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Oral presentation abstracts

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State Key Laboratory of Marine Pollution
&
Department of Chemistry

City University of Hong Kong

Abstract of

Plenary Lectures

Plenary lecture 1: 10:20-11:00, 3/1/2024 (Wednesday), Joseph Lee Hall, AC2

PERSISTENT EUTROPHICATION AND HYPOXIA IN THE COASTAL OCEAN

Dai M.H.

State Key Lab of Marine Environmental Science, Xiamen University, Xiamen, China

Coastal eutrophication and hypoxia remain a persistent environmental crisis despite the great efforts to reduce nutrient loading and mitigate associated environmental damages. Symptoms of this crisis have appeared to spread rapidly, reaching developing countries inAsiawith emergences in Southern America and Africa. The pace of changes and the underlying drivers remain not so clear. To address the gap, we review the up-to-date status andmechanisms of eutrophication and hypoxia in global coastal oceans, upon which we examine the trajectories of changes over the 40 years or longer in six model coastal systems with varying socio-economic development statuses and different levels and histories of eutrophication. Although these coastal systems share common features of eutrophication, site-specific characteristics are also substantial, depending on the regional environmental setting and level of social-economic development along with policy implementation and management. Nevertheless, ecosystem recovery generally needs greater reduction in pressures compared to that initiated degradation and becomes less feasible to achieve past norms with a longer time anthropogenic pressures on the ecosystems. While the qualitative causality between drivers and consequences is well established, quantitative attribution of these drivers to eutrophication and hypoxia remains difficult especially when we consider the social economic drivers because the changes in coastal ecosystems are subject to multiple influences and the cause–effect relationship is often non-linear. Such relationships are further complicated by climate changes that have been accelerating over the past few decades. The knowledge gaps that limit our quantitative and mechanistic understanding of the human-coastal ocean nexus are identified, which is essential for science-based policymaking. Recognizing lessons from past management practices, we advocate for a better, more efficient indexing system of coastal eutrophication and an advanced regional earth system modeling framework with optimal modules of human dimensions to facilitate the development and evaluation of effective policy and restoration actions.

Plenary lecture 2: 11:00-11:40, 3/1/2024 (Wednesday) [online]

HOW MUCH DO WE UNDERSTAND ABOUT THE OCEAN'S ROLE AS THE TERMINAL SINK FOR ANTHROPOGENIC CHEMICALS?

Sunderland E.M.

Harvard University, USA

The biogeochemical cycles of many trace elements have been greatly perturbed by human activities such as fossil fuel combustion and mining in the past and more recently climate-driven changes, with implications for global health. Further, fossil fuel feedstocks provide the parent materials for hundreds of thousands of synthetic organic pollutants that are widely used in modern commerce and end up in the global oceans as the terminal sink for environmental pollution. This presentation will discuss the persistence of different pollutants in the marine environment and the chemical/physical processes that control sustained biological exposures. Examples will be drawn from current understanding of the global cycles of selected per- and polyfluoroalkyl substances (PFAS), polychlorinated biphenyls (PCBs), and mercury (Hg). Key gaps in present knowledge and steps toward protecting the health of global ocean ecosystems will be discussed.

Plenary lecture 3: 11:40-12:20, 3/1/2024 (Wednesday), Joseph Lee Hall, AC2

ADVANCE MARINE SCIENCE DEVELOPMENT AND COOPERATION FOR PEACE AND SUSTAINABLE DEVELOPMENT

Zhu W.X.

IOC Sub-Commission for the Western Pacific, Intergovernmental Oceanographic Commission of UNESCO

The ocean is at the heart of the sustainable development, as it plays a fundamental and usually unrecognized role in the survival and development of humanity. Despite its significance, much of the ocean remains largely unknown to us. Advancing ocean science and cooperation is essential to improve ocean governance and to inform decisions at all levels.

The Ocean and seas have been deeply embedded in the long history and culture in the region. The Indo-Pacific Ocean-the 'heat engine' of the globe, is universally recognized as one major influence on the global climate and ocean circulation system. The ocean in this region is also home to the richest marine life abundance and diversity on the planet, with invaluable ecosystem services to sustain the well-being of our people in the region and beyond.

The region is highly populous, rapidly advancing, yet fragile. We do know that humans are exerting ever-increasing pressure on the ocean. Climate change and ocean acidification, overfishing and marine resource depletion, land-based pollution, habitat degradation, marine disasters are threatening the productivity and health of the ocean and prosperities of all countries in the region.

Ocean flows without any respect to political maritime boundaries. We must work together to generate ocean science solutions for the sustainable development of our shared ocean and humanity's wellbeing! This is why the Intergovernmental Oceanographic Commission of UNESCO is positioned to coordinate and facilitate the development of ocean sciences, observations and capacity-building to monitor the ocean's major role in the earth and climate system, predict its changes and human impacts on marine biodiversity and ecosystem, laying the ground for efficient climate adaptation and mitigation strategies, biodiversity conversation, and blue economy.

The UN Decade of Ocean Science for Sustainable Development (2021-2030) offers a much-needed opportunity for all countries, ocean institutions and stakeholders to work together towards the development of science-based solutions. Tremendous efforts are ongoing, but much more still needs to be done, particularly in this developing region.

Abstract of

Keynote Lectures

Keynote lecture 1: 16:30-17:05, 3/1/2024 (Wednesday), Lecture Theatre 1, YEUNG

ADVANCES AND PROSPECTS OF SCIENCE AND TECHNOLOGY INNOVATION FOR MARINE ENVIRONMENTAL PROTECTION IN CHINA

Wang W.

Division of Ocean, ACCA21, NSFC

In the context of the National Medium- and Long-term Science and Technology Innovation Plan for the Marine Sector (2021-2035), the National Key Research and Development Program "Marine Environmental Security and Sustainable Development of Islands and Reefs" (Marine Environment Program), implemented during "14th Five-Year Plan", has conducted systematic deployment on marine environmental protection and pollution control. During the past three years, the breakthroughs in marine environmental protection has been made by the projects supported by the Marine Environment Program, especially in the cutting-edge scientific issues and key technologies in marine environment, such as environmental pollution control, the prevention and control of ecological disasters, the restoration and protection of ecosystems, control and removal of emerging pollutants, and marine carbon sink. Overall, the Marine Environment Program aims to create sustainable marine ecological environments, provide scientific supports to the exploration of establishing a comprehensive governance system for the coasts, river basins and seas, and make contribution to marine environmental protection for building a strong maritime nation.

Keynote lecture 2: 17:05-17:40, 3/1/2024 (Wednesday), Lecture Theatre 1, YEUNG

PARADIGM OF COASTAL HYPOXIA OFF HONG KONG: CHALLENGES OF COUPLED PHYSICS-BIOGEOCHEMISTRY

Gan J.P.

The Hong Kong University of Science and Technology

The coastal waters off Hong Kong are affected by persistent and increasing eutrophication and hypoxia. This deteriorating situation results in other ecosystem disruptions. The grand OCEAN_HK project (https://ocean.ust.hk/), through coupled physical-biological-chemical observational and modelling studies over the interactive river-estuary-shelf (RES) system in the regions, aims to determine sources and sinks of nutrients, their biogeochemical and physical controls on the eutrophication/hypoxia in the RES waters off HK. Unlike conventional biogeochemistry consideration alone, we found that biogeochemical substances and processes are necessary conditions for hypoxia formation, while they become sufficient conditions by combining with the unique hydrodynamics in the coastal transition zone (CTZ). The distinct hypoxic centres off Hong Kong waters are mainly induced by oxygen consumption of eutrophication-induced organic matter in the CTZ between the estuary and adjacent shelf. Nutrient-rich plume waters with vortex-induced long residence time in CTZ provides a favourable biophysical hub for the formation of hypoxia. We holistically provide scientific evidence to explain where, when and how the hypoxia occurs, predict its long-term trend under changing climate, and assess potential mitigation scheme to tackle this marine environmental challenge we are facing.

Keynote lecture 3: 17:40-18:15, 3/1/2024 (Wednesday), Lecture Theatre 1, YEUNG

STATUS AND RESEARCH PERSPECTIVES OF HARMFUL ALGAL BLOOMS IN CHINA

Yu R.C., Geng H.X. and Zhang Q.C.

Institute of Oceanology, Chinese Academy of Sciences, China

Harmful algal bloom (HAB) is a typical marine ecological disaster in the coastal waters of China. Different types of HABs, such as red tides of dinoflagellates and haptophytes, brown tides of pelagophytes, and the macroalgal blooms of *Ulva* spp. and *Sargassum horneri*, have been recorded in different regions along the coast of China. The scale, frequency, and negative impacts of HABs exhibited remarkable increases over the last three decades, together with the marked shifts in HAB-causative species. Research on HABs has been supported continuously by the Natural Science Foundation of China, Ministry of Science and Technology of China, and Chinese Academy of Sciences. Great achievements have been made to understand the biological, ecological and oceanographic processes of major HABs in China. However, the emerging HABs in a changing marine environment driven by climate change and eutrophication bring new challenges to HAB studies and management. A comprehensive system on risk assessment, monitoring and mitigation of HABs needs to be established, besides the basic research on the mechanisms of HAB formation and evolution, to reduce their disastrous impacts.

Keynote lecture 4: 9:00-9:35, 4/1/2024 (Thursday), Lecture Theatre 1, YEUNG

"CAR-PFAS JAPAN" TO IMPROVE PFAS ACTION PLAN IN JAPAN – REGENESIS FROM THE LOST FIFTEEN YEARS

Yamashita N.

National Institute for Advanced Industrial Science and Technology (AIST)

AIST has been known for one of pioneers in PFAS research together with City University of Hong Kong (Prof. Paul K.S. Lam, the former vice president). The first international standard for measuring PFOS and PFOA in water - ISO25101 and 30 PFAS - ISO21675 were established by AIST in 2009 and 2019, respectively; they are widely used in the world. ISO21675 is the only available method to measure 0.004 ng/L of PFOA in water sample to date and lead "PFAS oceanography" including a novel report of global circulation of PFAS in open ocean.

However, recent literature survey revealed that good publications rarely reported PFAS issues in Japan for the last fifteen years while AIST reports were highly cited (CI 531). After discussion with Japanese government, emerging action is needed to improve research and technology for PFAS issue in Japan and finally, the **C**onsortium for **A**nalysis and **R**emediation of **P**er- and **P**oly-fluoroalkyl substances (**CAR-PFAS Japan**, https://unit.aist.go.jp/mcml/rg-org/pfasconsortium.html) was established in June 2021 in AIST. Currently CAR-PFAS Japan has 82 members from 44 organizations, which include Japanese EPA, MAFF (the Ministry of Agriculture, Forestry and Fisheries), major companies and institutions related PFAS issue until October 2023. All members of CAR-PFAS Japan recognized that Japan has to catch up with most recent research and technology to solve PFAS problems in Japan in October 2023 after the fifth international workshop of CAR-PFAS Japan.

CAR-PFAS Japan conducted several lectures, meetings, training workshops and technology transfer about state-of-the-art analysis and remediation of PFAS in the environment to members and harvested as several patents and new technology from Japanese institutions. One of the important activities is on-site training of PFAS technology by world famous professionals, such as Dr. Leo Yeung (Orebro University, Sweden), Prof. Lutz Ahrens (Swedish University of Agricultural Sciences, Sweden) and Prof. Wei Si (Nanjing University, China).

In this presentation, progress and future of CAR-PFAS Japan will be discussed together with recent development from our activity, which include 1) Triporous-PFAS, the first activated carbon derived from rice husk developed by the Sony Group, were certificated for 99% adsorption of twenty-one PFAS in water; 2) the use of liquid activated carbon to immobilize PFAS in soil will be demonstrated as well; 3) GC Orbitrap-HRMS enable most sensitive measurement of thirty-six volatile PFAS in air; and lastly, a new statement "How to remove PFAS from agriculture field" will be shown together with Dr. Leo Yeung.

Keynote lecture 5: 9:35-10:10, 4/1/2024 (Thursday), Lecture Theatre 1, YEUNG

REVISITING MILLENIAL FORECASTS OF IMPACTS AND STATUS OF ROCKY SHORES IN 2025: DID WE DO WELL?

Hawkins S.J. [1,2,3], Crowe T.P[4]., Branch G.M. [5], Castilla J.C.[6], Langmead O. [3], Firth L.B. [3,7], Burrows M.T. [8], Leung K.M.Y. [9], Mieszkowska N. [2,10], Bray S. [1,11], and Thompson R.C. [3]

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[9] *City University of Hong Kong, China*
[10] *University of Liverpool, UK*
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Experts were invited in 2000 to make forecasts of the status of aquatic habitats and ecosystems in 25 years-time for a meeting to be held in Zurich (Environmental Futures Conference). Here we revisit Thompson et al., 2002 (subsequently published in Environmental Conservation) considering rocky shores. We discuss what impacts we got right or at least partially right. We confess to what we got wrong by omission or failure to anticipate. The approach taken in the early 2000s was to use our judgement to look at trajectories of pollution and other impacts from the 1960s to date, thereby making forecasts of future states. These are updated. Our Eurocentric northern hemisphere view was challenged by experts from the South (Castilla and Branch) and a joint synthesis produced (Branch et al., 2008 in Polunin, N., Aquatic Ecosystems: Trends and global prospects, CUP). Here we revisit what we got mostly right (climate change, oil pollution, sewage, eutrophication, commercial and recreational/subsistence harvesting, invasive non-native species, some endocrine disrupters), only partially right (habitat modification by artificial structures), and completely missed (e.g., ocean acidification, PAHs, pharmaceuticals). We then turn to what has got better (sewage – but only in some places), got worse or has emerged since (plastics). We also briefly consider how legacy pollution can re-surface. We make some new forecasts for 2050 (validated with the help of the audience). We emphasize the importance of understanding multiple stressors, especially the interaction of global change with regional and local scale impacts. The role of MPAs in distinguishing more localised effects from global change is emphasized, as well as continued vigilance for emerging contaminants of concern. A plea to look at recovery of highly polluted systems is made again.

Keynote lecture 6: 10:10-10:45, 4/1/2024 (Thursday), Lecture Theatre 1, YEUNG

BLUE FOOD ASSESSMENT

Cao L.

Xiamen University, China

Global aquatic or "blue" food production faces the challenge of maintaining supply in a changing environment and providing significant and essential nutrition to over 3.2 billion people while meeting standards of food safety and sustainability. Despite growing concerns over the environmental impacts of blue food production, little attention has been paid to how production is influenced by anthropogenic environmental changes. To quantify the global vulnerability of blue foods to ongoing environmental shifts, we first identify the predominant anthropogenic stressors that have the potential to affect the quantity and safety of blue foods. We then perform an indicator-based an indicator-based analysis on a global scale, utilizing the most reliable public databases available to evaluate the spatial ranges of the predicted impacts of these stressors on blue food production. Our study seeks to identify highly susceptible blue food systems and production countries, in addition to the diverse geographical patterns of various environmental threats to production systems. The insights garnered from our study can lay the groundwork for future research to map environmental challenges and opportunities on various scales. This will aid strategic planning and policy development with the aim of maintaining resilient and sustainable blue food production.

Keynote lecture 7: 11:05-11:40, 4/1/2024 (Thursday), Lecture Theatre 1, YEUNG

IMPACTS OF CLIMATE CHANGE ON PESTICIDE TOXICITY IN COASTAL ENVIRONMENTS

Schlenk D.

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University of California, Riverside, CA USA

Sea Level rise has led to the intrusion of saltwater into estuarine coastal areas. Temperatures have also increased in coastal embayments, and combined with hypersaline conditions may serve as non-chemical stressors for organisms residing in these ecosystems. Our laboratory has shown that non-chemical stressors can have significant impacts on the toxicity of legacy and emerging contaminants that co-occur with climate-change derived environmental changes. Effects are species-specific with organisms having euryhaline life histories showing differential sensitivities to pesticides than those with stenohaline life histories. Hormonal changes as a result of osmoregulatory responses from non-chemical exposures impact biotransformation which can either activate contaminants or detoxify them depending on the life history of the animal. Targets are diverse and include numerous neuro-endocrine signalling pathways that alter behavior and reproduction. This presentation will provide an overview of how adverse outcome pathway paradigms can be used to estimate toxicity from combined chemical and non-chemical stressors which may be used in weight of evidence components of ecological risk assessments.

Keynote lecture 8: 11:40-12:15, 4/1/2024 (Thursday), Lecture Theatre 1, YEUNG

BIOENERGETICS APPROACHES TO ASSESS THE MECHANISMS AND EFFECTS OF MULTIPLE STRESSORS ON MARINE ORGANISMS

Sokolova I.M.

Marine Biology Department, Institute for the Biological Sciences, University of Rostock, Rostock, Germany

Energy metabolism (encompassing energy assimilation, conversion and utilization) plays a central role in all life processes and serves as a link between the organismal physiology, behavior, and ecology. Metabolic rates define the physiological and life-history performance of an organism and have direct implications for Darwinian fitness. Anthropogenic and natural stressors affect energy balance because the stress-induced disruption of homeostasis must be corrected to ensure the organism's survival. Pollutants can negatively affect different aspects of energy metabolism of an organism interfering with energy assimilation and conversion or increasing energy costs for basal maintenance. I will discuss the role of energy homeostasis in setting limits of environmental stress tolerance of aquatic ectotherms and the use of bioenergetic approaches in assessment of the combined effects of pollutants (including pharmaceuticals, nanoparticles and trace metals) with climate change-related drivers (temperature, ocean acidification and oxygen deficiency) using marine bivalves as a model group. I will also discuss the mechanisms underlying the pollutant-induced bioenergetics disturbances in marine organisms and the advantages and limitations of using bioenergetics as a tool linking the molecular and cellular stress responses to the whole-organism fitness in coastal environments of Anthropocene.

Keynote lecture 9: 12:15-12:50, 4/1/2024 (Thursday), Lecture Theatre 1, YEUNG

Host-Microbiota Interaction in Nano-, Microplastic, or Microfiber-Exposed Marine and Freshwater Water Fleas

Lee J.S.

Sungkyunkwan University, Suwon, South Korea

Anthropogenic environmental stressors (e.g., freshwater acidification [FA], elevated temperature, and microfiber [MF]) can interact with plastic pollution to disrupt brackish and/or freshwater ecosystems. However, the underlying mechanisms responsible for the interactive effects of FA and elevated temperatures with MF and micro- and nanoplastics [MNP] on aquatic organisms remain poorly understood. In this study, we investigated individual *Daphnia magna*-microbiota interactions affected by interactions between microfibers and FA (MFA) and the marine water flea *Diaphanosoma celebensis*-microbiota interactions in response to elevated temperatures and nanoplastics. We found that the accumulated amount of microfibers in pH-treatment groups in *D. magna* was significantly higher than in the control groups, resulting in negative consequences on reproduction, growth, and sex ratio, while the marine water flea *D. celebensis*-microbiota interactions also showed deleterious effects in response to elevated temperature and nanoplastics. We also observed that MFA interactions induced immunity- and reproduction-related biological processes in *D. magna*. In particular, the abundance of pathogenic bacteria increased only in MFA groups, indicating that MFA interactions can cause intestinal damage. Our integrated analysis of microbiomes and host transcriptomes revealed that the synergistic adverse effects of MFAs are closely related to changes in microbial communities, suggesting that *D. magna* fitness and the microbial community are causally linked. These findings may help elucidate the toxicity mechanisms governing the responses of *D. magna* to microfibers, acidification interactions, and host-microbiome-environment interactions.

Keynote lecture 10: 9:00-9:35, 5/1/2024 (Friday), Lecture Theatre 1, YEUNG

OVERVIEW OF KOREAN TIDAL FLATS: BIODIVERSITY AND ECOSYSTEM SERVICIES

Khim J.S.

School of Earth and Environmental Sciences, Seoul National University, Korea

The Korean tidal flats have been recently inscribed as the world natural heritage (WNH) by the UNESCO. Two major aspects were highlighted: 1) the excellency of coastal landscape and geomorphological feature and 2) importance of stopover place for migrating waterbirds. Whilst the importance of marine benthic invertebrates has not been fully emphasized. Our recent studies indicated that global top level of the marine biodiversity in macrozoobenthos from the Korean tidal flats, with reported species of 1,915 macrozoobenthos. It is also important to note that the designated areas include only four tidal flat areas of Seocheon, Gochang, Shinan, Boseong-Suncheon out of numerous tidal flats across the west and south coasts of Korea. This can be limitation in that ecological aspect of tidal flats, such as natural connectivity across structure and functioning of marine biota, has not been fully considered. Considering the valuable regulating services of the tidal flats, such as the blue carbon potentials and the natural purification capacity, further extension of the Korean tidal flats would be necessary in the future. Overall, to ensure the sustainability of the tidal flats, integrated management efforts aiming at reduction of the additional coastal developments should be given.

Keynote lecture 11: 9:35-10:10, 5/1/2024 (Friday), Lecture Theatre 1, YEUNG

HOLISTIC IMPACT EVALUATION OF HUMAN ACTIVITIES ON THE COASTAL FISH BIODIVERSITY IN THE CHINESE COASTAL ENVIRONMENT

Zhang X., Zhong Z., Zhang, J., Li H., Liu W.

School of the Environment, Nanjing University, Nanjing 210023, P. R. China;
National Marine Environmental Monitoring Center, Dalian 116023, P. R. China
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Ecological qualities and resources in coasts are threatened by various human activities, such as pollution and fishery. Impact evaluation of environmental stressors over a wide coastal stretch has been limited due to lack of efficient and standardizable biodiversity monitoring and assessment tools. Integrating environmental DNA (eDNA) and ecological traits, a holistic approach was developed to assess the impact of pollution and aquaculture on fish biodiversity in Chinese coastal areas. Taking the Yalujiang Estuary (YLJK) from the Yellow Sea and the Nan'ao Island Area (NAO) from the South China Sea as cases, the performance of the eDNA biomonitoring workflow was validated. First, the eDNA results of 22 sampling sites reached more than 85% of the asymptotes of species or ASVs in each area. A total of 115 fish species in both areas were detected and NAO was 1.8 times richer than YLJK using eDNA and the fish eDNA composition was consistent with the historical data. eDNA recovered distinct variations of fish sequence, taxonomic and functional diversity, and the corresponding trends following the offshore distance between the two areas. Fish sequence diversity was decreased primarily by estuarine pollution factors (chemical oxygen demand and zinc) in the YLJK. Compared with no breeding areas, lower fish sequence diversity was in breeding areas in the NAO. By integrating ecological traits, the eDNA approach offers promising opportunities for future fish biodiversity monitoring and assessment in national and global coastal environments.

Keynote lecture 12: 10:40-11:15, 5/1/2024 (Friday), Lecture Theatre 1, YEUNG

INDICATORS OF MARINE MICROPLASTIC POLLUTION

Sun C.J., Ding J.F., Li J.X.

First Institute of Oceanography, Ministry of Natural Resources, China

Potentially risky to the ecosystem, microplastics are ubiquitous in all the world oceans and have become a growing global concern. In order to comprehensively evaluate the impact of microplastic on the ecosystem, it is important to know the current microplastic pollution status and estimate the changing trend. Unfortunately, though a lot of research have been conducted on marine microplastic, there is no one-for-all standardized method for this complicated new pollutant. Different methodologies have made data generated from these research very often hard to compare. Under this circumstance, selecting the right indicators to monitor microplastic pollution provides a practical way to conduct microplastic investigations so as to provide comparable datasets. Since marine microplastics are present in all types of media including the seawater, sediment, biota and atmosphere, indicator selections need to consider both media type and biological species. This talk will focus on explaining the factors that may affect a bioindicator selection and introduce a scoring system that can be used for selecting the most appropriate bioindicator for different media type. A successful bioindicator will provide a great tool for microplastic pollution monitoring and help to gain information on the microplastic pollution status worldwide.

Keynote lecture 13: 11:15-11:50, 5/1/2024 (Friday), Lecture Theatre 1, YEUNG

MICROPLASTIC (ECO)TOXICOLOGY IN MARINE ENVIRONMENT: WHERE ARE WE NOW?

Wang W.X.

School of Energy and Environment and State Key Laboratory of Marine Pollution, City University of Hong Kong, Kowloon, Hong Kong, China

Microplastics (MPs) and nanoplastics (NPs) have become significant concerns in marine environments, ranking high on the list of major contaminants. The attention of various stakeholders, including academics, the public, industry, businesses, and policymakers, has been drawn to microplastics due to their unique properties. Consequently, there has been a remarkable increase in toxicological research in this field over the past decade. These studies primarily focus on three key aspects. Firstly, they investigated the presence of different types of microplastics in various marine organisms across different natural environments. These investigations often involve characterizing the microplastics themselves. Secondly, numerous studies examined the toxicity of MNPs on a range of marine organisms, including phytoplankton, zooplankton, bivalves, and fish. The endpoints of these studies encompass bioaccumulation of MNPs and their toxic effects at different levels, such as molecular and microbiome (omics), biochemical, physiological, and organismic levels. Lastly, many studies also explored the combined effects of MNPs with other classes of contaminants present in the environment. During this talk, I will discuss some caveats or limitations in the current environmental toxicological studies of MNPs in marine environments. Specifically, I will highlight the aspects that have been overlooked in earlier studies from the perspectives of ecology, physics, chemistry, and modeling. By enhancing our understanding of organism physiology, the chemistry of MNPs, and the mathematical modeling of MNPs kinetics, we may advance the field to a new stage of research. Furthermore, it is crucial for toxicological studies to incorporate the ecological component, making them more applicable to real-world environmental settings.

Keynote lecture 14: 11:50-12:25, 5/1/2024 (Friday), Lecture Theatre 1, YEUNG

MECHANISMS AND CONTROL MEASURES FOR THE RELEASE OF MICROPLASTICS FROM MARICULTURE

Shi H.H., Zheng Y.F., Zhao W.J., Su L., Du F.N.

State Key Laboratory of Estuarine and Coastal Research, East China Normal University, Shanghai, 200241, China

Various plastic products have been widely used in mariculture for decades all around the world, and the abandoned or lost plastic products also lead to the generation of large plastic debris and even microplastics. We conducted large scale of investiations and some simulation experiments on the reasons for the fragmention of large plastics and formation of microplastics in mariculture. Our study suggests that diverse weathering feathures (e.g., crack and erison) occurred on the surfaces of hard plastic fragments such as HDPE. The UV irridiation was likey to induce cracks on the plastic sunward surfaces, while biofilm was likely to form on the plastic seaward surface and to reduce the photooxidation degree of plastics. Huge microplastics could be generated from the highly weathered plastic fragments but hardly detected in the real environments. Unlike hard plastics, soft plastics (i.e, Styrofoam) used as floats in mariculture showed different weathering and broken processes. Our study suggests that burrowing invertebrates played a critical role in their fragmentation and dispersion. Huge microfoams could also be generated by the burrowing invetrbates directly. These results showed great implication for the control measures of microplastic release from mariculture. Generally, we should control large plastics rather than collect and remove microplastics directly from the environments. For hard plastics, it is urgent to clean them up in some hot areas such as coast before they get highly weathered; for soft plastics, it is critical to prevent them from being burrowed by the invebrates during the use.

Keynote lecture 15: 16:30-17:05, 5/1/2024 (Friday), Lecture Theatre 1, YEUNG

THE CAUSE, FORMATION AND PREDICTION OF GREEN TIDE IN THE YELLOW SEA

Liu D., Ge J., Ma Q.

East China Normal University, China

The world's largest macroalgal blooms during 2008-2023 occurred in the Yellow Sea, China and attracted the attention from scientists and management. This presentation will address the causes, formation, predication and future challenges in this unique case. Satellite imagery and field observations showed that the macroalgal blooms in the Yellow Sea originated from the coast of Jiangsu province and that favourable geographic and oceanographic conditions brought the green macroalgae from the coast to offshore. Optimal temperature, light, nutrients and wind contributed to the formation and transport of the massive bloom north into the Yellow Sea and its deposition onshore along the coast of Shandong province. Morphological and genetic evidence demonstrated that the species involved was Ulva prolifera, a fouling green alga commonly found growing on structures provided by facilities of nori aquaculture. Certain biological traits of U. prolifera including efficient photosynthesis, rapid growth rates, high capacity for nutrient uptake, and diverse reproductive systems allowed growth of the original thousand tonnes of U. prolifera biomass into more than one million tonnes of biomass in just two months. The proliferation of U. prolifera in the Yellow Sea resulted from a complex contingency of circumstances, including human activity (eutrophication by release of nutrients from wastewater, agri-culture, and aquaculture), natural geographic and hydrodynamic conditions (current, wind) and the key organism's biological attributes. A numerical model was developed based on the processes of biological -chemical-physical interactions in the ocean and has applied for early prediction and mitigation of green tides. In future, the strategy with consideration of scientific, social and political implications are critical to solving the green tide in the Yellow Sea.

Keynote lecture 16: 17:05-17:40, 5/1/2024 (Friday), Lecture Theatre 1, YEUNG

CIGUATOXIN CONTAMINATION RAISING THE RISK TO SEAFOOD SAFETY IN VIET NAM

Ha D.V.[1], Ky P.X[1]., Khanh-Hy L.H.[1], Chan L.L.[2], Wu J.J.[2], Suzuki T.[3], Uchida H.[3]

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Viet Nam is one of the Asian countries where people consume rice as a main carbohydrate source and seafood as a main protein source traditionally. Local people eat almost all variety of marine animals, which are caught by them from the sea, or are obtained from a market. Among of them, reef fishes are the most popular and favorite seafood not only for local people, but also for tourists. Since 2007, suspected CFP cases by the consumption of red snappers and moray eels, have been occurred mostly on the central coast of Viet Nam, where these fishes have been often caught and eaten. In Viet Nam, at least five *Gambierdiscus* species are reported commonly; however, there was a little known about ciguatoxins (CTXs) in these marine fishes.

In 2014 and 2016, there were two suspected CFP cases reported in central coast of Viet Nam by eating of red snapper *Lujanus bohar*. Using the single-quadrupole selected ion monitoring (SIM) liquid chromatography/mass spectrometry (LC/MS) and TOF-LC/MS; CTX-1B was detected and confirmed in these poisonous specimens. The concentrations of CTX-1B in red snappers quantified as 0.9–3.7 ng/g fish flesh, which were within the range reported from CFP cases in Pacific region. Following, CTX-1B was also detected in 12 out of 119 specimens (accounting for about 10% of total specimens) of 06 moray eel species collected from Vietnamese central water. The levels of CTX-1B in moray eels varied from ≤ limit of detection (LOD) to 4070 pg/g flesh among individuals, species and locations. The toxic specimens are found belonging to four *Gymnothorax* species (*G. fimbriatus*, *G. flavimarginatus*, *G. javanicus* and *G. undulatus*), but not in other moray eel genus (*Echidna* and *Enchelycore*) suggesting that the accumulation capacities of CTXs vary among moray eel species owing to their feeding habits and toxin storage and clearance capabilities. Remarkably, CTX-1B levels detected in all toxic specimens were beyond the safety threshold of 10 pg/g CTX-1B equivalent. These results suggested that there was CTX-1B contamination, at least on the central coast of Viet Nam indicating a CFP risk by consumption of these fishes. The CTX profile in Vietnam is similar to those of ciguatera fish from Australia, Okinawa Islands in Japan, Kiribati, and Hong Kong; recommended dominant distribution of CTX-1B in the region. It is known that recent significant increasing of CFP is associating with the increase of occurrence and/or expansion of distribution of ciguatoxin in the region. But up to now, almost of researches was at country level, therefore, it is no information on occurrence and distribution of marine toxins associated to seafood poisoning in the region. On the other hand, the transboundary issue concerning the export of toxin contaminated seafood to neighbouring countries become emerging issues of common regional interest. In such situation, efforts need to be made to assess the regional status on the occurrence of ciguatera to serve a strategy on seafood security to minimize the risk of CFP to the public health. For that, the cooperation and conduct joint studies among WESTPAC scientists, institutions and countries as well as improvising and supporting toxin analysis capacity in member states are needed.

Keynote lecture 17: 9:00-9:35, 6/1/2024 (Saturday), Lecture Theatre 2, YEUNG

HOW AND WHY GROUNDWATER MATTERS FOR THE MARINE ENVIRONMENT

Hose G.C.

Macquarie University, Sydney, Australia

After the marine environment, groundwaters are the largest and most widespread aquatic ecosystem on the planet and contain more than 200 times more water than all the rivers, lakes and reservoirs combined. Groundwaters are a key part of the hydrological cycle and can have a major impact on the structure, function, and health of marine ecosystems. Overall, the volume of fresh groundwater discharge to marine environments is only around 1% of the annual river discharge. However, groundwater discharge provides ecologically important and typically stable environmental conditions a local scale where it does occur. Although lower in volume than river discharge, groundwaters provide considerably more dissolved nutrients and materials, which support primary productivity in the benthos and water column.

Use of groundwater globally has intensified in recent decades, and is projected to further increase, and exacerbate existing problems of groundwater depletion. At a global scale, groundwater is a significant contributor to sea level rise, and groundwater depletion has been a significant contributor to shifts in the earth's access. At local and regional scales, groundwater discharge to the marine environment provides specific habitat conditions that are critical to some species and ecological processes. Groundwater can also be a significant source of pollution that is particularly difficult to manage or remediate. In this talk I will provide an overview of groundwater resources and ecosystems, and their importance to marine ecosystems. With increasing pressure on groundwater resources globally, I will discuss the implications of such changes to groundwater discharge to marine environments. Through a series of case studies, I will explore the impacts of groundwater contamination on marine environments and opportunities for mitigation and remediation.

Keynote lecture 18: 9:35-10:10, 6/1/2024 (Saturday), Lecture Theatre 2, YEUNG

A PARADIGM SHIFT IN ENVIRONMENTAL MONITORING AND ASSESSMENT OF ORGANIC CONTAMINANTS: ORGANOPHOSPHATE FLAME RETARDANTS

Lim J.E., Moon H.B.

Hanyang University, Korea

Organophosphate triesters (tri-OPEs) have been widely used as flame retardants and plasticizers in industrial and consumer products. With the increasing demand of flame retardants, tri-OPEs have been contaminated to the environment, wildlife, and humans. Despite numerous studies on the distributions of tri-OPEs in various environmental compartments, few studies are investigated on the occurrence of organophosphate diesters (di-OPEs). In the present study, tri- and di-OPEs were simultaneously determined for water and sediment from highly industrialized coastal waters of Korea to understand the environmental distribution and degradation processes of OPEs in coastal environment. We also assessed the suitability of types of OPEs for environmental and biological monitoring tools. All di- and tri-OPEs were detectable in almost water and sediment samples, indicating widespread contamination in aquatic environments. The concentrations of tri-OPEs in water were similar to those of di-OPEs, whereas tri-OPE concentrations in sediments were higher than those of di-OPEs. Predominant tri- and di-OPEs were different depending on the coastal waters and environmental compartments surveyed in our study. Di-OPEs, degradation products of tri-OPEs, were not matched with major parent OPEs in water and sediment samples, indicating the possibility of use for di-OPEs as parent. The occurrence of chemical types of OPEs may be influenced by impact of source, chemical properties, and degradation conditions of aquatic environments. Recent studies have reported that di-OPEs elicit comparable or greater adverse health effects with tri-OPEs. Our findings suggest that the present environmental and biological monitoring tools should be revised for accurate assessment of OPEs.

Keynote lecture 19: 10:40-11:15, 6/1/2024 (Saturday), Lecture Theatre 2, YEUNG

TOWARDS PRECISION ECOTOXICOLOGY: INTEGRATING ONE HEALTH DURING STUDY OF URBANIZING AQUATIC SYSTEMS

Brooks B.W.

Department of Environmental Science, Baylor University, Waco, Texas, USA

Translation of ecotoxicology to the practice of ecological risk assessment and natural resource management aims to protect biodiversity and ecosystem services, yet our future ability to do so relies on the development of a precision ecotoxicology approach wherein we leverage the genetics and informatics of species to better understand and manage the aquatic risks of global pollution. This effort is needed because biodiversity declines are pronounced, and the importance of developing new approaches for chemicals, waste and pollution prevention are receiving unprecedented attention around the world. For example, empirical safety information is unavailable for the majority of the >350,000 chemicals and chemical mixtures listed for global commerce, and the flows of rivers and base flows to bays and estuaries can be dominated by or dependent on sewage or reclaimed wastewater, which includes diverse contaminants of historic and emerging concern. Herein, persistence cut-off values, which are routinely used during chemical assessment and management, are challenged by site-specific changes in effective exposure duration. Recent efforts to understand human pharmaceuticals in the environment is affording opportunities to develop an understanding of bioaccumulation for ionizable chemicals and other organic contaminants that fall outside of the applicability domain of historic models for nonionizable compounds. We are further witnessing unprecedented advances in comparative toxicology, which present opportunities to identify susceptible organisms and systems to specific chemical stressors when targets (e.g., receptors, enzymes) and molecular initiation events leading to key events and adverse outcomes are evolutionarily conserved among species. Coupling precision ecotoxicology with sustainable molecular design and other elements of green and sustainable chemistry and engineering promises to advance the science and the practice, to stimulate innovation in chemicals development, and to reduce chemical risks in urbanizing aquatic systems.

Keynote lecture 20: 11:15-11:50, 6/1/2024 (Saturday), Lecture Theatre 2, YEUNG

EVENT DRIVEN TAXONOMY: AI IN IDENTIFYING CAUSATIVE CONTAMINANTS IN CHEMICAL MIXTURES

You J., Cheng F., Li H.

School of Environment, Jinan University, China

Ecosystems are often exposed to complex mixtures of chemicals. Identifying causative toxicants is essential to mixture risk assessments but there are data gaps among chemicals and bioactivities. In the big data era, scientific decision based on data mining and machine learning has been proposed as a powerful strategy. The collection retrospective risk-related big data can greatly promote scientific decisions on endpoint selection rather than traditional arbitrary decision-making that merely depends on expert judgment. We proposed an event-driven taxonomy (EDT) concept to integrate adverse outcome pathway-based metadata in risk assessments. Using EDT, molecular initiating events and the substances causing the events were fused in a data matrix, which was named an event driver (ED). Results showed narcosis, estrogen receptor- and aryl hydrogen receptor-mediators were the major EDs in aquatic systems across China. Individual regions had distinct ED fingerprints. Subsequently, an EDT-based artificial intelligence-assisted integrated testing strategy (ITS) was constructed for assessing aquatic risk by integrating high-throughput screening bioassays and chemical predictions. This EDT-based ITS was evaluated using complex sediment mixtures eliciting aryl hydrocarbon receptor activation and oxidative stress response. While mixture prediction using expert knowledge-oriented target analysis only explained <10% of observed sediment bioactivity, a big data-driven suspect analysis expanded the fraction explained to >80%. Additionally, deep learning models were developed to extract structure fingerprints of bioactive suspect candidates and then convert these fingerprints to HRMS-recognizable fragment ions for non-target analysis. The EDT-based ITS tool provides a promising strategy for mixture risk assessments in the AI era.

Keynote lecture 21: 11:50-12:25, 6/1/2024 (Saturday), Lecture Theatre 2, YEUNG

ARTIFICIAL INTELLIGENCE - BASED TOXICITY PREDICTION OF ENVIRONMENTAL CHEMICALS AND THEIR APPLICATION TO ADVERSE OUTCOME PATHWAY DEVELOPMENT

Choi J., Jeong J., and Kim D.

School of Environmental Engineering, University of Seoul, South Korea

In response to advancements in computer technology, research on artificial intelligence (AI)-based computational toxicology models has been on the rise, offering an innovative approach to predict toxicity without traditional animal testing. This study delves into the recent progress in AI toxicity prediction models and their role in the development of Adverse Outcome Pathways (AOPs). We conducted an extensive analysis of studies published since 2014, revealing the development of AI models to predict approximately 30 distinct toxicity endpoints utilizing over 20 toxicity databases. The integration of AI technology in toxicity prediction marks a paradigm shift with promising implications for scientific consensus and regulatory compliance. However, the utilization of AI with AOPs remains limited. Our research addresses this gap by conducting case studies that utilize toxicity prediction models to develop AOPs for environmental chemicals. First, we identified potential inhaled toxicants within regulatory database. Activities of each chemical led to the selection of candidates for AOP development. For chemicals not present in the ToxCast database, we employed toxicity prediction models based on ToxCast assays. Furthermore, we investigated the toxic effects of microplastics, with a focus on plastic additives. Our study scrutinized the toxicity of the fifty most common plastic additives through apical and molecular toxicity databases. By selecting pertinent ToxCast assays with specific gene targets, we uncovered the mechanisms of toxicity for these additives. Employing both ToxCast data and deep learning models, we identified active chemicals for each ToxCast assay. These findings allowed us to establish the most relevant mechanisms of toxicity for comprehending the effects of plastic additives, thus leading to the proposal of potential AOPs associated with microplastics pollution. Building upon this research, our ongoing efforts aim to develop a platform for predicting the toxicity and occurrence of environmental diseases linked to chemical exposure, using chemical and toxicity databases. Furthermore, we endeavor to create an Integrated Testing Strategy (ITS) for evaluating human health hazards arising from exposure to chemical mixtures within household products. These endeavors, which combine toxicity big data and AI models, provide valuable insights into the potent application of AI models within AOPs, particularly in the context of identifying potential toxicity posed by environmental chemicals.

Keynote lecture 22: 16:20-16:55, 6/1/2024 (Saturday), Lecture Theatre 2, YEUNG

MARINE LITTER, FROM SCIENCE TO POLICIES

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With several million tons of plastic entering marine environments every year, tens of trillions of floating plastic particles on the ocean's surface, and densities exceeding locally one million objects per square kilometre on the seabed, the issue of marine litter, especially plastic pollution, has become a major concern. It sometimes appears irreversible on a global scale due to the exponential increase in plastic production since the 1950s and the persistence of polymers deep within the environment for up to several hundred years.

The quantities of plastic in the sea, their distribution, typology, and impacts are fundamental questions, both conceptually and for field assessments. The solutions and management of this problem are complex due to the significant diversity of sources, which do not allow for single solutions.

Cleaning efforts are justified only for valuable, recyclable, or repairable objects, such as fishing nets, or indirectly to restore economic, tourist, or heritage value to a site. While the elimination of micro plastics in wastewater treatment plants is developing, bans on single-use plastics appear to be a viable solution but may limit recycling options in which many countries have invested. Public awareness and education remain crucial aspects of the necessary solutions. One of the most promising solution could be the design and widespread adoption of plastics that can be permanently recycled. New approaches are already proposed for certain polymers, which will give value to end-of-life plastics, one of the current bottlenecks, and be a significant advancement for the future.

At sea, issues related to marine litter include the regulation of activities, transportation, and maritime trade, political choices for management, food security, human health, and the risk to marine ecosystems, with an estimated cost of 10-12 billion USD, according to the United Nations. Several intergovernmental institutions, such as the G7, G20, and regional UN conventions on the seas, have adopted specific action plans against plastic pollution. The rounds of negotiations, underway, will help in concluding an internationally legally binding treaty in 2024 under the auspices of the United Nations Environment Assembly (UNEA). Through examples, we address the most current issues, regarding science, global ocean marine litter monitoring, regional or international action plans, and the need for scientific information to support policy and reduction measures.

Keynote lecture 23: 16:55-17:30, 6/1/2024 (Saturday), Lecture Theatre 2, YEUNG

PROGRESS AND CHALLENGES IN ENVIRONMENTAL ANALYSIS, ASSESSMENT, AND REMEDIATION OF CHEMICAL POLLUTION: NAVIGATING TOWARDS A CLEANER FUTURE

Leung K.M.Y.

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Over the past 50 years, the field of environmental sciences, especially environmental chemistry, pollution monitoring, and environmental quality management, has witnessed significant advancements driven by instrumental technologies. These advancements have revolutionized our ability to detect and quantify chemical contaminants at ultra-low concentrations, while also facilitating the development of tools for source tracking of the contaminants and assessing the health of organisms and ecosystems. As Professor Peter Drucker famously stated, "*If you can't measure it, you can't improve it*." Monitoring priority contaminants is crucial for water quality management, enabling us to identify pollution issues, improve water quality, and safeguard aquatic ecosystems and human health. Thus, the mission of environmental authorities, practitioners, and researchers should be centred around "*Measure to Improve*."

This presentation provides an overview of the achievements in marine pollution and ecotoxicology research in Hong Kong over the past 30 years. Real cases highlighting successful environmental quality improvements resulting from management interventions will be highlighted. Moreover, the global challenges posed by emerging contaminants will be discussed, emphasizing the need for international collaboration. Lastly, the UN-endorsed Global Estuaries Monitoring (GEM) Programme will be introduced, which aims to establish a global network for pollution monitoring, unravel the pollution status of estuaries worldwide, and co-design solutions to combat marine pollution, making our estuaries cleaner and safer for all.

Abstract of

Invited Talks

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Regular Presentations

Invited talk 1: 14:00-14:30, 3/1/2024 (Wednesday), P4701, YEUNG

EFFECTS OF IRREGULAR AND FIBRIL SHAPED MICROPLASTICS ON *ARTEMIA FRANCISCANA*: SIZE AND SHAPE-DEPENDENT TOXICITY

An Y.J., Kim L., Kim H., and Song Y.

Konkuk University, Republic of Korea

The marine ecosystem faces ongoing contamination from the pervasive presence of small plastic waste debris, notably microplastics (MPs). Some of these MPs can settle on the ocean floor, affecting benthic organisms. This study explores the toxicity of irregular and fibril-shaped MPs of varying sizes and lengths on *Artemia franciscana*, a common aquatic organism. Juvenile *A. franciscana* were exposed to polyethylene terephthalate fragments of two size categories, small (< 20 µm) and large (> 150 µm), as well as fibers of two lengths, short (200–300 µm) and long (3 mm), all at a concentration of 20 mg/L over a 4-week period. The study investigates size and shape-dependent effects on *A. franciscana*, focusing on parameters such as growth, swimming ability, and light sensitivity (phototaxis). Results indicate that, following long-term exposure, small fragments and short MPs exerted the most severe impacts in comparison to the other treatments. These effects included growth inhibition and alterations in movement, particularly in response to positive phototaxis. These findings underscore the significance of considering both the size and shape of MPs as critical factors in understanding their toxicity on aquatic eco-receptors.

Acknowledgement-This research was supported by the Basic Science Research Program through the National Research Foundation (NRF) of Korea, funded by the Ministry of Science, ICT, and Future Planning (2020R1A2B5B02001734).This research was also funded by the Ministry of Oceans and Fisheries (KIMST-20220383).

O.1: 14:30-14:50, 3/1/2024 (Wednesday), P4701, YEUNG

COLONIZATION OF ORGANISMS ON THE STYROFOAM FLOATS

Zheng Y.F., Zhao W.J., Zhu J.M., Li J.J., Li G.L., Shi H.H.*

State Key Laboratory of Estuarine and Coastal Research, East China Normal University, Shanghai 200241, China

Plastic has infiltrated every ecosystem on the planet. This anthropogenic pollutant and animals are inevitable encounters in the environment. Marine culture is popular along the coastal waters of China, and Styrofoam floats have been extensively used for several decades. There is a close coexistence in the environment between the floats and the organisms. Our previous studies have found that organisms used the floats as habitats to live in (Zheng et al., 2023). To monitor the colonization process of organisms, we conducted a two-year *in situ* simulation experiment by placing fresh Styrofoam floats at 4 sites with different conditions between 2021 and 2023. We found that the abundance and diversity of the organisms changed in succession and staggered over time. Changes in community structure depended on a variety of biotic and abiotic factors. Significant correlations existed between different organisms. The interactions between floats and macro-organisms were complex during the succession and more research was needed to better understand specific relationships. This study highlights the process of interaction between organisms and macroplastics, and the potential ecological risks posed.

O.2: 14:50-15:10, 3/1/2024 (Wednesday), P4701, YEUNG

DECIPHERING THE ECOLOGICAL ROLES OF THE PLASTISPHERE IN URBAN RIVERS IN HONG KONG

Bao Y.Y., Ho D.Y.W., K.H. Fang J.K.H., Leung K.M.Y., and Lee P.K.H.

City University of Hong Kong, Hong Kong SAR, China
The Hong Kong Polytechnic University, Hong Kong SAR, China

Microplastics (MP) are widely discharged and accumulated in urban rivers, providing new microbial niches and vectors for transportation into marine ecosystems. However, the ecological roles of the plastisphere in urban riverine ecosystems remains unclear, especially when compared to the microbiomes associated with the riverine natural particles (nonMP). By comparing the MP-attached, nonMP-attached and free-living microbiomes in 10 major urban rivers in Hong Kong, we demonstrated the uniqueness and ecological impacts of MP-attached microbiomes on urban riverine ecosystems. The taxonomic and functional compositions of MP-attached and nonMP-attached microbial communities were significantly different from the free-living community. The two particle-attached communities were enriched in many carbohydrate degraders and biofilm-forming members from Proteobacteria, and functions related to carbohydrate utilization and biofilm formation, indicating the important roles of particle-attached microorganisms on particle decomposition. Despite the highly shared species and similar structures between MP-attached and nonMP-attached microbial communities, the MP-attached community formed a more connected network with more collaborative behaviors, and exhibited enhanced capacities of xenobiotic degradation, plastic degradation and antibiotic resistance, which could benefit the detoxification and resource utilization under the stressed and nutrient-poor conditions on MP. Moreover, the MP-attached community was the only group whose compositions was significantly related to the corresponding microplastic types, and the decreasing Shannon diversity and increasing relative abundances of antibiotic resistance genes and virulence factors were found along with the increasing microplastic concentrations, suggesting that the plastisphere possesses potential ecological risks on urban rivers that were highly polluted by MP. Metagenome-assembled genomes (MAGs) with plastic degradation potential were identified and were found to be enriched in MP. These MAGs mainly contributed to complex carbon oxidation, denitrification and iron oxidation, and possessed significantly larger genome sizes and higher GC contents, indicating their enhanced ability in stress tolerance. Overall, our results highlight the similarities and differences between MP-attached and nonMP-attached microbiomes, which can assist objective ecological risk assessment of plastisphere in urban rivers in field.

O.4: 15:30-15:50, 3/1/2024 (Wednesday), P4701, YEUNG

PLASTICS MACROLITTER LITTERAROUND RODRIGUES ISLAND, SOUTHWEST INDIAN OCEAN: A FIRST ASSESSMENT

Perrine M. J. S.[1*], Mattan Moorgawa S.[1] and Bouvier T.[2]

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Marine litter is a global environmental concern and has adverse effects on the marine environment, biodiversity, beach aesthetics and economy. Rodrigues Island is an isolated Small Island Developing State (SIDS) which forms part of the Mascarene plateau in the Southwestern Indian Ocean (SWIO) region and has a coastline of 80 Km and a lagoon area of 240 Km². Being an island state, it's economy is highly dependent on marine resources, traditional fishing, and local tourism, and is especially vulnerable to local and global stressors and threats, such as climate change, ocean warming and marine litter. Due to the growing global concern about the quantity of litter and plastics in the marine environment, the Rodrigues Regional Assembly (RRA) came with regulations for the banning of use of plastic bags and disposable food items, with the aim to minimise plastics pollution (RRA Prohibition of Use of Plastic Bags Regulations 2014 and RRA Banning of Disposable Plastic Food Items Regulations 2019). However, studies on marine litter and plastics in the coastal and marine environment are missing on the island, and the status is unknown. This study expects to fill the gaps identified. This study, thus, aimed at quantifying the standing stock and accumulation rate of macro litter and plastics at selected sites around the island and evaluate the abundance, density, plastics composition, types, and potential sources and origin. Seven study sites were selected based on their remoteness or proximity to human activities and exposure to the South-East Trade Winds (SETW), namely, Baladirou, Pointe Cotton, Anse Ally, St Francois, Roche Noire, Graviers and Mourouk. The Western Indian Ocean Marine Science Association (WIOMSA) 2021 protocol for marine macrolitter monitoring on the beach was adapted in this study. The survey was carried out from June to September 2023 in the winter season. At each study site, a study area was earmarked along a 500 m stretch of the sandy beach, spanning from the low water mark (LWM) up to the vegetation line/berm. An initial day zero clean-up of all visible macro-litter (>2.5 cm in size) was carried out on the predetermined area of the beach to determine the standing stock of macrolitter and plastics. Collection of macrolitter was performed manually by walking along the stretch of the predefined length of beach, for each 100m stretch (n =5), and any visible macrolitter was collected first from the wet zone (area between the High Water Mark and Low Water Mark) and then from the dry zone (area between the High Water Mark and the vegetation line/berm) A total of 8026 items of macrolitter were collected from the seven beaches on initial day zero, amounting to 80.59 kg in total. Macrolitter abundance was widespread across all study sites and plastics constituted 97% and 98.9% of the macrolitter collected from the wet zone and from the dry zone, respectively. Pointe Cotton beach (on north-east) was an exception, where plastic comprised 65.2 % and 49.5 % from wet and dry zone, respectively. More litter was found above the dry zone in comparison to the wet zone. A significant amount (88.2%) of litter collected on the beaches was not of local origin but rather from sea-based or shipping activities. The results showed that high density polyethylene (HDPE) plastics were the most encountered type, at 54.2% in the wet zone and at 60.3% in the dry zone.

Unknown materials product accounted for 64.2% of the total standing stock, which comprised of plastic fragments of different dimensions, colours and thickness. This study provides an important baseline data on the abundance and composition of macrolitter and plastics around selected beaches of Rodrigues Island, and can be used by the relevant authorities for effective waste management strategies and awareness in the island.

Invited talk 2: 14:40-15:10, 4/1/2024 (Thursday), P4701, YEUNG

IMPACT OF MICROPLASTICS ON GROWTH AND BEHAVIOUR OF THE JUVENILE TRI-SPINE HORSESHOE CRAB *TACHYPLEUS TRIDENTATUS*

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The Hong Kong Polytechnic University, and City University of Hong Kong, China

This study aimed to investigate the physiological impact of different types of microplastics on the tri-spine horseshoe crab *Tachypleus tridentatus* at its juvenile stage. Over a 100-day laboratory experiment, the juveniles generally exhibited reduced growth rates and decreased activity when exposed to microplastics. Notably, *T. tridentatus* exposed to polyethylene terephthalate (PET) particles demonstrated the lowest survival probability compared to other treatment groups. Furthermore, a field survey was conducted to assess the presence of microplastics in the sediment of five major nursery grounds of *T. tridentatus* in Hong Kong. Lower abundance of *T. tridentatus* was generally observed in areas with a higher quantity of microplastics, among which PET was the most prevalent type of microplastics detected. Overall, PET microplastics appear to pose a greater threat to *T. tridentatus* juveniles and are more widespread in their natural habitats. Further research is necessary to understand the mechanisms underlying PET toxicity to *T. tridentatus* and to develop appropriate mitigation strategies to protect this important endangered species.

O. 5: 15:10-15:30, 4/1/2024 (Thursday), P4701, YEUNG

COMBINED EXPOSURE TO HYPOXIA AND NANOPLASTICS LEADS TO OXIDATIVE STRESS-MEDIATED SYNERGISTIC EFFECTS IN THE WATER FLEA *DAPHNIA MAGNA*

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Aquatic ecosystems face a growing threat in the form of hypoxia and microplastic pollution, including the emerging concern of nanoplastics. It is known that both hypoxia and nanoplastics induce severe oxidative stress and reproductive decline, but there are few studies validating the synergistic effects caused by hypoxia and nanoplastics in crustaceans. In this study, we investigated the combined effects of hypoxia and nanoplastics on the water flea *Daphnia magna*, a keystone species in freshwater environments. Our findings revealed that exposure to hypoxia induced oxidative stress in *D. magna*, as evidenced by elevated levels of reactive oxygen species and elevated antioxidant defenses. Moreover, when subjected to combined exposure to nanoplastics and hypoxia, *D. magna* exhibited significantly higher levels of oxidative stress than those exposed to either stressor alone. These findings suggest a synergistic relationship between hypoxia and nanoplastic pollution in intensifying oxidative stress in freshwater zooplankton species. The impact of such stress was further evident in reduced survivorship and impaired reproductive success, highlighting the potential for population-level consequences. Our study underscores the ecological relevance of understanding the complex interactions between environmental stressors and the potential implications for aquatic ecosystems in the face of ongoing environmental challenges.

O. 6: 15:30-15:50, 4/1/2024 (Thursday), P4701, YEUNG

INFLUENCE OF SURFACE-MODIFIED NANOPLASTICS ON ACCUMULATION AND TOXICITY OF TETRACYCLINE IN FRESHWATER MICROALGAE (*CHLORELLA VULGARIS*) IN THE PRESENCE OF HUMIC ACID

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Commercialization and industrialization increase the risk of fine plastic particles (FPs) entering aquatic ecosystems. Among them, nanoplastics (NPs) have a higher specific surface area and hydrophobicity than microplastics (MPs) and absorb hydrophobic pollutants of persistent organic pollutants more easily in aquatic ecosystems, affecting aquatic organisms like microalgae. MPs/NPs interact with water pollutants, which have received much attention in recent years. However, the surface functionalization of micro-nanoplastics has not been thoroughly investigated. Also, the behavior of NPs, in conjunction with other pollutants can be affected by aquatic factors such as natural organic matter.

In this study, we investigated the adsorption of tetracycline (TC) on polystyrene nanoplastics with and without functionalization (PS-NPs and NH_2-PS-NPs) under humic acid (HA) and then evaluated the impacts of NPs on the toxicity of TC under HA in freshwater microalgae *Chlorella vulgaris* and related physiological (heteroaggregation, cell surface interaction) and biochemical status (growth inhibition rate, the activities of photosynthesis, oxidative stress, and antioxidant enzymes, the cell membrane integrity, morphological changes). Our result showed that PS-NPs and NH_2-PS-NPs have different adsorption capacities for TC with/without HA. Under individual exposure to NPs and TC, dose-dependent toxicity of the cell growth and induction of oxidative stress in microalgae and the combined exposure of NPs with TC had distinct patterns on the inhibition of the cell growth and induction of oxidative stress in microalgae depend on functional group of NPs with/without HA. UHPLC is used to quantify the accumulation of TC in microalgae. Without HA, our experiment showed that PS-NPs and TC showed a synergistic toxicity effect, while NH_2-PS-NPs and TC exhibited an antagonistic effect because of different adsorption capacities for TC with NPs on microalgae. This is supported by the result of heteroaggregation and cell surface interaction of microalgae.

This is the first study to look at how NPs with and without functionalization, as well as environmental factors, affect organisms in aquatic systems. These studies help to understand the true ecotoxicity and risk of nanoplastic pollution in aquatic ecosystems.

Acknowledgement – This work was supported by the Postdoctoral Fellowship (PDF/2021/000713) and CRG project grant (CRG/2021/006020), funded by the Science and Engineering Research Board, India.

Keywords: Nanoplastic; Environmental factors; Microalgae; Interaction mechanism; Toxicity.

O. 7: 15:50-16:10, 4/1/2024 (Thursday), P4701, YEUNG

AGING EFFECTS OF TITANIUM DIOXIDE ON CU TOXICITY TO *DAPHINA MAGNA*: EXPLORING MOLECULAR DOCKING AND SIGNIFICANCE OF SURFACE PROPERTIES

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Titanium dioxide nanoparticles (TiO_2 NPs) are commonly found in cosmetics and personal care products, eventually reaching aquatic environments. The surface properties of TiO_2 NPs may change with aging due to environmental factors such as light, and potentially affect their biological effects in aquatic environments. This study explored the impact of the aging process and varying exposure concentrations on the metal bioaccumulation and toxicity of three commercially available TiO_2 NPs. *Daphnia magna* (*D. magna*) was selected as a model organism, and copper (Cu), a common aquatic metal pollutant, was selected for study.

The physicochemical properties of TiO_2 NPs were characterized during the aging process. A 48-h toxicity experiment was conducted on *D. magna* using mixed solutions of Cu and TiO_2 NPs of varying concentrations, types, and aging durations. Various concentrations, types and aging durations of TiO_2 NPs significantly influenced the bioaccumulation of Ti and Cu in *D. magna*, along with the endogenous ROS levels and intracellular antioxidant enzymes activities ($p < 0.05$). The primary difference observed in various types and aging durations of TiO_2 NPs was the change in hydrophobicity (contact angle ranged from 7° to 130°). Data analysis indicated that hydrophobicity significantly influenced the bioaccumulation of Ti and Cu and levels of toxicity biomarkers in *D. magna*, with these effects being concentration-dependent.

Increasing hydrophobicity resulted in decreased Ti bioaccumulation but increased Cu bioaccumulation. These changes correlated with the feeding pattern of *D. magna* and TiO_2 NPs's Cu adsorption capacity. As a filter-feeding animal, *D. magna* ingested more hydrophilic TiO_2 NPs and free Cu compared to hydrophobic TiO_2 NPs and those with adsorbed Cu. Changes of bioaccumulation of TiO_2 NPs and Cu in *D. magna* ultimately affected the activities of intracellular antioxidant enzymes such as SOD, CAT, GSH-Px, and the transmembrane protein Na^+/K^+–ATPase.

Molecular docking techniques was used to simulate interactions between TiO_2 NPs and biological enzymes to reveal the underlying mechanism affecting enzyme activity. Molecular docking calculations demonstrated that these biological enzymes were essentially affected by the hydrophobicity of TiO_2 NPs, although their changing trends were different. The changes of activities of these biological enzymes were due to the interaction between TiO_2 NPs, Cu, and the amino acid residues near the sites with the lowest binding energy and active center of the enzyme. Such effect was closely related to the hydrophobicity of TiO_2 NPs.

These results indicated that under realistic environmental conditions, the aging process of TiO_2 NPs altered their hydrophobicity, subsequently influencing the bioaccumulation and toxicity of TiO_2 NPs and Cu in *D. magna*. Our results revealed the intrinsic link between the environmental aging process and biological effects, which were beneficial to the evaluation and prediction of the toxicity of related cosmetics and personal care products.

O. 8: 16:10-16:30, 4/1/2024 (Thursday), P4701, YEUNG

ELUCIDATING MICROPLASTIC INGESTION AND RISKS IN MARINE BIOTA FROM ANTHROPOGENICALLY-DEGRADED COASTAL HABITATS IN TAMIL NADU, SOUTHERN INDIA

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Having proliferated worldwide, microplastic (MP) pollution now jeopardizes marine life across an expanding range. This baseline study quantified MP ingestion in 41 marine species, including ray-finned fishes, crustaceans, and molluscs, from the industrially polluted coastal waters of Cuddalore, Tamil Nadu, Southern India. Specimens were collected across five stations spanning the effluent contaminated Gadilam and Uppanar estuaries and adjoining coast. MPs were detected in all organisms at densities reaching 13.9 ± 11.1 particles/individual (*Nibea soldado*) and averaging 8.6 particles/individual overall. Physical characterizations were performed using a stereo-zoom microscope and SEM Imaging, while chemical characterization of MPs was done using FTIR. Fibers constituted 83% of MPs detected, 12% were fragments, and 48.8% were 100–500 µm in size. Despite producing species-specific results, quantitative risk evaluations highlighted the widespread occurrence of threat to the examined biota. MPs can cause physical harm, absorb additional chemicals, and accumulate biotically when consumed. As a result, significant MP contamination throughout Tamil Nadu's beaches endangers both marine food webs and human consumers of plastic-contaminated seafood, demanding immediate pollution management and seafood safety measures. Nonetheless, there are knowledge gaps addressing the health consequences for coastal people who rely on fishing supplies from these destroyed littoral zones. More multidisciplinary research that combines field surveys with toxicological evaluations is needed to understand the ecotoxicological implications of chronic MP contamination in areas where preventing plastisphere expansion is critical. Microplastics widespread in coastal Tamil Nadu's marine species demand immediate action for ecosystem and human health protection.

Keywords: Microplastic pollution, Marine species, Finned fishes, Benthic organisms, Ecotoxicology

O. 9: 16:50-17:10, 4/1/2024 (Thursday), P4701, YEUNG

Quantifying the efficacy of microplastics capture in PHYSICALLY-screened treated wastewater

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Microplastics entering the marine environment remain an ongoing global concern. Industrial and household wastewater represents a key pathway for microplastics to the marine environment. Mitigation action following a major accidental plastic pellet (nurdle) release into coastal waters from a regional Victorian wastewater treatment plant focussed on the installation of a 1 mm rotating drum post-treatment screening process specifically to capture plastics from the wastewater outflow prior to discharge into marine waters. This study aimed to assess the efficacy of this screening in removal of microplastics from pre-discharge treated wastewater. Plastics captured by the screen were identified from non-plastics using ultraviolet and royal blue fluorescence. Based on a wastewater flow rate of 21.54 ML / day, an estimated $107x10^3$ individual plastic items equal to and greater than 1 mm would be captured; under similar flow conditions per year, approximately $39x10^6$ individual microplastics would be captured. This estimate is considered highly conservative. Microfibres exceeding 1 mm in length, but less than1 mm in width would theoretically pass through the screen when fibres orientate with direction of water flow. However, congealed 'fat balls' which are also captured by screening, collect and store plastic particles across the micro-size range, including those less than 1 mm which would theoretically pass through the 1 mm screen if free-floating in treated wastewater. Physical screening of post-secondary treatment to trap microplastics represents a viable method to remove microplastic suspended material from treated wastewater prior to ocean discharge.

O. 10: 17:10-17:30, 4/1/2024 (Thursday), P4701, YEUNG

A FIRST REPORT OF MESO-LITTER ABUNDANCE, DENSITY, COMPOSITION, TYPE, AND COLOUR ALONG SANDY BEACHES: THE CASE OF RODRIGUES ISLAND, SOUTH-WEST INDIAN OCEAN

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Marine litter and plastics have become an environmental issue of global concern. It affects the marine environment aesthetics, biodiversity, marine resources, and the socio-economics benefits to local communities. Small island developing states are particularly vulnerable to plastics pollution due to their remoteness, isolation, and reliability on their marine resources, and the state of the marine environment for their socio-economic growth and benefits. Despite not being the greatest producers of plastics, island states do import a lot of plastic products for local consumption. If mismanaged, these can end up in the environment through different pathways such as littering, rivers or wind-blown and transport via oceans. Meso-litter mainly come from the breakdown of macro-litter and are hence more difficult to clean up. Rodrigues Island, located in the South-West Indian Ocean (SWIO) region, is known for its initiatives to ban the use of plastics bags and other single use plastics items. However, this region is understudied, and the status of meso-plastics contamination and its potential impacts on the coastal and marine environment is unknown. This study aimed to quantify, for the first time, the abundance and density of meso-plastics around the coastline of Rodrigues and to assess its densities, composition, type, and potential origin or source as well as identify any hotspot. To fill in the identified data gaps, the study was carried out in July-August 2022 month at nine selected sandy beach sites around the coastline of this island, namely, at Baladirou (North), Pointe Coton, Le Fumier, Anse Ally, St Francois and Trou D'Argent (on the East), Gravier (South-East), Mourouk (South) and Petite Butte (South-West), based on the geographical location, and their exposure to the South East Trade Winds (SETW). At each site, belt transects (1 m wide) were laid (in triplicates, n = 3 per site) from the low water mark (LWM) to the berm, at 50 m intervals on the sandy stretch of the beach. Quadrats of 1 m x 1m in size were placed at three different stations/zones along each transect (n = 3 per zone/site), namely, at the strandline (SL), the beach slope (BS), and the vegetation line (VL). Sediment was collected from each quadrat at the top 2.5 cm layer with the help of a hand-held metal spade. The sampled sediment was then sieved in situ through a series of sieves of sizes 2.5 cm, 2 cm and 5mm placed on top of one another. All items >2.5 cm in size were manually removed and discarded from the top sieve. All meso-litter items ≥5 mm to <2.5 cm identified in the sieves were collected with a hand-held stainless-steel tweezer with the help of a hand-held magnifying glass and collected in labelled zip-lock bags before transporting to the laboratory for further analysis. In the laboratory, the samples from each quadrat/ transect/ site were first weighed using a precision electronic balance, and then classified according to their composition (plastics, paper, processed wood, rubber, fabric, metal, glass, ceramic, or others) before weighing each type of item once again. The meso-litter items were further classified as per their colour (blue, green, white, red/pink, yellow/orange, black/grey or colourless). The plastics

components were further classified in terms of type (fragment, foam, pellets, fibre, or film) and the potential source (shoreline and recreational, dumping, medical and hygiene, ocean and waterway, smoking-related and unidentified source). A total of 2440 mesolitter items were collected from all nine sites, weighing a total of 251.547 grams). Mesolitter density per unit area was highest at St Francois followed by Petite Butte, Le Fumier, Anse Ally, Trou D'Argent, Gravier and Mourouk and Gravier, while the lowest densities were found at Baladirou and Pointe Coton which were fairly protected from the SETW. In terms of composition, plastics made up 70 -80 % of mesolitter, followed by glass (20 – 30%), while processed wood, rubber, paper, metal, and ceramic was mostly absent. Majority of the mesolitter source were from shoreline and recreational activities and other unidentified sources. Meso-litter were mostly prevalent at the vegetation line zone as compared to the slope or strandline zones, suggesting a more local or ocean-blown origin. Majority of meso-litter were blue or green (60%) in colour and were made up of fragments (60%) and fibres (20%), with negligible foam and pellets found.

O. 11: 17:30-17:50, 4/1/2024 (Thursday), P4701, YEUNG

ECOLOGY AND RISKS OF THE GLOBAL PLASTISPHERE AS A NEWLY EXPANDING MICROBIAL HABITAT

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Plastic offers a new niche for microorganisms, the plastisphere. The ever-increasing emission of plastic waste makes it urgent to understand the microbial ecology of the plastisphere and associated impacts. Here we present a global fingerprint of the plastisphere, analyzing samples collected from freshwater, seawater, and terrestrial ecosystems. The plastisphere assembles a distinct microbial community that has a clearly higher heterogeneity and a more deterministically-dominated assembly compared to natural habitats. New coexistence patterns – loose and fragile networks with mostly specialist linkages among microorganisms that are rarely found in natural habitats – are seen in the plastisphere. Plastisphere microbiomes generally have high potential to metabolize organic compounds, which could accelerate carbon turnover. Microorganisms involved in the nitrogen cycle are also altered in the plastisphere, especially in freshwater plastispheres, where a high abundance of denitrifiers might increase the release of nitrite (aquatic toxicant) and nitrous oxide (greenhouse gas). Enrichment of animal, plant, and human pathogens means that the plastisphere could become an increasingly mobile reservoir of harmful microorganisms in the future. Our findings highlight that if the trajectory of plastic emission is not reversed, the expanding plastisphere could pose critical planetary health challenges.

O. 12: 17:50-18:10, 4/1/2024 (Thursday), P4701, YEUNG

Research on the Environmental Behaviour and Ecotoxicology of Microplastics Based on Data-Driven Methods

Zhang Y., Zhang Z., Liu R.

Nanjing University, China

Microplastics exhibit complex multidimensional characteristics that influence their environmental behaviour and biological toxicity. However, the key toxic effects and critical influencing characteristics of microplastics are not yet clear, necessitating systematic analysis. Traditional laboratory simulation experiments not only involve a large workload but also incur high costs, making it difficult to fully reveal the relationship between the multidimensional characteristics of microplastics and their environmental occurrence and biological toxicity. This study used data-driven analysis methods to identify the occurrence characteristics of microplastic communities in different environmental phases, established a microplastic environmental source resolution model, and proposed environmental source factors, providing effective means for studying microplastic environmental migration and pollution flux. We systematically analysed the effects of different characteristics and exposure methods of microplastics on intestinal function and intestinal flora, and found that the particle size, concentration, and exposure time of microplastics significantly affect intestinal immune metabolic function, microbial diversity, functional microbial abundance, and F/B ratio. Correspondingly, a health risk assessment model for microplastics based on the comprehensive index of intestinal immune function and F/B ratio was established. Our results provide a theoretical basis and technical support for the environmental health risk assessment of microplastics.

Invited talk 3: 14:00-14:30, 5/1/2024 (Friday), P4701, YEUNG

SELECTIVE ENRICHMENT OF BACTERIAL PATHOGENS WITHIN PLASTISPHERE BIOFILMS

Cheng J.P., Lo L.S.H., Qian P.Y., Häggblom M.M.

The Education University of Hong Kong, Hong Kong

Recently, it has been recognized that plastics can serve as mobile hotspots for aquatic pathogens in the coastal environment. However, unraveling the precise dynamics between plastic surfaces, microbial biofilms, and the emergence of potential pathogen risks is an ongoing area of research that requires further investigation. In this study, field development and microcosm incubation experiments were employed to investigate differences in community composition between the plastisphere-biofilm and bacteria inhabiting surrounding seawater, with a special focus on the potential selection and enrichment of pathogenic bacteria. The utilization of scanning electron microscopy, combined with observations of community temporal succession, has provided visual evidence of microbial biofilm development on plastic surfaces. We further screened the pathogen profiles using our recently developed aquaculture pathogen database, and the results support a potential connection between the abundance of pathogens and the production of extracellular polymeric substances within these plastic biofilms. Pseudomonas and Pseudoaltermonas were dominant contributors to the general higher relative abundance of potential pathogens observed in the plastisphere-biofilm. Chemical treatment has been shown to further influence and shape the potential pathogens during biofilm formation. These results suggest that plastisphere-biofilms on common plastic surfaces can promote the recruitment, enrichment, and spread of pathogenic bacteria in the aquatic environment. This study provided new insights into the vector role of plastic biofilm for bacteria pathogens, contributing to the improved understanding of the microbial hazardous risks associated with emerging plastisphere-biofilms in light of global plastic pollution.

O. 13: 14:30-14:50, 5/1/2024 (Friday), P4701, YEUNG

NANOPLASTICS IMPAIR GROWTH AND NITROGEN FIXATION OF MARINE NITROGEN-FIXING CYANOBACTERIA

Deng L., Cheung S., Liu J., Chen J., Chen F., Zhang X. and Liu H.

Hong Kong University of Science and Technology

Nanoplastics pollution is a growing environmental problem worldwide. Recent research has demonstrated the toxic effects of nanoplastics on various marine organisms. However, the influences of nanoplastics on marine nitrogen-fixing cyanobacteria, a critical nitrogen source in the ocean, remained unknown. Here, we report that nanoplastics exposure significantly reduced growth, photosynthetic, and nitrogen fixation rates of *Crocosphaera watsonii* (a major marine nitrogen-fixing cyanobacterium). Transcriptomic analysis revealed that nanoplastics might harm *C. watsonii* via downregulation of photosynthetic pathways and DNA damage repair genes, while genes for respiration, cell damage, nitrogen limitation, and iron (and phosphorus) scavenging were upregulated. The number and size of starch grains and electron-dense vacuoles increased significantly after nanoplastics exposure, suggesting that *C. watsonii* allocated more resource to storage instead of growth under stress. We propose that nanoplastics can damage the cell (e.g., DNA, cell membrane, membrane-bound transporters, etc.), inhibit N_2 and CO_2 fixation, and hence lead to nutrient limitation and impaired growth. Our findings indicate that nanoplastics pollution may greatly reduce the new nitrogen input, and hence affect the productivity in the ocean. The impact of nanoplastics on marine nitrogen fixation and productivity should be considered when predicting the ecosystem response and biogeochemical cycling in the changing ocean.

O. 14: 14:50-15:10, 5/1/2024 (Friday), P4701, YEUNG

WEATHERING OF MICROPLASTICS REVEALED BY THE TRADITIONAL AND NOVEL SPECTROSCOPY APPROACHES

Liu M.Y.[1], Yan M.[1,*], Liao R.[2], Li J.J.[2], Liu H.M.[1], Leung K.M.Y.[1,*]

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Marine microplastic pollution has become a global problem of great concern. Under the effects of UV radiation and mechanical abrasion, marine plastics are weathered and broken down into tiny fragments known as microplastics (MPs), which potentially cause significant harm to organisms and human beings. To investigate the weathering process of marine microplastics, we conducted a six-month laboratory simulation using different sizes of PE-, PP-, and PS-MPs. The Fourier-transform infrared (FTIR) spectroscopy results revealed that the weathering condition accelerated the breaking of the C–H bonds within the polymer chains and the formation of –OH and C=O bonds. The carbonyl index values, especially within the first 30 days, exhibited a significantly increasing trend (0–0.97), while such trends fluctuated in the following five months (0.07–1.35). Besides the chemical changes in their functional groups, the fragmentation of the weathered microplastics was detected by polarized light scattering coupled with a machine-learning approach. The fragmented microplastics were classified into six size categories ranging from 200 nm to 80 μm, with a total accuracy of 50.43% for size-based identification using polarimetry. Our findings suggest that considerable plastic debris with submicron and nano sizes could be released during the weathering process, which warrants further investigation.

O. 15: 15:10-15:30, 5/1/2024 (Friday), P4701, YEUNG

POLYSTYRENE MICRO-/NANO-PLASTICS AFFECTED THE NUTRITIONAL QUALITY OF CHLAMYS FARRERI THROUGH DISTURBING THE FUNCTION OF GILLS AND PHYSIOLOGICAL METABOLISM

Sun Y. J., Xia B. and Zhu X. S.

Hainan University, China

Once plastic waste enters the marine environment, it will eventually decompose into smaller-sized microplastics (MPs) and even nanoplastics (NPs) under the action of ultraviolet rays, mechanical damage, and microbial degradation. Although MPs and NPs have become a global concern because of their possible hazards to marine organisms, few studies have investigated the effects of MPs/NPs on the nutritional quality of marine economic species, and the mechanisms remain unclear. In this experiment, adult scallops *Chlamys farreri* was exposed to polystyrene (PS) microplastics (MPs) and nanoplastics (NPs) at environmentally relevant concentration (0.23 mg/L), and checking their health states by the determination of nutritional composition, physiological metabolism, enzymatic response, and histopathology. The results showed that plastic particles significantly decreased the plumpness (by 33.32% for MPs and 36.69% for NPs) and protein content of the adductor muscle (by 4.88% for MPs and 8.77% for NPs) in scallops, and NPs caused notable impacts than MPs. Based on the integrated biomarker response analysis, NPs exhibited greater toxicity than MPs, suggesting a size-dependent effect for plastic particle. Furthermore, NPs significantly affected the physiological metabolism (e.g., filtration rate and ammonia excretion rate) than MPs. Using tissue section and ultrathin section analysis, it was found that MPs and NPs caused tissue lesions and cell structure changes. The most obvious damage was observed in the gills, followed by the digestive glands, while no obvious damage was observed in the adductor muscle. Through gill transcriptomics analysis, the key toxicological mechanisms caused by NPs included enrichment of the mitophagy pathway, responses to oxidative stress, and changes related to genes associated with nerves. This study provides new insight into the potential negative effects of MPs and NPs on the mariculture industry.

O. 16: 15:30-15:50, 5/1/2024 (Friday), P4701, YEUNG

POLYSTYRENE AND POLYETHYLENE TEREPHTHALATE MICROPLASTICS ALTER BIOAVAILABILITY AND TOXICITY OF CADMIUM IN THE POLYCHAETE *PERINEREIS AIBUHITENSIS*

Cong Y., Jiang Y.S., Lou Y.D., Wang Y., Li Z.C., Zhang M.X., Jin F. and Wang J.Y.

National Marine Environmental Monitoring Center, China

Heavy metal pollution in the marine environment has been of concern for decades. The bioavailability and potential impact of heavy metals in the presence of emerging marine pollutants such as microplastics (MPs) has attracted attention only in recent years. In this study, we select a sediment-dwelling polychaete, *Perinereis aibuhitensis*, as model organism, to investigate (1) the influences of two types of MPs (polystyrene, PS and polyethylene terephthalate, PET) on the cadmium (Cd) bioavailability in worms; (2) the single and combined chronic toxic effects of Cd (nominal concentrations of 10, 100, 1000 μg/L for PS and 1, 10, 100 μg/g dw for PET) with PS microspheres (1 μm, 10 μg/L) or PET microfibers (100 μm in diameter, 500 items/kg dw) on worms.

Our results showed that Cd body burdens in worms exposed to the Cd_M and Cd_H groups were significantly greater than those of control worms with or without the presence of PS or PET. In addition, Cd bioaccumulation was significantly higher with the coexistence of PS than those of Cd alone at the Cd_M and Cd_H groups. However, the coexistence of PET did not affect the bioaccumulation of Cd in worms exposed to any Cd concentration. The different role of two MPs in the Cd bioaccumulation by worms should be attributed to the discrepancies of MPs characteristics including type, size, concentration, exposure pathways (seawater vs. sediment) and exposure durations (7 days vs. 28 days). Nevertheless, through the subcellular fractionation procedure, we found that for Cd_L group, the presence of PET microfibers resulted in Cd proportion in subcellular fractions decreasing from 91.0% to 71.5% in the biologically detoxified metal (BDM) fraction, and increasing from 8.6% to 20.0% and from 8.7% to 20.4% in the metal-sensitive fractions (MSF) fraction and trophically available metal (TAM) fraction, respectively. This indicates that the coexistence of PET contributes to the increase of cell damage and the decrease of cellular detoxification capacity, as well as the increasing bioavailability of Cd through trophic level. In addition, the alteration of Cd proportion in different subcellular fractions by the PET is Cd concentration-related, as the reverse phenomenon was observed in the Cd_M group with the presence of PET.

Chronic toxicity experiment results demonstrated that Cd and PS did not affect worm growth for single or combined exposure, and Cd_L alone significantly decreased the burrowing time of *P. aibuhitensis* in sediment. The presence of PS mitigated the hormetic effect of Cd on worm burrowing behaviour, and this influence was also Cd concentration-related. Histopathological analyses demonstrated a trend of epidermal and intestinal damages for Cd alone and their co-exposure group with PS or PET, including the increased numbers of gland cells and basophilic granules, cytoplasmic loose and vacuolation of epidermis, as well as cytolysis, cell disordered arrangement, cell space enlargement, and villi exfoliation of intestines. Our results indicate that the bioavailability and toxic effects of Cd could be altered with the presence of PS or PET for *P. aibuhitensis*, especially at environmentally relevant concentrations.

Invited talk 4: 14:00-14:30, 6/1/2024 (Saturday), P4701, YEUNG

POSSIBLE ROLE OF MARINE BACTERIA IN MODULATING HARMFUL ALGAL BLOOMS OF *KARENIA MIKIMOTOI*

Lee F.W.F.

School of Science and Technology, Hong Kong Metropolitan University, Hong Kong, China

Karenia mikimotoi is a highly toxic species responsible for harmful algal blooms (HABs), often resulting in significant fish and shellfish mortality. In 2016, HABs caused by this species led to the death of over 200 tons of fish in various fish-farming zones in Hong Kong. Recently, researchers have started to investigate the relationship between the harmful algae and marine bacteria. It is speculated that the marine bacteria may play a key role in controlling the harmful effects of the algae. Some bacteria have been found to kill harmful algae, and others can alter their toxicity. However, research on the relationship between *K. mikimotoi* and marine bacteria is scarce, leaving our understanding in this area very limited.

This study aims to explore the interaction between *K. mikimotoi* and marine bacteria. We developed a promising methodology for establishing axenic culture for dinoflagellates (cell culture without bacteria). This method combined several techniques, enabling us to maintain an axenic monoculture of *K. mikimotoi* for over 100 generations without any antibiotic treatments. Algicidal experiments revealed that P4 (an algicidal bacterial strain isolated from a bloom caused by *K. mikimotoi*) had a significant algicidal effect on *K. mikimotoi* cells, dependent on bacterial dose and growth phase. Complete lysis of algal cells and 100% algicidal efficiency was achieved in 48 hours with a 25% v/v dose. We found that P4 was most effective at killing the algal cells when both the bacteria and the algae were in a stationary growth phase. Interestingly, algicidal effect of P4 was even more potent when it was grown with xenic *K. mikimotoi* cells. We compared the ichthyotoxicity between xenic and axenic *K. mikimotoi* cultures using an in vitro bioassay with a fish gill cell line. Surprisingly, we found that *K. mikimotoi* was more toxic when it was grown without associated bacteria. When we reintroduced the associated bacteria back to the axenic culture, the toxicity of the algae did not decrease as anticipated. We also discovered that different bacterial isolates could have varying specific modulatory effects on algal growth and ichthyotoxicity. Lastly, proteomic analysis indicated that exposure to P4 or its associated bacteria significantly affected proteins involved in the metabolism and chloroplast of the algal cells. Understanding the interaction between the harmful algae and the marine bacteria will provide valuable insights for the control of harmful algal blooms.

O. 17: 14:30-14:50, 6/1/2024 (Saturday), P4701, YEUNG

HOW MUCH DO COMMONLY MONITORED ORGANIC CONTAMINANTS EXPLAIN SPECIES-SPECIFIC IN VITRO CYTOTOXICITY OF SEAWATER?

Liu X., Xiong A., Zhang L., Jin L.

The Hong Kong Polytechnic University, China

The Indo-Pacific finless porpoise is a threatened marine mammal globally, including Hong Kong. Chemical pollution is amongst the multiple stressors that impact porpoise health. Our understanding is lacking of what pollutants are driving the toxic effect of marine water containing a complex mixture of pollutants on the porpoise. To fill this knowledge gap, for the first time, we developed a porpoise-specific cell line to assess the cytotoxicity of Hong Kong's marine water and identify key toxicity-contributing pollutants. We then profiled the cytotoxic potency of 32 chemicals previously detected in Hong Kong coastal waters, including persistent organic pollutants (*e.g.*, polycyclic aromatic hydrocarbons, polyfluoroalkyl substances and brominated flame retardants), organotins, ultraviolet filters, and algal toxins. Additionally, we performed mixture-toxicity modeling to assess their quantitative contribution to the cytotoxicity of seawater. Of the northern and eastern waters which serve as habitats for finless porpoises, Tolo Harbour and Kwo Chau Islands were identified as hotspots showing high toxicities. The identified toxic chemicals in these regions collectively accounted for an average of 25% (range: 5% - 66%) and 43% (range: 8% - 90%) of the overall seawater toxicity, respectively. Pectenotoxin-2, a natural algal toxin produced by *Dinophysis* spp., explained an average of 32% of the mixture effect on porpoise cells in northern and eastern waters (range: 2% - 84%). Second to pectenotoxin-2, Di-butyltin, a polyvinyl chloride stabiliser and as a catalyst in some industrial processes, also contributed considerably the overall seawater toxicity accounting for an average of 2% (range: 1.5% - 3%) in northern waters and 5% (range: 1% - 20%) in eastern waters. While further efforts to identify other toxicity contributors, the sources of the key toxicity drivers, and their toxicity pathways are merited, our study approach will facilitate the prioritization of marine contaminants in order for concerted management of water quality and biodiversity conservation.

O. 18: 14:50-15:10, 6/1/2024 (Saturday), P4701, YEUNG

DIVERSITY OF BENTHIC DINOFLAGELLATES IN HONG KONG WATERS AND THE IMPACT OF ENVIRONMENTAL CHANGES ON GROWTH AND TOXICITY OF LOCAL DINOFLAGELLATE SPECIES

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Marine benthic dinoflagellates are commonly found on various marine surfaces, such as sediment, rocks, coral reefs, macroalgae, or seagrass. Some benthic dinoflagellates can produce complex algal toxins. These toxins can harm marine life and accumulate in the food chain, posing a risk to human health. For example, *Ostreopsis* produces palytoxin, a neurotoxin, and *Prorocentrum* causes diarrhetic shellfish poisoning. This study focused on the diversity of benthic dinoflagellates in Hong Kong waters, identifying toxin-producing species and studying their growth, toxicity, and response to environmental factors.

Over 200 single-cell cultures of benthic dinoflagellates were isolated from Hong Kong waters. Based on morphology and molecular biology, 14 species from five genera were identified (*Prorocentrum, Ostreopsis, Amphidinium, Coolia*, and *Fukuyoa*). Three putative new species were also discovered. Toxicity screening confirmed toxin-producing species in the genera *Prorocentrum*, *Amphidinium*, *Coolia*, and *Fukuyoa*. Some microalgae showed genetic differences within species, and different genotypes of the same species exhibited varying levels of toxicity. Microalgae extracts caused harm to marine invertebrates and fish, and some strains were hemolytic.

Coolia was the most common benthic dinoflagellate genus in Hong Kong waters. Toxicity studies focused on *Coolia malayensis* and *Coolia tropicalis*, two highly toxic species compared to other species in the same genus. The study examined the toxicological mechanisms and their response to environmental factors. Results showed that exposure to *Coolia tropicalis* negatively affected the development of marine fish larvae, as well as cell apoptosis, immune response, and energy metabolism. Temperature had a significant impact on the physiology and toxicity of microalgae, while salinity and ocean acidification had less influence. The toxicity of *Coolia malyensis* increased with temperature. The study's findings highlighted Hong Kong as a hotspot for benthic dinoflagellates in subtropical waters and provided important data on the potential threats these microalgae pose to local marine ecology and human health. The study also emphasized the need to monitor the distribution and toxicity changes of harmful benthic microalgae in response to seawater warming and ocean acidification.

O. 19: 15:10-15:30, 6/1/2024 (Saturday), P4701, YEUNG

TEMPERATURE EFFECTS ON PHYSIOLOGY, TRANSCRIPTION, AND TOXIN PRODUCTION OF THE BENTHIC DINOFLAGELLATE *GAMBIERDISCUS BELIZEANUS*

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Ocean warming is increasing the occurrence of harmful dinoflagellate blooms, which pose a significant threat to coastal ecosystems in tropical and subtropical regions. However, the understanding of how temperatures affect the growth and toxicity of these harmful species remains limited. In this study, we investigated the physiological and transcriptional responses, and the the toxin production of *Gambierdiscus belizeanus*, a common dinoflagellate responsible for benthic harmful algal blooms, when exposed to different temperatures (18°C to 28°C). Higher temperatures (26°C and 28°C) elevated the growth rate, chlorophyll *a* and *c* content, and photosynthetic efficiency. In contrast, lower temperatures (18°C and 22°C) suppressed growth and photosynthesis but resulted in higher levels of algal toxins (44-methylgambierone and gambierone). Transcriptomic analysis revealed enhanced growth and photosynthesis at higher temperatures correlating with the up-regulation of key genes involved in carbon metabolism (ATP synthase beta chain) and photosynthesis (e.g., photosystem I P700 chlorophyll *a* apoprotein A1 and photosystem II protein). This suggests that these genes contribute to energy resources for growth and potentially promote the bloom of *G. belizeanus*. On the other hand, the lower temperatures triggered molecular adaptations in *G. belizeanus*, including the modulation of genes related to cell cycle (cell division cycle 14 and 14-3-3 protein epsilon) and suppression of photosynthesis, explaining the observed physiological changes. Furthermore, the activation of toxin production-related genes (*type I polyketide synthase* and *SxtA short isoform precursor*) under lower temperatures suggests a potential health risk to ecosystems due to bioaccumulation of toxins. Overall, our study highlights distinctive cellular responses of harmful dinoflagellates to temperature variations. It is believed that these responses can play a crucial role in determining the potential risks to coastal marine ecosystems and human health posed by dinoflagellate blooms in a warming ocean.

O. 20: 15:30-15:50, 6/1/2024 (Saturday), P4701, YEUNG

EXOLORATION OF IRON ADDITION AS A MITIGATION MEASURE FOR THE DETRIMENTAL EFFECTS OF SARGASSUM BLOOMS ON RED MANGROVES WETLANDS (RHIZOPHORA MANGLE) IN A LAB ENVIRONMENT

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As a new and annual normal, the accumulated and decaying *Sargassum* on coastal shorelines changed the status of local primary producers massively, including seagrass/mangroves. As a species famous for its resilience, the unusual mortality of mangroves after *Sargassum* blooms raised scientists' concern. In this case, Sulphide was considered as a potential factor since it was noticed in the field. However, this assumption is not valid until the status of mangroves with *Sargassum*-induced sulphide can be studied over time in a controlled environment. Therefore, the aim of this research is to investigate 1) the potential of iron oxides (FeOx) in binding sulphide released by *Sargassum*, 2) the influence of FeOx/*Sargassum* ratio on mangrove survival and 3) the overview of water chemistry during the decomposition of *Sargassum* with mangrove sediments. This study conducted a series of pilots in pots and a formal experiment in jars. In the pot experiment, juvenile red mangroves were involved. By reducing the *Sargassum* inputs, the mangroves could survive longer periods. Though the FeOx addition reduced the sulphide levels significantly, it did not prevent the mangrove from mortalities. In the follow-up jars experiment, a detailed comparison is made among different ratios of FeOx and *Sargassum* inputs (n(Fe:S)). Besides sulphide levels, total sulphur(TS)/phosphorus(TP)/iron(TFe) was also measured. Their changes illustrate that the anaerobic decomposition of *Sargassum* mainly started after 1 week, when the sulphide levels increased. The relationship between sulphate reduction rate and iron ions releasing rate from FeOx jointly determined the sulphide release rate. According to the sulphide records, when the n(Fe:S) was over 1:1, the sulphide could be mitigated sufficiently. When the FeOx was exceeded, TP and TS would be significantly consumed by released Fe ions. It indicated that to effectively bind the sulphide and minimise the depletion of the nutrients, n(Fe:S) is expected to be 1:1. The value of this research lies in new inspiration and understanding of a potential mitigation measure for decaying *Sargassum*. By designing a mesocosm study, this approach can be used to explore the relationship between potential stressors and effects observed in the field.

Invited talk 5: 14:00-14:30, 3/1/2024 (Wednesday), P4703, YEUNG

DECADAL HISTORICAL CHANGES OF LEGACY AND EMERGING PER- AND POLYFLUOROALKYL SUBSTANCES IN SEDIMENTS FROM THE MARGINAL SEAS OF CHINA: GROWING USAGE OF EMERGING PFAS

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Per- and Polyfluoroalkyl Substances (PFAS) are land-derived oceanic pollutants with the potential for global transport; however, a comprehensive understanding of the historical trend of PFAS in Chinese coastal sediments has been lacking for decades. Therefore, we collected sediments in 2009 and 2021 from the Yellow Sea, the East China Sea, and the South China Sea. The results show a higher concentration of PFAS in northern sea areas compared to southern sea areas before and after the decade. There is a similar trend in both spatial and temporal distributions of PFAS concentrations in the East China Sea and the South China Sea. Emerging PFAS concentrations and species have increased, with perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid (PFOS) and perfluorononanoic acid (PFNA) identified as primary compounds, among PFOA exhibits the highest concentration. The difference is that in 2021, the total PFAS concentration in the East China Sea is significantly improved, and the total PFAS concentration in the South China Sea is significantly decreased ($p < 0.05$). This result reflects that although traditional PFAS (PFOA and PFOS) continue to be used, the alternatives have started to be widely used along coastal regions. Correlation analyses indicated that long-chain PFAS were homologously and readily adsorbed to sediments. The risk assessment reveals that in the East China Sea, PFOS remained at a high-risk level, while PFOA's moderate risk decreased. In the South China Sea, PFOS shifted from medium-high risk to medium-low, and PFOA maintained a medium-low risk level. The environmental behavior of PFOS in the East China Sea deserves further attention.

O. 21: 14:30-14:50, 3/1/2024 (Wednesday), P4703, YEUNG

THE LATEST PROGRESS AND FUTURE PROSPECTS OF THE GLOBAL ESTUARIES MONITORING PROGRAMME

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Currently, more than 100,000 chemical substances are used in our daily lives and industries. Among them, 4,000 pharmaceuticals are used for preventing and treating human and animal diseases. Many of these chemicals eventually find their way into estuaries through various pathways, such as rivers, surface runoff, and partially treated wastewater discharged from treatment plants. There is a lack of information at a global level regarding the occurrence and environmental risks of different chemical contaminants in urbanized estuaries, particularly in Africa, South America, Southeast Asia, and Oceania coastal areas.

To address this issue, the Global Estuaries Monitoring (GEM) Programme aims to develop standardized methods for sampling, extracting, detecting, and quantifying priority chemical contaminants in water samples collected from major urbanized estuaries worldwide. These methods will enable a scientifically sound comparison of contamination profiles across various estuaries.

The GEM Programme is one of the first Ocean Decade Programmes endorsed by the United Nations Decade of Ocean Science for Sustainable Development (2021-2030) on June 8, 2021. The study focuses on six key aspects, including capacity building, standardization of research methods, promotion of best practices in pollution monitoring and control, data sharing, co-designing research strategies, and revealing the estuary health status.

Over the past two years, we have been fully committed to method development and establishing connections with global collaborators. GEM has already developed and verified a robust analytical method to quantify 65 pharmaceuticals in river, estuary, and marine water samples for the GEM Programme, using only a small sample volume. This allows for economical transportation of collected samples to State Key Laboratory of Marine Pollution in Hong Kong for chemical analysis. We have also received contributions from 140 estuaries in 65 cities across 45 countries. Currently, samples are being collected from these major urbanized estuaries globally.

The GEM Programme aims to contribute to unveiling the global pollution situation and promoting best practices to combat pollution problems, thus achieving cleaner estuaries for a better and greener future. We warmly welcome everyone to share and contribute to the GEM programme. We expect to share our latest findings and co-design the second phase of GEM with our collaborators in 10th International Conferences on Marine Pollution and Ecotoxicology.

O. 22: 14:50-15:10, 3/1/2024 (Wednesday), P4703, YEUNG

BIOMAGNIFICATION OF PHARMACEUTICALS IN THE ARCTIC FOOD WEB

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Although human pharmaceuticals and stimulants are increasingly reported in streams, effluents, seawater and sediments of the Arctic, accumulation of drugs in the resident biota and trophic transfer have not been yet examined. This study investigates behaviour of several pharmaceuticals in the rocky-bottom macrobenthic food web in the coastal zone of Isfjorden (western Spitsbergen) using stable isotope analyses coupled with liquid chromatography-mass spectrometry (LC/MS). Across 16 macroalgal and invertebrate species the highest average concentration of pharmaceuticals was measured for ciprofloxacin (CIP) (60.3 ng g^{-1} dry weight) followed by paracetamol (PCT) (51.3 ng g^{-1} dry weight) and nicotine (NIC) (37.8 ng g^{-1} dry weight). Biomagnification potential was assessed for six (out of 13 detected) target compounds that were quantified with frequency across all biological samples > 50 %. The trophic magnification factor (TMF) ranged from 0.221 to 2.768 and was significant only for NIC and CIP. TMF < 1.0 for NIC, DIC, carbamazepine (CBZ) and caffeine (CAF) indicated that neither compound accumulated with trophic position. Dilution of pharmaceutical residues in the food web might be a result of limited intake with dietary route, poor assimilation efficiency and biotransformation rates in benthic invertebrates. TMFs for CIP (2.768) and PCT (1.324) suggest trophic magnification, the phenomenon observed previously for several antibiotics in freshwater systems. Evidently, trophic transfer plays a role in controlling CIP and PCT concentrations in the Arctic benthic communities. This study provides the first evidence of the Arctic food web which indicates that behaviour of human pharmaceuticals varies among target compounds.

O. 23: 15:10-15:30, 3/1/2024 (Wednesday), P4703, YEUNG

STUDY ON ENANTIOSELECTIVE UPTAKE AND PURIFICATION KINETICS OF METOPROLOL AND VENLAFAXINE IN MARINE MEDAKA

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City University of Hong Kong, China

The number of individuals using long-term pharmaceuticals is increasing worldwide, and their incomplete removal by wastewater treatment has resulted in their widespread release into the aquatic environment. Metoprolol is one of the most used β-blocker to treat cardiovascular disorders such as hypertension, congestive heart failure, and atrial fibrillation. Venlafaxine, as one of the most prescribed SNRIs, is mainly used to treat major depressive disorder and anxiety disorders. Studies have shown that both metoprolol and venlafaxine exhibit certain toxicity to aquatic organisms. More than 50% of currently marketed pharmaceuticals are chiral, often exhibiting enantioselectivity in environmental distribution, fate, and ecotoxicity. But there is still limited research on the uptake and purification of chiral pharmaceuticals in marine organisms. The aims of the present study were to (a) provide first-hand data on the uptake and depuration of two chiral pharmaceuticals among different organs or tissues of a model fish species (i.e., marine medaka [*O*. melastigma]); (b) investigate the toxicokinetic characteristics of metoprolol and venlafaxine from an enantiomeric perspective; and (c) identify possible pharmaceutical metabolites using a suspect screening analytical approach. The toxicokinetics of the studied pharmaceuticals, including uptake and depuration rate constants, depuration half-life ($t_{1/2}$), and bioconcentration factor (BCF), were reported for the first time and highest tissue-specific BCFs of the four enantiomers were all found in the eyes. The whole fish results demonstrated a higher *S*- than *R*-venlafaxine bioaccumulation potential, while no significant difference was observed between *S*- and *R*-metoprolol. And different chiral enantiomers showed different metabolic tendencies that *O*-desmethyl-metoprolol (ODM) and *a*-hydroxy-metoprolol (AHM) were the main metoprolol metabolites identified by suspect screening, and the ratios of ODM to AHM were 3.08 and 1.35 for *S*- and *R*-metoprolol, respectively. *N*,*O*-Didesmethyl-venlafaxine (NODDV) and *N*-desmethyl-venlafaxine (NDV) were the main venlafaxine metabolites, and the ratios of NODDV to NDV were 1.55 and 0.73 for *S*- and *R*-venlafaxine, respectively.

O. 24: 15:30-15:50, 3/1/2024 (Wednesday), P4703, YEUNG

USING MACHINE LEARNING TO PREDICT ADVERSE EFFECTS OF POLLUTANTS TO VARIOUS AQUATIC ORGANISMS

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Beihang University, China

Chemicals widespread in aquatic environments that can seriously affect the species diversity and species distribution of aquatic organisms when concentrations exceeding threshold values. Experimentally evaluating the (eco)toxicity of pollutants is time-consuming and expensive due to the multiple environmental factors, the complexity of material properties and the species diversity. Machine learning (ML) models provide an option to deal with heterogeneous data sets and complex relationships. We proposed an *in silico* model based on Machine Learning considering physicochemical properties of pollutants, environmental conditions and biological characteristics of multi species, that can be applied to predict the toxicity of different pollutants towards multiple aquatic species. We applied this new model to two examples: (I) predicting metallic nanomaterials toxicity for a variety of organisms and (II) predicting the toxicity of different fish including rare and endangered species for nineteen metals, which all obtained good results. In addition, feature importance and interaction analysis based on the random forest method were used to fully understand the model and the importance of the features. In Example I, the results showed that exposure duration, illumination, primary size, and hydrodynamic diameter were the main factors affecting the ecotoxicity of MNMs to a variety of aquatic organisms. In Example II, site-specific HC5 of Chinese eastern lake region for these metals was derived. Moreover, incorporating additional detailed information on the ecological traits of the test species will allow to further optimize and improve the predictive performance of the model. The study provides a new approach for ecotoxicity predictions for organisms in the aquatic environment and will help better develop site-specific WQC to protect rare and endangered species for chemicals in the future.

Invited talk 6: 14:40-15:10, 4/1/2024 (Thursday), P4703, YEUNG

TEMPORAL TRENDS AND SUSPECT SCREENING OF HALOGENATED FLAME RETARDANTS AND THEIR METABOLITES IN BLUBBERS OF CETACEANS STRANDED IN HONG KONG WATERS

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Halogenated flame retardants (HFRs) are a large class of chemical additives intended to meet flammability safety requirements, and at present, they are ubiquitous in the environment. With the phasing out of legacy HFRs, many novel HFRs have emerged as replacements. Target analysis of HFRs usually focuses on a limited number of novel HFRs; many HFRs have biotransformation potential, but HFR metabolites are less studied compared; all these can be partly attributed to the absence of relevant reference standards.

As top predators, marine mammals can bioaccumulate high amounts of persistent organic pollutants and are particularly susceptible to HFR exposure. Thus, we conducted comprehensive target analysis and suspect screening of HFRs in blubber samples from 105 resident marine cetaceans stranded in Hong Kong waters between 2013 and 2020; eight common metabolic pathways were considered in suspect screening, including methylation, debromination, hydroxylation, dihydroxylation, methoxylation, demethylation, sulfation, and glucuronidation.

Results showed that target HFRs were found at μg/g lipid weight levels in the blubber samples, revealing their high pollution burden. Polybrominated diphenyl ethers (PBDEs) and *a*-hexabromocyclododecane (*a*-HBCD) accounted for more than 95% of ΣHFRs. Significant decreasing temporal trends were observed in the concentrations of tetra-/penta-/hexa-BDEs in adult porpoises stranded in 2013−2015 than those stranded in 2016−2020. A significant positive correlation between these legacy and novel HFRs in the investigated cetaceans indicates their similar contamination source. 2,3-dibromopropyl-2,4,6-tribromophenyl ether (DPTE), a novel HFR, was found at high levels in the investigated marine cetaceans and accounted for more than 85% of the total novel HFRs. Semi-quantification results indicate the existence of methyl-methoxy-tetra-BDE (Me-MeO-tetra-BDE) at μg/g-level in the cetacean bubbler samples.

The declines of tetra-/penta-/hexa-BDE levels coincided with the phasing out of these PBDEs in China. No decreasing trend was observed in the levels of deca-BDE or HBCD, probably due to their exemption from the ban in China until 2023 and 2021, respectively. The current results provide a baseline for verifying if the ban of the exemption will be effective in lowing deca-BDE and HBCD in the future. A significant positive correlation was found between concentrations of tetra-BDE and Me-MeO-tetra-BDE, indicating that the metabolism of tetra-BDE may be a potential source of Me-MeO-tetra-BDE in marine mammals.

O. 25: 15:10-15:30, 4/1/2024 (Thursday), P4703, YEUNG

LEGACY AND EMERGING PER- AND POLYFLUOROALKYL SUBSTANCES FROM EIGHT MAIN OUTLETS OF THE PEARL RIVER DELTA, CHINA: PHASE DISTRIBUTION, TEMPORAL VARIATION, AND ENVIRONMENTAL STRESS

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Per- and polyfluoroalkyl substances (PFASs) are a diverse group of widely used anthropogenic chemicals. The heavily industrialized and urbanized Pearl River Delta (PRD) region in China is a significant source of PFAS emissions to the adjacent coastal South China Sea (SCS) through its eight main outlets, thereby posing potential ecological risks. This study collected water samples (n = 192) from these outlets between 2020 and 2021 to determine 39 legacy and emerging PFAS levels. It was estimated that 5.06×10^4 kg/y PFASs were discharged from the riverine outlets to the coastal SCS in 2020-2021 while perfluorooctanoate (PFOA) was the predominant PFASs (50%) followed by perfluorobutane sulfonate (16%), perfluorobutanoate (11%), and perfluorooctane sulfonate (PFOS, 10%). Hydrological parameters could pose a significant influence on the suspended particulate matter (SPM)-dissolved phase distribution coefficients of emerging PFASs, such as polyfluoroalkyl ether sulfonic acids (PFESAs). Using the hydrodynamic model, current PFOS emitted from Pearl River outlets have exceeded their environmental capacity, which may pose a risk to many species inhabiting the coastal SCS, while PFOA and 6:2 Cl-PFESA could bring potential risks to resident marine top predators.

O. 26: 15:30-15:50, 4/1/2024 (Thursday), P4703, YEUNG

ACUTE TOXICITY AND RISK ASSESSMENT OF COMMON TIRE COMPOUNDS, 6PPD AND 6PPD-Q, IN THE MARINE ENVIRONMENT

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N-(1,3-dimethylbutyl)-N′-phenyl-p-phenylenediamine (6PPD), a widely used antioxidant for tire rubbers and its ozonation product N-(1,3-dimethylbutyl)-N′-phenyl-p-phenylenediamine-quinone (6PPD-Q) have recently raised concerns. 6PPD-Q is reported to be toxic to Coho salmon under environmentally realistic concentrations. However, there are There is scanty data available for the toxicity of 6PPD and 6PPD-Q to marine species, especially marine invertebrates. This study, therefore, aimed to investigate the acute toxicity of 6PPD and 6PPD-Q to eight marine species, including microalgal species, small invertebrates, and marine medaka fish. Surprisingly, the toxicity of 6PPD-Q was found to be low to most tested organisms, and much lower than those of 6PPD. With the newly generated toxicity data of 6PPD, we constructed its species sensitivity distribution, from which a predicted non-effect concentration (PNEC) of 6PPD was determined to be 16.84 μg/L. As 6PPD-q did not show acute mortality effect to species in this study, we constructed its species sensitivity distribution based on data from literature reviews, which were mainly studies on fish, and the PNEC of 6PPD-q was 64 ng/L. The environmental concentrations of these two tire compounds were also measured in seawater samples collected from 11 coastal sites, with the highest concentration of 6PPD and 6PPD-q recorded to be 5.27 (ng/L) and 2.34 (ng/L). As the PNEC is much higher than the measured environmental concentrations, it can be concluded that the current ecological risk of 6PPD and 6PPD-q to the coastal marine ecosystem is low.

O. 27: 15:50-16:10, 4/1/2024 (Thursday), P4703, YEUNG

DISTRIBUTION AND BIOACCUMULATION CHARACTERISTICS OF LIPOPHILIC MARINE BIOTOXINS AND ASSOCIATED MICROALGAE IN SOUTH SEA COAST OF KOREA

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Here, we investigated the current contamination status of lipophilic marine biotoxins (LMTs) on the southern coast of Korea from January to December 2022. Specific objectives were to: i) identify the occurrence of LMT-producing phytoplanktons at 13 sites (n=127), ii) determine the spatiotemporal distributions of LMTs in phytoplankton (20–200 μm SPM, n=127) and mussel (*Mytilus galloprovincialis*, n=106), iii) investigate the contamination status of LMTs in domestic seafood samples (bivalves, n=123), and iv) monitor continuously LMTs in seawater using solid phase adsorption toxin tracking (SPATT). Nineteen LMTs, such as YTX, homo-YTX, PTX-2, PTX-11, AZA-1, AZA-2, AZA-3, AZA-4, AZA-5, OA, DTX-1, DTX-2, BTX-1, BTX-2, BTX-3, BTX-5, DA, GYM, and SPX, were quantitated using HPLC-MS/MS. Causative phytoplanktons of LMTs, such as *Gonyaulax spinifera*, *Dinophysis* sp., and *Karenia brevis,* were found in the southern coastal waters, but their density was not high (maximum: 4.7 cells mL^{-1} in April). Concentrations of LMTs in phytoplankton and mussels ranged from <LOD to 2,590 ng g^{-1} ww and from <LOD to 350 ng g^{-1} ww, respectively. LMTs in phytoplanktons showed maximum concentrations in May, and then tended to decrease. Concentrations of LMTs in mussels showed a significant positive relationship with the concentration in phytoplankton, but it was shown that LMTs can accumulate in mussels for a relatively extended period (maximum in August). Homo-YTX and PTX-2 were predominant LMTs in phytoplanktons, and homo-YTX was also predominantly detected in mussels. In the SPATT sampler, more diverse LMTs were detected compared to seawater, phytoplankton, and mussels. For example, OA, DTX-1, and AZA-2 were detected in SPATT and showed relatively great contributions. SPATT can be used to monitor changes in the composition of LMTs, transitioning from PTXs to YTXs, in the South Sea Coast of Korea. This study confirmed that even though the density of causative algae is low, it can sufficiently cause contamination in shellfish. Therefore, continuous monitoring and related research on these toxins should be conducted.

O. 28: 16:10-16:30, 4/1/2024 (Thursday), P4703, YEUNG

EXPOSURE TO NORFLUOXETINE, AN ENDOCRINE DISRUPTING COMPOUND, LEADS TO ALTERATIONS IN SEVERAL GENES EXPRESSION AND TRANSCRIPTOMIC PROFILES IN THE BALTIC BLUE MUSSEL *MYTILUS TROSSULUS*

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Depression is an emerging health issue of the modern societies – according to World Health Organization, approximately 3.8% of the world's population suffers from this disease. Fluoxetine, a selective serotonin reuptake inhibitor, is one of the most frequently prescribed antidepressant drug. Growing consumption of fluoxetine leads to an increase in the concentration of its active metabolite, norfluoxetine (NFLX), in the wastewater. NFLX has been proved to be persistent in marine organisms, which only increases the risk of inducing negative impact on their physiology. NFLX may also act as an endocrine disrupting compound and its influence on the endocrine system of the blue mussel *Mytilus trossulus* (one of the most common benthic species in the Baltic Sea), has been highlighted in our previous research: we observed sex-dependent changes in the concentration of estrogens and serotonin after treating the bivalves with 500 ng/L NFLX.
Therefore, the aim of our present study conducted on *M. trossulus* was to assess the changes in the expression of genes related to detoxication and metabolism of serotonin in the gonads after exposing the bivalves to NFLX, and to investigate the potential impact of the treatment with this compound on the gonadal transcriptome profile. In our experiment, adult bivalves were exposed to 500 ng/L NFLX for 6 days. The control group of non-treated bivalves was kept in parallel. After the incubation, live individuals were counted, sexed, and sectioned. 1 µg of total RNA isolated from gonads was either used in reverse transcription to obtain cDNA for real-time PCR, or prepared for RNA sequencing. The expression of *CYP1L1*, *CYP3AL1*, *CYP3AL2*, *GSTς3*, *PGLY1*, and *5-HT1* was assessed with *GAPDH* and *COX1* as reference genes and the results for the bivalves treated with NFLX were compared to these obtained for the control animals. *CYP1L1*, *GSTς3*, and *5-HT1* expression was decreased in males and increased in females. mRNA levels of *CYP3AL2* were lowered in males. No changes in the expression of *CYP3AL1* and *PGY1* were observed. Transcriptomic profiles assessment revealed differences between the bivalves exposed to NFLX and the control group: 140 differentially expressed genes were identified in males and 285 in females. The analyzes performed for males and females separately demonstrated, among others, significantly higher expression of *ROP1L* (ropporin-1-like) and *DOPO* (dopamine beta-hydroxylase-like) and lowered expression of *GST1* (glutathione S-transferase 1-like) in the norfluoxetine treated males group. In the NFLX-treated females, lowered expression of genes such as *CYP1A2* (cytochrome P450 1A2-like), *GST7* (glutathione S-transferase 7), and *ROP1L* was observed.
Our current research highlights the influence of NFLX, a compound widely present both in the sewage and in the marine waters, on the detoxication pathways and neuroendocrine system regulation in *M. trossulus*. The observed changes may lead to disturbances in these bivalves reproduction processes.

O. 29: 16:50-17:10, 4/1/2024 (Thursday), P4703, YEUNG

TOXICOKINETICS OF OSELTAMIVIR ETHYLESTER AND OSELTAMIVIR CARBOXYLATE IN *DAPHNIA MAGNA*

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The antiviral drug Tamiflu has been heavily used for treating influenza. The metabolites of Tamiflu, oseltamivir ethylester (OE), and oseltamivir carboxylate (OC) have been detected in rivers, sewage treatment plants, and freshwater environments. However, the study regarding freshwater organisms exposed to Tamiflu metabolites (OEOC mixture) is insufficient. This study evaluated the accumulative capacity of *Daphnia magna* with OE exposure and OEOC exposure, as well as the transfer rate of OE turning into OC in the water environment. *D. magna* were separately exposed in two groups: OE single exposure and OEOC mixed exposure for 72 hours, followed by 36 hours depuration phase. We analyzed the time-course OC and OE concentrations in *D. magna* and water using a Thermo Finnigan Acella1250 ultra-high-pressure liquid chromatography (UHPLC) system linked with a Thermo Finnigan TSQ Quantum ultra-triple quadrupole mass spectrometer (MS/MS), and estimate the toxicokinetics parameters of OC and OE with first-order four-compartment toxicokinetic model. The results of the single OE exposure group revealed detectable concentrations of OC in the water, along with the accumulation of OC within the *D .magna*. Furthermore, in the experiments involving either single OE exposure or the OEOC mixed exposure, the transfer rate of OE into OC ranged from 9% to 16%. In the OEOC exposure group, OC concentrations increased over time in the water, while OE concentrations decreased. In particular, the degradation rate of OE in the water was faster in the OEOC exposure group compared to the singular OE exposure group. In situations where *D. magna* were exposed to environmentally relevant concentrations, both OE and OC exhibited bioconcentration factors (BCFs) greater than 1, indicating the potential for bioaccumulation. In the depuration test, within the mixed exposure group of OEOC, the BCF for OC was found to be 1.47. Thus, if environmental concentrations lead to the bioaccumulation of these compounds within *D. magna*, the elimination of OC is likely to be more challenging than that of OE. This study confirms that even in the area exposed only to OE, the accumulation of OC occurs, especially at environmentally relevant concentrations. Moreover, OC exhibits a more pronounced bioaccumulative effect on *D. magna* than OE.

O. 30: 17:10-17:30, 4/1/2024 (Thursday), P4703, YEUNG

SEVERE CONTAMINATION AND TIME TREND OF NEUTRAL PER- AND POLYFLUOROALKYL SUBSTANCES (N-PFAS) IN SEDIMENTS FROM LAKE SHIHWA, KOREA: SOURCE AND EFFECTIVENESS OF REGULATORY ACTION

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Per- and polyfluoroalkyl substances (PFAS) are a group of chemicals used in various industrial and consumer applications as surfactants, grease repellents, waterproofing agents, and flame retardants since 1950s. Because of their bioaccumulation potential, toxicity, and ubiquitous presence, perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) have been listed as the persistent organic pollutants (POPs) under the Stockholm Convention. Consequently, neutral PFAS (n-PFAS) used as major intermediates in industrial sectors, such as fluorotelomer alcohols (FTOHs), perfluorooctane sulfonamides (FOSAs), and perfluorooctane sulfonamidoethanols (FOSEs), have been contaminants of emerging concern as precursors of PFOS and PFOA. Despite of growing evidence for the contribution of n-PFAS to ionic PFAS and their adverse health effects, research on environmental contamination profiles of n-PFAS are scarce and limited on air. In the present study, n-PFAS were measured in sediments from the highly industrialized Lake Shihwa in 2008 to 2021 using gas chromatography coupled with tandem mass spectrometer (GC-MS/MS) to investigate the occurrence, contamination profile, and time trend. FTOHs were predominant compounds with over 80% contributions of total n-PFAS concentrations in all samples, followed by FOSEs. Total concentration of n-PFAS had declined by approximately one order of magnitude in 2021 compared to 2008. The highest concentrations of n-PFAS were observed in creeks taken near industrial complexes. The concentrations of n-PFAS decreased with increasing distance from creeks to inshore and rarely detected in offshore. Two sites of creeks considered as hotspots for PFAS contamination, were identified as being near the water repellent manufacturing facilities. These results suggest geographical proximity to industrial sources is a major factor governing n-PFAS contamination. The contribution of 6:2 FTOH increased from 1% to 28%, and the contribution of 8:2 FTOH decreased from 54% to 39% in 2021 from 2008, implying that consumption of n-PFAS in fluorochemical industries is shifting from long-chain (≥C8 compounds) to short-chain (C6 compounds) based substances. A clear reduction of FOSEs was observed between 2008 and 2015 as a result of the regulation on PFOS and related chemicals in 2009. In the correlation analysis with our previous result for ionic PFAS from 2021, FOSEs were well correlated with PFOS, suggesting 'stepwise contamination' in the environment from the precursors. These results indicate that sediment of Lake Shihwa can represent the temporal trends of PFAS according to industrial consumption and regulatory actions. Our findings provide a fundamental basis for the contamination profiles of n-PFAS in industrialized areas.

O. 31: 17:30-17:50, 4/1/2024 (Thursday), P4703, YEUNG

POLLUTION CHARACTERISTICS AND SOURCE ANALYSIS OF PERFLUOROALKYL COMPOUNDS IN TYPICAL ESTUARY AREAS OF FUJIAN PROVINCE

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Per- and polyfluoroalkyl substances (PFASs) are a group of emerging persistent organic pollutants that are widely used in consumer and industrial products due to their anti-fouling, oil-repellent, water-repellent, and non-stick properties. PFAS have become a global concern due to their toxicity and bioaccumulation1. In this study, 30 PFAS,including 13 carboxylic acid PFAS,7 sulfonate PFAS, and 10 precursors PFAS, were investigated and analyzed in the surface water of Jiulong River-Xiamen Bay and Zhangjiang Estuary in China. The concentrations of PFAS in Zhangjiang Estuary (1.35-500 ng/L) were higher than those in Jiulong Jiang-Xiamen Bay (2.03-170 ng/L). The composition was dominated by carboxylic acid PFAS (>56%), such as PFPeA, PFOA, PFNA, and PFBA. New PFAS substitutes were also detected, such as HFPO-DA. Both the concentration and composition of PFAS showed seasonal variations in the two estuaries. Specifically, levels of PFAS decreased from Spring to Winter, but the compositions of Sulfonic acid PFAS increased accordingly, indicating the changes of source inputs. In both area, the concentration of PFAS showed an decreading trend from the upper reaches of the river to the downstream. The source analysis results show that the PFAS in Xiamen Bay-Jiulong River may be mainly affected by the shipbuilding industry, terminals, and airports. The impact of Zhangjiang Estuary is more complex, in addition to the impact of the shipbuilding industry, it may also be affected by residents' domestic garbage.

O. 32: 17:50-18:10, 4/1/2024 (Thursday), P4703, YEUNG

RISK ASSESSMENT OF E-WASTE CONTAMINANTS – LIQUID CRYSTAL MONOMERS RELEASED BY DREDGING SEDIMENT PLUMES IN PRE

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Liquid crystal monomers (LCMs), as the critical component in liquid crystal display (LCD) panels, are easily released into the environment as emerging organic pollutants. As one of the most urbanized estuarian regions, the Pearl River Delta (PRD) possesses massive LCD manufactories and acts as an important e-waste recycling center in the world, posing a great threat to the nearby marine environment, namely the Pearl River Estuary (PRE). Based on the survey data on LCMs concentration in sediment, 10 highly persistent LCMs were detected in PRE with total LCMs ranging from 0.9 – 31.1 ng/g dry sediment (Tao et al., 2022).

Massive dredging projects have been conducted in PRE which could generate a huge amount of re-suspension sediment in water columns and raise various environmental problems. Here in this study, secondary LCMs pollution, caused by the re-suspension of sediment during dredging activities, was investigated using computational fluid dynamics (CFD). The dredging source plumes were estimated referring to the Lantau Tomorrow project and implemented in the FVCOM (Finite-Volume Coastal Ocean Model) sediment module. In the meanwhile, the artificial technique, namely the clustering analysis, was applied to generate representative weather conditions based on 44 years of historical data, which were applied as external forcing. The model output, i.e. the spatial and temporal suspended sediment concentrations (SSC), were used to estimate the risk of LCMs according to their toxicity levels on seawater mysid shrimp. Five dredging locations were chosen around Lantau Island to explore the impact of dredging locations on the risk of LCMs. This will also provide insightful information to the decision-makers when dredging locations are under consideration.

Based on all the results, the most severe secondary LCMs pollution were generated when dredging near the Urmston Road, a compound channel where massive and persistent macro-vortices were generated and transported by the tidal currents (He et al., 2022). The transport of LCMs was significantly affected by the local estuarine circulations, especially the macro-vortices dynamics around compound channels, headlands, and islands (He et al., 2022, 2023). In general, the choice of dredging locations should avoid places with a high density of macro-vortices, where contaminants could be transported quickly to the far field.

Invited talk 7: 14:00-14:30, 3/1/2024 (Friday), P4703, YEUNG

LIQUID CRYSTAL MONOMERS: FROM INDOOR TO MARINE ENVIRONMENTS

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The widespread use, recycling and disposal of electronic devices (e-devices) leads to the release of numerous hazardous substances into the environment. Liquid crystal monomers (LCMs) are key displaying materials used in the manufacture of liquid crystal display (LCD) panels. LCMs have recently gained attention as an emerging class of chemicals of concern related to e-waste, which have been detected in sediment samples collected near e-waste recycling facilities. However, LCMs can be emitted at various stages in the life cycle of e-devices, including during their regular usage. This can result in a significant input of total LCMs into the environment through routes other than industrial discharges (e.g., through municipal sewage). We have conducted a series of studies investigating the occurrence, distribution, and fate of LCMs, from indoor environments to wastewater treatment plants (WWTPs). Our research findings illustrate the pathway by which LCMs, emitted from e-devices, collected by indoor dust and sewage, move into the WWTP, and finally enter the receiving water of WWTP effluent, suggesting a substantial contribution of LCMs to the marine environment derived from routine e-device use. Further investigation is urgently needed to assess the ecological impact of LCMs on the marine ecosystem, and to develop active treatment and control measures for LCMs in sewage systems.

O. 33: 14:30-14:50, 5/1/2024 (Friday), P4703, YEUNG

ADDRESSING AN IMMINENT PROBLEM PRESENTED BY A NEW CLASS OF POLLUTANTS: CHEMICALS WITH EPIGENETIC AND TRANSGENERATIONAL EFFECTS

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Recent mammalian studies have revealed that some endocrine disrupting chemicals (EDCs) can modify the epigenome by DNA methylation, histone modification or miRNAs interference, resulting in adverse transgenerational effects on subsequent generations (e.g. deformities, reproductive impairments and infertility), even though these offspring have never been exposed to EDCs throughout their whole life. *In vitro* studies carried out by our group showed that certain EDCs could modify the epigenome and potentially transmit the epigenetic changes through the human female and male germ lines. Arguably, chemicals that can cause epigenetic alterations and transgenerational reproductive impairment might pose a dramatic and long-lasting threat to the sustainability of the species.

Using the marine medaka (*Oryzias melastigma*) as a fish model, this project set out to test the hypothesis that F0 exposed to environmental realistic concentration of certain EDCs can cause epigenetic alterations, leading to transgenerational reproductive impairment in both males and females in the subsequent generations (F1 to F3). Four EDCs commonly found in elevated concentrations in coastal waters of PRD and China [i.e. BDE-47, triclosan, TDCPP and BP-3) were selected, and their transgenerational effects in association with Darwinian fitness traits (including gametogenesis, sperm number and motility, ovarian atresia, reproductive hormones and expression of related genes along the HPG axis, fecundity, onset of puberty, fertilization success, sex ratio, apoptosis and cell proliferation) are being studied. In parallel, high-throughput massively parallel sequencing will be used to reveal the epigenetic mechanism (i.e. miRNA profile, global and gene specific DNA methylation patterns) underlying the observed reproductive impairments.

This research will enable us to coin a new class of pollutant with epigenetic and transgenerational effects, which is likely to attract global concern. The transgenerational effects revealed will compel a re-evaluation on the environmental and public health risks of these EDCs. Since endocrine and epigenetic regulations are highly conserved in vertebrates, our novel discoveries in this study will also shed light on epigenetic and transgenerational effects of epigenetic modifiers on higher vertebrates, including humans.

O. 34: 14:50-15:10, 5/1/2024 (Friday), P4703, YEUNG

TRANSGENERATIONAL PLASTICITY AND INHERITANCE TO EMERGING CONTAMINANTS AND ENVIRONMENTAL CHANGE

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Emerging contaminants are increasingly detected in the environment potentially leading to adverse ecological and human health effects. Among them, tris(1,3-dichloro-2-propyl)phosphate (TDCPP) is a chlorinated organophosphate flame retardant commonly employed in a wide range of consumer products and commonly found in the aquatic environment. We investigated and compared the multi-generational neuromolecular responses of marine medaka (*Oryzias melastigma)* upon chronic exposure to TDCPP (F0 to F3) A sex-dependent tolerance to TDCPP was found, with tronger transcriptional responses in female fish and trans-synaptic signalling is altered in females regardless of duration of exposure. Exposure of F0 in female s to TDCPP alone resulted in 2,123 differentially expressed genes (DEGs), mostly related to cognition and memory and learning. If female fish were exposed chronically across three generations, the accumulative effect of TDCPP resulted in differential regulation of genes involved in neurotransmitter secretion and G-protein-coupled signalling receptors. While TDCPP induced much less transcriptional adjustment in male exposed to TDCPP for one generation, chronic exposure over three generations resulted in 241 differentially expressed genes. Lastly, transgenerational F3 females still exhibit strong responses to TDCPP exposure with differential expression (2,472 DEGs, mostly related to neurotransmitters) when compared to unexposed individuals. Our result indicates long lasting effect upon exposure to TDCPP. Given that the neuromolecular pathways affected by TDCPP are conserved among vertebrates, results of this study suggest TDCPP may similarly pose a significant neurological risks to higher vertebrates.

O. 35: 15:10-15:30, 5/1/2024 (Friday), P4703, YEUNG

MULTI- AND TRANSGENERATIONAL TOXICITY IN ZEBRAFISH UPON LIFE CYCLE EXPOSURE TO DECABROMODIPHENYL ETHANE

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The novel brominated flame retardant decabromodiphenyl ethane (DBDPE) has become a ubiquitous emerging pollutant, hence the knowledge of its long-term toxic effects and underlying mechanism would be critical for further risk assessment. Firstly, the multi- and transgenerational toxicity of DBDPE was investigated in zebrafish upon a life cycle exposure at environmentally relevant concentrations. The results indicated significantly increased malformation rate and declined survival rate specifically in unexposed F2 larvae, suggesting a transgenerational development toxicity by DBDPE. The changing profiles revealed by transcriptome and DNA methylome confirmed an increased susceptibility in F2 larvae, and figured out potential disruptions of glycolipid metabolism, mitochondrial energy metabolism and neurodevelopment. The changes of biochemical indicators such as ATP production confirmed a disturbance in the energy metabolism, whereas the alterations of neurotransmitter contents and light-dark stimulated behavior provided further evidence for multi- and transgenerational neurotoxicity in zebrafish. Consequently, the role of mitochondrial dysfunction in DBDPE-induced toxicity was further studied through a short-term exposure and recovery experiment. The results indicated inhibited mitochondrial oxidative respiration accompanied by decreased mitochondrial respiratory chain complex activities, mitochondrial membrane potential and ATP contents upon DBDPE single exposure. However, addition of nicotinamide riboside could effectively restore DBDPE-induced mitochondrial impairments and resultant neurotoxicity, oxidative stress as well as glycolipid metabolism in zebrafish larvae. Taken together, our data suggest that mitochondrial dysfunction was involved in DBDPE-induced toxicity, providing novel insight into the toxic mechanisms of DBDPE as well as other emerging pollutants.

O. 36: 15:30-15:50, 5/1/2024 (Friday), P4703, YEUNG

TEMPORAL VARIATIONS OF CHLORINATED PARAFFINS IN THE SEDIMENT CORES FROM THE PEARL RIVER ESTUARY AND HONG KONG

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Chlorinated paraffins (CPs) are chemicals manufactured and used in large quantities, which ultimately released into the marine environment. Nevertheless, the temporal variations and pattern change of CP categories with longer carbon chain lengths in the marine environment are poorly understood. Two sediment cores were collected from the Pearl River Estuary (PRE) and Hong Kong with estimated dates from 1940 to 2021, for which short-, medium-, and long-chain chlorinated CPs (SCCPs, MCCPs, and LCCPs) were analyzed via high-resolution mass spectrometry. MCCPs and LCCPs, as substitutes to SCCPs, showed increasing temporal trends while SCCPs remained stable since the 1980s, implying the shifts in production and use from SCCPs to M/LCCPs in the PRE and Hong Kong. The occurrence and temporal trend of LCCPs and very long-chain CPs (vLCCPs) in marine sediment cores in China were reported for the first time. CPs with carbon chain lengths up to 30 were identified in sediments dated the 1970s and 1990s in the PRE and Hong Kong respectively. Significant higher levels of LCCPs and vLCCPs were observed in the two investigated cores before and after the 1980s, possibly resulting from the rapid increase of the CP industry in China in the 1980s. Statistically significant positive correlations found between vLCCPs and other CP categories indicated their common source in the investigated regions.

Invited talk 8: 14:00-14:30, 6/1/2024 (Saturday), P4703, YEUNG

PAST AND FUTURE TROPICAL MARINE BIODIVERSITY HOTSPOTS

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Hotspots of tropical marine biodiversity are places that harbour disproportionately large numbers of species or species richness compared to the rest of the tropics. Richness and location of these hotspots have changed throughout the Cenozoic era. Here we overview the global dynamics of Cenozoic tropical marine biodiversity hotspots, including the four major hotspots of the Indo-Australian Archipelago (IAA), western Tethys (present Mediterranean), Arabian Sea and Caribbean Sea. Our synthesis supports the 'Hopping Hotspots' model, which proposes that locations of peak biodiversity are related to Tethyan faunal elements and track broad-scale shallow-marine habitats and high coastal complexity created by the collision of tectonic plates. A null hypothesis is the 'Whack-A-Mole' model, which proposes that hotspots occur in habitats suitable for high diversity regardless of taxonomic identity or faunal elements. Earlier 'Centre-of' theories (e.g. centres of origin with diversity decreasing with distance from supposed areas of exceptionally high rates of speciation, for which easy connection to adjacent regions to the east and west is important) were based on the analysis of recent biotas with no palaeontological foundation and may better explain diversity dynamics within a hotspot rather than those between hotspots. More recently, however, human disturbance is massively disrupting these natural patterns. Synthesis effort in paleobiology advances the understanding of tropical biodiversity in the past, present and future.

O. 37: 14:30-14:50, 6/1/2024 (Saturday), P4703, YEUNG

EFFICIENT E-FUEL ELECTROSYNTHESIS FROM CARBON DIOXIDE

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The carbon footprint of ocean-related sectors, particularly shipping and fishing, needs to be minimized through approaches such as a transition to green energy sources. The electroreduction of carbon dioxide (CO_2RR) powered by renewable electricity provides a sustainable avenue to produce fuels and chemicals. Although a wide range of different products from C_1 to C_3 have been produced, CO_2RR still suffers from low selectivity at commercially relevant current densities (100 milliamperes per square centimeter). In this talk, I will present our recent progress towards the electrosynthesis of fuels (e.g., methane and ethanol) from CO_2RR, looking both at the catalyst and at the system.

O. 38: 14:50-15:10, 6/1/2024 (Saturday), P4703, YEUNG

EPIGENTIC PLASCITY ENABLES COPEPODS TO COPE WITH OCEAN ACIDIFICATION

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Plasticity enhances species fitness and survival under climate change. Ocean acidification poses a potential threat to copepods, a major zooplankton group that serves as a key link between the lower and higher trophic levels in the marine environment, yet the mechanisms underlying different adaptive responses remain poorly understood. Here we show that although elevated CO_2 can exert negative effects on reproduction of *Paracyclopina nana*, multigenerational plasticity can enable recovery after three generations. By integrating the methylome and transcriptome with the draft genome and undertaking DNA methylation treatments, we demonstrate the vital role of epigenetic modifications in ocean acidification responses and identify regions associated with reproductive resilience. Our results demonstrate that DNA methylation might play an important role in enhancing species fitness of copepods and that failing to consider phenotypic plasticity could lead to overestimation of species' vulnerabilities.

O. 39: 15:10-15:30, 6/1/2024 (Saturday), P4703, YEUNG

TRENDS IN PROJECTED BODY TEMPERATURE OF INTERTIDAL SPECIES IN EAST ASIA

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To explore trends of the operative temperature of intertidal molluscs in East Asia (0°-45°N, 100°E-140°E) from 1980 to 2019, projected hourly body temperatures of 25 intertidal molluscs that were distributed from the low intertidal zone to the splash zone were simulated using heat budget models (HBMs). With this dataset of projected body temperature, the annual 99th percentile hourly maximum temperature (annual T_{99}), seasonal variations of the daily maximum temperature (DMT), and biological heatwaves (BHMs) were selected for analyzing the temporal and spatial characteristics of body temperature of intertidal species in this region. We also comparatively analyzed the variation patterns between projected body temperature and environmental temperatures (air temperature and sea surface temperature). Our results showed that in East Asia, interannual warming rates of annual T_{99} were higher than that of environmental air and water temperatures, suggesting that the thermal risk of global warming to the intertidal biotas may be underestimated. The pattern of seasonal variation of the body temperature, calculated using DMT, was different from the environmental temperatures, especially in spring and summer, implying the deleterious impacts of global warming on phenology might be underestimated using environmental temperature data. Environmental heatwaves (marine heatwaves [MHW] and atmospheric heatwaves [AHW]) overestimate the frequency of heatwaves to which intertidal organisms are directly affected but underestimate the intensity of individual heatwaves experienced by intertidal organisms. In addition, there are underlying biological heatwaves that cannot be directly recorded by environmental temperatures, especially for low intertidal organisms that suffer the most BHWs, leading to incorrect assessment of thermal risks. These results emphasize that body temperature should be applied as a more reliable metric for evaluating and predicting the impacts of global warming and weather extremes in the intertidal biological system.

O. 40: 15:30-15:50, 6/1/2024 (Saturday), P4703, YEUNG

EFFICACY OF ACTIVE BROMIDE AS TARGETED SUPPLEMENTARY BIOCIDE FOR COMBATING GREEN MUSSELS FOULING IN COOLING WATER SYSTEM OF A TROPICAL POWER STATION

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The green mussel *Perna viridis* is reported as the most dominant macrofoulant in the cooling water systems (CWS) of Madras Atomic Power Station (MAPS), located at Kalpakkam, East coast of India. The CWS has adopted using continuous low dose chlorination (CLDC) also referred to as exomotive chlorination at 0.2 - 0.5 mg/L, total residual oxidant (TRO) supplemented with twice-a-week booster dose chlorination at residuals of 0.5 mg/L since its inception for biofouling control. However, in-spite of CLDC regime in vogue, the inlet water boxes of process seawater heat exchangers (PSWHX) experience heavy biofouling and flow blockage by green mussels, posing an operational challenge. Supplementary targeted biocidal additions with Actibromide® (AB) dosing in the upstream of the PSWHX at residuals of 0.1 ± 0.01 mg/L, for one hour in a shift was adopted at the power station. However, it was not adequate for preventing green mussels biofouling. The present study was carried out to investigate the efficacy of continuous AB dosing (at 0.2, 0.5 and 1.0 mg/L, TRO) on adult green mussels. The biocidal efficacy was investigated in a laboratory flow through system to determine the time taken for mortality. Additionally the mechanism of toxicity on organelles and cellular processes was analysed using various biomarkers at molecular and cellular levels. Complete mortality (100%) in green mussels was achieved within 12, 7, and 4 days with 0.2, 0.5 and 1.0 mg/L TRO, respectively. Deterioration in condition index (CI) was observed with increase of AB concentration with time. Subsequently, a decrease in CI from 48% (0.2 mg/L) to 92% (1.0 mg/L) by the end of the experiment. Ammonia production was induced even with tested lowest TRO of 0.2 mg/L. An increase in endogenous reactive oxygen species (ROS) was observed in the gills, mantle, digestive gland and foot of tested population as compared to control mussels. Induction in ROS generation was found to be highest in the digestive gland as compared to other tissues as well as control. A dose-dependent increase in hydrogen peroxide (H_2O_2) production was observed in the treated green mussels. Superoxide dismutase (SOD) (8.9 – 49.4 U/mg protein) and catalase (CAT) (29-50 U/mg protein) activity was recorded more in the digestive gland compared to other tested tissues. Similar trend was also observed with reduced glutathione (GSH) activity also showed prominent activity in the digestive gland and foot (264 – 834 nmol/mg protein) of green mussels exposed to AB. The DNA damage (expressed as % tail DNA) assessed by comet assay indicated that even the lowest TRO of AB dose (0.2 mg/L) caused DNA damage (34%) in green mussels. Maximum DNA damage (37 %) was observed with the highest TRO of 1.0 mg/L. Acetylcholinesterase (AChE) activity reduced (80 – 91%) as compared to control, indicating significant neuronal toxicity at 0.2 – 1.0 mg/L TRO. The present study clearly indicates the penetration of the biocide inside the green mussel during respiration causing digestive gland damage resulting in lower food uptake and cellular, neuronal and genotoxic effects. This study shows that AB concentration can be increased from the existing 0.1 to 0.5 mg/L TRO for minimizing biofouling by green mussels in the CWS.

Invited talk 9: 14:00-14:30, 3/1/2024 (Wednesday), P4704, YEUNG

TRANSCRIPTOME ANALYSIS OF HERMATYPIC CORAL *ACROPORA TENUIS* AND ITS SYMBIOTIC DINOFLAGELLATES EXPOSED TO ANTHROPOGENIC CHEMICALS

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While the genus *Acropora* is one of the dominant genera constituting coral reefs in East Asia, the cover of *Acropora* spp. has recently declined under various anthropogenic stresses. Therefore, elucidating the viability environment of *Acropora* spp. is one of the most pressing issues for conserving coral reef ecosystems.

The molecular effects of various anthropogenic activities, including climate change and ocean acidification, on corals and symbionts have been well studied. However, the effects of anthropogenic chemicals on *Acropora* spp. remain poorly understood. To perform ecotoxicity experiments to elucidate the molecular effects under different anthropogenic stresses in the laboratory, we established the compact rearing system for *Acropora* spp. using a commercial small aquarium. We conducted a 1–2-week experiment on *Acropor*a spp. using this system at the Ehime University campus in western Japan. Our campus is located far from the coral reef zone in southern Japan.

In this symposium, we give a brief overview of our compact rearing system for *Acropora* spp. and report on the transcriptome analysis of *A. tenuis* and its symbiotic dinoflagellates exposed to Irgarol 1051, a photosystem II herbicide, and BP-3, a sunscreen organic ultraviolet (UV) filter, using our compact rearing system.

In corals exposed to 10 µg/L Irgarol 1051 for seven days, body colour, expressed as red, green, and blue (RGB) values, significantly increased, although no such effect was observed in the 1 µg/L treatment group. Transcriptome analysis revealed that the differentially expressed genes (DEGs) in corals (*e.g.*, green fluorescent protein, blue-light-sensing photoreceptor, chromoprotein, caspase 8, and nuclear receptors) and symbiotics (*e.g.*, light-harvesting proteins, photosystem II proteins, and heat shock proteins) were identified. In addition, bioinformatics analysis showed that both Irgarol 1051 treatments disrupted various gene ontology terms, pathways, and protein interaction networks.

Conversely, seven days of exposure to BP-3 (50 and 500 µg/L) did not affect the body colour of corals or the photosynthetic activity of symbiotic algae. These concentrations were higher than most of the detection records of BP-3 from coastal regions. Transcriptome and bioinformatic analyses using DEGs showed no significant effects on the gene ontology terms or pathways in coral and symbiotic dinoflagellates except for upregulating several fluorescent protein genes in coral exposed to 500 µg/L. These results suggest that the effects of 500 µg/L BP-3 in seven days did not induce the coral colour and photosynthetic activity and only very limited variation in the coral transcriptome. Our study provides new insights into the potential molecular mechanisms underlying anthropogenic chemicals' bleaching effect, such as Irgarol 1051 and BP-3 on corals and symbiotic dinoflagellates.

O.41: 14:30-14:50, 3/1/2024 (Wednesday), P4704, YEUNG

SEASONAL DYNAMICS OF PAHS IN ESTUARINE MICROPLANKTON FROM AN ANTHROPIC NORTHEASTERN SOUTH CHINA SEA REGION

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The fate and impacts of polycyclic aromatic hydrocarbon (PAHs) in the primary trophic system are crucial in marine food web health but remain understudied. We characterized the seasonal dynamics of PAHs in microplankton in a heavily impacted anthropic estuarine ecosystem bordering the northeastern South China Sea. Replicate plankton samples were collected from seven stations during the Summer (2022), Autumn (2022), and Spring (2023) in the polluted Kaohsiung Harbor, Taiwan. Size-fractionated microplankton (55–1000 μm) was freeze-dried, and PAHs were extracted with a 1:1 v/v ratio of acetone: n-hexane, then analyzed using GC-MS. The total PAHs ranged between 68–2548 ng/g in microplankton, greatest during spring (130–2548 ng/g), followed by autumn (135–772 ng/g) and summer (44–423 ng/g). Spatial distribution varied through seasons but was higher in the southern part of KH (Stations 6>4>5>2>3>1>7), dominated by higher rings PAHs from mixed pyrogenic and petrogenic sources. PAHs also showed a significant relationship with environmental factors, higher in the colder season (spring) in lower salinity areas (river mouths). The relationship between Chl-a and total suspended solids suggests the potential influence of suspended matter (microplankton and other abiogenic particulates) in PAH transport and partitioning. PAH positively correlated with Chl-a in summer and spring, suggesting the accumulation of PAHs by plankton. In contrast, the negative relationship of PAHs with Chl-a and positive with suspended particulates suggest the biodilution in the particulate phases during Autumn. Overall, this study presents the seasonal changes of PAHs in size-fractionated microplankton, with some insights into the influence of microplankton in PAHs cycling and other physical controls on their distribution in an anthropic environment.

O.42: 14:50-15:10, 3/1/2024 (Wednesday), P4704, YEUNG

USING MACHINE LEARNING TO PREDICT ADVERSE EFFECTS OF METALLIC NANOMATERIALS TO VARIOUS AQUATIC ORGANISMS

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The wide production and use of metallic nanomaterials (MNMs) leads to increased emissions into the aquatic environments and induces high potential risks. Experimentally evaluating the (eco)toxicity of MNMs is time-consuming and expensive due to the multiple environmental factors, the complexity of material properties and the species diversity. Machine learning (ML) models provide an option to deal with heterogeneous data sets and complex relationships. The present study established an *in silico* model based on Machine Learning Properties-Environmental conditions-Multi species-Toxicity prediction model (ML-PEMST) that can be applied to predict the toxicity of different MNMs towards multiple aquatic species. Feature importance and interaction analysis based on the random forest method indicated that exposure duration, illumination, primary size, and hydrodynamic diameter were the main factors affecting the ecotoxicity of MNMs to a variety of aquatic organisms. Illumination was demonstrated to have the most interaction with the other features. Moreover, incorporating additional detailed information on the ecological traits of the test species will allow to further optimize and improve the predictive performance of the model. This study provides a new approach for ecotoxicity predictions for organisms in the aquatic environment and will help us to further explore exposure pathways and the risk assessment of MNMs.

O. 43: 15:10-15:30, 3/1/2024 (Wednesday), P4704, YEUNG

FROM VALLEY TO PLAIN: DISTRIBUTION OF MERCURY ALONG THE FRESHWATER TO SALTWATER CONTINUUM IN A RURAL AREA OF HONG KONG

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Mercury (Hg) and its organic toxic form, methylmercury (MeHg) are considered as global pollutants, and MeHg can biomagnify in natural food webs, threatening the environmental quality of natural ecosystem. The distribution of Hg in different water bodies (for example along the river continuum) is yet elucidated which plays an important role in understanding how Hg is transported and transformed in the natural environment and enters into the food webs.
Kuk Po, an abandoned Hakka village located at northeastern Hong Kong, has a diversified habitats with both freshwater and saltwater components. Particularly, Kuk Po River is designated as an Ecologically Important Stream (EIS) by the Hong Kong government, showing its ecological importance and prompting our research interest to examine the Hg cycling there.
This study aimed in (1) investigating the spatial distribution of total mercury (THg) and MeHg among different aquatic habitats (i.e., freshwater stream, marshland and the ocean) and within the same habitat (i.e., different longitudinal sections of the river), while identifying the Hg methylation hotspot; (2) determining the possibilities on the seasonal variation (e.g. dry vs. wet seasons), and 3) studying how various physicochemical factors in the natural environment could affect the formation of MeHg.

Hence, analyses of THg and MeHg in water and sediment samples were conducted and they were obtained in different aquatic habitats in Kuk Po as mentioned above. The sampling work were done monthly for one year from 3/2022 to 2/2023. Different water quality parameters, including temperature, pH, dissolved oxygen and salinity were also measured on site.

Our study demonstrated spatial and temporal variations in THg and MeHg of water and sediments. Sediments in mangrove were found to have significantly higher in both THg and MeHg content than that in stream by 570% and 30%, respectively, as attributed to the enriched organic content in the sediments of marshland, indicated by loss of ignition analysis ($LOI_{marshland}$: 6.78%; LOI_{stream}: 1.73%). However, an opposite trend was observed on water samples that THg concentration is highest at the freshwater source, especially in summer (2.39 ng/L) and it gradually decreases, and reaches at the lowest value in the ocean water (THg_{summer}: 0.86 ng/L). This study provides a better understanding on the Hg cycling in different aquatic components and habitats within the freshwater-saltwater continuum.

O. 44: 15:30-15:50, 3/1/2024 (Wednesday), P4704, YEUNG

REVIEW OF MERCURY POLLUTION RESEARCH IN SOUTHEAST ASIA MARINE ENVIRONMENTS

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Mercury (Hg) is a global pollutant of widespread concern, and modern Hg levels have been elevated 3-4 times compared to pre-industrial levels. The majority of environmental Hg assessment occurred in the developed world in the temperate region, but recent years we have witnessed increases in research activities in polar, subtropical, and tropical biomes. Southeast Asia is a geographic region mostly within tropical biomes and the region contains important marine and coastal resources. The region consists of 11 countries of different economic and development status, and has more than 600 million of population, and there is a rapid industrialization and commercialization in the region. Further, important Hg-emitting activities such as coal burning and artisanal gold mining are active within the region, posing a threat to the ecosystem and human health by this global contaminant. In our review, we found only ~30 published articles studying marine Hg pollution in Southeast Asian countries. Since methylmercury (MeHg) is the highly toxic and bioavailable form of Hg, measurements of MeHg in environmental compartments would be crucial to our understanding of its cycling. However, the majority of these reviewed studies did not involve or report MeHg data, undermining the effectiveness of these environmental assessments. This presentation will provide a review of the known Hg contamination issues in Southeast Asian marine environments, and will provide some recommendations to elevate the Hg research and monitoring in the region.

Invited talk 10: 14:40-15:10, 4/1/2024 (Thursday), P4704, YEUNG

A METAGENOMICS-BASED MICROBIAL SURVEILLANCE FRAMEWORK FOR ASSESSING CUMULATIVE ANTHROPOGENIC IMPACTS ON ESTUARINE BENTHIC ECOSYSTEMS

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A wide range of anthropogenic contaminants are discharged into estuaries but assessing their cumulative impacts on estuary ecosystem health is challenging. Using spatially distributed sediments from the Pearl River Estuary (PRE) in southern China, which has long been influenced by various anthropogenic activities, we demonstrated the utility of metagenomics-based microbial surveillance for assessing cumulative anthropogenic impacts on estuarine benthic ecosystems. By representing 11 anthropogenic factors as the anthropogenic index, a decreasing anthropogenic gradient from nearshore to offshore was identified in the PRE sediments. Correlational and threshold analyses between microbial compositions and the anthropogenic index indicated that anthropogenic disturbances significantly influenced benthic microbial communities, with the anthropogenic index explaining most of the variations in taxonomic and functional community compositions. Based on the responses of individual taxa to the anthropogenic gradient, an ecological community threshold of anthropogenic disturbances was identified, and this threshold delineates the PRE sediments into two groups (H and L) with distinct taxa and functional traits.

Being located nearshore and subjected to a higher level of anthropogenic disturbances, Group H was enriched in pollutant degraders, putative human pathogens, fecal pollution indicators, and functional traits related to stress tolerance. In contrast, being located offshore and subjected to a lower level of anthropogenic disturbances, Group L was enriched in halotolerant and oligotrophic taxa and functional traits related to growth and resource acquisition. Using the machine learning random forest model, a number of taxonomic and functional indicators was identified for differentiating PRE sediments between Groups H and L. Our results highlight the sensitivity and specificity of microorganisms' responses to anthropogenic disturbances. In the metagenomics-based microbial surveillance framework, the identified ecological community threshold and microbial indicators can provide references for routine environmental monitoring as well as determining the extent and sources of anthropogenic disturbances across space and time, which can assist marine environmental management to better protect ecosystem health.

O. 45: 15:10-15:30, 4/1/2024 (Thursday), P4704, YEUNG

ENVIRONMENTAL BENZO[A]PYRENE INDUCES MULTIGENERATIONAL OSTEOTOXICITY IN MEDAKA FISH

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Polycyclic aromatic hydrocarbons (PAHs) are one of the most widely distributed emerging pollutants in the environment, which are generated by incomplete combustion of organic compounds such as petroleum products, coal, wood, and waste in daily life and industrial production. PAHs are widely present in various environmental media, leading to bioaccumulation and adverse effects on biological communities. Wild fish living in PAH-contaminated waters have significantly higher proportions of vertebral and craniofacial deformities, posing a serious threat to fish health. Vertebral deformities greatly affect the swimming ability of fish, thereby reducing their ability to forage, avoid predators, and mate, ultimately potentially threatening the stability and sustainable development of fish populations. Notably, exposure of F0 fish to environmental concentration (1 μg/L) of benzo[a]pyrene (a representative PAH) affects the skeletal system and health of F1-F3 progenies without subsequent exposure. The integrity of the skeletal system plays a decisive role in maintaining fish health and population stability. However, in ecological risk assessments of benzo[a]pyrene/PAHs, (multigenerational) skeletal toxicity is rarely assessed separately and is often only used as a simple indicator to reflect overall developmental toxicity. Therefore, the adverse effects of environmental benzo[a]pyrene/PAHs on fish health are underestimated. Moreover, compared to single-generation toxicity tests on fish, multi-generational toxicity tests may be more suitable for assessing the ecological risk of persistent organic pollutants to fish. In view of this, this study uses a col10a1:nlGFP/osterix:mCherry double transgenic medaka bone research model to elucidate the potential molecular mechanisms of multigenerational skeletal toxicity induced by ancestral benzo[a]pyrene exposure in fish, which is conducive to a comprehensive assessment of the ecological risk of environmental benzo[a]pyrene/PAH exposure to fish. We aim to establish a fish-based multigenerational osteotoxicity standard test guideline for the assessment of ecological risks of BaP/PAHs and other persistent organic pollutants. It can generate mechanistic information for AOP construction, facilitating the health risk assessment and conservation of wild fish.

O. 46: 15:30-15:50, 4/1/2024 (Thursday), P4704, YEUNG

VARIATIONS OF METHYLMERCURY IN A MANGRVOE WETLAND SEDIMENTS: INSIGHTS FROM SUBTROPICAL ECOSYSTEMS IN HONG KONG

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Tropical and subtropical coastal wetland ecosystems serve vital bridging functions between offshore and inland environments. Most tropical and subtropical wetland areas, estimated to be between 60% and 75%, is mangrove forest. Mangroves are considered to have significant ecological and economic value, however, mangrove sediments with strong reducing conditions may play an important, yet not well understood, role in converting inorganic mercury (Hg) into highly toxic methylmercury (MeHg). In this study, multiple 15cm sediment cores were collected over different seasons from Mai Po Nature Reserve in Hong Kong along a field transect: from within mangrove stands, land-water interface (margin), middle of the water channel, to the open water area. Sediment cores were sliced every centimeter for measuring total mercury (THg), MeHg, and organic matter content. We found that THg in sediments ranged narrowly between 90.32 and 225.81 ng/g among all samples and did not show a positive correlation with MeHg, which have been shown in many other sediment studies. Interestingly, elevated MeHg concentrations were found at surface sediment near the root zones of mangrove trees, which may provide oxygen to re-oxidize any produced sulphide and thus can promote hg methylation via sulfate-reduction. The percentage of THg as MeHg, i.e., %MeHg, was significantly correlated with loss-on-ignition (LOI), a proxy of organic matter content ($p<0.0001$), which suggests that sedimentary organic matter could serve as the ultimate controlling factor mediating Hg methylation in mangrove sediment. Over different seasons, a significantly higher MeHg ($p<0.05$) was observed during summertime, e.g., June & August. During summertime, the water would have lower salinity and higher temperature, which we suggest to be important factors promoting Hg methylation in sediments. Currently, our team is examining Hg cycling in other mangrove forests around Hong Kong, and Shenzhen (including one site at Futian Mangrove Reserve), in which we will perform analyses for THg, MeHg, LOI, and Hg methylation related genes (*hgcAB* and *merAB*). Our current work will provide new insights into the key factors influencing Hg methylation in mangrove wetlands, where the resident food webs can extensively bioaccumulate and biomagnify.

O. 47: 15:50-16:10, 4/1/2024 (Thursday), P4704, YEUNG

EVEL OF HEAVY METALS IN MARINE STINGRAYS (CHONDRICHTHYES: DASYATIDAE) LANDED FROM JOHOR WATERS

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Heavy metal pollution is a concern in aquatic ecosystems, as it can lead to a harmful build-up of substances in organisms such as stingrays. The presence of heavy metals in marine organisms can pose potential health risks to humans. Therefore, in order to determine the potential harm to human health from consuming stingray fillets, a total of 45 individual stingrays were sampled from Johor Waters (Pontian, Muar, and Batu Pahat) and determined the heavy metals content using Inductively Coupled Plasma Mass Spectrometry (ICP-MS) after closed digestion with nitric acid. The average concentration of Cu, Zn, As, Cd, Pb, and Hg in the stingrays' fillet from Johor Waters were 0.982±0.637, 31.3±5.93, 93.57±24.5, 0.039±0.047, 0.158±0.036, 0.592±0.424 μg/g dw, respectively. In general, the concentration of As in the fillet of stingrays was found to be the highest among all the metals studied. Besides, the findings suggest that the fish size does not solely influence heavy metal accumulation in stingrays, and the presence of heavy metals in Johor Waters shows inconsistent correlation, varying with locations. Maximum consumption limits for different metals in stingray fillets have been calculated to ensure human safety. Monitoring stingray fillet intake and staying below established limits is crucial to minimize exposure to these metals. Overall, data obtained in this study can be used to evaluate the risks of metal contamination and as a basis for future research on protecting the marine ecosystem in the Johor Waters.

O. 48: 16:10-16:30, 4/1/2024 (Thursday), P4704, YEUNG

TOXICITY, SPECIATION OF INORAGNIC ARSENICS AND ITS ADVERSE EFFECTS ON *IN VIVO* ENDPOINTS AND OXIDATIVE STRESS IN THE MARINE MEDAKA *ORYZIAS MELASTIGMA*

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Arsenic is a widely present metalloid that causes toxicity to organisms in an aquatic environment, and its effect varies depending on its form. This study investigated the acute and chronic exposure of two inorganic arsenic species, As^{V} and As^{III}, in the marine madaka *Oryzias melastigma* to determine the effects of exposure on *in vivo* effects, bioaccumulation, biotransformation, and oxidative stress. The embryonic development investigation showed no effect on in vivo parameters, but the hatching rate increased in the As^{III}-exposed group. In both acute and chronic exposure using juveniles, the highest concentration of arsenic was detected after As^{III} exposure, and higher bioaccumulation was found during chronic exposure. In the case of arsenic speciation, the proportion of AsB in chronic exposure was high, ranging from 64.2 to 81.9%. On the other hand, in acute exposure, the ratio of As^{V} and As^{III} was relatively higher than that of chronic exposure, indicating that bioaccumulation of inorganic arsenic induced oxidative stress. As ROS occurrence was induced in acute exposure, an increase in antioxidant enzymes SOD and CAT was observed, the highest increase in As^{III} exposure, but no significant oxidative stress was induced in chronic exposure. Also, during acute exposure to As^{V}, GST enzyme activity increased twice as high and GSH decreased compared to other groups, suggesting that the role of GST in the initial detoxification process is important when exposed to As^{V}. In addition, RNA-seq-based ingenuity pathway analysis showed that inorganic arsenic affects various signaling pathways, particularly oxidative stress-related signal pathways. Also, MAPK signaling pathways were significantly activated in response to acute exposure to arsenic.

Keywords: Arsenic, speciation, oxidative stress, marine medaka, *Oryzias melastigma*

O. 49: 16:50-17:10, 4/1/2024 (Thursday), P4704, YEUNG

TRANSPORTATION, TRANSFORMATION AND BIOACCUMULATION OF MERCURY IN THE YANGTZE RIVER ESTUARY AND THE ADJACENT EAST CHINA SEA

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As the largest estuary in China, the Yangtze River estuary (YRE) receives tremendous inputs of freshwater and suspended particles from the Yangtze River, which accompanied with massive inputs of terrestrial contaminants that may pose threats to the ecosystems of YRE and the adjacent East China Sea (ECS). It has been widely observed that the Hg contents in fishes collected from the coastal ECS are higher than in other Chinese coastal regions, which is highly associated with the transportation, transformation and bioaccumulation of Hg. We observed that the total Hg (THg) concentration in the sediments of the YRE and the adjacent ECS continental shelf increased significantly since 1950s. The Yangtze-derived Hg was mainly associated with fine particles that enriched with organic matter, and THg was mainly deposited in the ECS southern inner shelf (near Zhoushan Fish Ground) driven by the coastal currents. However, the spatial distribution of methylmercury (MeHg) was distinct from THg, which exhibited higher MeHg concentration and higher MeHg/THg ratio at the open shelf of ECS, recognized as the regional hotspots of the net in situ MeHg production. Along a typical transect from the YRE to the ECS continental shelf, significantly higher THg concentration in sediments and water were observed within the turbidity maximum zone (TMZ) of the YRE, recognized as the regional Hg pollution hotspots. In contrast, the ECS open shelf showed remarkably higher MeHg/THg ratio in sediments and porewater, which could be explained by the lower AVS, lower TOC and higher salinity at those sites that promoted the release of bioavailable inorganic Hg into porewater for Hg-methylation bacteria. As a result, the spatial distribution of THg and MeHg in water column showed site-to-site variations along the YRE-ECS transect, resulting in site-specific bioaccumulation in zooplankton. We then investigated the THg and MeHg contents in wild fishes collected in the YRE and the adjacent ECS, and observed significantly higher contents in benthic fishes comparing with benthopelagic and pelagic fishes, which might be highly associated with the relative strong in situ MeHg production in surface sediments in the ECS continental shelf. Furthermore, we tried to trace the MeHg source in two migratory fishes based on the isotopic signatures of Hg and carbon, and the observed higher Δ^{199}Hg of MeHg (owing to strong phytodemethylation of MeHg prior to entering food webs) in muscle comparing with liver strongly indicates that MeHg produced in the open shelf of ECS was the major MeHg source in migratory fishes.

O. 50: 17:10-17:30, 4/1/2024 (Thursday), P4704, YEUNG

OCCURRENCE OF ANTIBIOTICS AND ANTIBIOTIC RESISTANCE GENES IN WATER AND SEDIMENT OF THE LOWER REACHES OF TYPICAL RIVERS IN BOHAI RIM BASIN

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The frequent use and extensive discharge of antibiotics have led to the accumulation of antibiotics and the emergence of antibiotic resistance genes (ARGs), posing significant threats to the ecological environment. Bohai Rim Basin is a crucial industrial hub in China, facing various pollutants due to resource development and frequent human activities. To understand the extent of antibiotic and ARGs pollution and ecological risks, this study selected 38 the lower reaches of typical rivers as research subjects. High-performance liquid chromatography-tandem mass spectrometry and high-throughput detection methods were employed to detect antibiotics and ARGs, respectively. The results showed that a total of 40 antibiotics were detected in the water, and the pollution level was at nd-8959 ng/L, where amoxicillin was the highest. Meanwhile, the detection rates of the sulfamethoxazole, sulfamethazine, amoxicillin, sulfamethoxazole-methyl, moxifloxacin, gatifloxacin, josamycin, and pioglitazone were 100%, and the quinolones was the dominant. In sediments, 21 antibiotics were detected, and the concentrations of which ranged from nd-74 ng/g, among the highest detected was norfloxacin, with the highest detection rate for enrofloxacin at 100%, and quinolones had the highest detection diversity. In water, 51 ARGs were detected, and the absolute abundance was at 9.62×10^{0} - 1.18×10^{5} copies/L. *Aad*A-02, *aad*A1, *bla*TEM, *ere*A, *mac*B, *mph*A-01, *mph*A-02, *sul*1, *sul*2, *sul*3, and *tet*G were all detected at 100%, with tetracycline ARGs being the most detected. Totally 52 ARGs were detected in sediments, and the absolute abundance at 1.17×10^{1} - 2.13×10^{5} copies/L. *Sul*2 and *mac*B were detected at 100%, with tetracycline ARGs being multiplicity detected. Therefore, Bohai Rim Basin are contaminated by antibiotics and ARGs.

O. 51: 17:30-17:50, 4/1/2024 (Thursday), P4704, YEUNG

ENVIRONMENTAL BEHAVIOR AND POLLUTION STATUS OF TIRE ADDITIVES IN SURFACE WATER

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Tire particles are a significant source of microplastics released into the environment during driving. When exposed to conditions such as rainfall, tire particles can release tire additives (TAs) into the aquatic environment through surface runoff. These TAs undergo transformation within the tire material as well as after entering the water. This research aimed to investigate the leaching, degradation, and transformation behavior of selected TAs and through simulated leaching of tire particles and degradation of TAs in the laboratory. Targeted analysis and suspect screening techniques were employed for chemical analysis. The findings indicated that antioxidants are prone to degradation, whereas other TAs exhibited relative stability. Antioxidant substances reached their highest concentrations in tire particles that enter the water within 18 hours to 2 days, while other additives reached peak concentrations between 30 to 60 days. The main components identified in the leachate were hexamethoxymethylmelamine (HMMM), (N-(1,3-Dimethylbutyl)-N′- phenyl-p-phenylenediamine) 6PPD, and benzothiazole (BT). Liquid chromatography-high-resolution mass spectrometry suspect screening detected a total of 56 transformation products (TPs) in the leachate, with 28 originating from 6PPD and the remaining 28 from other TAs. Notably, 12 tire particles were reported for the first time in this study. Building upon these findings, the pollution status of TAs and their TPs in surface water (river water and stormwater) in Hong Kong was further investigated. The results revealed that benzotriazole (BR), HMMM, and 2-hydroxybenzothiazole (2HBZ) exhibited the highest concentrations in the dissolved water phase, while BR, 1,3-diphenylguanidine (DPG), and DPPD showed the highest concentrations absorbed on suspended particulate matter. A total of 28 tire particles were detected, with certain particles dominating the water phase due to their strong polarity. 6PPDQ, 6PPD, DNPD, DCU, and DCA demonstrated medium to high-level risks, with 6PPDQ having the highest risk value of 910 in Hong Kong's stormwater. The persistence, bioaccumulation, and toxicity assessment revealed that 6PPD-266 is a widespread and potentially harmful tire particle in the aquatic environment. Overall, this study contributed to a comprehensive understanding of the environmental behavior and potential impacts of TAs, providing valuable data and a theoretical basis for relevant policy-making and risk management.

O. 52: 17:50-18:10, 4/1/2024 (Thursday), P4704, YEUNG

UNIQUE BIOGEOCHEMICAL CHARACTERISTICS IN GHOST FORESTS: INFLUENCES OF SEA LEVEL RISE ON COASTAL ECOSYSTEMS

Chow A.T., Chen H., Rücker A.M., Liu Y., Miller D., Dai J.-N., Wang J.-J., Suhre D.O., Kuo L.-J., Conner W.H., Campbell B.J., Rhew R.C.

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Seawater intrusion by rising sea levels has created large areas of ghost forests along low-lying coastal wetlands in the southeastern USA. Here, we characterized several soil and environmental parameters, including tree litterfall, surface and soil porewater quality, emissions of greenhouse gases, and microbial communities along a forest-to-marsh transect, including a freshwater forested wetland, a salt-impacted degraded ghost forest, and a salt marsh in Winyah Bay, South Carolina, USA. General water quality parameters such as salinity, dissolved oxygen, temperature, and pH showed distinct trends along the freshwater forested wetland, degraded ghost forest, to salt marsh transect, whereas there were no obvious trends in soil biogeochemical parameters. Concentrations of dissolved organic carbon (DOC) in the degraded ghost forest were generally similar to the freshwater forested wetland, but on average were higher than those in the salt marsh. More labile molecular features observed through Fourier transform ion cyclotron resonance mass spectrometry indicated an increase in the DOC biodegradability along the forest-to-marsh transect. Greater DOC biodegradability in the degraded ghost forest was observed and confirmed through its generation of the highest average electrical currents from sediment microbial fuel cells. The lowest CH_4 and CO_2 fluxes, but the highest degradable DOC, were observed in the degraded ghost forest, suggesting that lateral C export is important in this wetland. In addition, unique halocarbon emission including methyl chloride, methyl bromide, chloroform and bromoform from these wetlands were observed. Moreover, the degraded ghost forest was dominated by a unique microbial community, including high abundance of Woesearchaeia, which enables carbon metabolism via symbiotic and/or fermentation-based lifestyles. Our study illustrates a ghost forest with very different characteristics compared to its parental freshwater forested wetland and its transitioned salt marsh. Data obtained from the two endmember ecosystems along the salinity gradient transect were not useful in predicting the unique biogeochemical processes in the degraded ghost forest.

Invited talk 11: 14:00-14:30, 5/1/2024 (Friday), P4704, YEUNG

A NEW MECHANISM OF REPRODUCTIVE ENDOCRINE DISRUPTION BASED ON ISOTHIAZOLINONES

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Isothiazolinones are widely used as preservatives and disinfectants due to their potent antibacterial efficacy. However, the unintended exposure of humans and animals has led to increasing concern regarding their health hazards. Isothiazolinones were previously shown to disrupt the endocrine homeostasis and impair reproductive functions, while the underlying mechanism remains ambiguous. In this study, exposure of medaka to a representative isothiazolinone DCOIT significantly elevated the concentrations of GnRH and FSH in female brain, with concomitant stimulation of oogenesis and fecundity, despite that the development of offspring was compromised. An estrogenic activity was induced in the male, which drove the sex ratio towards female dominance. Chem-Seq and proteome analyses demonstrated the disturbances in GPCR, MAPK, and Ca^{2+} signaling cascades by DCOIT. *In vitro* mechanistic exposure identified the pivotal role of MEK and ERK phosphorylation in inducing the endocrine disruptive effects. In addition, DCOIT had a binding affinity to the active pocket of G protein αi subunit. DCOIT-bound Gαi turned to interact with the mitochondrial calcium uniporter, consequently changing the intracellular Ca^{2+} dynamics and mediating the phosphorylation of MEK and ERK. Furthermore, other isothiazolinone analogues were tested to verify the generalizability of endocrine disrupting mechanism. Depending on the side chain structure and chlorine substitution, OIT, BIT, and DCOIT showed higher potency to bind with Gαi, phosphorylate MEK and ERK, and cause imbalance of sex hormones. Overall, this study characterized the consecutive causative occurrence of key molecular events underlying the outcome of endocrine disruption and proposed a novel framework of AOP relevant to reproduction.

O. 53: 14:30-14:50, 5/1/2024 (Friday), P4704, YEUNG

SPATIOTEMPORAL VARIABILITY ON LOCAL-REGIONAL SCALE IN SUBTIDAL MEIOFAUNAL AND MACROFAUNAL ASSEMBLAGES ALONG THE SOUTHERN COAST OF KOREA

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We aimed to investigate the spatiotemporal variability of subtidal benthic meio- and macrofaunal assemblages at local and regional scales along the southern Korean coast in relation to both natural and anthropogenic impacts. Abiotic and biotic samples were collected by sites (three site at least 10 km) within region (three coastal regions at least 50 km apart) over 7 years (2015-2021). The species richness, density, and composition of the meiofaunal and macrofaunal assemblages differed significantly among sites within regions. Nematoda and Annelida were the most dominant meiofaunal and macrofaunal taxa, respectively. However, the dominant taxa varied among sites and years. A distance-based multivariate multiple regression analysis revealed that the mean sediment grain size, and heavy metals concentrations were key environmental variables determining the variation of both assemblages. This study can furnish fundamental ecological data to enhance our comprehension of the spatial and temporal variations in benthic assemblages along the southern coast of Korea, and contribute to the formulation of management strategies aimed at mitigating marine pollution in the region.

O. 54: 14:50-15:10, 5/1/2024 (Friday), P4704, YEUNG

LIPID METABOLIC DISRUPTION OF A NEW BROMINATED FLAME RETARDANT TBPH IN ZEBRAFISH

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Bis(2-ethylhexyl)-2,3,4,5-tetrabromophthalate (TBPH), one of the widely used new brominated flame retardants (NBFRs), is a ubiquitous environmental contaminant that has been raising great concerns over its contamination in aquatic environments and health risks. However, the bioaccmulations and adverse effects of TBPH in different organs of aquatic organisms are rarely known. In this study, adult zebrafish, after exposure to 2 μM TBPH for 28 days, was found with high bioaccumulation either in male or female organs with the same order of intestine > liver > gonad > brain > muscle. We further investigated the detrimental effects on gut and liver by exposure to 0.2 ~ 200 nM TBPH. The results showed that TBPH induced pathological changes including the declines in villus length, crypt depth and muscular thickness of the gut, as well as the up-regulations of genes related to intestinal barrier. Dysbiosis of gut microbiota were also observed in the exposed fish of both genders. While in the liver, histological changes indicated obvious steatosis without sex difference. However, biochemical indices of liver and blood, which related to lipid metabolism disorders, including TG, TC, LDL and HDL, were significantly changed, especially in male fish. In addition, the transcriptome analysis also revealed that metabolism processes were mainly disrupted in the liver. Moreover, significant increase of glucose in male blood was found, while an opposite trend was determined with the insulin. Taken together, water borne TBPH led to higher accumulation of it in the gut and liver of fish, where generated histological injuries and metabolism disorders of lipid and glucose.

O. 55: 15:10-15:30, 5/1/2024 (Friday), P4704, YEUNG

TOXIC EFFECTS OF SINGLE AND COMBINED EXPOSURES TO NANOPLASITCS AND BISPHENOL A IN DEVELOPING MEDAKA OYRZIAS MELASTIGMA

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Nanoplastics (NPs) as emerging contaminants have become a global environmental issue due to their small size and high bioavailability. However, there are still knowledge gaps regarding effects of co-existing pollutants on NPs toxicity to marine organisms at their respective environmentally relevant concentrations. Herein we investigated developmental toxicity, histopathological alterations caused by single and co-exposure of polystyrene nanoplastics (PS-NPs) and bisphenol A (BPA) to marine medaka, Oryzias melastigma and potential molecular mechanisms were explored. Embryos at 6 hours post-fertilization were exposed to 50-nm PS-NPs (55 μg/L) or BPA (100 μg/L) or co-exposed to a combination of both. Results showed that PS-NPs exhibited decreased embryonic heart rate, larval body length, and embryonic survival as well as larval deformities such as hemorrhaging and craniofacial abnormality. When co-exposed, BPA mitigated all the adverse developmental effects caused by PS-NPs. PS-NPs also led to an increase in histopathological condition index of liver with early inflammatory responses, while co-exposure of BPA with PS-NPs did not. Our data suggest that the toxicity reduction of PS-NPs in the presence of BPA might result from the decreased bioaccumulation of PS-NPs caused by the interaction between BPA and PS-NPs. Transcriptome results indicated that single exposure to PS-NPs produced a total of 776 differentially expressed genes, affecting 33 biological pathways in growth and development, metabolism, immune and inflammatory responses. This study unveiled the impact of BPA on the toxicity of nanoplastics in marine fish during early developmental stages and highlight the need of more research on the long-term effects of complex mixtures in the marine environment by applying more omics approaches to better understand the toxicity mechanism.

O. 56: 15:30-15:50, 5/1/2024 (Friday), P4701, YEUNG

THE 22 CHROMOSOME-LEVEL GENOME ASSEMBLY OF THE BRACKISH WATER FLEA *DIAPHANOSOMA CELEBENSIS*: COMPARATIVE GENOME ANALYSIS AND THEIR GLOBAL METHLYATION PATTERNS FOR EPIGENETIC STUDY

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The brackish water flea, *Diaphanosoma celebensis,* has recently emerged as a comparative model species in the brackish ecosystem. For a better analysis of its mechanistic study, genome information is essential for various comparative studies of model species, but the genome information of *D. celebensis* reported so far is limited to the contig level due to technical limitations. Here, we have assembled the *D. celebensis* genome into 22 chromosomes with Hi-C technology using the *D. dubium* genome (as a reference genome). The total length of the assembled genome was 91.2 MB. Of them, 90.9 Mb (99.67%) was anchored into 22 chromosomes. A total of 15,524 genes were identified. In addition, the global methylation pattern of annotated genes at the basal level was evaluated through whole-genome bisulfite sequencing. In summary, our study provides a better insight into adaptation to brackish water based on an epigenetic study of *D. celebensis*.

Invited talk 12: 14:00-14:30, 6/1/2024 (Saturday), P4704, YEUNG

ANTHROPOGENIC IMPACTS ON COASTAL BACTERIOME AND ANTIBIOTIC RESISTOME

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Human imprints on natural microbiome and resistome are well documented but the underlying mechanisms remain to be elucidated. In this study, we investigated bacterial communities and antibiotic resistomes in coastal surface water under varying degrees of anthropogenic impacts, comparing them to surface oceans with fewer impacts, serving as a global baseline. Our results revealed a substantial loss of biodiversity and a notable increase in human pathogens within the coastal bacteriome when compared to the baseline. Moreover, the antibiotic resistomes in coastal waters exhibited greater diversity, abundance, higher risk, and co-occurrence with mobile genetic elements (MGEs) prone to transfer. We identified various emerging human pathogens in coastal waters, some of which harbored transferable resistance. For instance, multiple-resistant strains of *Escherichia coli* and *Aeromonas caviae* displayed a close phylogenetic relationship with clinical strains of extended-spectrum beta-lactamase (ESBL) producing *E. coli* and *A. caviae* FDAARGOS_72, associated with community-based infections. Additionally, we observed clear seasonal and geographic patterns in coastal bacteriome and resistome, with an increased relative abundance of human pathogens during the wet season and an elevated resistome risk during the dry season. Hong Kong exhibited higher levels of antibiotic resistance and resistant pathogens compared to Qingdao. Mantel tests and selection analyses indicated that environmental concentrations of antibiotics alone were unlikely to be the sole drivers of structural variations in coastal bacterial and resistome metrics. Other potent selection agents acting in combination must be responsible. Furthermore, anthropogenic activities were found to impact environmental parameters, influencing coastal bacterial and resistome metrics. Our findings confirm that anthropogenic impacts contribute to spatiotemporal alterations of natural coastal microbiome and resistome, leading to an increased potential for health risks through the transmission loop of anthropogenic activity, environmental dissemination, and human re-exposure via recreational activities or seafood consumption.

O. 57: 14:30-14:50, 6/1/2024 (Saturday), P4704, YEUNG

IDENTIFICATION OF DIOXIN-LIKE EFFECTS OF POLYHALOGENATED CARBAZOLES (PHCZs) AND POTENTIAL TOXIC MECHANISMS

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Polyhalogenated carbazoles (PHCZs) are a kind of organic compounds constituted by a series of halogen atom/atoms (Cl, Br, I) substituted carbazole congeners, the number of single halogen atom substituted PHCZs is up to 135. PHCZs are referred to as dioxins nitride compounds for their structural similarity with polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofuran (PCDFs). Recently, PHCZs have been defined as emergent environmental pollutants. PHCZs were reported to be identified in various environmental media and came with the characteristics of bioaccumulation and biomagnification. However, little effort has been made toward the studies about the potential ecological risks, toxicity, and toxic mechanisms of PHCZs. According to national significant requirements on paying attention to emergent environmental pollutants proposed by the national "14th Five-Year Plan", it is a desiderate task to start risk assessment on PHCZs. At present, limited toxicologic study has showed that PHCZs could pose developmental toxicity to aquatic organism and activate the downstream genes of aryl hydrocarbon receptor (AhR). Given the dioxin-like toxicity of PHCZs, their wide distribution in the environment as well as the increasing residue levels in various environmental media, it is of great urgence to carry out systematic researches about their potential ecological risks and toxic mechanisms. Herein, multiple in vivo, in vitro, and in silico models were applied to systemically investigate the ecological risks and toxic mechanisms of PHCZs.

The main conclusions are as follows: (1) over 50% tested PHCZs can exhibit significant AhR against effects and disturb the expression level of AhR downstream genes, among them 2-CCZ, 3-CCZ, 3-BCZ, 2,7-DBCZ, 3,6-DBCZ, 3,6-DCCZ, and 3,6-DICZ exhibited significant AhR against effects. The affinity pattern between PHCZs and AhR is similar with that of TCDD; (2) 2,7-DBCZ exhibited significant developmental toxicity, especially cardiac teratogenic effects, and the developmental toxicity induced by cardiovascular abnormal development was partially consistent with AhR activation; (3) 2,7-DBCZ could demethylate the *Ang2* promoter to potentiate *Ang2* expression, thus altering angiogenic phenotype of HUVECs by reducing the proportion between *VEGFs* and *Ang2*.

Our study had specified the environmental risks of PHCZs and indicated the potential toxic mechanism. Data presented here can provide theoretical support for the environmental safety management of these chemicals.

O. 58: 14:50-15:10, 6/1/2024 (Saturday), P4704, YEUNG

DEVELOPMENT AND APPLICATION OF FAST THYROID DISRUPTING SCREEN ASSAY

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Thyroid disrupting chemicals (TDCs) have received much attention due to their potential adverse effects on animal and human health, which calls for rapid screen assays to identify them. There are three assays for TDCs detection based on the model Amphibians, which are Amphibian Metamorphosis Assay (AMA), Larval Amphibian Growth and Development Assay (LAGDA) and Xenopus Eleutheroembryonic Thyroid Assay (XETA). However, they need improvement. For AMA and LAGDA, the exposure spans are 21 days and 16 weeks respectively, which are too long. The inhibitors of thyroid hormone (TH) synthesis can't be detected by XETA, since NF45 stage eleutheroembryos don't synthesise their own TH. In our group, the T3-induced Xenopus metamorphosis assay (TiXMA) were developed, and verified with standard TDCs, which can both detect TH signalling disruptors and TH synthesis inhibitors. It has been successfully applied to screen the chemicals with thyroid disrupting potency, such as bisphenol F, brominated flame retardants, and isothiazolinone. In comparison with AMA and LAGDA, it shows advantage of shorter exposure span, which only takes 4 days. In comparison with XETA, it shows advantage of detecting inhibitors of TH synthesis.

O. 59: 15:10-15:30, 6/1/2024 (Saturday), P4704, YEUNG

AN INTEGRATED TRANSCRIPTOME-MICROBIOME HOST RELATIONSHIP ASSOCIATED WITH PARABEN TOXICITY IN THE BRACKISH WATER FLEA *DIAPHANOSOMA CELEBENSIS*

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Parabens, a group of alkyl esters of p-hydroxybenzoic acid, have been found in aquatic systems in particular, leading to concerns about their potential impact on ecosystems. This study investigated the effects of three commonly used parabens, methylparaben (MeP), ethylparaben (EtP), and propylparaben (PrP), on the brackish water flea *Diaphanosoma celebensis*. The results showed that PrP had the most adverse impact on survival rates, followed by EtP and MeP, while MeP and EtP induced significant adverse effects on reproductive performance. A transcriptome analysis revealed significant differential gene expression patterns in response to paraben exposure, with MeP associated with the most significant effects. MeP and EtP exposure produced greater disruption in the microbiota of *D. celebensis* than did PrP compared with control groups, and we identified eight key microbiota, including *Ruegeria* and *Roseovarius*. Correlation analysis between transcriptome and microbiome data revealed key interactions between specific microbiota and host gene expression. Certain microbial taxa were associated with specific toxicological pathways, shedding light on the complex molecular response and *in vivo* toxicity effects of parabens. These findings contribute to a deeper understanding of the molecular mechanisms underlying paraben toxicity and highlight the importance of considering the ecological impact of chemical contaminants in aquatic ecosystems.

O. 60: 15:30-15:50, 6/1/2024 (Saturday), P4704, YEUNG

MECHANISM OF HYDROGEN NANOBUBBLES TO ALLEVIATE THE OXIDATIVE STRESS OF COPPER ON *TETRAHYMENA THERMOPHILA*

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Aquatic ecosystems are the most crucial components of Earth's ecology. Environmental pollutants in aquatic ecosystems impose toxic stresses on a variety of aquatic organisms across different trophic levels. Oxidative stress, induced by various pollutant, is regarded as one of the mechanisms causing toxic effects, displaying a wide range of structural characteristics. Consequently, effective methods that mitigate oxidative damage are essential for early ecosystems restoration. Hydrogen nanobubbles (NBs), acting as novel antioxidants, have attracted widespread attention due to their beneficial effects in various medical models and botanical fields. However, the molecular mechanism of their protective effects is poorly understood.

In this study, we used *T. thermophila* as a model organism and Cu ions to induce exogenous stress. We found that hydrogen NBs decreased the Cu toxicity to *T. thermophila* and played a role in antioxidative stress. To clarify this molecular mechanism, we first investigated the effects of hydrogen NBs on the removal of endogenous and exogenous ROS (including H_2O_2, $O_2^{\bullet-}$, and •OH). The results demonstrated that hydrogen NBs could remove H_2O_2 and $O_2^{\bullet-}$ at molar ratios of 8:1 and 240:1, respectively, which were unable to be removed by dissolved hydrogen molecules only. This may be due to the existence of hydrogen radicals (•H) in the hydrogen NBs. The generation of •H, on the one hand, reduced the reaction energy between hydrogen and ROS; on the other hand, increased the rate constant of the reaction. Then, molecular biology tools, such as microplate and qPCR, were conducted to investigate the effects of hydrogen NB on endogenous antioxidant system. The results showed that hydrogen NBs significantly increased the specific activity of SOD and GPx antioxidant enzymes, as well as the expression of related genes. Finally, transcriptome sequencing methods were used to investigate the key genes regulated by hydrogen NBs. The results revealed that hydrogen NBs played a major regulatory role in the glutathione metabolic pathway. In particular, the hydrogen NBs enhanced the GPx expression to promote the glutathione redox cycling process. These findings will enhance our knowledge on the biological effects of hydrogen NBs and provide a theoretical basis for the development of appropriate applications of hydrogen NB technology.

Invited talk 13: 14:00-14:30, 3/1/2024 (Wednesday), P4320, YEUNG

DEVELOPMENT OF NOVEL APTASENSOR FOR THE DETECTION OF ENROFLOXACIN

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The abuse of Enrofloxacin contaminates the marine environment and lead to antimicrobial resistant (AMR) in our human body through the intake of aquatic products. Hence, it is necessary for us to develop an aptasensor for the rapid and specific detection of Enrofloxacin. Aptamers were selected through Capture-SELEX (systematic evolution of ligands by exponential enrichment). After 14 rounds of selection, we selected 11 aptamer candidates for further study. Among 11 candidates, Enro_ap3 exhibited high affinity (K_d: 1.64 ± 0.18) and specificity to Enrofloxacin, as confirmed by microscale thermophoresis (MST) assay and further validated using strand displacement assay. We also design a novel fluorescence aptasensor by conjugating our aptamer with a fluorogenic aptamer. This suggests that Enro_ap3 has the potential to serve as a biomolecular recognition element in an aptasensor for further investigation in real water samples.

O.61: 14:30-14:50, 3/1/2024 (Wednesday), P4320, YEUNG

INTEGRATED APPROACH FOR TROPHIC POSITION OF BLACK-TAILED GULL (*LARUS CRASSIROSTRIS*) EGGS OVER A DECADE: COMBINING STABLE ISOTOPES OF AMINO ACIDS AND FATTY ACIDS

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Recently, compound-specific isotope analysis (CSIA) using amino acid nitrogen stable isotope ratio ($\delta^{15}N_{AAs}$) has been widely used for accurate estimation of trophic position (TP). A quantitative fatty acid signature analysis (QFASA) provides an information of diet source. In this study, we integrated multiple approaches using the techniques to improve the estimation of TP for seabirds by applying multi-mixing trophic discrimination factor (TDF) and mixing Δ. Since the black-tailed gulls (BTGs) are income-breeding seabirds, which rely on energy sources obtained around their breeding sites, they and their eggs (BTGEs) could be useful bioindicator for environmental monitoring. However, the ecological properties of BTGs such as habitats, diets, and TP are not well known due to their large migration range for wintering or breeding and their feeding habits on both aquatic and terrestrial prey. In this study, the BTGE samples were used for estimating TP and for predicting TP of mother birds to overcome the difficulties such as capturing birds and collecting non-invasive tissue samples. The BTGEs, sampled in the three islands of Korea over a decade, showed a spatial difference of diet origins. Considering both food chains and physiology of BTG, the TP of BTGEs was estimated to be 3.3–4.0. Notably, the TP was significantly higher at site H (3.8±0.1) than that at site B (3.5±0.2), which was consistent with the results of the more marine diet contributions confirmed by QFASA. Using a reproductive shift of $\delta^{15}N_{AAs}$, the TP of the mother birds was predicted to be 3.6–4.3, positioning them at the top predator in the food web. This advanced integration of multiple approaches provides valuable insights into bird ecology and offer essential information for understanding the ecological behavior and bioaccumulation of pollutants using seabirds.

O. 62: 14:50-15:10, 3/1/2024 (Wednesday), P4320, YEUNG

HYPOXIA-ASSOCIATED SEASONAL VARIATIONS OF ZOOPLANKTON COMMUNITY IN JINHAE BAY, SOUTH KOREA: A CASE STUDY THROUGH ENVIRONMENTAL DNA METABARCODING

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Jinhae Bay coast is likely to have continuous community structural changes due to seasonal hypoxia. Conventional methods that rely on morphological identification have limitations in identifying these changes. In the present study, using eDNA metabarcoding technology, the monthly changing zooplankton community composition was investigated and identified around hypoxia period in Jinhae Bay. Study of eight months of eDNA survey confirmed significant changes in community in summer when hypoxia and stratification occurred. This change in composition was largely influenced by phylum Arthropoda that showed a negative correlation with hypoxic water mass, especially in the order Calanoida and Poecilostomatoida, thus confirming negative influence of hypoxia on species diversity. After the disappearance of hypoxia, the species diversity recuperated with recovery of only a few species that had disappeared during hypoxia along with detection of new members of the community. Moreover, environmental factors affecting each ASVs were identified through WGCNA, and nine families assumed to be resistant to hypoxic environment were detected. Our study suggests eDNA metabarcoding as an efficient game changing tool in identification of variations in community composition upon environmental changes in the marine ecosystem.

O. 63: 15:10-15:30, 3/1/2024 (Wednesday), P4320, YEUNG

MONITORING OF COASTAL ENVIRONMENT USING ENVIRONMENTAL DNA

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Monitoring the coastal environment plays a crucial role in understanding its ecological dynamics and assessing the impacts of human activities. Traditional monitoring methods often rely on labor-intensive and time-consuming approaches, making it challenging to capture a comprehensive picture of biodiversity and ecosystem health. The emergence of environmental DNA (eDNA) analysis has revolutionized environmental monitoring by offering a non-invasive and efficient approach. For example, the increasing diversity of pathogen occurrence in coastal areas necessitates the development of improved monitoring platforms to mitigate potential economic and public health implications. However, traditional monitoring methods that rely on culture-based identification techniques have limitations in their ability to provide comprehensive coverage of the diverse range of pathogenic species present. A crucial component of eDNA monitoring is the availability of accessible databases that contain up-to-date knowledge and taxonomy of environmental concerns. To address this need, we have constructed an updated aquaculture bacterial pathogen database, which covers over 210 bacterial pathogenic species that impact aquaculture species. Furthermore, by employing environmental DNA metabarcoding monitoring in Hong Kong coastal waters, we were able to effectively profile regional pathogen dynamics. This approach improved the identification of new potential pathogen targets and provided valuable insights into the impact of aquaculture activities and associated inorganic nitrogen loads. Notably, the results highlighted the significant increase in potential pathogen abundance during the atypical dry winter season, primarily driven by the dominant enrichment of Vibrio species. The use of environmental DNA-based approaches has proven to be valuable in coastal marine pathogen surveillance, offering benefits for water resource management and aquaculture development on a global scale. By employing these approaches, we can gain a better understanding of pathogen profiles, detect emerging threats, and implement appropriate measures to safeguard both aquaculture operations and the surrounding environment.

O. 64: 15:30-15:50, 3/1/2024 (Wednesday), P4320, YEUNG

GAP ANALYSIS OF DNA BARCODING DATABASE OF HONG KONG'S MARINE BIOTA

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Accurate DNA-based taxonomic identification relies on the availability of DNA barcode reference libraries, but the uneven barcode coverage presents a challenge to biodiversity assessment worldwide. In this study, we aimed to assess the barcode gap of COI in BOLD and GenBank databases, and three other commonly used markers (12S rRNA, 16S rRNA, and 18S rRNA) in GenBank for marine animals in Hong Kong waters, which account for 26 % of the total marine species reported in China. We compiled a species checklist comprising 4023 species from 17 phyla, utilizing information from HKRMS and FishBase databases. Based on BOLD, the COI barcode coverage of 17 phyla arranged from 0 in Platyhelminthes to 89.71% in Chordata. Based on GenBank, the average barcode coverage for the 17 phyla was 58.49% for COI, 32.51% for 16S rRNA, 20.06% for 12S rRNA, and 19.29% for 18S rRNA. The proportion of concordant BINs based on the BOLD database in the groups with available sequences was only 21.95%, suggesting that many Hong Kong species may be undescribed or cryptic species. Since the barcoding gap was large for most phyla of marine animals, a concerted effort should be applied to complete the database. The huge differences in barcoding coverage and the different sensitivity in species delimitation among the markers imply that using more than one marker may significantly enhance the success in species identification. In addition, careful validation and annotation of available sequences are also essential for the DNA-based tools and increasing the reliability of the reference sequences should be conducted to enabling rigorous species identification. Finally, based on available sequences in public databases and our own new data, we present a DNA barcode library with four markers for a total of 2852 species of marine animals, which will facilitate species identification based on barcoding or eDNA approaches for biodiversity monitoring and conservation in Hong Kong waters.

Invited talk 14: 14:40-15:10, 4/1/2024 (Thursday), P4320, YEUNG

UNRAVELING THE NEXUS OF CARBON, OXYGEN, AND NUTRIENTS DYNAMICS UNDER ANTHROPOGENIC PRESSURE IN HONG KONG AND THE GREATER BAY AREA

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Ocean deoxygenation, primarily driven by human activities, significantly affects coastal ecosystems. This depletion in dissolved oxygen arises from increased organic matter respiration due to nutrient pollution and climate warming, both enhancing eutrophication and biological activity. Hong Kong and the Greater Bay Area have experienced extensive anthropogenic pressures from dense urbanization and human activities that impact biogeochemical cycling. Predicting future ocean oxygen levels involves understanding biological oxygen demand linked to organic matter respiration, including variations in the respiration quotient (ratio of oxygen to organic carbon consumed by respiration). This is particularly relevant in areas already experiencing hypoxia like Hong Kong and the Greater Bay Area, or regions with a fragile oxygen balance like the South China Sea. Variations in the respiration quotient, driven by nutrients, temperature, and phytoplankton populations, could significantly impact modeling of oxygen depletion.

This presentation will discuss research aimed at unravelling the complex nexus of carbon, oxygen, and nutrient dynamics in this region under these anthropogenic pressures. The major objectives are to quantify the sources of new nitrogen to Hong Kong coastal waters and determine the impacts of this reactive nitrogen on primary productivity, oxygen consumption, and elemental stoichiometry. The main nitrogen sources to be evaluated include sewage effluent, atmospheric deposition, and the potential for nitrogen fixation. A combination of field measurements, incubation experiments and isotope tracer techniques will be used to trace the pathways and fates of these nitrogen inputs. Controlled nutrient addition bioassays will assess how nitrogen loading affects phytoplankton growth, community composition, and particulate carbon production. Dissolved oxygen monitoring and incubation-based measurements of community respiration will elucidate connections between external nitrogen supply, primary production, and oxygen consumption from respiration and nitrification. Stable isotopes of nitrate and nitrous oxide produced during nitrification will provide insight into the links between the various nitrogen sources and biogeochemical cycling. Finally, observations and experimental manipulations examining the impacts of anthropogenic nitrogen inputs on the C:N:P stoichiometry of dissolved and particulate matter will shed light on variability in the respiratory quotient and provide independent constraints on organic matter sources and diagenetic alterations. Overall, this research aims to advance understanding of how excessive anthropogenic nitrogen loading impacts biogeochemical dynamics in the highly urbanized and populated environments of Hong Kong and the Greater Bay Area.

O. 65: 15:10-15:30, 4/1/2024 (Thursday), P4320, YEUNG

OPTIMIZATION OF ENVIRONMENTAL DNA METHODS FOR FISH DIVERSITY ASSESSMENT IN ESTUARINE AND OCEANIC WATER: PRIMERS, VOLUMES, AND REPLICATES

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Environmental DNA (eDNA) metabarcoding is a widely used non-destructive approach for biodiversity assessment in various ecosystems. Optimizing methodology is crucial for eDNA research to ensure accurate biodiversity assessment due to the complex and diverse heterogeneous water conditions. This study aims to optimize an eDNA method for the assessment of fish diversity in subtropical oceanic and estuarine waters. We evaluated the efficiency of three pairs of primers (12S-v5, MiFish-U, and MiFish-E) and a combination of sample volumes (1, 2, 4, and 10 L) and replicates (20, 10, 5, and 4) based on samples collected from an estuarine site and an oceanic site and filtered using 0.45 µm pore glass fibre filter. After data cleaning and filtering, we detected a total of 184 and 188 fish species in the oceanic and estuarine samples, respectively. Overall, MiFish-U detected the highest number of species (101) in the oceanic water, whereas MiFish-E performed best in the estuarine water with 140 species detected. Based on the read abundance, the primers exhibited differential sensitivity to fish from different families. For example, 12S-v5 detected significantly higher reads from Lutjanidae, Serranidae, and Siganidae compared with MiFish-U/E, implying the need for dual/multiple primer assays to maximize fish detection. Regarding sample volumes and replicates, we found that the species accumulation curve approached near asymptotes with 5 replicates of 4 L or 4 replicates of 10 L in oceanic and estuarine water, respectively. Moreover, we detected the highest number of species per replicate in 4 L of samples (65 ± 11 in oceanic, and 82 ± 7 in estuarine). Based on our results, we recommend sampling 5 replicates of 4 L to balance the need for cost-saving, time-efficiency, and maximum species detection in subtropical oceanic and estuarine waters.

O. 66: 15:30-15:50, 4/1/2024 (Thursday), P4320, YEUNG

BOTTOM TRAWLING AND MULTI-MARKER EDNA METABARCODING SURVEYS REVEAL HIGH DIVERSITY OF VERTEBRATE AND CRUSTACEAN COMMUNITIES IN AN URBANIZED SUBTROPICAL ESTUARY

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Estuarine habitats play critical ecological roles as feeding and nursery grounds for many aquatic species while supporting local fisheries. However, monitoring these complex ecosystems is difficult, destructive, and labor-intensive. This study employed multi-marker eDNA metabarcoding to monitor fish and macroinvertebrate communities in southern Hong Kong waters with complex hydrographic environments and pollution stresses from sewage drainage systems. We aim to assess whether eDNA could be a cost-effective and non-destructive tool for monitoring species community and distribution compared to concurrent bottom trawling. By analyzing 64 two-liter water samples using five primer assays (i.e., 12S-V5, MiFish-U, Berry-Fish, MiDeca, and 18Suni) and 16 trawls, we found that eDNA metabarcoding detected more bony fishes (300 vs. 106), elasmobranchs (6 vs. 3), and macroinvertebrates (273 vs. 127), as well as taxon number at each site. Notably, we showed the effectiveness of eDNA in the detection of 18 threatened species (vs. 4 in trawling) without impacting local populations, including two marine mammals (Chinese White Dolphin and Indo-Pacific Finless Porpoise) and the critically endangered Large Yellow Croaker, as five cryptic corals. Multivariate analyses showed that eDNA data can distinguish community differences and spatial patterns among fish and crustacean assemblages, which are significantly associated with turbidity and organic pollution gradients. Our result highlights that eDNA provides the high resolution of species compositions and community-environment relationships in estuarine ecosystems, particularly for fish. Integrating the non-destructive eDNA into regular monitoring programs improves decision-making for sustainable fishery management and conservation practices.

O. 67: 15:50-16:10, 4/1/2024 (Thursday), P4320, YEUNG

Environmental DNA Reveal Conservation Effects upon fish communities of Marine Protected Areas in Hong Kong

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Marine protected areas (MPAs) in Hong Kong were established to contribute to fishery resource conservation and marine ecosystem protection. However, the conservation effect of the MPAs was rarely investigated. Fish diversity complex comprising taxonomic, functional, and phylogenetic diversity is one of the predominant aspects in evaluating the ecosystem function and stability. Utilizing the above fish diversity complex to interpret the conservation effect of MPAs in Hong Kong can help enhance our understanding of the ecosystem status and may benefit the establishment of the marine conservation scheme in the area.

In this study, we collected water samples from six marine parks, one marine reserve, and one proposed marine park across the eastern and western waters and utilized the environmental DNA (eDNA) method to obtain fish diversity. In the meantime, traditional fishing methods including long lining, hand lining, and gill netting were used at the same site to get survey data.

The results showed that the eDNA method outperformed the traditional methods in detecting fish diversity. Specifically, the eDNA method successfully obtained 131 fish species (53 families) by using the primer set *12S_V5*, and 84 species (42 families) were obtained by traditional methods. We further implemented the downstream analysis based on the eDNA data. The functional diversity was calculated based on the distribution (water column position, and latitude distribution range), biological traits (maximum body length), feeding ecology (trophic level), fishery resource (fishery value, and price category), and conservation importance (IUCN status) of the fishes. The fish taxonomic diversity (species richness and Shannon diversity) in MPAs was higher than that in the proposed marine park, however, the result of the Analysis of Variance indicated no significant difference. Consistently, phylogenetic diversity representing evolutionary relationships between species of fish community in MPAs is higher than that in the proposed marine park with no significant difference. For the functional diversity, FEve representing the evenness of species abundance distributions in functional trait space in the MPAs is higher than that in the proposed marine park. However, FRic representing the total amount of functional space filled by the community in the MPAs is lower than that in the proposed marine park. No significant difference was found between functional diversity in MPAs and the proposed marine park.

The eDNA-based fish capture method combined with an evaluation of multi-facets of biodiversity reveals a mismatch between taxonomic diversity and functional diversity of fish communities in MPAs. This kind of prediction can guide the establishment of the marine conservation system and further facilitate the biodiversity and ecosystem stability in the area.

O. 68: 16:10-16:30, 4/1/2024 (Thursday), P4320, YEUNG

BIOMINERALIZATION TO PREVENT MICROBIALLY INDUCED CORROSION ON CONCRETE FOR SUSTAINABLE MARINE INFRASTRUCTURE

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Microbially induced corrosion (MIC) on concrete represents a serious issue impairing the lifespan of coastal/marine infrastructure. However, currently developed concrete corrosion protection strategies have limitations in wide applications. Here, a biomineralization method was proposed to form a biomineralized film on concrete surfaces for corrosion inhibition. Laboratory seawater corrosion experiments were conducted under different conditions [e.g., chemical corrosion (CC), MIC, and biomineralization for corrosion inhibition]. A combination of chemical and mechanical property measurements of concrete (e.g., sulfate concentrations, permeability, mass, and strength) and a genotypic-based investigation of formed concrete biofilms was conducted to evaluate the effectiveness of the biomineralization approach on corrosion inhibition. The results show that MIC resulted in much higher corrosion rates than CC. However, the biomineralization treatment effectively inhibited corrosion because the biomineralized film decreased the total and relative abundance of sulfate-reducing bacteria (SRB) and acted as a protective layer to control the diffusion of sulfate and isolate the concrete from the corrosive SRB communities, which helps to extend the lifespan of concrete structures. Moreover, this technique had no negative impact on native marine microbial communities. Our study contributes to the potential application of biomineralization for corrosion inhibition to achieve long-term sustainability for major marine concrete structures.

O. 69: 16:50-17:10, 4/1/2024 (Thursday), P4320, YEUNG

SIMULTANEOUS ELECTROCHEMICAL EXFOLIATION AND COVALENT FUNCTIONALIZATION OF MOS_2 MEMBRANE FOR WATER PURIFICATION

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Transition metal dichalcogenide membranes exhibit good antiswelling properties but poor water desalination property. Here, a one-step covalent functionalization of MoS2 nanosheets for membrane fabrication is reported, which is accomplished by simultaneous exfoliating and grafting the lithium-ion-intercalated MoS2 in organic iodide water solution. The lithium intercalation amount in MoS2 is optimized so that the quality of the produced 2D nanosheets is improved with homogeneous size distribution. The lamellar MoS2 membranes are tested in reverse osmosis (RO), and the functionalized MoS2 membrane exhibits rejection rates of >90% and >80% for various dyes (Rhodamine B, Crystal Violet, Acid Fuchsin, Methyl Orange, and Evans Blue) and NaCl, respectively. The excellent ion-sieving performance and good water permeability of the functionalized MoS2 membranes are attributed to the suitable channel widths that are tuned by iodoacetamide. Furthermore, the stability of the functionalized MoS2 membranes in NaCl and dye solutions is also confirmed by RO tests. Molecular dynamics simulation shows that water molecules tend to form a single layer between the amide-functionalized MoS2 layers but a double layer between the ethanol-functionalized MoS2 (MoS2-ethanol) layers, which indicates that a less packed structure of water between the MoS2-ethanol layers leads to lower hydrodynamic resistance and higher permeation.

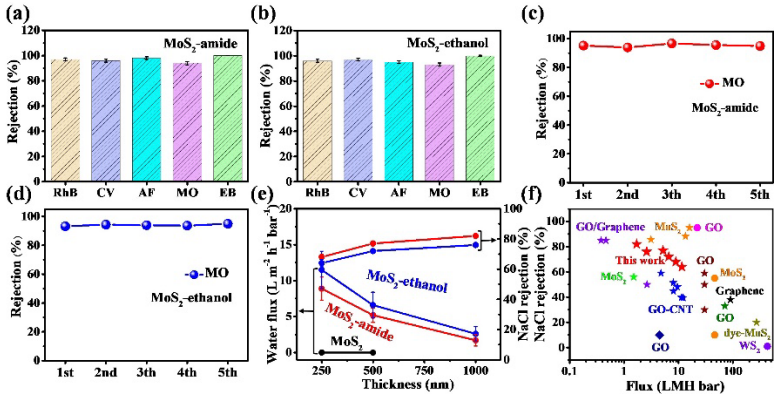

Figure 1 Reverse osmosis (RO) performance tests of layered MoS2 membranes: water flux, sodium ion and dye rejection.

O. 70: 17:10-17:30, 4/1/2024 (Thursday), P4320, YEUNG

MUNICIPAL SEWAGE TREATMENT BY A SALT PAN COLONIZED MANGROVE

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Nutrient output by humans is one of the primary causes of eutrophication. Tai O is a popular tourist destination and the iconic stilt houses attract more than 600 million visitors every year. Municipal sewage treatment service in Tai O is rather limited. Municipal sewage generated by residents and tourists is either directly discharged into Tai O's tidal channels, or sent to the primary sewage treatment plant nearby. Our preliminary work showed that concentrations of ammonia in Tai O waters are often higher than 0.2 mg/L, which exceeds the requirements of Hong Kong Water Quality Objectives and China's Sea Water Quality Standards, potentially threatening aquatic lives nearby.

Tai O is also popular for its abundant mangrove wetlands, and is surrounded by more than 20 hectares of mangrove wetland. While some of the mangroves were planted by the government, Tai O's unique hydrology provides suitable conditions for mangrove plants to grow. A salt pan near Sun Kei Street (northern Tai O), which was abandoned since the mid-2000s, has been colonized with various mangrove plants. Unlike other mangrove wetlands that are flooded regularly by tidal movements, a sluice gate was installed at the only entrance of this particular mangrove to limit the outflow of water. Therefore, nutrient rich tidal water from Tai O enters this wetland and is trapped for a longer time before returning to the tidal channels. Sun Kei Street's many stilt houses are also built facing the wetland, and municipal sewage generated is directly entering the wetland. This particular setting creates an interesting environment. The present work aimed to study whether this particular mangrove wetland could contribute to municipal sewage treatment. The mangrove wetland was roughly divided into two parts by the sluice gate. The left side (LH) is more enclosed with a choke point further limiting tidal water from entering, while the right side (RS) has a larger mudflat, with more populated stilt houses and some farming fields. Transects were set on both LH and RH, at the edge of mangrove swamps parallel to the stilt houses, and each transect had five sampling points. Tidal water, sediment and mangrove leaves, in both wet and dry seasons, were collected to investigate whether distance from stilt houses and the sluice gate could lead to differences in nutrient distribution in the mangrove wetland, and seasonal variations. Results suggested the sampling points near the sluice gate and those with higher stilt house density tended to have higher levels of nutrients, while the farthest sampling points did not result in the highest nutrient levels. Two-way ANOVA revealed that nutrients were utilized by mangrove plants during the wet season, while nutrients accumulated in sediment during the dry season. Results indicated that the mangrove wetland is capable of retaining nutrients generated from Tai O.

O. 71: 17:30-17:50, 4/1/2024 (Thursday), P4320, YEUNG

ABSORB + DEGRADE: A NOVEL OIL SPILL MITIGATION METHOD USING *ACINETOBACTER VENETIANUS* IMMOBILIZED ON PVDF MEMBRANES INCORPORATED WITH CELLULOSE TRIACETATE

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Pollution due to crude oil spills are hard to clean because of how withstanding hydrocarbons are. With the downside of being easily washed away, bioremediation methods haven't been that effective. This further enhanced the need to develop a suitable carrier that can be used in-situ. This study aimed to produce an absorptive membrane that simultaneously acts as a carrier for oil-degrading bacteria. Cellulose triacetate (CTA) was successfully synthesized from kapok fiber, that's cheap, grows fast, has a high cellulose content and high porosity due to its large lumen and thin cell walls. Degree of substitution of the CTA was 2.9 by titration and confirmed by ^{1}H- and ^{13}C-NMR. The CTA, which is thermally stable and porous, was then blended into PVDF membranes at different concentrations (0% - 5%, PC0 – PC5) and the respective characteristics of each membrane were observed. PVDF membrane incorporated with 3% CTA (PC3) membrane was chosen as it displayed improved characteristics compared to pure PVDF membrane (PC0). In PC3, significantly increased porosity (68% in PC0 to 85%) was observed together with increased water contact angle (68° in PC0 to 75°) and surface porosity (43% in PC0 to 55%). High porosity decreased tensile strength but increased elongation. It also improved oil-degrading bacteria immobilization capacity (1.1mil CFU in PC0 to 15mil CFU) and crude oil absorption capacity (169% in PC0 to 265%). The morphological characteristics were observed using scanning electron microscopy (SEM) where the sponge-like structure was slowly changed to be finger-like structure as the concentration of CTA went up. Degradation of crude oil is using the immobilized PVDF/CTA membrane is currently being tested. With higher immobilization and crude oil absorption capacity, PVDF membrane with 3% CTA is expected to be a novel oil spill mitigation method.

O. 72: 17:50-18:10, 4/1/2024 (Thursday), P4320, YEUNG

ASSESSING THE BIOLOGY OF CORAL POLYPS USING 3D VISUALIZATION TECHNIQUES

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The Hong Kong Polytechnic University, China

The objective of this study is to investigate the biology of coral polyps using advanced 3D visualization techniques, with a specific focus on the staghorn coral *Acropora tumida*. To achieve this, we employ an advanced multiphoton microscope equipped with far-red and infrared emission lasers. This cutting-edge microscope enhances penetration power, allowing us to observe and quantify various components within a coral polyp, including soft tissue, endosymbionts, and any ingested particles such as microplastics. By utilizing tissue clearing and 3D reconstruction techniques, we can digitally reconstruct the coral polyp and visualize it in a 3D layout. This approach provides valuable insights into the distribution patterns of endosymbionts and any other ingested particles within the soft tissue of the coral. The implications of this study extend beyond *Acropora tumida* and can be applicable to other species. The utilization of 3D visualization techniques enables a deeper understanding of the anatomy of coral polyps and their interactions with endosymbionts. It also serves as a valuable tool for assessing the impacts of microplastics and other particles on corals, offering insights into the potential effects on their biology and overall health.

Invited talk 15: 14:00-14:30, 5/1/2024 (Friday), P4320, YEUNG

COMMUNITY BASELINE, THREATS, WINNERS, AND LOSERS OF HONG KONG'S URBAN CORALS

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School of Biological Sciences, Hainan University

Global climate change has been predicted to cause substantial degradation of tropical coral reefs over the coming decades, but whether subtropical reefs will serve as refugia of climate change remains unclear. Under the support of the Agriculture, Fisheries and Conservation Department, we conducted a study of Hong Kong's subtropical urban coral communities in 2017-2018 to quantify its baseline and to identify the threats. Our transect surveys revealed five community types, among them the most common one inhabited oceanic water and dominated by both massive and upward-plating corals. 21 of the 33 survey sites in the eastern sites had 40-79% coral cover, indicating an overall healthy condition. Sites in the southern waters had low coral cover. In several sites, there were signs of external bioerosion or bleaching-induced damage. Both coral cover and generic richness correlated negatively with several water quality parameters including total inorganic nitrogen concentration and turbidity, indicating the development of Hong Kong's coral communities is constrained by water quality parameters. At the sites that suffered from coral bleaching, we conducted tagging and post-bleaching observation, which revealed good recovery of most species, except in the plate-like *Acropora solitaryensis*. Based on results of this field study, we conducted laboratory experiments to determine the relative susceptibility of nine coral species to thermal stress. We exposed *Acropora digitifera*, *Acropora pruinosa*, *Dipsastraea rotumana*, *Echinophyllia aspera*, *Montiopora peltiformis*, *Pavona decussata*, *Platygyra carnosa*, and *Porites lutea* to 30°C (treatment) or 25°C (control) for one month. Four species (*D. rotumana*, *E. aspera*, *P. decussata*, and *P. carnosa*) were resilient to the heat treatment, and survived the whole experiment, although bleaching occurred after one to two weeks of exposure. The heat exposure caused total mortality in the other five species: at day 2 in *A. solitaryensis*, day 5 in *P. lutea*, day 7 in *A. digitifera*, day 9 in *A. pruinosa*, and day 17 in *M. peltiformis*. These results suggest that repeated heatwaves in the past may have impacted the coral community structure by causing disproportionally high mortality of heat-sensitive species, especially those in the *Acropora*, *Porites*, and *Montipora* genera tested in this study. Given that Hong Kong has been predicted to become warmer with more and stronger heatwaves in the coming decades, regular monitoring of coral communities should be conducted, especially in areas that are still populated by relatively heat-susceptible species. Furthermore, when choosing coral species for restoration, heat-susceptible species should be avoided.

O. 73: 14:30-14:50, 5/1/2024 (Friday), P4320, YEUNG

EFFECTS OF SURFACE TOPOGRAPHY AND SURFACE MATERIAL ON CORAL SETTLEMENT SUCCESS

Wong W.C.C., Mang M.C.Y., Yuen K.C.H., Cheung C.C., Tang C.Y., Chui A.P.Y. and Fang J.K.H.

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The Chinese University of Hong Kong, Hong Kong SAR, China

The successful settlement and recruitment of coral larvae are crucial for maintaining the sustainability of a coral community. While previous studies have primarily focused on identifying biological and chemical factors influencing larval settlement, the role of physical factors remains less understood. In this regard, this study aimed to investigate the effects of surface topography and surface material on the settlement rate of larvae, using the staghorn coral *Acropora tumida* as a model species. Gamete bundles of *A. tumida* were collected from the eastern waters of Hong Kong. *In-vitro* fertilisation was performed on the eggs and sperm to produce planula larvae. To assess the larval settlement preferences, a factorial design experiment was conducted incorporating two factors, namely surface topography (with four levels: smooth surface, sinusoidal crevice widths of 800 μm, 1200 μm, and 1600 μm), and surface material (with two levels: with or without calcium carbonate coating). The experiment lasted 20 days, and our results provide support for the hypothesis that coral larvae display a stronger preference for settling on crevices that are similar in width to their body size. Specifically, the tiles with 800 μm crevices exhibited the highest settlement rate, exceeding 18%, outperforming the smooth tiles and the tiles with crevices of 1200 μm and 1600 μm width. Furthermore, the tiles coated with calcium carbonate also showed a 20% higher settlement rate compared to those without the coating. These findings hold implications for the design of artificial reefs, offering insights for promoting coral larval settlement and enhancing ecological restoration efforts.

O. 74: 14:50-15:10, 5/1/2024 (Friday), P4320, YEUNG

ACQUISITION OF SYMBIODINIACEAE IN *ACROPORA TUMIDA* JUVENILES UNDER FUTURE WARMING SCENARIOS

Cheung B.C.T.[1], Leung J.C.H.[1], Wong E.L.C.[1], Cheng T.K.T.[1], Tse I.W.Y.[1], Li C.G.W.[1], Lau A.S.U.[1], Chan M.H.C.[1], Wu L.J.[2] and Chui A.P.Y.[1]

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Global warming is causing episodic heat waves and extreme weather which are stressful to marine organisms. Among the most susceptible to these environmental changes are scleractinian corals. Under heat stress, scleractinian corals expel their symbiotic algae, Symbiodiniaceae, causing a bleaching event, which often resulted in extensive mortality if the bleaching is severe or prolonged. Thermal tolerance in coral differs among genera, species, individuals, and the composition of Symbiodiniaceae plays an important role in bleaching tolerance and coral resilience. To date, most studies on coral-Symbiodiniaceae interaction have focused on adult corals. Better understanding of the effects of thermal stress on the establishment of symbiosis in coral early life stages is needed to offer insights on how corals can cope with future ocean conditions. In this study, aposymbiotic *Acropora tumida* juveniles were exposed under 28°C (the average summer ambient temperature), as well as 30°C and 32°C (representing marine heatwaves or future elevation of seawater temperatures) to examine (i) the effect of temperature on coral acquisition of the *Cladocopium* sp. and *Durusdinium* sp. pure cultures, and (ii) the subsequent survival and growth of the coral juveniles. After five weeks, the infection success was significantly lowered at 32°C in all treatment groups, except for those infected with *Durusdinium* sp.. They were the only ones that could still largely be infected at 32°C (72.29 ± 9.13%), and subsequent survival of *Durusdinium* infected corals was higher at 28°C compared to the uninfected corals. These preliminary results align with previous studies showing that *Durusdinium* were dominant in *A. tumida* juveniles, and such dominance was suggested to be related to stress-tolerance. Further experiments on long-term juvenile growth and physiological performance will be needed to reveal any potential tradeoff underlying this stress-tolerance associated with *Durusdinium*.

O. 75: 15:10-15:30, 5/1/2024 (Friday), P4320, YEUNG

DERIVING ENVIRONMENTAL QUALITY STANDARD CONSIDERING ENDOCRINE DISRUPTION

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Endocrine-disrupting chemicals (EDCs) are a reason for growing concern because of their substantial and long-lasting deleterious effects on human health and wildlife populations. These include direct effects on aquatic organisms and may be a concern to species feeding on the aquatic food chains and water, including humans. In the European Community, the dedicated legislative tools to protect the aquatic environment and human health from contaminants released to surface waters is the Water Framework Directive (WFD). The achievement of protection goals is assessed through the comparison of concentrations measured in the media and thresholds of no effect called Environmental Quality Standards (EQSs). As EDCs are explicitly mentioned in the WFD, an analysis of the state of the art was undertaken on how far and how consistently ED properties were considered in the derivation of EQS values. Our results reveal substantial heterogeneity according to substance and that among substances with ED evidences, EQSs have been derived without considering ED properties for 70 % of them. A methodology to better consider endocrine disrupting properties is proposed and includes a logical and systematic approach to derive EQSs with a proposal to specify additional assessment factors based on the specific hazard and potential uncertainty.

O. 76: 15:30-15:50, 5/1/2024 (Friday), P4320, YEUNG

CITIZEN SCIENCE AS PART OF LONG-TERM MONITORING OF MARINE PLASTIC POLLUTION

Bell T.E.M.

PEMSEA (Partnerships in Environmental Management for the Seas of East Asia)

Despite the increasing awareness surrounding marine plastic pollution and its impacts on environmental and human health, gaps remain in our understanding of its intensity, impact, and change through time. Geographical and temporal variations in cause and impact make drawing broader understanding from local studies challenging, with wide-reaching and standardised monitoring needed to generate more applicable reduction and mitigation strategies.

Citizen science, which can provide the manpower needed for extensive scientific research, is a promising approach to expanding the spatial and temporal scope of marine plastic pollution research. Plastic is a ubiquitous substance, and related issues such as littering and pollution are already well-known among the public.

Over the past few years, PEMSEA has been working with other partners in the region to adopt a consistent citizen science methodology for monitoring plastic pollution accumulation on beaches. This is based on an approach pioneered by the Korean National Marine Debris Monitoring Program (KNMDMP), which has been implemented since 2008.

By adopting similar methodologies elsewhere in the region, comparability between different localities is possible, allowing for larger-scale assessment of marine plastic pollution. The use of local citizen scientists is a scalable pathway to improving understanding of the geographical and temporal variation of beach plastic debris, increasing both the spatial coverage and the frequency of data collection. The method used is simple enough to be effectively undertaken by citizen scientists, while being robust enough to provide data comparable to professional initiatives.

Citizen science is a valuable and effective tool in the long-term monitoring and understanding of marine plastic pollution. By collaborating with civil society, researchers are able to not only expand the reach of their initiatives, but also to foster community engagement and awareness, contributing to a broader societal understanding of marine plastic pollution.

The use of citizen science as part of long-term monitoring programs will help ensure a more comprehensive and sustainable approach to understanding marine plastic pollution in the seas of East Asia and beyond.

Invited talk 16: 14:00-14:30, 6/1/2024 (Saturday), P4320, YEUNG

RESTORATION OF DEGRADED HONG KONG CORAL HABITATS USING MULTIPLE ACTIVE CORAL RESTORATION APPROACHES

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Hong Kong, located in southern China, supports extensive coral communities, with a high coral diversity of at least 84 scleractinian coral species in 28 genera recorded. Yet there are pressures from coastal development, eutrophication, overfishing etc. Tolo Harbour and Channel in North-eastern Hong Kong, used to support high coverage of corals until the 1980's, were severely affected by extensive pollution impacts. Our surveys showed that, fifteen years after the progressive improvement of water quality inside Tolo Harbour and Channel, coral recovery is very slow. One of the most likely reasons for this slow recovery is a lack of recruitment, which could be due to high sedimentation or intense competition for space with fouling organisms, e.g. algae, oysters, barnacles and bryozoans. In the current time frame, it shows that natural recruitment of corals is necessary, but is not sufficient to restore the damaged coral communities. While majority of the existing restoration protocols are focused on reefs, marginal non-reefal coral communities have their own limitations which make restoration even more challenging. Coral habitat restoration is still in its infancy in Hong Kong and most efforts have focused on using asexual propagation of coral, i.e. fragmentation of source colonies for transplantation. This approach relies heavily on the availability of existing corals from natural environment and is limited by genetic diversity of the source colonies. Taking advantage of the high fecundity of corals, sexual propagation approach has negligible damage to source colonies and offers the promise of greater genetic diversity of the transplanted coral colonies that is likely to improve the adaptive potential of these corals to future disturbance. This talk will be focusing on how the team utilize multiple active coral restoration approaches for coral restoration in Tolo Harbour and Channel, including sexual and asexual coral propagation, ex situ coral nursery, and larval enhancement technique, in degraded coral areas to mitigate population declines of corals, enhance biodiversity, and promote reef resilience to cope with future climate change.

O. 77: 14:30-14:50, 6/1/2024 (Saturday), P4320, YEUNG

OYSTER HABITATS ENHANCE DENITRIFICATION IN A HEAVILY DEGRADED AND POLLUTED MARINE SYSTEM

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Oyster reefs are one of the most degraded marine habitats, with at least 85% lost globally. Yet, even in heavily degraded states oyster habitats provide multiple ecosystem services. One of the most underappreciated of these services is reduction of coastal eutrophication though denitrification. Therefore, to understand the current and potential future capacity of denitrification by oyster reefs in Hong Kong, we quantified denitrification of oyster and adjacent soft-sediment habitat at 6 locations across two seasons. The nitrogen and oxygen flux of habitats was calculated from field-based incubations immediately following collection. We found that mixed-species oyster habitat (primarily *Magallana* spp.) had N-N2 flux of ~1500 mmol m^{-2} hr^{-1}, over 5 times greater than the bare soft-sediment. Importantly, these rates are comparable to those found in well studied regions globally (e.g., Chesapeake Bay, USA). Therefore, while oyster reefs in Hong Kong have been exploited to near functional extinction, projections of potential future denitrification rates following large-scale restoration can be informed by not only our data, but also rates seen on more intact reefs in other regions.

O. 78: 14:50-15:10, 6/1/2024 (Saturday), P4320, YEUNG

CAN MONEY MAKE GHOSTS GRIND? THE LONG-TERM EFFECTIVENESS OF PAYMENT FOR ECOSYSTEM SERVICES

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The perceived effectiveness of payment for ecological services (PES) often declines when subsidies discontinued. This study aims to examine the long-term effectiveness of the China's Sloping Land Conservation Program (SLCP), a PES initiative aimed at converting farmlands into forests. Through a quasi-experiment, we investigated the impact of the SLCP on participants' motivation and behavior after payment cessation. The results revealed a positive influence of the SLCP participation on intrinsic motivation (e.g., environmental concern), leading to a motivation crowding-in effect (β=2.66, P<0.01).

As a consequence of strengthened intrinsic motivations, participants exhibited more pro-environmental behaviors, such as domestic waste recycling. Surprisingly, nearly 60% of the participants continued to maintain their forests even after the payment period concluded. Additionally, the study identified the combined influence of intrinsic motivations, initial willingness to participate, and contextual factors (e.g., farmland area) on land-use behavior during the post-SLCP stage. These findings underscore the importance of promoting sustainable livelihood transformation and enhancing intrinsic motivations to achieve long-term effectiveness in PES projects. The insights gained from this study have significant implications for improving the effectiveness of PES schemes on a global scale.

O. 79: 15:10-15:30, 6/1/2024 (Saturday), P4320, YEUNG

STUDY ON EFFECTIVENESS EVALUATION OF RESTORATION DAMAGED COASTAL SHORELINE: CASES STUDY OF RIYUE BAY AND KAOZHOUYANG

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The living shoreline has gradually become a common coastline remediation technology in the shoreline system affected by human beings. However, there is a lack of awareness of the ecological and human interaction impacts of shoreline restoration technologies for polluted coastal lines and how to meet the effects of remediation. In order to solve this problem, We studied the effectiveness of the sandy shoreline restoration project in Riyue Bay, Wanning, Hainan, and the biological shoreline restoration project in Kaozhouyang, Huizhou, Guangdong. We investigated the environmental quality and human-perceived value of the two restoration projects. Eleven ecological environment indicators and human perceived value indicators were selected to establish the target layer-criterion layer-index layer. The weight of each index was calculated by Analytical Hierarchy Process(AHP) and Fuzzy Comprehensive Evaluation(FCE) method. Firstly, The results showed that there were obvious differences among the 8 common seawater indicators and different types of shoreline damaged restoration projects had different ecological environment. Secondly, the three special indicators represent the particularity of the ecological environment of the damaged shoreline.The bottom quality of the shoreline will have different impacts on human senses. Thirdly, the restoration effect of Riyue Bay was not good and the influencing factors were seawater oil and seawater sulfide. The mangrove restoration project in Kaozhouyang was ideal and its restoration track showed a series of functional improvements as the restoration period going on. In this paper, the restoration project evaluation technology proposed will be of great significance to the restoration of China's shoreline and the construction of beautiful bays.

O. 80: 15:30-15:50, 6/1/2024 (Saturday), P4320, YEUNG

SPOKESPERSON OF THE HONG KONG MARINE PROTECTION ALLIANCE

Shea S.

Hong Kong Marine Protection Alliance

Who We Are?

Launched in 2022, HKMPA is the first collective in Hong Kong focusing on marine conservation and sustainability.

HONG KONG MARINE PROTECTION ALLIANCE
香港海洋保育聯盟

HKMPA's Mission:

The HKMPA is committed to:

1) **Preserve Hong Kong Waters** - To widen the coverage of MPAs by influencing local marine policy planning.
2) **Enhance Public Awareness** - To arouse public awareness on marine sustainability and promote marine conservation.

Our Members:

And Dr. Andy Cornish, Ms. Angel Lam, Dr. Apple Chui, Mr. Charles Goddard, Mr. Harry Chan Tin-Ming, Mr. Joshua Wong, Prof. Ka Hou Chu, Ms. Lindsay Porter, Ms. Marcy Trent Long, Miss. Natalie Chung, Ms. Smriti Safaya, Ms. Suzanne Gendron, Dr. Yannick Kuehl, Dr. Yvonne Sadovy

Our 3 Key Asks:

1) Immediately gazetting of 10% local waters as MPAs;
2) Gazetting 30% of local waters as MPAs by 2030;
3) Increasing the percentage of no-take zones to 20% within all designated MPAs.

These requests have been submitted to the HKSAR government right after we launched.

HKMPA, in order to make our requests feasible and achievable, we have prioritised 3 sites of the suggested Marine Protected Area:

1) Shui Hau (Marine Park);
2) Pak Nai and nearby sites (Coastal Protection Zone);
3) Port Shelter (Fisheries Protection Area)

Shui Hau, a large expanse of sheltered, intertidal sandy-mudflat, which is rare in Hong Kong, it nurtures juvenile horseshoe crabs before they migrate to the sea. It is also an important stopover site for the survival of over 20 species of migratory shorebirds.

Pak Nai, a famous tourist spot with diverse types of coastal habitats and endangered species, is an essential feeding ground for horseshoe crabs, black-faced spoonbills, and other waterbirds. A total of 238 bird species visiting Pak Nai over the years demonstrates high bio-diversity of the site.

Port Shelter, as one of the best dive sites in Hong Kong, is famous for its high diversity of coral and marine fish species. It holds significant recreational and ecological values, providing important habitat for the ecosystem in Hong Kong.