



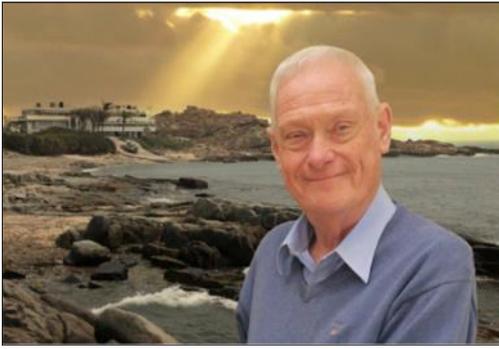
The Swire Institute of Marine Science

太古海洋科學研究所



Annual Report

2021



Professor Brian S Morton, 1942-2021

Prof Brian S Morton

SWIMS founding Director, and the “father of marine conservation in Hong Kong”, Prof Brian S Morton passed away on 28th March 2021. Whilst Brian started his career in the UK working with Richard Purchon and Maurice Yonge, a pedigree which he always appreciated, he moved to Hong Kong in 1970. He quickly established a marine biology programme based in the Zoology Department at HKU. During these early years he co-authored “*The seashore ecology of Hong Kong*” which remains the definitive publication on Hong Kong’s intertidal systems. Brian also initiated a series of international workshops bringing experts to work on Hong Kong’s rich coastal systems which contributed to him founding a new journal, *Asian Marine Biology*.

Whilst Brian was a world expert on bivalves and a gifted illustrator of marine life, he was also a strong advocate for marine conservation, especially for Hong Kong. His passion and contributions in this area brought him international acclaim as well as local support, most notably from the Swire Group. The Swire Group shared Brian’s vision to establish a marine laboratory and in 1990 the Swire Marine Laboratory was opened and rapidly expanded as the Swire Institute of Marine Science in 1994, all supported by Swire Group Charitable Trust. In 1996, Brian achieved another important conservation goal when the area surrounding SWIMS, Cape d’Aguilar, was designated as Hong Kong’s first Marine Reserve. Brian continued to lead SWIMS until his retirement in 2003, although he still returned to maintain links with his students and give guest lectures as an Emeritus Professor at HKU.

Brian’s legacy and influence is not, however, just seen in his work and the “bricks and mortar” of SWIMS but also in the contributions of his students. Brian supervised and inspired literally 1,000s of undergraduate and more than 75 postgraduate students many of whom went on to contribute, on many different stages, to marine science and conservation.

Brian’s life and career were celebrated in a ceremony on 26th June, attended by many, many, SWIMers past and present (see <https://www.scifac.hku.hk/celebration-of-life-prof-brian-morton/>) and his obituary can be viewed at <https://www.scifac.hku.hk/celebration-of-life-prof-brian-morton/obituary>).

I think we shall all remember his infectious passion for marine biology and Brian regaling us with his knowledge and stories over a few beers in HKU’s Senior Common Room bar...

Director's Foreword

Sadly, 2021 proved another incredibly challenging time globally with the COVID-19 pandemic affecting almost every facet of our lives. As in 2020, much of SWIMS activities were curtailed because of the pandemic which further delayed the expansion project. Despite these challenges we were able to officially open SWIMS expansion in July, but ironically were unable to occupy the building until the end of December 2021, and so the information in this report represents work completed whilst we were remote from SWIMS.

Despite these issues SWIMS researchers had another very successful year of publications and especially grants awarded, amounting to more than HK\$20M. This year saw successes in the Fishery Development & Enhancement Fund with funding awarded to JD to develop sea cucumber aquaculture and Rajan to establish an oyster hatchery with support from Lee Kum Kee Co. Ltd. and Deep Bay Oyster Cultivation Association. SWIMS researchers also joined with the Faculty of Education to work on a project “ECO (Environmentally CONscious) Advocates for Hong Kong and the Greater Bay Area” collaborating with Wong Fung Ling College school to explore the integration of field-surveys and VR technology to enhance “deep learning” of environmental issues.

On a global scale, SWIMS researchers were involved in important position papers: Moriaki contributed to the UN Second World Ocean Assessment (WOA II) and JD to the IPCC AR6 Working Group II - Climate Change Impacts, Adaptation & Vulnerability. SWIMS is also an Academic Partner in the UN Decade of the Ocean programme “Coastal-SOS: coastal zones under intensifying human activities and changing climate” led by MEL, Xiamen University. This multi-university cross-sectorial partnership is designed to “conduct and deliver the science we need for the ocean we want” by following the trajectories of six coastal ecosystems in SE Asia and integrating science, governance, and society to formulate new approaches to coastal zone development .

Finally, please enjoy our new promotional videos filmed/edited by Alex Reshikov on our YouTube channel, (<https://www.youtube.com/channel/UCREjrg2LntTDOgo2sLj2isw>) we hope these will encourage researchers and visitors to come and visit us in 2022!

Best wishes,



Gray A Williams



Gray giving a speech at SWIMS opening ceremony



Officiating guests with the unveiled plaque to commemorate SWIMS' expansion

Expansion ceremony

SWIMS HK\$100M expansion, funded by the Swire Group Charitable Trust, HKU and the University Grants Committee was opened on 28th July 2021 by Mr Merlin Swire (Chairman of Swire Pacific Ltd), HKU's President and Vice-Chancellor Prof Xiang Zhang and Dean of the Faculty of Science, Prof Matthew R Evans as well as colleagues and friends.

The event was marked by speeches from Mr Swire who highlighted the vision shared by SWIMS and the Swire Group to create a more sustainable marine environment, and HKU President Zhang who thanked the Swire Group for their continued support in enabling HKU to develop such an important and unique marine facility. Prof Evans and Gray then explained how the newly expanded SWIMS would contribute to marine science in the region and globally.



A replica of the whale skeleton was presented to Mr Merlin Swire by Professor Matthew R Evans

Guests were then toured around the new facilities to meet SWIMS staff and students and finally gathered at the whale skeleton to launch the campaign for its renovation (see below). As ever, we would like to extend our continued thanks to the Swire Trust for its long term support of SWIMS.

Hong Kong's Whale Restoration Campaign

For over twenty years, the skeleton of an infant fin whale has watched over the shores of Cape d'Aguiar on SWIMS rocky footsteps. In September 2018, as super typhoon Mangkhut ravaged the southern coast of Hong Kong, huge waves and 260 km/h winds smashed into the unprotected skeleton, destroying and removing many of the bones. The remaining skeleton has continued to deteriorate and in 2021 plans were made to revitalize the whale skeleton.



The fin whale skeleton in front of SWIMS on the shores of Cape d'Aguiar

In tandem with SWIMS' official re-opening in July, a donation campaign was launched to support the recreation of this iconic symbol of marine conservation. The goal is to replace the decayed skeleton by 3-D printing the bones with durable materials, synthesized to withstand the salt, wind, and scorching sun of the rocky shore. The remnants of the original skeleton will be preserved in the SWIMS biodiversity collection. By the end of 2021 the campaign was well on the way to reach its HK\$120,000 goal and it is hoped that the restoration can be completed in 2022.

Staff Research

Gray A Williams

As with everyone around the globe, COVID hugely disrupted research in 2021. A number of projects were cancelled but we were very lucky to have support from colleagues in Singapore, and Thailand who helped sample for us during this period and maintained projects on thermal acclimation in high shore species. Due to the travel restrictions, our new projects are concentrating on Hong Kong systems. The ECF survey of Hong Kong's rocky shores continues to reveal our rich biodiversity and strong seasonal variations, while we also launched a new RGC project to investigate the impacts of thermal stress on ecosystem engineers, oysters and mussels, affecting rocky shore biodiversity.



Gray showing Secretary for the Environment Mr Wong Kam-Sing SWIMS Museum collection

Bayden Russell

Given the ongoing COVID travel restrictions Bayden's focus this year was expanding subtidal oyster reef restoration to show the increased biodiversity of marine species and benefits for humans through increased ecosystem services (including, but not limited to, water filtration and production of fisheries species). Bayden also managed to continue research investigating the effects of marine heatwaves on key species, particularly focusing on sea urchins with Prof Maria Byrne (University of Sydney), leading to another RGC General Research Fund grant. We also celebrated Rhyn submitting and successfully defending his PhD! Well done Dr Rhyn Cheung!



Bayden preparing oysters for deployment on subtidal oyster reefs in the western waters of Hong Kong

Stefano Cannicci

This year the iMeco Lab celebrated the reopening of SWIMS with continued internationally recognized scientific results and intends to keep achieving such high quality research in the next year. Rebekah and Pedro successfully defended their PhD theses on the anthropogenic impacts affecting Hong Kong mangroves and on the effects of climate change on mangrove fauna. Pedro had his first thesis chapter accepted for publication, while Christine and Matthew published their first papers. Stefano's lab also welcomed a new RA, Kenny, who joined the team working on the ECF project on the impact of macro- and microplastics on HK mangroves.



Stefano and Bayden enjoying the reopening of SWIMS



Research team meeting with AFCD, Lee Kum Kee Ltd and oyster growers (Deep Bay Oyster Association)

V. ThiyagaRajan

This year Rajan's focus was on 1) establishing the "Hong Kong Oyster Hatchery and Innovation Research Unit" as part of the Sustainable Fishery Development Fund, 2) setting up an oyster hatchery, and 3) recruiting Post-Docs to work on seafood chemistry, selective breeding and biomineralization. Despite COVID, his team accomplished all these tasks. With this platform, Rajan's team strengthened their knowledge exchange with oyster growers, successfully completed a multiple-generational ocean acidification experiment in oysters, and found that the Hong Kong oyster species can develop epigenetic mechanisms to cope with OA stress within a few generations.



The Baker-McIlroy Lab during a brief window of relaxed social distancing

David Baker

In 2021 Dave's team welcomed new PhD student Joe Brennan (Florida International University) who will focus his first efforts on testing the limits of bleaching tolerance in Hong Kong's corals. We celebrated many PhDs, congratulations to Taihun Kim, Vicki Sheng, and Jane Wong. Dave had a "sabbatical to nowhere" which focused his efforts on archiREEF, Ltd. an HKU-spinoff start-up led by student Vriko Yu which received funding from the Technology Startup Support Scheme for Universities. At the same time, our CRF-funded MarineGEO project led by Shelby picked up steam, as did the global SED-BIOME project led by Isis.



Moriaki giving a plenary keynote at the 1st Annual Ecology & Biodiversity Research Symposium, HKU

Moriaki Yasuhara

Firstly, warm welcome to Jingwen Zhang, Pedro Jimenez, and He Wang! Jingwen started her MPhil from September whereas Pedro and He started their Post-Docs in August and October. Moriaki's core team is now composed of 1 MPhil (Jingwen), 2 PhDs (KK and Skye), 3 Post-Docs (He, Pedro and Yuanyuan), as well as co-supervised students and interns/volunteers. We miss May who started her Peter Buck Postdoctoral Fellowship at the National Museum of Natural History, Smithsonian Institution. This year Moriaki also contributed to the UN 2nd World Ocean Assessment, and started an editorship for the *Journal of Micropalaeontology*, the flagship journal of the UK Micropalaeontological Society.

Christelle Not

Christelle and her team continued to work on several topics related to climate change and the impacts of humans on the marine environment. Christelle's team particularly works on Arctic paleoclimate reconstruction, proxies development using the geochemistry of ostracods shells, but also on Hong Kong coastal sediment properties and their link with the carbon cycle. Her team also continues its work on plastic monitoring and its degradation under natural environmental conditions. As in previous years, Christelle was actively involved in several local and international outreach events (exhibitions, podcasts etc.) focused around plastic pollution.



Christelle with her 2021 graduated students

JD Gaitán-Espitia

2021 was an exciting year for the the Integrative Biology and Evolutionary Ecology Research group (iBEER). JDs group grew with the arrival of Jaimie Dwi, Greenie Ng (MPhil students) and Natasha Chik (RA) who are part of two funded projects on seagrass restoration and conservation in Hong Kong! We also received two new international members; Marcelo Lagos (Chile) and Natalia Albarrán (Mexico) who joined as Post-Docs working on animal physiology. They will lead the recently funded GRF project that explores physiological adaptations of marine life in tropical extreme environments. Stay tuned for their work and lab updates for 2022!



iBEER lab New Year celebration in Victoria Harbour

Celia Schunter

It has been a very productive year in the Schunter lab, despite many challenges. We all worked together to perform experiments, fieldwork and computational analyses. Several international collaborations were formed or strengthened with grants funded in Macao, Portugal and Spain, as well as several new projects in Hong Kong, including a General Research Fund, an Environmental Conservation Fund, and an Ocean Park Conservation Fund award to work on a variety of aspects related to fish species in Hong Kong waters and fish's acclimation potential to climate change. The first MPhil student graduated from Celia's lab: Congratulations Sandra! We are looking forward to 2022 and all the exciting science it will bring.



Amphiprion clarkii ("Hong Kong Nemo") fieldtrip to get breeding pairs for long-term experiments



Nicole and Howard measuring the elevation of surface samples to interpret sedimentary archives in Mai Po

Nicole Khan

Given COVID restrictions, the Sea-level and Coastal Change Laboratory continued to work in Hong Kong, again, working in the Mai Po wetlands and attending conferences virtually. Nicole's group welcomed a new member, Zhaojia (Francis) Liu, who will be developing environmental DNA methods to understand past ecological and sea-level changes.



Philip's team at a dinner cruise and squid fishing in Victoria Harbour

Philip Li

Philip's team grew with the arrival of one Post-Doc, one PhD student, and two RAs. In 2021, he got two external funds and set up an LC-MS for metabolic analysis. With two postdocs, 7 PGs, and two RAs, his team kicked into full gear for the genomics-guided discovery of marine natural products. His team has established an integrated discovery approach of microbial natural products by the combination of AI-aided genome mining and synthetic biology. Philip's team applied a new correlational networking-based genome mining approach to guide the discovery of unflustered biosynthetic genes and published the results in *Nature Communication*.



The MarineGEO team present their work at the SWIMS expansion opening ceremony

Shelby McIlroy

In 2021 Shelby began to build her research program through HKU and SWIMS based research in collaboration with Dave, short-term Post-Docs Inga and Felix, and co-supervised students Róisín, Alison and Vriko. The CRF-funded MarineGEO project moved forward with the deployment of 91 more ARMS, the translocation of 31 ARMS and sampling of 4 ARMS in an experiment to understand how biodiversity impacts resistance and resilience to environmental stress. Shelby was also awarded a GRF to continue her research on coral symbiosis. In recognition of her expertise, Shelby joined a scientific working group of international coral researchers at the Symbiodiniaceae Diversity Working Group supported by the US National Science Foundation.

Cesar Jung-Harada

Cesar is affiliated with the Department of Architecture, and as a SWIMS researcher he worked with Rajan and Kanmani on the design of a semi-automated floating oyster hatchery. Building on this, Cesar obtained a grant from the Hong Kong Art Centre and the NEAR Foundation to build a floating oyster hatchery that is also a solar to hydrogen production pilot. This renewable energy prototype demonstrated the potential of producing green energy, while benefiting the marine environment. The installation, decorated by the artist Kay Wong, was moved from North Point to Lau Fau Shan and donated to the oyster farming community.



Floating solar to hydrogen plant and underwater oyster hatchery pilot in North Point

Post Doctoral Fellows

Ashley Hemraj

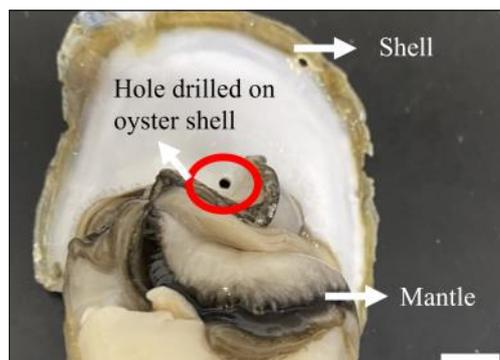
In 2021, Ashley has been assessing methods for subtidal oyster reef restoration in the western waters of Hong Kong, initially setting up large patches of reef made of limestone and monitoring recruitment of oysters and other organisms. He is now DNA barcoding the organisms collected from the reefs. Ashley has also been involved in sampling on an ECF funded project to build a database of the biodiversity associated with oyster reefs. Finally, Ashley has been working on experiments to investigate the physiological responses of copepods to marine heatwaves, following on from his benchmark meta-analysis of the global impact of ocean acidification and warming on copepods.



Ashley preparing for a dive to sample the newly built oyster reefs along the Hong Kong Airport 3rd Runway

Kanmani Rajan

Kanmani completed her PhD and joined as a Post-Doc at SWIMS from December! In June 2021, Kanmani won a Constance Boone award for best student presentation at the American Malacological Society virtual annual meeting. As a Post-Doc Kanmani is continuing her research on oyster biomineralization, particularly, mechanisms of oyster shell repair under ocean acidification using her expertise in Scanning Electron Microscope – Electron Backscatter Diffraction techniques and mechanical property analysis. She is also working on developing an oyster shell inspired biomimetic material for bone tissue engineering applications. For this biomimetic material design, she is excited to collaborate with mechanical engineers from Hong Kong Polytechnic University and medical researchers from HKU Medicine.



Manual shell damage to study oyster shell repair mechanisms. Scale bar: 1 cm.



Sunrise at SWIMS where Kang lives

Jing-Liang Kang

In 2021 Kang finished his analysis on the molecular responses to elevated CO₂ levels across six coral reef fish species from the CO₂ seep in Papua New Guinea and proposed a new hypothesis of why some species may be more sensitive to elevated CO₂ than others. In addition, he has now become an expert in the analysis on long non-coding RNAs, one potential mechanism for gene expression regulation, which may be involved in the response to environmental change. Furthermore, Kang *de novo* assembled a chromosome-scale genome of the cleaner wrasse *Labroides dimidiatus* and annotated this genome which will be a great resource for the coral reef fish research community.



Yuanyuan taking sediment samples at Sai Kung

Yuanyuan Hong

Microfossil Ostracoda are sensitive indicators for anthropogenic impacts, but our knowledge of the autoecology of indicator species remains limited and lacks robust statistical support or comprehensive comparison with environmental data. Yuanyuan studies paleoecology based on ostracods to reveal natural-baseline biological communities before human-induced environmental modification in Hong Kong. She has analysed environmental data and applied linear models to reveal relationships between species distribution and environmental factors, and identified indicator species of environmental parameters. Her next step will focus on establishing an AI deep learning-based automatic identification system for ostracods.



Isis working in the laboratory on DNA extraction

Isis Guibert

This year was a fruitful year! The SED-BIOME project that aims to look at the effect of eutrophication and emergent health risks in coastal marine ecosystems was deployed around the world, and Isis has been leading this work in Hong Kong. In total 30 partners have retrieved their experiments so far and more should do soon. For the giant clam project, the SIA, DNA, RNA and lipids data came back and Isis is now dedicating time to analyze them. Isis is also working for the MarineGEO project for which ARMS were moved around Hong Kong.

Jonathan Cybulski

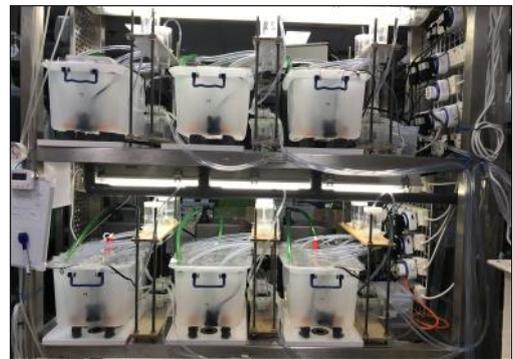
In February 2021, Jonathan successfully defended his PhD thesis on Hong Kong coral assemblages through time. His major findings included: documenting a 40% reduction in habitat for ecologically important *Acropora* corals; the first simultaneous analysis of a corals' synthesis of amino and fatty acids; and the first 6000+ year nitrogen record for the Greater Bay Area. Dr Cybulski then accepted a Postdoctoral Fellowship in HKU Stable Isotope Ratio Mass Spectrometry laboratory, where he worked on methods development for both ecological and medical research and collaborated with numerous SWIMS and HKU students in his continued efforts to promote and support the use of stable isotope analyses in ecology.



Jon prepares for his interview with National Geographic in one of his SciComm outreach pieces

Sarah Lau

While millions of intertidal animals on North America shores were killed by heat waves this year, prolonged hours of extreme heat are not news to tropical intertidal animals. Sarah is studying one of the most thermally tolerant species, *Echinolittorina malaccana*, and investigating how these snails manage to cope with the thermal variability and extremes experienced on tropical shores. Specifically, she has been examining the metabolic performance of this species from various populations across its geographic range to assess whether the spatial variation in metabolic depression patterns (which is believed to be a key energy conservation mechanism that contributes to thermal tolerance) is due to phenotypic plasticity or local adaptation.



A system designed and built by Sarah to acclimate snails to different thermal regimes

Tommy Hui

Using a custom-built wavelogger, Tommy has quantified the spatial variation in wave forces across Hong Kong's rocky shores as part of the project to assess the baseline biodiversity of rocky shores in Hong Kong. These loggers revealed that on-shore wave force was less strong when ocean wave height was lower, but this was mediated by site-specific fetch, where wave height was most prominent in sites with longer fetch. By quantifying on-shore wave forces independently from the biologically-defined exposure scale, Tommy aims to quantify the relationship between species composition and wave exposure to model the processes important for spatio-temporal dynamics of local rocky shore assemblages.



Tommy guiding a BioBlitz in Turtle Cove to introduce rocky shore biodiversity to Hong Kong citizens



Marcelo exploring the intertidal zone at Cape d'Aguilar

Marcelo Lagos

2021 was a challenging year! After finalizing Marcelo's first Post-Doc in Chile, he moved to Hong Kong to work in JD's iBEER Group. His research focuses mainly on the relationship between marine invertebrates and oxygen levels in the environment, studying metabolic scaling, physiologic oxygen thresholds and behavioural responses. During his first year in HKU, he has been involved in a project related to sea cucumber management, ecophysiology of invasive freshwater snails and shrimps and started research into the thermal physiology of intertidal snails.

Research Assistants

Calvin Foo



Calvin introducing specimen collections to secondary students at SWIMS

Calvin has joined SWIMS as a RA in a joint faculty project on environmental sustainability education in 2021. He was involved in developing rocky shore ecology-related learning materials and technologies that will empower teachers and students to be advocates of environmental sustainability. Calvin's work included producing teaching materials for regular ecology lessons, using VR technologies to create an immersive experience for students, and organizing rocky shore field trips to offer hands-on experience. Calvin is also responsible for providing occasional guided tours and workshops at SWIMS for schools that are interested in this research facility and its unique location.



Haze during deployment of SED-BIOME frames and traps in Hong Kong

Haze Chung

Apart from continuing the conservation forensics work that Haze had participated in since her undergraduate study, Haze spent more time assisting two big projects – MarineGEO and SED-BIOME. She extracted hundreds of invertebrate samples collected from Hong Kong waters for MarineGEO, contributing to the documentation of Hong Kong's stunning marine biodiversity. While for the SED-BIOME project Haze mainly participated in the preparation stage, making 50+ boxes of identical experimental equipment that were sent to partners all over the world. With this equipment kit, experimental results will be comparable across locations, and valuable quality-assured information of the biome composition can be obtained.

Iván Loaiza Alamo

Iván is working on the seafood chemistry component of the research-industry and knowledge exchange project in partnership with Lee Kum Kee Ltd. Iván and his team are committed to search for the “supreme” oyster, which will be the most nutritious, tasty and safe oyster to consume from south China and Hong Kong. He is also tackling the oyster “winter mass mortality” problem in south China and Hong Kong, by using this “supreme” oyster with traits for high salinity tolerance and superior meat quality. Initial results reveal that oysters with outstanding concentrations of beneficial compounds (i.e. polyunsaturated fatty acids, essential amino acids) and elements (i.e. Zn, Fe, Cu) can contribute to a healthier diet for humans.



Iván working on the oyster (raft) culture in Lau Fau Shan, Deep Bay

Jay Minuti

This year Jay has been running an ECF project assessing the biodiversity associated with remnant oyster reefs in Hong Kong. As part of this project, Jay was awarded a Smithsonian National Zoological Park Fellowship, where she is working remotely with Dr Qiongyu Huang from the Smithsonian Conservation Biology Institute (SCBI) to analyze remote sensing data from the reefs. Jay has also been focusing on outreach work to share the work of SWIMS and the oyster reef project., running workshops with local schools to teach students skills in identification and specimen sorting, as well as participating in public education displays with Hong Kong Art Centre.



Jay running a workshop with students teaching species ID and specimen sorting

Kam Yan-Chit

Kam graduated from the Ecology & Biodiversity BSc degree and joined Celia’s lab as a Research Assistant last year. She works on various interesting projects in the lab, from evaluating the behavioural and molecular effects of acidification on an aquatic model species, *Danio rerio*, to collecting *Amphiprion clarkii* mating pairs from the field and rearing them in the aquarium for an experiment to look at their symbiotic behaviour with sea anemones. The most remarkable project Kam is involved in is the environmental DNA project to find the endangered grouper species, *Epinephelus akaara*, in different sites of Hong Kong waters across seasons.



Celia, Arthur and Kam on a windy winter day on the way to collect water samples for their eDNA project



Lyle collecting sediment samples

Lyle Vorsatz

This year Lyle and the plastic pollution crew from the Environmental Biogeochemistry and Oceanography lab initiated phase 2 of the project monitoring the distribution of plastics in Hong Kong's mangroves. Phase two specifically looks at the accumulation rates and ecosystem level effects of plastic pollution in mangrove habitats. Lyle also published a paper in *Limnology and Oceanography Letters* postulating that spawning females and embryos of intertidal crabs from warm temperate latitudes are more vulnerable to temperature increases than tropical conspecifics, particularly in water, suggesting that ontogeny-specific aerobic capacity dictates overall species' thermal sensitivity to temperature changes.



Natalia enjoying the view of Hong Kong, after fieldwork

Natalia Albarrán-Melzer

Natalia is from Mexico, and moved to Hong Kong after a stay in Chile to join the iBEER Lab, participating in research projects in JD's group, working with sea cucumbers, determining growth and repeatability of their behaviour. Natalia is also a specialist in freshwater malacology with invasive and autochthonous species, in physiological adaptations to physicochemical changes due to climate change and has also worked on the analysis of hard structures in cephalopods, mainly in octopuses, to determine age and growth through direct readings. In January 2022, she will start working as a Senior Research Assistant at the iBEER Lab.



Phil scuba diving over an ARMS and 3-D printed archiREEF tile

Phil Thompson

Phil assesses the effects of sedimentation, aquaculture, and sewage on marine communities. To do this, Autonomous Reef Monitoring Structures (ARMS) are deployed within a marine community for one year and then sampled to measure biodiversity. Presently, 70 ARMS have been deployed to measure how biodiversity changes 1) within established communities in pristine habitats which are physically transported to stressor sites through a transplantation experiment; and 2) within established communities of variable habitats after being exposed to water quality stressors in a mesocosm experiment. These experiments are a novel way of asking ecological questions on a community-level scale.

Pedro Jimenez

This year, Pedro successfully defended his PhD thesis on thermal physiology shaping the local and geographic distribution of brachyuran crabs. His research showed how local and latitudinal patterns of distribution of intertidal crabs are linked to both environmental temperatures and physiological mechanisms. With the results in his thesis, Pedro argues for the integration of various aspects of organisms' biology to better understand patterns of adaptation and the vulnerability of species to climate change. Pedro is now working as a Research Assistant at SWIMS, studying impacts of human activity on subtidal fauna through time.



Pedro measuring abiotic conditions from Hong Kong waters

Wu Cheuk-ho

In the science community, quality and quantity of data are of great importance. FishBase is an internationally renowned database, highly accessed all over the world. SWIMS became an official consortium member in 2021, due to our efforts in contributing high-quality data to FishBase. As a coordinator in the SWIMS-FishBase/SeaLifeBase collaboration project, Ho has participated in this international collaboration by identifying, organising, compiling and encoding a wide range of data from Hong Kong and China. As of this year, he has integrated nearly all Hong Kong fish occurrence records (~1,200) which can assist global progress in understanding ecosystem dynamics, and support biodiversity conservation and management efforts.



Ho had a great time at the 22nd FishBase Consortium Annual Meeting

Valerie Hickey

The multi-faceted approach to the ECF funded project “A baseline evaluation of Hong Kong’s rocky shore biodiversity” has kept Valerie busy. When not in the field co-ordinating her team’s bi-annual spatio-temporal surveys she can be found in the molecular laboratory extracting DNA and sequencing the diverse array of intertidal species. Promoting the conservation of Hong Kong’s rocky shore biodiversity is further enhanced by the involvement of the local community, where Valerie and her team share their knowledge and passion with university students and NGOs in the ECF’s BioBlitz shore-led workshops. With three seasons of biological, physical, and environmental data collected, analysis has begun on the implications these findings will have for the future of Hong Kong’s rocky shores.



Valerie and the team conducting Tolo Harbour quadrat counts



Steven counting the abundance of mobile species during a rocky shore survey

Steven Wong

As part of the team working on the ECF rocky shore project, Steven has participated in the bi-annual field surveys and complementary laboratory work in measuring various physical and biological parameters of Hong Kong's rocky shores. He has been processing and analysing rock samples for organic matter content and porosity, in order to better understand the physical environment that supports Hong Kong's diverse intertidal species. Steven has also assisted in the delivery of the ECF BioBlitz outreach programme to introduce rocky shore ecology to local students and contribute to large scale biodiversity records in the wider Hong Kong area.



Wilson during field work to retrieve ARMS

Wilson Wan

2021 was a year of uncertainty. Amidst a global pandemic, Wilson managed to support different projects including sea urchin monitoring, 3D artificial reef site maintenance, and the MarineGEO field work. To achieve this, Wilson kept building up different skillsets for marine research and will start a new journey as a PhD student at SWIMS in the new academic year. He will focus his work to 1) devise different methodologies to better quantify coastal marine biodiversity, 2) better understand how human activities influence biodiversity, and 3) provide insights to guide future conservation efforts.

Postgraduate Research

Learning the effectiveness of immersive virtual reality in environmental education

Angela Lui's research focuses on investigating the learning effectiveness of the application of immersive virtual reality (IVR) in environmental education. She is particularly interested in investigating whether IVR could help students comprehend the abstract climate system and encourage them to take pro-environmental actions. She is also interested in exploring how the combination of fieldwork and virtual reality experiences can enhance youngsters' environmental literacy and foster their advocacy.



Angela on a field trip with secondary school students

Decoding molecular pathways and the evolution of molluscan shell biomineralization

Alessia Carini has been finalizing a reproducible method for preparing microscopic biominerals prior to organic matrix analyses. Using Hong Kong oyster larvae, Alessia optimized the protocol for shell proteomics by combining different electron microscopy techniques. She also described the proteome of oyster larval shells secreted under ambient and adverse carbonate chemistry conditions. Hong Kong oyster larvae in low pH can secrete 60% of control level protein diversity, including all major shell protein domains. Alessia also developed the last chapter of her PhD to investigate the evolution of shell formation across the Bivalvia highlighting Hong Kong species.



Bivalve shells collected on Lantan Island for investigation of the evolution of biomineralization

Using isotopes to study carbon and nitrogen pathways of a coral holobiont

Through shared metabolic pathways between corals and their endosymbiotic algae, coral holobionts can utilize a variety of nutrient sources: dissolved inorganic nitrogen and carbon are acquired autotrophically by algal symbionts, coral hosts augment their nutrient budgets through planktivory, and both partners have access to dissolved organic material. From a feeding experiment using isotopically-enriched nutrient sources, Alison Corley studied the flow of nitrogen and carbon in *Acropora* corals. She found dissolved organic and inorganic nutrients to be the primary source of carbon and nitrogen to the holobiont, with heterotrophic feeding accounting for a much smaller proportion of the nutrient budget.



Alison attending a virtual conference from the comfort of the lab

Tales of a high shore limpet living in a seasonally extreme environment

On Hong Kong shores, intertidal organisms experience two distinct extreme environments in winter and summer. In winter, primary productivity is high and physical stresses are low; whilst in summer organisms are subject to extreme heat and desiccation stress, especially on the high shore where food availability is reduced. Preliminary results from Adrian Wong's project show that the high shore limpet, *Lottia dorsuosa*, only move to feed in winter but appear to be inactive, hiding in shaded areas for the whole summer. Adrian is currently using stable isotope analysis and calorimetric techniques to investigate whether this limpet adopts a seasonal energy acquisition/allocation strategy to cope with these seasonally extreme and distinct environments.



Adrian measuring the shell length of limpets at Cape d'Aguilar



A drone photo taken at the field site to quantify sea cucumbers populations

Large scale ecological surveys of sea cucumbers in Hong Kong using remote sensing

Cheryl Chu is studying the role of sea cucumbers in nutrient cycling, using *Holothuria leucospilota* as a model species. To quantify their population demographics, Cheryl is currently developing a new survey method to efficiently map *H. leucospilota* populations. Compared to traditional transect sampling, the use of remote sensing (e.g. drones) in surveys can substantially increase spatial coverage within a much shorter period, while *H. leucospilota* captured in the images can be successfully recognized with deep learning. The resulting understanding of their populations in Hong Kong has allowed Cheryl to calculate overall nutrient turnover rates of sea cucumbers in the region.



Coco with her plastic samples at Ap Lei Chau pier

Plastic degradation in natural environments

Coco Cheung continued her MPhil studying the *in situ* degradation of different plastic polymers in natural environments. Plastic degradation was characterized by physical and chemical changes. Using FT-IR and contact angle analyses, Coco identified short term oxidation in conventional plastics within 40 days of exposure to marine conditions and results showed faster plastic degradation rates in the summer. Coco's findings have raised an alarm of potential micro- or nano-plastic production from conventional plastics firstly within a short time span, and secondly with a higher risk in summer. Further research will be done to understand degradation of "green" plastics in comparison to conventional plastics.



Chasmagnathus convexus inhabiting mangrove-associate forests

Ecology of terrestrial crabs

Little is known about the crabs of marine origin living in terrestrial environments. Christine Cheng studies the ecology of native terrestrial crabs, focusing on their diet and behaviour. Her results show that terrestrial crabs mainly feed on plant materials, while soil organic matter also makes up part of their diet. To understand the crabs energetics, the roles of symbiotic microorganisms in their nutrition is now being examined. With the help of her labmates, Christine is also conducting monthly surveys to investigate the life history of the forest dwelling crabs.

Molecular mechanisms underlying cleaning behaviour in coral reef fishes

Daniele Romeo joined SWIMS as a PhD student in 2021, coming originally from Italy. He is excited to start his thesis on the molecular mechanisms responsible for mutualistic relationships. Mutualism is an interaction between species that is beneficial to both. In the underwater world, one important mutualistic interaction is between the “cleaner wrasse” *Labroides dimidiatus* and different species of “client” fishes. This small coral reef fish eats parasites and dead tissues off other fishes, gaining a trophic resource and keeping its clients body healthy and clean. Daniele hopes to tell more about this relationship next year.



*Daniele feeding *Amphiprion clarkii* in the laboratory*

Trophic plasticity of subtropical corals in response to seasonal fluxes

Corals acquire nutrients through both autotrophic and heterotrophic pathways, and a coral’s trophic strategy may be a key factor for determining its resilience to stressors or disturbances. Using an extensive coral stable isotope dataset, Emily Chei examined trophic strategy shifts of seven coral genera between Hong Kong’s wet and dry seasons. She found that the magnitude of trophic plasticity varied greatly between genera and most were more heterotrophic during the dry season and likely to tolerate low light levels and cold temperatures. Emily is planning a transplantation experiment to further study coral trophic plasticity in differing water quality conditions.



Emily diving to collect coral samples at Bluff Island

Understanding oyster winter mortality in Deep Bay

Winter mortality syndrome in oysters has severely impacted oyster aquaculture in Hong Kong and southern China, with 40% to even 100% loss in harvest during Chinese New Year. The unpredicted mass mortality during winter is being investigated by David Lee. Traditionally growers can only combat this threat by harvesting early or moving the oysters to low salinity areas, both of which lead to economic loss. By studying and understanding the cause behind this mortality event, David plans to help oyster growers develop strategies to reduce harvest loss in the short term and develop a selective breeding program in the long run. The success of David’s project will contribute to revive the declining oyster aquaculture industry in Hong Kong.



Interaction of antimicrobial resistance among aquaculture, the environment and humans!



*Fazil and David meeting
Lau Fau Shan local oyster growers*

The pathobiome in Hong Kong oysters

The importance of the microbiome to the health and growth of oysters has received increasing attention from the scientific community. The microbial flora of oysters is linked to disease resistance, seasonal mortalities and even nutritional and taste aspects. Investigating the oyster pathobiome can, therefore, improve the commercial value of oyster aquaculture. Fasil Mohamed Madhar is investigating the linkage of the Hong Kong oyster microbiome to meat quality, food safety and disease tolerance, thereby utilising the knowledge towards the “one health” approach to contribute to making oyster aquaculture in Hong Kong sustainable.



Henry deploying a sampler to collect seawater samples

Microbial responses to ocean deoxygenation

Henry Cheung is particularly interested in marine microbial biogeochemistry. His current research focuses on microbial respiration under low oxygen concentrations, aiming to reveal the capabilities of microorganisms to respire and thrive in modern anoxic marine systems. More precisely, Henry has investigated the respiratory kinetics of key bacteria and a microbial eukaryote to get insights into the mechanisms of respiration under low-oxygen conditions. He also documented seasonal changes in local coastal community respiration. His findings will help predict and manage local and regional ocean oxygen loss, which can be extended to forecasting global ocean deoxygenation.



*Hamsun collecting plastic samples in
Aberdeen Harbour*

The plastisphere: microbial community composition and metabolic potential

Hamsun Chan has been studying the bacterial community on plastic surfaces (the plastisphere) in the marine environment, as well as their potential functions. He discovered the plastisphere of polystyrene has the highest biodiversity, followed by other polyolefins such as polyethylene and polypropylene. Members of the plastisphere includes *Alcanivorax*, a hydrocarbon degrader and *Vibrio*, a group of pathogenic bacteria. Apart from different types of plastic, the location of the sample was also an important factor affecting the plastisphere composition. Next, Hamsun will investigate the temporal change of the plastisphere.

Coastal stratigraphy and late Holocene sea-level change of Hong Kong

This year Howard Yu conducted field work on the stratigraphy of sediments in the northwest New Territories to reconstruct coastal evolution and sea-level change in Hong Kong during the late Holocene. He also collected surface sediment samples in inner Deep Bay for micropaleontological analysis, which will provide essential clues for his sea-level reconstruction. Howard presented the preliminary results of his South China Holocene sea-level database at the Oceania Geosciences Society conference. His work will help decipher the mechanism driving sea-level change along the South China Coast, which has been spatially and temporally variable since the Last Glacial Maximum.



Howard and his teammates collecting sediment samples in Mai Po wetlands

What processes drive patterns of species assemblages on Hong Kong's rocky shores?

Species assemblages on rocky shores in Hong Kong show great spatial and temporal variation because of the high complexity of the coastline, the seawater salinity gradient from western to eastern seawaters, and seasonal differences. To identify the key processes that shape such variation in species assemblages, Jackson Lau and colleagues have been surveying rocky shore biodiversity on 24 shores in Hong Kong for over one year to test which environmental processes are important to explain the observed spatial variation. Jackson is also monitoring species assemblages on three shores to study temporal changes to test, using empirical dynamic modelling, the casual relationships between species densities and environmental variables.



Jackson taking photoquadrats during his monthly surveys

Global environmental changes, behaviour and gene expression

This year, Jade Sourisse designed and conducted several experiments to investigate the effects of global environmental changes (rising temperature and ocean acidification) on the behaviour and molecular state of aquatic organisms at the nervous system level. She exposed sea hares to elevated CO₂ levels and zebrafish larvae to elevated temperatures. Behaviour was recorded and tissue samples collected and are currently being analysed. Jade also defended her PhD proposal and attended the first Ecology and Biodiversity Symposium at HKU, in which she won the People's Choice Award for "best lightning talk".



Jade dissecting a seabare while her labmate, Arthur prepares cameras to record their behaviour



James and team outplanting hatchery-bred spat of Hong Kong oysters in Zhanjiang, China

Transgenerational plasticity provides insights into sustaining oyster aquaculture under future conditions

James Lim found that it is the low pH conditioning of the broodstock and not of the larval offspring that improves the survival and growth of the Hong Kong oyster at estuarine farm sites. He found that epigenetic mechanisms can explain the improved traits. A distinct gene regulation profile and selective methylated catalytic genes were found only in parental-exposed and not larval-exposed oysters and mediate the positive carry-over traits. James hopes that these methylated genes can be utilized as a reference to explore experience-dependent plasticity in other aquaculture shellfishes in the near future.



iBEER lab celebrating Christmas

Are phytoplankton depressed? Physiological responses of diatoms to pharmaceutical pollution

Pharmaceutical pollutants are a major threat to marine organisms but empirical studies have focused mainly on how they affect the behaviour of marine animals. Pharmaceutical pollution can, however, alter many physiological and cellular processes in microbial organisms such as marine phytoplankton. Zhenzhen Li has explored the phenotypic effects of Fluoxetine (a type of antidepressant) on marine diatoms. His results revealed that Fluoxetine inhibits growth, pigment production and thermal plasticity of two model diatom species. Currently, Zhenzhen is conducting transcriptomic analyses to understand the mechanisms underpinning such phenotypic responses and the potential regulatory capacity of marine primary producers.



Katie sampling seawater at the coast of Tung Lung Chau

Ecological risk assessment of retinoic acids

Katie Yeung continued her PhD study on assessing ecological risks of retinoic acids (RAs) in coastal marine environments of Hong Kong. Although she discovered no immediate risks of RAs under normal circumstances and during algal blooms, concentrations of RAs in local seawater were much higher during blooms. Katie tested whether RAs would be naturally degraded in marine environments and found that the concentration of all-*trans*-RA would decrease by 75% in filtered artificial seawater after 24 hours, while a greater degradation was observed in natural and unfiltered seawater.

Winter causes increased lipid peroxidation in sea urchins

Homeoviscous adaptation is when cells regulate lipid membrane composition to maintain fluidity and function with changing temperatures. As temperatures decrease lipids desaturate to maintain fluidity. Increased lipid saturation, however, will lead to increased lipid peroxidation. Jake Dytnerki found that the sea urchin, *Diadema setosum*, decreases lipid saturation in winter, despite cold temperatures and increasingly viscous membranes, possibly because they already suffer increased lipid peroxidation. Membrane composition may, therefore, be a trade-off between function and cell survival as oxidative stress can lead to cell apoptosis.



Jake ecstatic after completing a winter of hard field surveys

Holocene sea-level change in Western Australia

Western Australia sea levels have been a subject of early global investigations during the Holocene and several questions remain regarding the uncertain nature of relative sea level (RSL). To improve constraints on RSL historical behaviour, Kayla Murai's research focuses on standardizing dated coastal archives from the literature and integrating the data with statistical and geophysical models to understand the driving mechanisms of sea-level change across the Western Australia coastline. Kayla's work involves aggregating and synthesizing existing data and developing new and precise Holocene sea-level reconstructions for southwestern Western Australian coastlines using microfossils (foraminifera, ostracods, and diatoms).



Kayla during sediment core collection and preliminary scouting in Lamma Island

The effects of marine heatwaves on the microbiome of a rocky shore crab

Ocean warming and marine heatwaves pose a major threat to ecosystems and the species that contribute to their function. Kevin Geoghegan used an experimental tidal system to investigate the effects of predicted future thermal stress on the physiology, microbiome and feeding behaviour of the predatory rocky shore crab, *Eriphia ferox*. Kevin found distinct bacterial communities in the crabs' foregut, hindgut and gills. Contrary to expectations, predicted future temperatures and concomitant heatwaves did not impact the bacterial biodiversity found in the crabs. There were, however, some changes to individual taxa which have functions related to disease and digestion.



*Kevin holding his model species, the rocky shore predator *Eriphia ferox**



Khan collecting oysters from a mudflat

Ecosystem functioning in oyster reefs

Oyster reefs are one of the most productive coastal habitats in estuarine areas in terms of biofiltration, habitat and food provisioning. Khan Cheung's research aims at gaining a mechanistic understanding of the constituents of a healthy and functioning oyster reef and seeks to derive a set of best management practices to guide future oyster reef restoration programs. Khan has found that oysters promote microbial diversity in the sediment which may enhance nutrient processing capacity. In the coming year, he will determine if the quality of oyster reefs correlates with their capacity to modify the sediment microbiome.



Chiu gave a talk to the local community about the new artificial shoreline enhancement in Tsuen Wan

Can eco-engineered features enhance the ecology of artificial shorelines?

Coastal development often causes natural habitat destruction and shoreline hardening. However, replacement artificial structures, such as seawalls and breakwaters, usually have low habitat complexity, which reduces coastal biodiversity and disrupts the associated ecosystem functions. Chi Chiu Lo has been studying the feasibility of ecological enhancement of vertical and sloping seawalls, by retrofitting different types of eco-engineered features such as oyster baskets and precast concrete structure (e.g. tidal pools and panels) to the artificial shorelines. Two years after installation, the eco-engineered features demonstrate more diverse communities, especially the oyster baskets in the low intertidal zone which tripled the species richness as compared to control boulders.



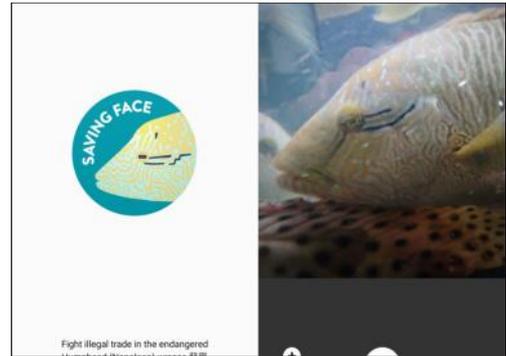
Laetitia sampling sediments in an anaerobic chamber

Carbon cycle in mangrove ecosystems and the related biogeochemical processes

In the last year, Laetitia Allais conducted a final campaign of fieldwork and worked on sample analysis. She analysed carbon, nitrogen, sulfur content and stable isotope signature as well as grain size and sediment mineralogy. She also ran microbial respiration experiments and prepared samples for identifying the sediment microbial community. In the future Laetitia will analyse the heavy metal concentration in her sediment samples. This year, she participated in the IMBeR West Pacific Symposium 2021 "Changing West Pacific Ocean: Science and Sustainability" where she presented her geochemical data.

Application of humphead wrasse facial recognition to combat illegal trade in Hong Kong

The Humphead wrasse, *Cheilinus undulatus*, is a reef fish that is popular in luxury seafood markets in Hong Kong and mainland China. Hong Kong is the trading hub of this huge, long-lived but threatened and CITES-protected species. Loby Hau has been collaborating with mobile application developers, Corvidae and Clear Robotics Ltd., to develop artificial intelligent models for facial recognition of fish individuals and a tailor-made mobile application to assist enforcement by local government officials against illegal trade and to support research in this species. The application is currently in the final testing stage and released in mid-2021.



Sample interface of the mobile application, Saving Face, to record and recognize humphead wrasse

Biogeochemical cycles in mangrove sediments

Maximiliano Rodriguez is investigating sulfur and iron biogeochemical cycles in mangrove sediments. Iron and sulfur reduction take place during organic matter degradation, influencing carbon storage. Maximiliano has performed Fe speciation of sediments collected from several Hong Kong mangroves and quantified the Fe present in different fractions of the sediment such as carbonates, oxides and silicates. His preliminary results indicate the availability of enough Fe in oxides to prevent the accumulation of high concentrations of H_2S , which is toxic for most organisms. Future extractions on sulfur will complement this information, giving further insight on redox processes in mangrove sediments.



Maximiliano collecting sediment samples from mangroves

Phylogeography and adaptative evolution of seaweeds in changing oceans

Interactions between historic and current environmental factors influence present-day patterns of genetic diversity and distribution. The repeated transgression and regression of coastlines along the West Pacific in the Quaternary have, for example, shaped biogeographic patterns. By integrating genetic and functional approaches, Kaile Zhong will explore the mechanisms underpinning temporal and spatial patterns of biological diversity of seaweeds in this region. Considering the regional clines in environmental conditions such as temperature, Kaile will assess whether these geographic gradients have influenced the phenotypic and genetic diversity of seaweeds, and their capacity to tolerate environmental stress, providing important insights for conservation.



Kaile is busy in the molecular lab



Mériadec at Sai Kung East Country Park

Variations in the strength of the Atlantic Meridional Overturning Circulation during the Holocene

During this first year of his PhD, Mériadec Le Pabic developed his understanding of the Atlantic Meridional Overturning Circulation (AMOC) and its variations through the Holocene. The AMOC plays a main role in the climate system and any disturbance of its strength induces significant impacts. Mériadec works on a sediment core from the Iceland Basin in the North Atlantic Ocean and is using the changes in the geochemistry of benthic and planktonic foraminifera shells to reconstruct the intensity of the AMOC.



*One of the air breathing crabs in Hong Kong,
Mictyris brevidactylus*

Contrasting respiratory responses define different thermal niches in semi terrestrial crabs

Ka Hei Ng is interested in terrestrialization events and uses Hong Kong crab species as study model. Among all aspects of adaptations, changes in respiratory system largely determines the species' dependency on the aquatic medium and hence, primarily affects the degree of terrestriality. Comparative physiological analysis revealed the respiratory adaptations of semi terrestrial crabs was tightly associated with their thermal performances. A widened thermal window in air was reported in the Ocypodid crabs but not in the Sesarmids. This coincides with field temperature data, showing a widened thermal window which may enable the Ocypodids to inhabit hotter microhabitats.



Oliver attending the congregation class of 2021

Sedimentary Th-230 and Pa-231 records of paleoenvironmental changes in the Arctic Ocean

In 2021, Oliver Xu successfully defended and submitted his PhD thesis (both onsite and via zoom). His research systematically presented sedimentary records of ^{230}Th and ^{231}Pa from across the Arctic Ocean and their implications for paleoceanographic reconstruction in the Arctic Ocean. One of Oliver's major discoveries was that there is a deficit of ^{230}Th in sediments from the western Arctic and this was published in *Paleoceanography and Paleoclimatology*. Oliver has since left SWIMS and started a Scientific Officer position at the University Research Facility in Chemical and Environmental Analysis (UCEA), the Hong Kong Polytechnic University.

Physiological responses and ecosystem functions of *Sargassum* forests under local and global changes

Macroalgal forests are important habitat formers and carbon fixers in coastal ecosystems. Rhyn Cheung surveyed the coasts in eastern Hong Kong using SCUBA and aerial drone transects to quantify algal populations. Rhyn showed that *Sargassum hemiphyllum*, which grows during winter, can cover up to 7,000 m² and produce 25,000 kg of biomass in a single cove but increasing ocean temperatures may shorten growth. Rhyn also experimentally showed that ocean acidification will cause increased microbial decomposition of algal detritus and, therefore, the role of macroalgal forests as carbon sinks in the future ocean may be reduced.



Rhyn getting ready for algal biomass surveys using SCUBA

Competition in the coral microbiome: exploring the role of nutrients in symbiont genetic diversity

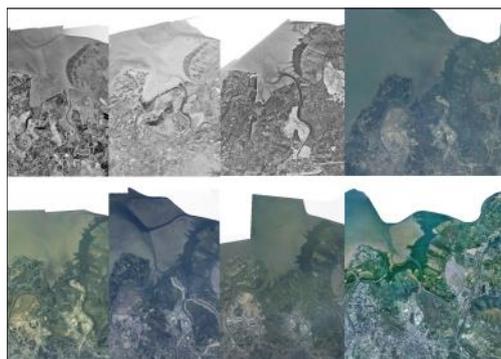
Coral reefs are considered to be some of the most biodiverse habitats on the planet, but are currently under threat from global climate change. The resilience of reef-building corals has been linked to their symbiotic associations with the dinoflagellate family Symbiodinaceae, a hopeful avenue for coral conservation. Róisín Hayden has successfully inoculated bleached corals with mixed communities of target Symbiodinaceae species, and will use stable isotope analysis to investigate how these communities function within the coral microbiome. Her research aims to further understand coral microbial ecology and its contribution to overall resilience and health of the coral.



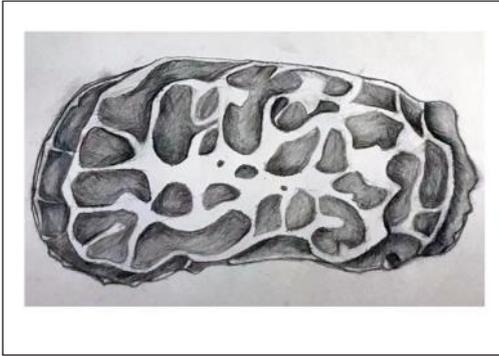
*Róisín uses *Galaxea fascicularis* to study symbiosis in reef-building corals*

Fishponds as biodiversity hotspots: implications for management and restoration of wetlands

Simon Tse's PhD thesis focuses on developing a comprehensive functional analysis of fishponds under different management strategies to provide essential tools and information for planning and decision-making processes of wetland conservation in Hong Kong. He recently utilized historical aerial photos of North-western Hong Kong (from 1924-2020) to access and visualize the environmental changes throughout the years. With this data, Simon can analyze the different pressures resulting from land reclamation, infrastructural development, urbanization and habitat fragmentation which have been brought to this type of habitat over the past century.



Historical images of fishponds and their surrounding changes throughout the past years



Sketch of species in the genus Callistocythere from Java, Indonesia

Cenozoic history of the Indo-Australian Archipelago hotspot

The richness and location of biodiversity hotspots have migrated across the globe throughout the Cenozoic era. Today, the Indo-Australian Archipelago (IAA) hotspot has the highest number of species and endemism for most shallow-marine taxa. The origin of this hotspot can be traced to the early Miocene, however, we lack a comprehensive reconstruction of its developmental history. To address this Skye Tian has built a IAA microfossil dataset to increase our understanding of the evolutionary and ecological factors that may together structure biodiversity in the past, present and anticipated future.



Amphiprion clarkii breeding pairs in south Ninepin Island, Hong Kong

Molecular responses of fish to acidifying oceans

Ocean acidification (OA) has adverse effects on fish behaviour and physiology. Sneha Suresh's PhD focuses on understanding the molecular basis of behavioural changes and is investigating the molecular processes enabling gobies to live in naturally acidified waters. Several ion transporters and circadian rhythm genes were found to be differentially expressed in fish from CO₂ seeps compared to nearby control sites. Parental care is one important behaviour affected by environmental factors including OA and Sneha is now testing the molecular pathways involved in parental care and impacts of OA in *Amphiprion clarkii*.



Yifei presenting HKRISE to VC Prof Xiang Zhang and Mr. Merlin Swire

Modelling the effects of thermal stress on intertidal mussels

During 2021, Yifei Gu co-authored the WebGIS "HKRISE" (<https://hkriase.vercel.app>) with a MSc intern student Yvonne Li and showcased this site during SWIMS expansion opening ceremony. This year he was enrolled as the first joint PhD student between SWIMS, HKU, and the Marine Science Center, Northeastern University, USA, where he will be jointly supervised by Gray and Dr Jin Wu, and in Boston by Prof Brian Helmuth and Prof Mark Patterson. For his PhD Yifei will be using computer vision and remote sensing to model the patch formation process and changes in distribution patterns of intertidal mussels under thermal stress at multiple spatial scales in both Hong Kong and Boston.

archiREEF: enhancing coral restoration using 3D-printing technology

Artificial reefs are being widely used to enhance topographic rugosity to rehabilitate degraded marine ecosystems, and are a successful tool for ecological restoration. Recent developments in 3D printing technology allows scientists to engineer structures customized for the environmental challenges of specific locations. Vriko Yu's research team, in collaboration with the School of Architecture, have developed an algorithm-based "reef tile" 3D-printed in terracotta. Vriko is currently evaluating the ecological performance of these tiles using visual surveys of indicator species of fish and invertebrates as well as quantifying biodiversity using eDNA metagenomics.



Vriko featured on CNN's Inventing Tomorrow showcasing the 3-D printed restoration tiles

Pearl oyster culture

WT Yan found that it is feasible and profitable to use idle fish rafts in mariculture zones for pearl oyster culture. Yan has recommended the government to support the pearl oyster culture business because of its positive externalities, such as its ecosystem services and potential benefits to other industries. Based on the results of his study, Yan suggested that the government should encourage fish raft owners, especially those in Sai Kung north, to explore the business opportunities of pearl oyster culture. He further recommended that the government should train locals to learn grafting and promote local pearl and pearl powder products.



Yan giving a talk to students on pearl oyster culture

Edible oysters' immunological responses to ocean acidification

Ocean acidification (OA) is well known to reduce calcification rates in marine species including several edible oyster species. However, oysters' immunological and gut microbial responses to OA are yet to be explored, especially when they are exposed to multiple stressors. Xin Dang has utilized two edible oyster species to study the host-microbiota-environment interaction. After exposure to OA, survival decreased and hemocyte apoptosis increased in the coastal oyster (*Crassostrea angulata*) but not significantly in the estuarine species (*C. hongkongensis*). Phagocytosis of hemocytes was not affected by OA but *in vitro* bacterial clearance capability decreased in both species. Oyster immunological responses to OA are, therefore, highly species-specific, emphasizing the importance of host-microbiota interactions in OA studies.



Xin is harvesting wild oysters in Zhanjiang, China



Yang is processing shell samples in the Zhanjiang hatchery

Transgenerational effects of ocean acidification in the Portuguese oyster

Ocean acidification (OA) alters the biomineralization process in several shellfish species including edible oysters and this effect is more severe in the mechanically weaker shell forming Portuguese oyster. Yang Li is probing into the regulation of shell microstructure, shell matrix proteins and related functions in the Portuguese oyster under OA. Especially, he is studying transgenerational effects of OA on physiological and molecular responses, which will provide novel insights into biomineralization processes and the adaptive molecular mechanism of oysters under OA.



Hester is checking the "sick" sea cucumbers

Tempo and mode in host-microbiome interactions during marine disease outbreaks

Hester He is exploring questions about the interactions between host and host-symbiotic microbes in marine disease. Her project is tracing the changes in the skin microbiome of the sea cucumber (*Holothuria scabra*) under the epidemiology of a skin ulceration disease (SKUD) to help sea cucumber conservation and reduce the prevalence of SKUD in aquaculture. Hester will study the mechanisms underpinning the microbial influence on the host's susceptibility and tolerances to outbreaks, and the interplay of these threats with climate change.



Mandy, Kenny and Lyle sampling in Ha Pak Nai mangrove

Fate of plastic in mangrove forests: from big to small

In the second year of her MPhil study, Mandy So continued her research focusing on microplastic pollution in mangrove forests by quantifying the microplastic abundance and distribution in sediments and macrofauna across mangrove forests in Hong Kong. Through laboratory experiments, Mandy found mangrove crabs may play a role in microplastic formation via interactions with the offered plastics. Further studies will be conducted to acquire a better understanding of plastic fragmentation mechanisms associated with mangrove macrofauna.

Mercy release impact assessment

Building connections and sample collections summarized Arthur Chung's 2021. Arthur is analyzing the gut content of hybrid groupers and other local groupers obtaining grouper specimens either by spearfishing himself, or collecting/purchasing them from local fishermen. The connections with local fishermen/spearfishermen are particularly valuable as they have first-hand experience of the impacts of mercy release, and the extent of hybrid groupers in the wild. Arthur also invested into building connections with international collaborators to answer broader questions regarding population connectivity and evolutionary history of groupers in the region.



Arthur taking a big step towards sample collection

Unravelling the drivers that shape eco-evolutionary processes of life in a changing ocean

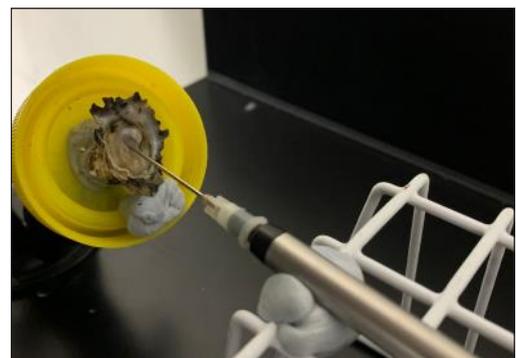
Bovern Arromrak is an evolutionary biologist working with diverse systems with different biological complexity spanning unicellular bacteria to multicellular metazoans. He is interested in understanding the main factors that modulate ecological and evolutionary processes of life in changing environments. For instance, when microbial organisms are challenged by novel environmental conditions there is a general decline in fitness that characterises the response to selection. Bovern's research shows that this fitness effect is conditioned by the genetic background, specifically the genome size, a factor that also influences the rate of adaptation.



Bovern relaxing after fieldwork

Withstanding the stress: behavioural and physiological strategies to survive emersion of intertidal bivalves

The relative abundance of organisms is strongly affected by environmental fluctuations and determined by how well they are adapted to these stresses. Benjamin Chiu is investigating the adaptations of the rock oyster, *Saccostrea cucullata*, which dominates sheltered rocky shores around the Indo-Pacific. Measurement of the oysters' thermal tolerance revealed that it is lower than the maximum environmental temperatures, but physiological assays showed small fluctuations across the hot and dry emersion period. Ben's findings suggest the oyster must be employing other strategies such as variation in behavioural patterns and active cell volume regulation to survive summer stress, and these will be the focus of his work for the next year.



*Measuring oxygen concentrations from the blood of the oyster, *Saccostrea cucullata**



Alex Reshikov filming Adrian for one of the SWIMS promotional videos

Research Opportunities

The Laurence Caplin Scholarship in Marine Biology

Established in memory of Laurence Caplin by his widow, Mrs E Caplin and daughter, Mrs J Woodford, to bring young people to SWIMS to undertake research in marine biology with a resident staff member.

The Intertidal Trust Fund

Established in 1982 with profits from the book “The Seashore Ecology of Hong Kong”, grants from the Intertidal Trust Fund can be made to overseas students and scientists who wish to undertake research on intertidal ecology at SWIMS.

Cape d'Aguilar Trust Fund

Established in 1995 with profits from the book “An Introduction to the Cape d'Aguilar Marine Reserve, Hong Kong”, grants from the Cape d'Aguilar Trust Fund can be made to local or overseas students and scientists who wish to undertake marine biological research on the Cape d'Aguilar Marine Reserve at SWIMS.

Higher Degrees (M.Phil / Ph.D)

Students who are interested in undertaking a research postgraduate degree (M.Phil or Ph.D) in marine biology and ecology should directly contact SWIMS academic staff for more information regarding individual projects.



View of Kau Pei Chau island from SWIMS slipway

Student Research Assistantships/Internships

Undergraduate students holding a permanent Hong Kong identity card are encouraged to apply to work as volunteer student research assistants during the semester breaks/summer holidays. Undergraduate students from both local and overseas institutions who are enrolled in a degree programme, which requires the completion of an internship, may also contact us to discuss how we can facilitate that requirement. Interested students should contact SWIMS Secretary, Ms Sylvia Yiu.

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Other Contributions from SWIMS

Bayden Russell

Editor, *Oceanography and Marine Biology: An Annual Review*
 Academic Editor, *PLoS ONE*
 Associate Editor, *Frontiers in Marine Science*;
 Funding Review College Member, British Ecological Society
 Funding Reviewer, Ocean Park Conservation Foundation
 Chair, Scientific Research Sub-Committee, Hong Kong Marine Ecological Association
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Christelle Not

Scientific Advisor, “We love the Sea” campaign and exhibition, Agnès b., Hong Kong

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 Chairman, MarineGEO Partnerships Committee
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Deep Ocean Stewardship Initiative (DOSI), Climate Change Co-lead Scientific Committee Member, bioDISCOVERY, Future Earth
Member, Global Ocean Oxygen Network (GO2NE), IOC-UNESCO
Member, State Key Laboratory of Marine Pollution (SKLMP)
Editorial Board Member, *Global and Planetary Change*, *Marine Micropaleontology*, *Open Quaternary*
Associate Editor, *Journal of Paleontology*, *Palaeoworld*, *Marine Biodiversity*, *Paleontological Research*
Editor, *Plankton and Benthos Research*, *Journal of Micropalaeontology*
Member, PAGES Q-MARE
Member, Annual Meeting Panel, Conservation Paleobiology Network
Advisory Board Member, NSF-funded project: FossilSketch: Developing a Digital Sketching Application That Delivers Personalized Feedback to Improve Student Learning and Engagement in Micropaleontology. NSF EHR DUE: IUSE 1937827
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Shelby McIlroy

Associate Editor, *Proceedings of the Royal Society of London, Biological Sciences*
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Stefano Cannicci

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Fellow, Royal Institute of Navigation
Member, Mai Po Management Committee, HKSAR
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Academic Editor, *PLoS ONE*
Editor (Review), *Aquatic Biology*, *Inter-Research Journal*
Editorial Board Member, *Global Change Biology*
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Council Member: Hong Kong Proteomics Society
Founder and Chairman of a symposium series: Interdisciplinary Symposium on Ocean Acidification and Climate Change (ISOACC)

Marcelo Lagos

Editor, *Gayana*

Conferences and Workshops

Bayden Russell

Invited Lecture; The Magic of Oysters and How They Help Humans, Faculty of Science Public Lecture Series, 21 Apr 2021, The University of Hong Kong, Hong Kong.
Online TV Series; RTHK Hong Kong Ecologists Series: *Oyster Reefs* Oct 2021 (Online).

Celia Schunter

Keynote Lecture; The 13th UCAS Postgraduate Symposium, 18-22 Apr 2021 (Online) Xiamen, China.
Invited Talk; 2021 Chinese Mainland and Hong Kong Joint Symposium on Ecology and Biodiversity, 6 Aug 2021 (Online).
Keynote Lecture; Ecology and Biodiversity Research Symposium, 30-31 Aug 2021, The University of Hong Kong, Hong Kong.
Invited Talk; FishBase Symposium: 30 years of FishBase, 6-7 Sep 2021 (Online) Paris, France.
Invited Talk; Cross-Strait and Hong Kong Macao Young Women Scientists Forum, 15-18 Oct 2021 (Online).

Christelle Not

Oral Presentation; Myth and Reality of Sustainable plastics. Sustainable Procurement Webinar of the Hong Kong Green Council, 21 Jan 2021 (Online).
Oral Presentation; Investigate the Past to Understand the Future Climate of the Arctic Ocean. China & the Arctic: A view to 2050, 22-23 Apr 2021 (Online).

Gray A Williams

Group Facilitator; Responsible Conduct of Research Seminar, 5 May 2021, The University of Hong Kong, Hong Kong.
Guest Lecture; (with Tommy Hui & Sarah Lau) Surviving Thermal Stress on the Shore: Tales From the Tropics, 27 Oct 2021, University of Johannesburg, South Africa (Online).
Chair; Roundtable Discussion "Implementation of Cross-Sectorial Partnership Coastal-SOS and Beyond" UN Ocean Decade Kickoff Conference for the Western Pacific and its Adjacent Seas, WESTPAC, IOC/UNESCO, 26 Nov 2021 (Online).

Moriaki Yasuhara

Invited Plenary Keynote; 28th Estuary Research Meeting, 9-10 Jan 2021 (Online), Shimane, Japan.
Invited Plenary Keynote; 1st Annual Ecology and Biodiversity Research Symposium, 30-31 Aug 2021, The University of Hong Kong, Hong Kong.
Invited Seminar; Paleobiology seminar in the Smithsonian Institution, 10 Sep 2021 (Online), Washington DC, USA.
Invited Plenary Keynote and Session Organizer; 16th Deep-Sea Biology Symposium, 12-17 Sep 2021 (Online), Brest, France.
Invited Outreach Seminar; Tokyo Sea Life Park, 26 Sep 2021 (Online) Tokyo, Japan.
Workshop; GO2NE – GOOD Workshop, 21-22 Oct 2021 (Online) Paris, France.

Nicole Khan

Invited Seminar; WCRP Sea Level Grand Challenges, IAG Subcommission on Cryosphere Deformation, PALSEA and SCAR-INSTANT Seminar Series on sea-level changes, GIA and ice sheets, 13 July 2021 (Online)
Invited Seminar; Local to Global Drivers of Past and Future Sea-Level Change, 3 Dec 2021, The Chinese University of Hong Kong, Hong Kong.

Shelby McIlroy

Invited Seminar; The Fundamental Role of Ecology in Marine Biodiversity Conservation, Department of Ocean Science, 21 May 2021, The Hong Kong University of Science and Technology, Hong Kong.

Invited Seminar; Building Blue Networks: Measuring and Conserving Marine Biodiversity, 2021 Chinese Mainland & Hong Kong Joint Symposium on Ecology and Biodiversity, 6 Aug 2021 (Online).

Kanmani Rajan

Oral Presentation; American Malacological Society Virtual annual meeting, 14-18 June 2021 (Online).

Jing-Liang Kang

Participant; 14th International Coral Reef Symposium, 19-23 Jul 2021 (Online).

Jonathan Cybulski

Invited Lecture; Environmental Science Seminar Series, 23 Feb 2021, American University, USA.

Invited Lecture; Applications in Palaeontology, 1 Mar 2021, The University of Portsmouth, UK.

Invited Lecture; Research Seminar Series, 18 Jun 2021, The Hong Kong University of Science and Technology, Hong Kong.

Participant; 3rd Paleontological Virtual Conference, 8-15 Dec 2021 (Online).

Award; Professor Brian Morton Postgraduate Prize in Marine Biology

Valerie Hickey

Participant; The 5th Xiamen Symposium of Marine Environmental Sciences, 11-14 Jan 2021 (Online) Xiamen, China.

Participant; The 13th UCAS Postgraduate Symposium, 18-22 Apr 2021 (Online) Xiamen, China.

Participant; Half-Earth Day Summit, 22 Oct 2021(Online).

Wu Cheuk-ho

Participant; The FishBase - SeaLifeBase Symposium, 6-7 Sep 2021 (Online).

Oral Presentation; 22nd FishBase Consortium Annual Meeting, 8-10 Sep 2021 (Online).



Drone's eye view of SWIMS expansion during a low water tide at the Marine Reserve

Postgraduates

Alison Corley

Oral Presentation; 14th International Coral Reef Symposium, 19-23 Jul 2021 (Online).

Coco Cheung

Panel Discussion Moderator; Agnès b and Tara Ocean Foundation 'We Love The Sea' Sustainability Campaign Event, 17 Jun 2021, Hong Kong.

Participant; APEC Workshop on Nanoplastics in Marine Debris, 13-15 Dec 2021 (Online).

Cheryl Chu:

Participant; The 13th UCAS Postgraduate Symposium, 18-22 Apr 2021 (Online) Xiamen, China.

Emily Chei

Oral Presentation; 14th International Coral Reef Symposium, 19-23 Jul 2021 (Online).

Awards; International Coral Reef Society (ICRS) Graduate Fellowship

Howard Yu

Oral Presentation; Asia Oceania Geosciences Society Annual Meeting, 3 Aug 2021 (Online).

Jake Dytnerski

Oral presentation; The 60th Annual Meeting of the Canadian Society of Zoologists, 17-20 May 2021 (Online).

James Lin

Award: Best Oral Presentation, The 13th UCAS Postgraduate Symposium, 18-22 Apr 2021 (Online) Xiamen, China.

Participant; IODC-High level launch of ocean decade, 1 Jun 2021 (Online).

Lo Chi Chiu

Participant; The 13th UCAS Postgraduate Symposium, 18-22 Apr 2021 (Online) Xiamen, China.

Participant; The 1st International Symposium on Marine Science and Engineering for Young Scientists and Postgraduates 12-14 Jul 2021 (Online).

Participant; 1st Annual Ecology & Biodiversity Research Symposium, 30-31 Aug 2021, The University of Hong Kong, Hong Kong.

Mandy So

Participant; APEC Workshop on Nanoplastics in Marine Debris, 13-15 Dec 2021 (Online).

Sneha Suresh

Oral Presentation; The 13th UCAS Postgraduate Symposium, 18-22 Apr 2021 (Online) Xiamen, China.

Oral Presentation; 14th International Coral Reef Symposium, 19-23 Jul 2021 (Online).

Oral Presentation; 1st Annual Ecology and Biodiversity Research Symposium, 30-31 Aug 2021, The University of Hong Kong, Hong Kong.

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Prof. Gong Peng, Vice-President and Pro-Vice-Chancellor, HKU
Prof. IM Holliday, Vice-President and Pro-Vice-Chancellor, HKU
Prof. Max Shen, Vice-President and Pro-Vice-Chancellor, HKU
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Visitors to SWIMS

As we have moved out of SWIMS due to the expansion, no formal visitors were recorded for 2021.

Many thanks to Mr. Jon Wong for his cheerful and excellent help.

Student Graduations

Ph.D

Agusto, Laura Elisabeth - Multiple roles of brachyuran crabs in wetlands : their importance for bioturbation and central role in the food web
Butler, Rebekah Jane - Heavy metal contamination in Hong Kong mangroves: multiscale impacts on key ecosystem components
Cybulski, Jonathan David - Hong Kong's coral assemblages through time : a paleoecological and geochemical look at human-driven change
Doherty, John - Oceanographic and biogeochemical change in the high-latitude North Atlantic during marine isotope stage 11 and the common era
Ho, Yuen Wa - Foraging ecology of Indo-Pacific humpback dolphins in the Pearl River estuary : a multifaceted approach
Kim, Taihun - Coral lipid biomarkers and stable isotope values in the anthropocene
Lau, Sarah Lok Yee - Thermal extremes and variability shape the performance of rocky shore littorinids
Rodriguez, Maximiliano - Trace-elements in ostracods as proxies of environmental parameters in shallow marine waters
Sheng, Victoria Li - A world without sharks: forensic methods, trade networks, and impacts of shark removal
Xu, Qian - Sedimentary thorium-230 and protactinium-231 records of paleoenvironmental changes in the Arctic Ocean

Staff Training

Mr. Cheung Ming Hong has attended and taken the examination on "Certificate of competency in radiotelephony restricted (Hong Kong Waters)" on 17 March 2021.

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