developing an artificial seeding technique to cultivate *Monostroma nitidum* seedlings in an indoor environment and then seed them onto aquaculture nets.

In this presentation, we will introduce our research on an artificial seeding technique and report on our findings on the maturation timing of wild thalli, as well as the conditions required for the zoospore release under laboratory conditions.

Poster Presentations

Using underwater drones and image detection AI to study the health of corals and fishes in Okinawa

Kazuyo Toma & Miku Kakihara, National Institute of Technology, Okinawa College

2024 In Okinawa, the first large-scale coral bleaching event since recent decades is occurring, and countermeasures are urgently needed. In order to protect marine life, it is most important to first accurately understand its current status. Therefore, we propose a marine life survey system (name: Aquascope). This system uses AI to analyse underwater images acquired by underwater or marine drones to acquire and survey data on the habitat status of coral and the fish that live there, without manual intervention. The marine life information analysed by region and season by AquaScope will be used in efforts to conserve living organisms and improve the marine environment.

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The Expansion and Prospects of the Marine Science Program: The Future of Marine Human Resource Development through Diverse Approaches

Naoto Higa & Kenzaburo Sawano JAMSTEC GODAC

We are advancing initiatives to expand science content to children by deploying our marine science program not only through outreach classes and visits but also through its utilization in university teacher training courses for future educators involved in children's education. This effort extends to community schools, aiming to familiarize students with marine science, thereby increasing opportunities for children to engage with and develop an interest in marine science.

Furthermore, we actively contribute to cultivating future leaders in the field of science and technology through research support aimed at students who already possess a strong interest in marine science and through high-level programs designed for high school students.

These initiatives are expected to make marine science more accessible to children, increase their interest in marine science as a future career path, and contribute to the development of future marine

professionals. Additionally, by fostering collaborations with different industries and expanding internationally, we aim to create a platform for nurturing diverse talent.

Differential feeding preferences of six obligate corallivore fishes during mass coral bleaching

Rickdane Gomez, University of the Ryukyus

Mass coral bleaching impacts fish communities by affecting food sources and habitat qualities. Obligate corallivores, which feed primarily on coral polyps and mucus, are one of the most heavily impacted groups as coral mortality results to not just a reduction in nutrient intake, but also higher energy expenditure to find suitable prey items. While some corallivores have been shown to feed on bleached corals, the extent of this behavior across species remains poorly understood. Thus, in this study, we opportunistically investigated whether obligate corallivore fishes maintain a preference for unbleached over bleached corals during a mass bleaching event. In August 2024, we observed the feeding behavior of 192 individuals from six obligate corallivore species (*Chaetodon lunulatus*, *C. plebeius*, *C. trifasciatus*, *Labropsis manabei*, *Labrichthys unilineatus*, and *Oxymonacanthus longirostris*) at Kakinouchi reef, Okinawa Island. Bite frequencies on various coral substrates were quantified during 5-min SCUBA observations for each individual. The results showed that four species exhibit broad prey selection over several coral types, while *C. trifasciatus* and *O. longirostris* primarily targeted branching and tabular *Acropora*. In general, all species fed on bleached corals, albeit in significantly lower proportions than unbleached ones. Among the species, the wrasses *L. manabei* and *L. unilineatus* showed less discrimination between bleaching conditions, while the filefish *O. longirostris* exhibited the strongest preference for unbleached corals. As coral bleaching intensifies, obligate corallivores with strict dietary preferences, like *O. longirostris*, may face heightened vulnerability due to the depletion of suitable prey.

Investigation of the source of White Spot Disease in Kuruma Shrimp on Miyako Island

Masaki Asato & Masatoki Tamaki, Okinawa Prefectural Fisheries Research and Extension Center

Since fiscal year 2016, White Spot Disease (WSD) has continuously occurred at the Kuruma shrimp farm in Miyako Island, causing significant damage in fiscal year 2021. The farm is currently in a state of suspension, and virus control measures are a challenge for its reopening. Therefore, to investigate the source of the virus causing WSD, Known as WSSV, and to consider control measures based on the presence of WSSV, we conducted a survey of WSSV presence in environmental organisms and DNA analysis of environmental water in and around the farm. Starting from fiscal year 2022, we collected environmental organisms and water samples once a month and quantified the presence and amount of the virus using real-time PCR. The results and discussions will be presented on the poster on the day.

Understanding biodiversity information collecting activities through analog experiences - Development of marine education activities for elementary and junior high school students

Shuko Azuma, Shoko Matsuda, Ayana Fusho, Kinuyo Kobashigawa, Azusa Kishimoto, & Takashi Hosono, Marine Works Japan, LTD. & JAMSTEC GODAC

GODAC has been developing its own database, BISMAL, since 2009, and integrating and publishing marine biodiversity information obtained from research activities around Japan. Currently, not only researchers but also the general public can access the compiled marine biodiversity information, making it easy to

obtain the results they want. We will introduce content developed as an experiential activity for elementary and junior high school students on the process from collection to visualization that lies behind the biodiversity information that has become so familiar to them.

Detection of tridacnid giant clams from seawater

Hiroshi YAMASHITA, Fisheries Technology Institute, Japan Fisheries Research and Education Agency

Tridacnid giant clams are large bivalves that inhabit in shallow water of coral reefs. The population of these clams are drastically decreased, thus protected areas, closed season, and allowable catch size for the clams have been established in Okinawa prefecture. To verify the effect of these rules, clam distribution/population surveys are needed. However, since these surveys are usually based on visual observation, it requires a great deal of time and effort. Therefore, it is difficult to expand areas and the frequency of surveys. In recent years, environmental DNA analysis has often been used to detect the organisms present in the survey areas. In this study, we investigated whether DNA of the giant clams could be detected from water samples. We first established a specific PCR primer set for the giant clam species belong to genus *Tridacna* and *Hippopus*. DNA was extracted from rearing tank water of *Tridacna crocea*, and PCR was performed using the above-mentioned primer set. The clam DNA was detected by this PCR step. We then applied this operation on natural reef water sample. As a result, DNA of some tridacnid giant clam species were successfully recovered from the water sample. However, there are still a lot of issues to be cleared to conduct a distribution/population survey of the giant clams using environmental DNA analysis.

Early life stage disappearance: A tiny predator (*Calanopia thompsoni*) during *Sarcophyton cf. elegans* (*Octocorallia*) spawning release in Okinawa Island, Japan

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On the third night after a full moon in summer (August 23, 2024), we documented the spawning release of a semi-brooding spawner soft coral (*Sarcophyton cf. elegans*) on the shoreline of Okinawa Island, Japan. A tiny predator, a pontellid copepod (*Calanopia thompsoni*), was observed consuming *Sarcophyton* eggs, and we detected the presence of soft coral genes (mitochondrial MutS) inside collected copepods using a DNA mini-barcoding method. Predation on spawn material by copepods indicates an unexplored trophic relationship between soft corals and invertebrates ranging from small to large. Based on our observations, soft corals may have unknown entanglements for reproductive success and population survival that remain to be explored.

Potential *Acropora* coral larvae

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Ocean warming is now causing coral bleaching in tropic and subtropic ocean, while northward migration of corals has been observed in temperate ocean. Hence, temperate ocean may function as refuges for coral, while there is a risk of community and ecosystem change in temperate ocean. However, the mechanism of how coral migrates to northward has not yet been clarified. Here for the aim of clarifying whether Okinawa coral larvae can cause direct expand to higher latitudes, we evaluated the settlement and survival rate of Okinawa corals larvae under higher latitude environment condition.

Here we used two coral species, *Acropora hyacinthus*, which shows distribution expand to the main Island of Japan, and *A. digitifera*, which expand has not been observed. In experiment 1, settlement tiles were placed at 1m depth of three sites; Sesoko, Kikai Island, and Shimoda, for 1 to 2 months. After transporting tiles to Sesoko, one tile and 50 coral larvae of each two corals from Sesoko were added to each 500 ml container, and settlement and metamorphosis rate were evaluated. In experiment 2, only tiles from Sesoko were used to evaluate the settlement and survival rate of two corals at three different temperatures (25°C, 21°C, 19°C).

For *A. hyacinthus*, in exp. 1, the settlement rate was Sesoko > Kikai > Shimoda tiles. In exp. 2, the settlement rate was highest at 25°C, followed by 21°C, and none were observed at 19°C. For *A. digitifera*, in exp. 1, there was no difference in the settlement rate between Sesoko and Kikai tiles, while none were observed at Shimoda. In exp 2, there was no difference in the settlement rate between 25°C and 21°C, and lowest at 19°C. From those results it has been suggested that seawater temperature has a largest effect on the settlement of larvae, however the substrate also can affect the settlement rate. Furthermore, it became clear that there were differences in responses between coral species.

Temperature tolerance of *Porites cylindrica*, and its cryptic species

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Seawater temperatures rise due to global warming are now causing extensive coral bleaching all over the world. Therefore, in order to conserve corals, it is highly essential to understand the differences of temperature tolerance among coral species, and to conserve coral populations according to their tolerance. However, recent studies have shown the potential presence of number of genetic cryptic coral species, and it is yet unclear whether there are any differences in physiological responses such as temperature tolerance among these species. For example, recent genetic analysis has revealed the existence of cryptic species within *Porites cylindrica*, and it has been suggested that the geographic distribution of those population may differ depending on latitude. Such differences may be due to the differences in water temperature tolerance among species. Therefore, in this study, we aim to evaluate the temperature tolerance of those two potential cryptic species of *P. cylindrica*.

A total of 51 colonies were collected from communities around Sesoko Island's Anti-hama beach, and each eight colonies were selected based on skeletal morphological characteristics. The *P. cylindrica* and its potential cryptic species were reared for 21 days under three water temperatures of 21°C, 18°C and 15°C, and photosynthetic efficiency (Fv/Fm), calcification rate, photosynthetic rate, zooxanthellae density and chlorophyll concentration were measured.

Genetic analysis revealed that all colonies were *P. cylindrica*. Corals reared under 15°C showed lowest photosynthetic efficiency, zooxanthellae density, photosynthetic rate, and calcification rate, indicating that low temperature tipping point of *P. cylindrica* is between 15 to 18 °C.

Swimming in ancient fish: exploring the hydrodynamics of *Sacabambaspis*

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As one of the earliest known vertebrates, the Ordovician jawless fish *Sacabambaspis* represents a rare opportunity to understand life at the dawn of vertebrate evolution. Well-preserved specimens provide critical insights into its morphology but raise key questions about its locomotion. How did *Sacabambaspis* steer and stop while swimming, in the absence of any paired fins? Did its elongated horizontal tail lobe serve as a stabilizer? Could the broad, rounded head shield interact with the benthic substrate to generate ground effect forces, thereby influencing its ecology?

To address these questions, we employed a combination of computational fluid dynamics (CFD) and experimental particle image velocimetry (PIV). A 3D digital reconstruction of *Sacabambaspis* was modeled in a computational fluid domain, where simulations were performed evaluating hydrodynamic parameters across various angles of attack, substrate proximities, and flow velocities. Complementary experiments in a flume tank using a 3D-printed model enabled detailed PIV analysis of flow dynamics around the head shield. Additional turbulence modeling evaluated the potential stabilizing effect of the trailing lobe on a gliding bluff body, before specific application to *Sacabambaspis*.

This study represents the first investigation into the locomotion of *Sacabambaspis*, offering significant insights into ancestral swimming patterns and biomechanics of early vertebrates.

Regional distribution of the GC content in cephalopods and molluscs

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Cephalopods, among the most advanced of molluscs, are known for their evolutionary convergence with mammals of brain function, eye structure, and transposon activity. Sequencing of cephalopod genomes revealed a peculiar bias in base composition toward AT richness that is unexpected for such an advanced lineage. To better assess this bias, we modified our Python tool for visualizing AT/GC and repetitive proportions along assembled chromosome sequences to enable the processing of large genomes such as those of cephalopods. Our tool EVAN3.0 combined with repeat-masking revealed several patterns of AT/GC heterogeneity along assembled mollusc chromosomes that were previously attributed only to mammals and birds. We also found an unexpected AT richness in the cephalopod coding genome and in other molluscs that is unusual even for invertebrates. Mollusc genomes are highly repetitive, approaching 70% in cephalopod genomes. The repetitive elements, including DNA transposons and retrotransposons, vary in their GC fractions, resulting in the regional AT/GC heterogeneity along mollusc chromosomes. The GC fraction of the whole genome thus results from complex mutual interactions between the host genome and its repeats. We speculate that emergence of cephalopods specific transposons in their genomes is connected to emergence of their highly advanced evolutionary novelties involved in brain development.

Morphological assessment of the Spotted garden eel (*Heteroconger hassi*) for prospective research ideas

Diala Joy Edde, OIST

Spotted garden eels (*Heteroconger hassi*) are members of the subfamily *Heterocongrinae*, which includes around 36 species. These eels exhibit a unique colonial lifestyle, inhabiting sandy ocean floors and rarely leaving the burrows they create. Their semi-sessile behavior, coupled with their burrowing and feeding mechanisms, suggests anatomical adaptations that are yet to be fully understood.

This study seeks to investigate the musculature and skeletal structure of *H. hassi* through the use of micro-

computed tomography (micro-CT), allowing for high-resolution 3D models to be developed. These models will help elucidate the biomechanics of their burrowing, anchoring behaviors, and unique feeding strategies. Understanding these morphological traits provides a foundation for comparative studies with other species within the *Heterocongrinae* sub-family, as well as other anguilliform or burrowing fish.

Distribution and habitat characteristics of the juvenile mudskipper, *Periophthalmus modestus* on the Edogawa flood channel

Yijin Lee, OIST

Coastal development in the 20th century has resulted in the loss of approximately 90% of intertidal flats in Tokyo Bay. However, surviving tidal flats, as well as small-scale artificial tidal flats formed in flood channels, now serve as habitats for benthic organisms. The mudskipper (*Periophthalmus modestus*) is one of the inhabitants in this urbanized environment. Given its amphibious lifestyle, the mudskipper has the potential to serve as a bioindicator for assessing intertidal ecosystems. Therefore, studying the population dynamics of *P. modestus* in Tokyo Bay can provide valuable insights into identifying potential habitats and conserving species. This study aimed to expand current knowledge of *P. modestus* population dynamics by investigating the distribution of the species during its juvenile stage and its relationship with environmental factors. In 13 sites along the Edogawa flood channel, the largest habitat for *P. modestus* in Tokyo Bay, we collected data on the species' distribution and various environmental factors (sediment water contents, sediment gradient, copepod population, chlorophyll a concentration, organic matter content, and vegetation distribution) while the juveniles are active. By employing Generalized Linear Mixed Models, we identified the factors influencing the juvenile distribution. The vegetation distribution (*Phragmites australis*) was the most significant environmental factor influencing juveniles distribution; habitats with complex structure of the vegetation tend to have more juvenile population as the vegetation is used as shelter from predators. Furthermore, we found out that different environmental factors were dominant during certain periods. The present findings will be helpful for artificial tidal flats management and species conservation.

Microplastic collection robot No.3

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It is said that each person ingests the equivalent of one credit card full of microplastics per week. As the effects of microplastics on the human body begin to be understood, they are becoming more and more of a problem and are attracting more and more attention each year.

However, when it comes to collecting microplastics, it is difficult to collect them due to their small size. Therefore, we thought that automating the collection of microplastics would be a good way to raise awareness of environmental issues as a part of marine litter pickup activities.

In this presentation, we will review the prototype microplastic collection robot we have created, introduce the results of our research on the third robot we are currently creating, and discuss the potential this robot has for impacting the marine environment.