SKLMP

SKLMP

2020

ANNUAL REPORT
年度報告

Content

Annual Report 2020

Visions and Missions of SKLMP
願景和使命

我們的願景

- 在監察和控制污染、環境風險評估、生態系統對污染的響應、以及生態修復有關的海洋環境研究中，擔當領導角色。
- 揭示海洋所面對的主要威脅，制定解決這些問題的技術及政策，為保護和管理海洋環境作出貢獻。

Our Visions

- To play a leading role in marine environmental research relevant to pollution monitoring and control, environmental risk assessment, ecosystem responses to pollution, and ecological restoration.
- To contribute to the protection and management of the marine environment by revealing major threats, and developing technologies and policies to address and solve these problems.

我們的使命

- 通過提供高質素的跨學科創新研究、教學、培訓、顧問工作及專業服務，守護香港、南中國以及東亞地區的海洋環境。
- 培養及訓練區內的環境科學家及環境管理人員，並建立核心能力。
- 支持香港特區政府與中央政府管理及保護海洋環境。

Our Missions

- To protect marine environments of Hong Kong, South China and Asia-Pacific region through high quality multidisciplinary and innovative research, teaching, training, consultancy work and professional services.
- To nurture and train environmental scientists and environmental managers and build core capability in the region.
- To support the governments of Hong Kong and China in management and protection of marine environments.

Message from the Director
主任致辭

2020是充滿變化的一年。新冠肺炎在全球爆發，徹底地改變了社會和我們的生活：全球有超過一億宗感染個案及逾兩百萬宗死亡個案；像其他人一樣，我們的工作亦因社交距離措施而深受影響。許多學術會議不是停辦便是轉為網上舉行；在多個國家和城市封城期間，外遊變成不可能的任務；不少研究項目，尤其是涉及國際合作亦被迫中斷或延期。雖然我們面對種種嚴峻的挑戰，但我們大部分的研究項目仍能如期進行，實在令人感恩。

適逢在這個變化的時刻，我們的實驗室創始人之一暨首任實驗室主任林群聲教授，在去年七月圓滿地完成了第二個任期，並將寶貴的接力棒交至我手中。在香港城市大學校長郭位教授的鼎力支持下， 我於去年8月3日正式接替林教授出任SKLMP實驗室主任一職。

在此，我衷心感謝林教授對實驗室的貢獻及過去十年來的卓越領導。他為SKLMP奠下穩固的根基，確保實驗室能夠持續發展。他更帶領SKLMP於2018年獲得優秀國家重點實驗室的榮譽。我們非常高興得悉林教授被任命為香港公開大學候任校長，並即將於今年四月履新。我們衷心感激林教授作為模範學術領袖的傑出貢獻，並在此祝他在今後的工作中一切成功。同時，我們很高興獲得林教授的支持，繼續擔任SKLMP的核心成員。

在過去數月，我組織了一系列會議，聽取了來自42位成員對實驗室未來發展的建議，為SKLMP草擬了一份三年的發展計劃書。在他們的支持下，我已逐步推行計劃，為我們的願景、使命、組織架構、重點研究主題、資助計劃、人力資源架構、網站建設和知識交流策略等注入新元素和動力。例如，我將實驗室的重點研究主題從4個整合為3個，包括：(1)　污染監測與控制的創新技術；(2)　生態安全和環境風險評估；(3)　生態系統響應與生態修復，並為各研究主題委任了組長。從2020年9月開始，我一直在為SKLMP廣納人才。我相信，在這些新措施的推動下，以及在各位成員的共同努力下，SKLMP一定能再闖高峰，為國家及保護海洋作出更多貢獻。

2020 was a year of change. There is no doubt that it has been one of the most challenging years in recent history. The COVID-19 pandemic has radically changed our way of life with over 100 million infected cases and more than two million deaths reported worldwide. Our work, was like everyone else, significantly affected by social distancing measures. Many of the academic meetings were either suspended or held online. International travel was practically impossible during the coronavirus lockdowns in many countries; some research projects, especially those involving international collaboration, were inevitably interrupted and postponed. While we faced many serious challenges last year, I was immensely grateful that most of our research programmes were unabated.

In the midst of all this change, Professor Paul Lam, our Founding Director completed a productive second term of directorship in July 2020, and passed on his torch to me. With the great support of Professor Way Kuo, President of City University of Hong Kong, I officially succeeded Professor Lam to serve as the Director of SKLMP on 3 August 2020.

Here, I would like to express my profound gratitude to Professor Lam for his dedication and tremendous leadership over the past decade. He has developed a solid foundation and ensured the sustainability of SKLMP. He also steered SKLMP to be rated as an outstanding SKL in 2018. We were absolutely delighted to hear that Professor Lam had been appointed as the next President of the Open University of Hong Kong and will commence his presidentship in April 2021. We heartily congratulate him for his outstanding achievements as an exemplary academic leader, and wish him every success in his future endeavors. We are ecstatic that he will remain a core member of SKLMP and continue to support us.

Over the last several months, I had organized a series of forums in which I solicited views on the future of SKLMP from 42 members, and drafted a 3-year plan for SKLMP. With their support, I have been gradually rolling out the plan including revitalization of our visions, missions, organizational structure, key research themes, funding schemes, human resources, website and knowledge exchange strategy etc. For instance, I have consolidated the key research themes from four to three, including (1) Innovative technology for pollution monitoring and control, (2) Eco-safety and environmental risk assessment and (3) Ecosystem responses and ecological restoration, and appointed leaders to lead each theme. Since September 2020, I have been recruiting a number of new talents to join SKLMP. I am confident that with these new initiatives and joint efforts of our members, SKLMP will scale to new heights and will contribute more to our country and protection of our oceans.

2020年對於SKLMP而言亦非常特別，因為這年正是SKLMP成立的十周年。為紀念這個重要的里程碑，我們精心製作一本《十周年紀念特刊》，以回顧SKLMP過去十年的歷程與成就。這本紀念刊物擬定於2021年4月出版。

大家或許已經留意到，今年年度報告的格式增加了不少故事和圖片，來記述實驗室成員有趣的科研發現、成果以及科普活動，而不僅限於使用列表方式來展示我們所獲的研究經費和已發表的文章等。這格式上改革的靈感源於我們合作夥伴的啓發 - 廈門大學近海海洋環境科學國家重點實驗室製作了一份極為吸引讀者的年度報告。在此我要特別感謝SKLMP的全體研究成員、員工和研究生們，感謝他們對這份報告作出了重大貢獻。

最後，希望你喜歡閱讀這份年報，並在閱讀的過程中能夠感受到我們對研究工作的熱情。

2020 was also very especial to SKLMP, because it was the 10th Anniversary of SKLMP. To mark this significant milestone, we would like to produce an anniversary booklet to recapitulate the history and achievements of SKLMP over the past decade. It is scheduled to be published by April 2021.

You may note that the format of this year's Annual Report has been modified with more stories and pictures to highlight our interesting research discoveries, achievements and science outreach, rather than simply presenting numerous tables to summarize our research grants and publications etc. Such changes were inspired by our partner - State Key Laboratory of Marine Environmental Science of Xiamen University which produced an attractive annual report for stakeholders and general readers. I would like to especially thank all of our members, staff and research students of SKLMP for their great contributions to this report.

Finally, I hope you will enjoy reading this report and feel the excitement and passion of our research endeavors!

Professor Kenneth Leung, Director of SKLMP
海洋污染國家重點實驗室主任 梁美儀 教授

31 December 2020
2020年12月31日

Research Scopes in SKLMP
實驗室研究範疇

Based on our competitive advantage and core capability, SKLMP identifies the following three key research themes. SKLMP also endeavours to conduct translational research and deliver recommendations of environmental management strategies and policies for supporting the government.

鑑於SKLMP的核心科研力量及競爭優勢，我們確立以下三大主要研究主題；並積極把研究成果轉化，為政府提供環境管理的策略，支持其實施政策。

Theme 1: Innovative Technology for Pollution Monitoring and Control
主題一：污染監測的創新科技

This research team primarily aims to develop a variety of novel technologies for monitoring and controlling marine pollution. These may include, but not limited to, new methods and tools for monitoring of priority chemical contaminants, algal toxins, waterborne pathogens and microplastics etc.; innovative numerical models for forecasting the fate of pollutants and pathogens and estimating their carrying capacity in water bodies; real-time monitoring of water and sediment quality with novel sensors and IoT; advanced and cost-effective treatment technologies for removal of pollutants from wastewater, *in situ* methods for combating harmful algal blooms, and emerging technologies for monitoring marine biodiversity and ecosystem health (e.g. remote sensing, artificial intelligence, environmental DNA).

Team Leader
小組組長

Prof. Tong Zhang
張彤 教授
(HKU 香港大學)

Deputy Team Leader
小組副組長

Dr. Chun Kit Kwok
郭駿傑 博士
(CityU 香港城市大學)

該研究團隊主要目的為研發一系列嶄新的科技，用以監察及控制海洋污染。這些科技可能包括(但不限於)監測受關注的化學污染物、藻類毒素、水生病原體和微塑膠等的新方法及工具；創新的數值模型，預測污染物和病原體在水環境中的暴露情況，並估計其在水體中的承載能力；運用新型感應器及物聯網實時監察水和沉積物的質量；以先進及具成本效益的處理技術移除污水中的污染物；建立創新方法去除海水中有害藻華 (紅潮)；以及探索監測海洋生物多樣性及生態系統健康的新技術(例如遙遠感應、人工智能、環境基因技術)。

Theme 2: Eco-safety and Environmental Risk Assessment
主題二：生態安全與環境風險評估

This research team chiefly targets to investigate the environmental fate, exposure, bioaccumulation, biological effect and environmental risk of chemical contaminants, algal toxins and waterborne pathogens in the marine environment, and their implication to seafood safety. The results will provide scientific basis for environmental risk assessment and for the derivation of environmental quality benchmarks for risk management of these stressors to ensure ecosystem safety and human health. In particular, SKLMP is keen to make contributions to the establishment of national marine water quality criteria for protecting coastal marine environments in China.

Team Leader
小組組長

Prof. Wenxiong Wang
王文雄 教授
(CityU 香港城市大學)

Deputy Team Leader
小組副組長

Dr. James Chung Wah Lam
林忠華 博士
(EdUHK 香港教育大學)

該研究團隊主要目的為研究海洋環境中的化學污染物、藻類毒理、水生病原體在水環境中的暴露的情況、生物累積、生物效應與環境風險，以及對海產食物的安全性影響。研究結果將為環境風險評估提供科學基礎，以推導及制定環境質量基準和管理這些壓力源的風險，以確保生態系統安全及人類健康。SKLMP尤其希望為建立國家海洋水質基準作出貢獻，以保護中國沿海海洋環境。

Theme 3: Ecosystem Responses and Ecological Restoration
主題三：生態系統響應與生態修復

This research team principally aims to reveal the response of the marine ecosystem to anthropogenic stressors such as water pollution, eutrophication, hypoxia, habitat destruction, overharvesting, warming, and acidification etc.; understand the process and mechanisms of ecosystem recovery after cessation of the environmental insult; and develop effective policy and novel technologies for restoration of degraded marine ecosystems (e.g. eco-engineering technologies).

Team Leader
小組組長

Prof. Jianwen Qiu
邱建文 教授
(HKBU 香港浸會大學)

Deputy Team Leader
小組副組長

Dr. Leo Lai Chan
陳 荔 博士
(CityU 香港城市大學)

該研究團隊主要目的為揭示海洋生態系統對人為壓力的反應，例如水污染、水體富營養化、缺氧、自然生境破壞、過度捕撈、暖化與酸化等；了解在停止環境侵害後，生態系統修復的過程和機制；以及制訂有效政策和創新技術 (例如生態工程技術)，藉此修復已受損的海洋生態系統。

Team Building and Management
隊伍建設與管理

New Members 新加入成員

Dr. Jin WU
Assistant Professor

Jin Wu is an Assistant Professor of the School of Biological Sciences at the University of Hong Kong. He received a B.S. with honors at Wuhan University in 2007, and a PhD in ecology and evolutionary biology at the University of Arizona in 2015. Prior to his HKU appointment, he held a Goldhaber Distinguished Fellow position at Brookhaven National Laboratory. He shares very broad research interest in ecosystem ecology, biodiversity and conservation, and global climate change. He is especially keen to advance our understanding of these topics by integrating multidisciplinary approaches (e.g. field surveys, remote sensing and AI technique) with the domain knowledge, so that we can scale up our fine-scale detailed knowledge to even larger spatial and temporal scales, with ultimate goals to improve the way people experience, understand and appreciate our living habitats and to inspire actions for sustaining our managed and natural ecosystems. Since 2016, he has published 48 papers on the relevant topics in the top peer-review journals, including a first-author publication in *Science*, featured as the cover story. He is currently an Associate Editor of *Remote Sensing* (Section of *Biogeosciences Remote Sensing*).

Dr. Chun Kit KWOK
Assistant Professor

Dr. Kit Kwok obtained his B.Sc. in Chemistry (2009) from the Chinese University of Hong Kong, after completing an exchange program at University of California, Los Angeles in 2007-2008. He completed his PhD in Pennsylvania State University (2014), mentored by Professor Philip C. Bevilacqua and Professor Sarah M. Assmann. In Apr 2014, Dr. Kwok worked as a Croucher Postdoctoral Fellow in University of Cambridge under the supervision of Professor Sir Shankar Balasubramanian. In Oct 2016, Dr. Kwok's joined the City University of Hong Kong as an Assistant Professor. In 2019, he was one of the recipients of the CityU President Award and Croucher Innovation Award. In 2020, Dr. Kwok's joined the State Key Laboratory of Marine Pollution, City University of Hong Kong.

Dr. Kwok's current research focus is to explore the role of RNA structures and interactions in biology, especially the functions of G-quadruplex structures/interactions and non-coding RNA structures/interactions in the mammalian transcriptome and their relevance to gene regulation, RNA metabolism and diseases. Two new research directions in the Kwok's lab are to develop targeting tools for detection, imaging, intervention of these important RNA structures and interactions, as well as to invent innovative nucleic acid-based technologies for sensing chemical pollutants and biological toxins. To cultivate a stimulating learning environment for students and to establish RNA community in Hong Kong, Dr. Kwok, together with Dr. Minh Le, has founded the Hong Kong RNA Club in Aug 2017 and organized RNA seminar and symposium events regularly.

Dr. Moriaki YASUHARA
Associate Professor

Moriaki Yasuhara is an Associate Professor of environmental science in the School of Biological Sciences and the Swire Institute of Marine Science at the University of Hong Kong. He has broad interests in integrating organismal biology (ecology and evolutionary biology), paleontology, and paleoceanography/paleoclimatology, especially by using highly resolved micropalaeontological records. His recent research has focused on the spatio-temporal dynamics of large-scale biodiversity patterns, the impact of climate on species diversity, and the controlling factor(s) of biodiversity pattern/change in deep-sea, shallow-marine and pelagic ecosystems. He is also interested in microfossil-based conservation palaeobiology (i.e., fossil evidence of anthropogenic impacts, including pollution, eutrophication, deoxygenation, etc) and palaeontology of the Ostracoda in general.

Dr. Theodora Ern Mei NAH
Assistant Professor

Dr. Theodora Nah received her Hon. B.Sc. in Chemistry and Mathematics from the University of Toronto in 2009, and her Ph.D. in Chemistry from the University of California, Berkeley in 2014. From 2014 to 2018, she was a postdoctoral fellow at Georgia Institute of Technology. In 2015, she was one of 25 early career scientists selected to participate in the Atmospheric Chemistry Colloquium for Emerging Senior Scientists (ACCESS) XIII. She has published 23 SCI papers so far. She is currently an Assistant Professor at the School of Energy and Environment at City University of Hong Kong. Her expertise lies in the field of Environmental Chemistry, and her research program uses a combination of laboratory, field, and modelling studies to investigate environmental reaction mechanisms involved in the formation and chemical transformation of air and water pollutants in coastal and marine environments. Of specific interest are the multiphase chemistry of organic and biological materials present in atmospheric aerosol particles and in surface waters. The three central research areas in her research program are: 1) Trace gas and aerosol interactions, 2) Chemistry of particulate metals in aerosols, and 3) Chemical a-atransformations of organic and biological matter at the air-water interface.

New Research Students and Research Staff
新加入研究生及研究人員

KWOK Yin Cheung, John
郭言彰
PhD Student

Supervisor: Dr. KOT Chin Wing, Brian
Period: 2020 ~ 30-Apr-2024

LIU Xiaowan
劉曉灣
PhD Student

Supervisor: Dr. CHAN Lai, Leo
Period: 15-Jul-2020 ~ 30-Jun-2024

ROBLES MALAGAMBA
Maria Jose
PhD Student

Supervisor: Dr. KOT Chin Wing, Brian
Period: 17-Aug-2020 ~ 31-Aug-2024

TAO Danyang
陶丹陽
PhD Student

Supervisor: Prof. LAM Kwan Sing, Paul
Period: 07-Jan-2020 ~ 30-Sep-2024

YUEN Nim Tung, Calista
袁念彤
PhD Student

Supervisor: Prof. LAM Kwan Sing, Paul
Period: 01-Sep-2020 ~ 31-Aug-2024

ZHU Jingyi, Chloe
朱靜儀
PhD Student

Supervisor: Dr. CHAN Lai, Leo
Period: 28-Aug-2020 ~ 31-Aug-2024

CHUNG Sui Leung, Casper
鍾歲良
Artisan

Supervisor: Prof. LEUNG Mei Yee, Kenneth
Period: 01-Dec-2020 ~ 30-Nov-2021

LAI Weng Seng, Racliffe
賴榮盛
Postdoc

Supervisor: Prof. LAM Kwan Sing, Paul
Period: 05-Oct-2020 ~ 30-Sep-2021

LIU Yuan
劉 源
Postdoc

Supervisor: Prof. LAM Kwan Sing, Paul
Period: 07-Aug-2020 ~ 24-Jan-2021

TAO Shiru, Lily
陶世如
Postdoc

Supervisor: Prof. LEUNG Mei Yee, Kenneth
Period: 03-Aug-2020 ~ 31-Jul-2021

CHAN Sze Wen, Sharon
陳思允
Research Assistant

Supervisor: Prof. LAM Kwan Sing, Paul
Period: 02-Jul-2020 ~ 01-Jul-2021

CHANG Miu Sum, Natalie
張妙深
Research Assistant

Supervisor: Prof. LAM Kwan Sing, Paul
Period: 05-Oct-2020 ~ 05-Oct-2021

CHAU Hiu Yan, Grace
周曉恩
Research Assistant

Supervisor: Prof. LEUNG Mei Yee, Kenneth
Period: 03-Aug-2020 ~ 31-Jul-2021

DELLISANTI Walter
Research Assistant

Supervisor: Dr. CHAN Lai, Leo
Period: 22-Oct-2020 ~ 02-May-2021

HO Hei Nam, Heysen
何禧楠
Research Assistant

Supervisor: Dr. KOT Chin Wing, Brian
Period: 09-Nov-2020 ~ 30-Jun-2021

LIMBU Khem
Research Assistant

Supervisor: Dr. CHAN Lai, Leo
Period: 23-Mar-2020 ~ 22-Sep-2020

LIU Yuen Mei, Agnes
廖婉薇
Research Assistant

Supervisor: Prof. LEUNG Mei Yee, Kenneth
Period: 19-Oct-2020 ~ 18-Oct-2021

TO Tsz Ying, Althea
杜紫瑩
Research Assistant

Supervisor: Prof. LAM Kwan Sing, Paul
Period: 06-Jan-2020 ~ 05-Jan-2021

WEI Jiehong
韋杰鴻
Research Assistant

Supervisor: Prof. LAM Kwan Sing, Paul
Period: 16-Nov-2020 ~ 14-Aug-2021

WU Rongben, Kenny
吳荣本
Research Assistant

Supervisor: Prof. LAM Kwan Sing, Paul
Period: 01-Sep-2020 ~ 31-Aug-2021

XU Shaopeng
許少鵬
Research Assistant

Supervisor: Prof. LAM Kwan Sing, Paul
Period: 12-Oct-2020 ~ 26-Sep-2021

MA Linlin
馬林林
Research Assistant

Supervisor: Prof. LAM Kwan Sing, Paul
Period: 06-Jul-2020 ~ 06-Jan-2021

ASTUDILLO PLACENCIA
Juan Carlos
Research Associate

Supervisor: Prof. LEUNG Mei Yee, Kenneth
Period: 05-Oct-2020 ~ 30-Sep-2022

ZHOU Guangjie
周廣杰
Research Associate

Supervisor: Prof. LEUNG Mei Yee, Kenneth
Period: 31-Jul-2020 ~ 31-Jul-2021

The SKLMP Members 實驗室成員

City University of Hong Kong 香港城市大學

Prof. Kenneth Mei Yee LEUNG 梁美儀 教授

Director of the State Key Laboratory of Marine Pollution
海洋污染國家重點實驗室主任

Chair Professor of the Department of Chemistry
化學系講座教授

Dr. Leo Lai CHAN 陳 荔 博士

Associate Director of the State Key Laboratory of Marine Pollution
海洋污染國家重點實驗室副主任

Visiting Associate Professor of the Department of Biomedical Sciences
生物醫學系客座副教授

Prof. Shuk Han CHENG 鄭淑嫻 教授

Chair Professor of the Molecular Medicine, Department of Biomedical Sciences
生物醫學系講座教授

Prof. Michael Hon Wah LAM 林漢華 教授

Professor of the Department of Chemistry
化學系教授

Congratulations to Promotion

Prof. Paul Kwan Sing LAM 林群聲 教授

Jeanie Hu Professor of Science
胡梁子慧教授 (理學)

Chair Professor of the Department of Chemistry
化學系講座教授

President of The Open University of Hong Kong
香港公開大學校長

Prof. Michael Kwok Hi LEUNG 梁國熙 教授

Professor of the School of Energy and Environment
能源及環境學院教授

Prof. Ying LI 李 嬰 教授

Chair Professor of the Department of Neuroscience
神經科學系講座教授

Prof. Nora Fung Yee TAM 譚鳳儀 教授

Emeritus Professor of the Department of Chemistry
化學系榮休教授

Prof. Wenxiong WANG 王文雄 教授

Associate Dean (Research and Postgraduate Studies) of the School of Energy and Environment
能源及環境學院副院長 (研究及深造教育)

Chair Professor of School of the Energy and Environment
能源及環境學院講座教授

Congratulations to Promotion

Prof. Michael Mengsu YANG 楊夢甦 教授

Vice-President (Research & Technology)
副校長 (研究及科技)

Yeung Kin Man Chair Professor of the Department of Biomedical Sciences
生物醫學系楊建文講座教授

Prof. Peter Kwan Ngok YU 余君岳 教授

Professor of the Department of Physics
物理學系教授

Dr. Siu Gin CHEUNG 張肇堅 博士

Associate Professor of the Department of Chemistry
化學系副教授

Dr. Henry Yuhe HE 何宇鶴 博士

Assistant Professor of the School of Energy and Environment
能源及環境學院助理教授

Dr. Richard Yuen Chong KONG 江潤章 博士

Associate Professor of the Department of Chemistry
化學系副教授

Congratulations to Promotion

Dr. Brian Chin Wing KOT 葛展榮 博士

Research Associate of the State Key Laboratory of Marine Pollution
海洋污染國家重點實驗室副研究員

Visiting Assistant Professor of the Department of Veterinary Clinical Sciences
臨床動物醫學系客座助理教授

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Positions of Members in International Academic Journals
SKLMP成員在國際學術期刊的任職情況

Member	Position	Name of Academic Journal	Duration
Dr. C. C. CHEANG	Editorial Board Member	The Asian Journal of Biology Education (Asian Association for Biology Education)	2020 – Present
Dr. J.P. CHENG	Editorial Board Member	Bulletin of Environmental Contamination and Toxicology (Springer)	2013 – Present
Dr. S.G. CHEUNG	Corresponding Editor	Environmental Geochemistry and Health (Springer)	2015 – Present
Prof. Jianping GAN	Associate Editor	Journal of Applied Oceanography (Journal of Applied Oceanography Editorial Office)	2008 – Present
	Editorial Board Member	Acta Oceanologica Sinica (Springer)	2012 – Present
	Special-issue Editor	Progresses in Oceanography (Elsevier)	2019 – Present
Prof. Keith W.K. HO	Editorial Board Member	International Journal of Photoenergy (Hindawi)	2012 – Present
	Associate Editor	Journal of Research in Science Mathematics and Technology Education (Eastern Mennonite University, US)	2018 – Present
	Editorial Board Member	Chinese Journal of Catalysis (Elsevier)	2020 – Present
Dr. L. JIN	Editorial Board Member	Environmental Toxicology and Chemistry (Wiley-Blackwell)	2018 – 2020
Dr. Brian C.W. KOT	Editorial Board Member	Forensic Imaging (Elsevier)	2020 – Present
Prof. Paul K.S. LAM	Editors-in-Chief	Aquatic Toxicology (Elsevier)	2020 – Present
Prof. Joe S.Y. LEE	Review Editor	Frontiers in Forests and Global Change (Frontiers)	2018 – Present
	Editorial Board Member	Ocean Science Journal (Springer)	2016 – Present
Prof. Kenneth M.Y. LEUNG	Editor-in-Chief	Regional Studies in Marine Science (Elsevier)	2014 – Present
	Editorial Board Member	Marine Pollution Bulletin (Elsevier)	2008 – Present
	Editorial Board Member	Toxicology and Environmental Health Sciences (Springer)	2009 – Present

Member	Position	Name of Academic Journal	Duration
Prof. Kenneth M.Y. LEUNG	Editorial Advisory Board Member and Associate Editor	Canadian Journal of Zoology (NRC)	2011 – Present
	Editorial Board Member	Ocean Science Journal (Springer)	2012 – Present
	Editorial Board Member	Journal of Hazardous Materials Letters (Elsevier)	2020 – Present
Prof. X.D. LI	Deputy Editor	ACS Environmental Au (ACS)	2021 – Present
	Associate Editor	Environmental Science and Technology (ACS)	2012 – Present
	Associate Editor	Applied Geochemistry (Elsevier)	2008 – Present
Prof. J.W. QIU	Academic Board Member	Frontiers in Marine Science (Frontiers)	2016 – Present
Dr. V. THIYAGARAJAN	Contributing Editor	Marine Ecosystem Ecology (Frontiers)	2019 – Present
	Academic Editor	Aquaculture Environment Interactions (Inter-Research Science Publisher)	2019 – Present
	Academic Editor	PLoS One (Public Library of Science)	2019 – Present
Dr. Chris Y.F. TSANG	Editor-in-Chief	Energy & Environment (SAGE)	2017 – Present
	Associate Editor	Chemical Engineering Journal (Elsevier)	2019 – Present
	Subject Editor	Process Safety and Environmental Protection (Elsevier)	2016 – Present
	Editor	Water Science and Technology (IWA)	2018 – Present
Prof. W.X. WANG	Editor	Environmental Toxicology and Chemistry (Wiley-Blackwell)	2009 – present
	Associate Editor	Environmental Pollution (Elsevier)	2015 – present
	Associate Editor	Aquatic Biology (Inter-Research Science Publisher)	2012 – present
	Associate Editor	Estuaries and Coasts (Springer)	2008 – present

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Dr. J. WU	Editorial Board Member/ Section Associate Editor	Remote Sensing (MDPI)	2019 – Present
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	Editor	Plankton and Benthos Research (The Plankton Society of Japan, The Japanese Association of Benthology)	2015 – Present
	Editorial Board Member	Global and Planetary Change (Elsevier)	2014 – Present
	Editorial Board Member	Open Quaternary (Ubiquity Press)	2018 – Present
	Associate Editor	Marine Biodiversity (Springer)	2018 – Present
	Editorial Board Member	Marine Micropaleontology (Elsevier)	2019 – Present
	Associate Editor	Palaeoworld (Elsevier)	2019 – Present
	Associate Editor	Journal of Paleontology (Paleontological Society)	2020 – Present
Prof. Peter K.N. YU	Editorial Board Member	Journal of Environmental Radioactivity (Elsevier)	May 2005 – Present
	Advisory Editorial Board Member	Nuclear Technology & Radiation Protection Journal (Vinča Institute of Nuclear Sciences)	Sep 2010 – Present
	Editor	Open Physics (Biological and Medical Physics section) (De Gruyter)	Aug 2015 – Present
Prof. T. ZHANG	Senior Editor	Microbiome (Springer)	2020 – Present
	Associate Editor	Applied Microbiology and Biotechnology (Springer)	2017 – Present

Nurturing of Talents
人才培養

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136 PhD

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10 MSc

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14 Research Associate / Fellow

49 Postdoc

49 Research Assistant

Awards, Recognitions and Patents
獎項、讚譽和專利

Awards 獎項

Member	Award Description	Country	Award Date	Awardee(s)
Dr. Apple P.Y. CHUI	Finalist of the 2020 University Grants Committee Teaching Award	Hong Kong	2020	Apple P.Y. CHUI
	University Education Award 2020 (CUHK)	Hong Kong	2020	Apple P.Y. CHUI
Prof. Keith W. K. HO	Clarivate Highly Cited Researcher in the Field of Cross-Field	International	Nov 2020	Keith W. K. HO
Prof. X.Y. LI	HKIE Best Transactions Paper Prize 2020 HKIE Transactions Vol 26 No 2, The Hong Kong Institution of Engineers (HKIE)	Hong Kong	Oct 2020	R.H. LI and X.Y. LI
Dr. V. THIYAGARAJAN	Outstanding Teaching Award (HKU)	Hong Kong	2020	V. THIYAGARAJAN
Dr. Chris Y.F. TSANG	Silver Medal, The 11th International Innovation and Invention Competition (IIIC)	Taiwan	2020	Chris Y.F. TSANG, W.N. CHENG
	Top 20 Best Invention Awards, The 5th International Invention Innovation Competition in Canada (iCAN)	Canada	2020	Chris Y.F. TSANG
	Gold Medal, The 5th International Invention Innovation Competition in Canada (iCAN)	Canada	2020	Chris Y.F. TSANG
	Special Award, Toronto International Society of Innovation & Advanced Skills (TISIAS)	Canada	2020	Chris Y.F. TSANG
Prof. T. ZHANG	Outstanding Researcher Award (HKU)	Hong Kong	16 Dec 2020	T. ZHANG
	Clarivate Highly Cited Researcher in the Field of Microbiology	International	19 Nov 2020	T. ZHANG
	Clarivate Highly Cited Researcher in the Field of Environment and Ecology	International	19 Nov 2020	T. ZHANG

Patents 專利

Member	Type	Description	Authorization Date	Country	Inventor(s) (in the order on the patent document)
Dr. C.K. KWOK	Invention Patent	USPTO Patent No. 10,640,828 Low Sequence Bias Single-Stranded DNA Ligation	5 May 2020	US	Philip C. Bevilacqua, State College, PA (US); Sarah M. Assmann, State College, PA (US); Yiliang Ding, State College, PA (US); Chun Kit Kwok, State College, PA (US)

Congratulations to Prof. Keith HO

Field of Cross-Field

Congratulations to Prof. Tong ZHANG

Field of Environment and Ecology

Field of Microbiology

Research Highlights
研究亮點

Global application of artificial mussels
人工貽貝在全球應用

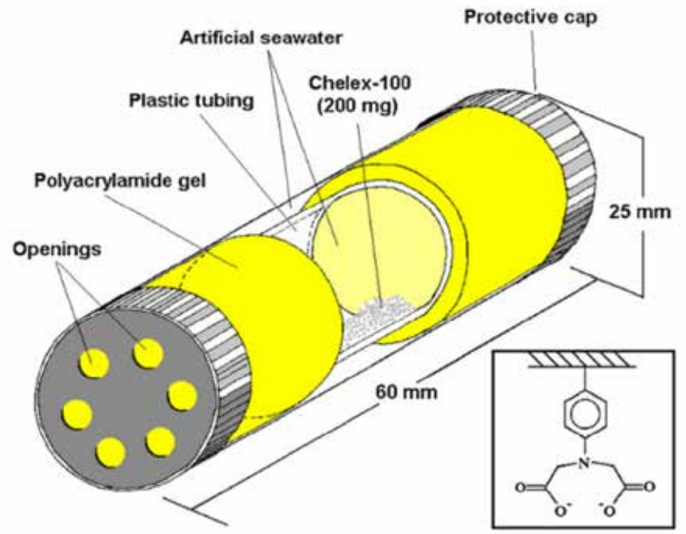
Involved Members:
Prof. Rudolf Shiu Sun WU, Prof. Kenneth Mei Yee LEUNG, Dr. Jill Man Ying CHIU

為了克服監測海洋環境中金屬長期存在的問題和局限性，胡紹燊教授的科研團隊早於2007年研發了一套新的化學採樣裝置，稱為人工貽貝(Artificial Mussel，AM)。該裝置主要由浸於人工海水的高分配配位體 chelex 100 樹脂、外壁為不透性有機玻璃、兩端用半透過性聚丙烯醯胺 (polyacrylamide，SPP) 密封的管道構成。SPP膠可以使金屬離子通過孔隙緩慢滲透進入管道後與樹脂螯合。

在蘇格蘭、冰島、南非和葡萄牙水域的實地測試表明，AMs積累的常見有毒金屬與活貽貝(living mussel) 相似 (Leung et al., 2008; Degger et al., 2011; Gonzalez-Rey et al., 2011; Claassens et al., 2016)，但鋅 (Degger et al., 2011; Gonzalez-Rey et al., 2011) 和鉛 (Leung et al., 2008; Gonzalez-Rey et al., 2011) 的積累模式則與活貽貝有顯著差異。Kibria等人(2012)應用AMs建立了澳洲維多利亞州內Goulburn-Murray淡水流域微量金屬污染物的熱點地圖並評估了其對水生生態系統和公眾衛生的潛在威脅。

To overcome the longstanding problem and limitation of metal monitoring in the marine environment, a novel chemical sampling device, artificial mussel (AM), has been developed by Wu et al. (2007) for monitoring metals in marine environments. The device consists of a non-permeable Perspex tubing with the polymer-ligand Chelex100 resin suspended in artificial seawater inside and enclosed with semi-permeable polyacrylamide (SPP) gel at both ends. The SPP gel allows slow passage of metal ions through the pores before chelating with the resin.

Field tests with AMs in coastal environments of Scotland, Iceland, South Africa, and Portugal have illustrated that AMs and different species of native mussels exhibit similar accumulation patterns for common toxic metals (Leung et al., 2008; Degger et al., 2011; Gonzalez-Rey et al., 2011; Claassens et al., 2016), but a significant difference was found for Zn (Degger et al., 2011; Gonzalez-Rey et al., 2011), and Pb (Leung et al., 2008; Gonzalez-Rey et al., 2011). Kibria et al. (2012) used AMs to identify “hot spots” of trace metal in freshwater catchments in Victoria, Australia, and estimate the potential environmental and public health risks .



A schematic diagram showing the design of the artificial mussel. The chemical structure of Chelex-100 is shown in the inset.
人工貽貝設計模式圖及其內置Chelex-100的化學結構

Ruiz-Fernández等人(2018)發現，在墨西哥水域中汞和鈾不能在牡蠣和貽貝積累，但可以被AMs檢測到，表明AM可能比生物監測器更有效。基於中國沿海從溫帶到熱帶環境五個城市的綜合研究，Degger等人(2016)得出的結論是：AMs可以提供可靠的時間綜合估算，以評估不同水文條件和大範圍水域內的金屬濃度，並克服了監測水，沉積物和生物中金屬的長期問題。同樣地，沈等人(2020)對比澳洲沿海水域鎘、鉛、銅、鋅、鉻、硒、汞和砷八種微量金屬在AMs和LMs中的積累模式，指出AMs能在多種微量金屬的生物監控中作為活貽貝的良好替代品。

AMs首次實現了全球海洋環境中金屬濃度的比較。

有關人工貽貝在全球範圍內的應用研究已經發表在國際重要期刊*Environment International, Environmental Pollution, Chemosphere, Ecological Indicators, Journal of Environmental Management, Marine Pollution Bulletin, Marine and Freshwater Research*。

Ruiz-Fernández et al (2018) found that Hg and U can be accumulated in AMs but not in native oyster and mussel species in Mexico waters, suggesting that AM may be more robust than biomonitors in metal monitoring. Based on a comprehensive study in five cities spanning from temperate to tropical environment along the China coastline, Degger et al. (2016) concluded that AMs can provide a more reliable time integrated estimate on metal concentration over large geographic areas with different hydrographic conditions, and overcomes the longstanding problems of monitoring metals in water, sediment and bioindicators. Likewise, Shen et al., (2020) compared accumulations of eight trace metals: Cd, Pb, Cu, Zn, Cr, Se, Hg, and As, between AMs and live mussels (LMs) in Australian coastal waters, and concluded that AMs are excellent replacement of LMs for the biomonitoring of multiple kinds of trace metals.

For the first time, the AMs allow us to make global comparison of metal concentrations in the marine environment.

The global application of AM in metal monitoring have been published in leading international journals including *Environment International, Environmental Pollution, Chemosphere, Ecological Indicators, Journal of Evironmental Management, Marine Pollution Bulletin, Marine and Freshwater Research.*

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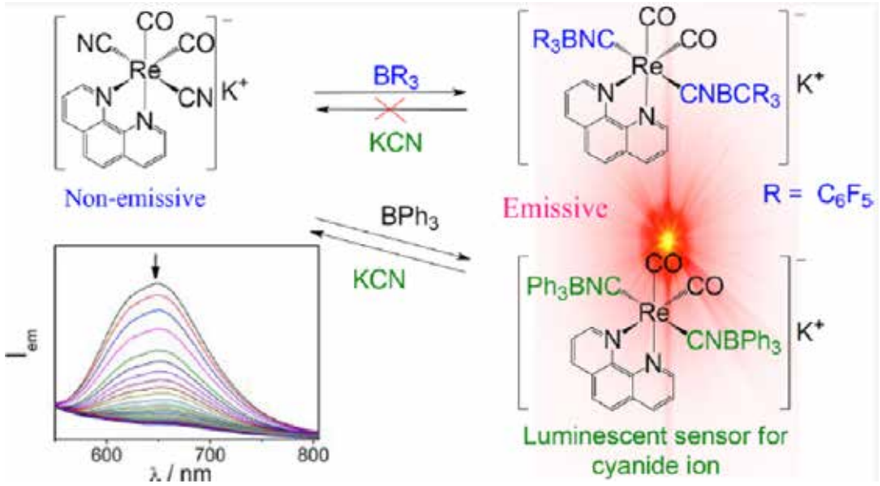
10. **Wu, R.S.S.**, Lau, T.C., Fung, W.K.M., Ko, P.H. and **Leung, K.M.Y.** (2007). **An 'artificial mussel' for monitoring heavy metals in marine environments.** *Environmental Pollution,* 145(1), 104-110.

Design and synthesis of luminescent bis(isocyanoborato) rhenate(I) complexes as a selective sensor for cyanide anion

發光雙異腈硼烷錸(I)複合物作為氰酸根離子的選擇性指示物的設計與合成

New Applicant to SKLMP/ Involved Researcher:
Dr. Vincent Chi Chiu KO



這研究報導一系列的雙異腈硼烷錸(I)鄰二氮菲發光複合物〔通用化學式為*cis,trans*-[$Re(CO)_2(CNBR3)_2$(phen)]K (R = C_6F_5 and C_6H_5)〕的設計和合成。這一些系列複合物的溶液表現出MLCT磷光性。本研究經過詳細的陰離子滴定實驗表明雙異腈硼烷複合物在CH_3CN/H_2O溶液中加入氰酸根離子(CN^-)會導致其發光亮度顯著下降，而將氰酸根離子換為其他陰離子(包括F^-, Cl^-, Br^-, I^-, OH^-, AcO^-, N_3^-, ClO_4^-, $H_2PO_4^-$, HSO_4^-, NO_3^-, NO_2^-, IO_3^-, and SCN^-)則無此現象。

此研究首次證明雙異腈硼烷配位體可以應用於選擇性化學傳感領域，將有望開創一個有別於其他過渡金屬與硼烷加合的發光複合物系統的新的氰酸根離子感測器的設計思路。

以上工作於2020年5月發表在期刊*Organometallics*，第一作者為 Xiao, Y.L.， 通訊作者為香港城市大學的高志釗博士。

A series of luminescent bis(isocyanoborato) rhenate-(I) phenanthroline complexes with the general formula of *cis,trans*-[$Re(CO)_2(CNBR3)_2$(phen)]K(R=C_6F_5 and C_6H_5) have been designed and synthesized. The solutions of these complexes exhibit MLCT phosphorescence. Detailed anion titration study showed that the emission intensity of bis(isocyanotriphenylborato) complex in CH_3CN/H_2O solution would be significantly decreased in the presence of cyanide anion, while such a change would not be observed in the presence of other anions including F^-, Cl^-, Br^-, I^-, OH^-, AcO^-, N_3^-, ClO_4^-, $H_2PO_4^-$, HSO_4^-, NO_3^-, NO_2^-, IO_3^-, and SCN^-.

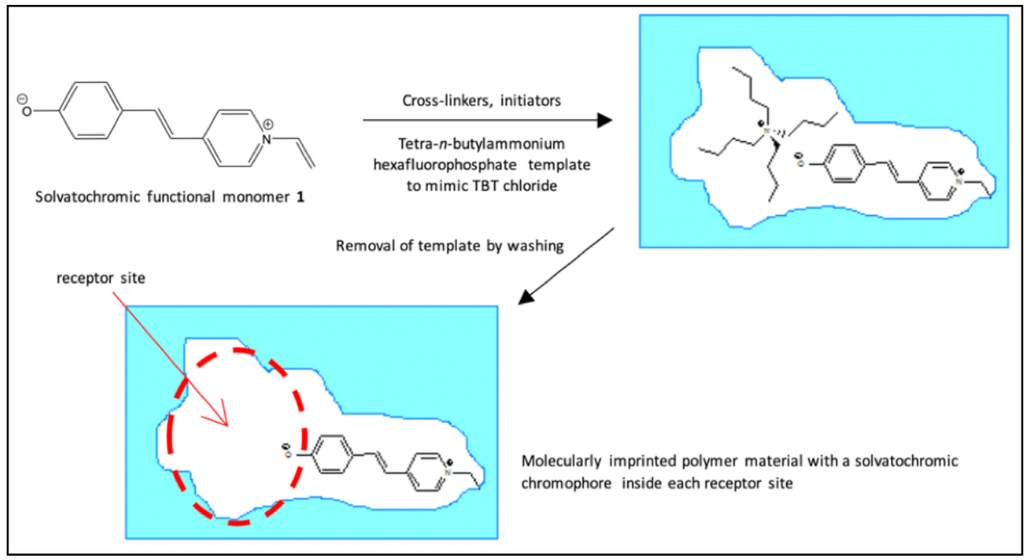
This represents the first example demonstrating the application of isocyanoborate ligand for selective chemosensing purpose. It is anticipated that it would initiate a new design strategy for selective cyanide sensors from the borane adducts other luminescent transition metal complex systems.

Reference:

Xiao, Y.L., Chu, W.K., Ng, C.O., Cheng, S.C., Tse, M.K., Yiu, S.M. and **Ko, C.C.** (2020). **Design and synthesis of luminescent bis(isocyanoborato) rhenate(I) complexes as a selective sensor for cyanide anion.** *Organometallics,* 39(11), 2135-2141.

Smart stimulti-responsive materials for rapid detection of pollutants
於污染物快速檢測的智慧型快速反應材料

Involved Member:
Prof. Michael Hon Wah LAM

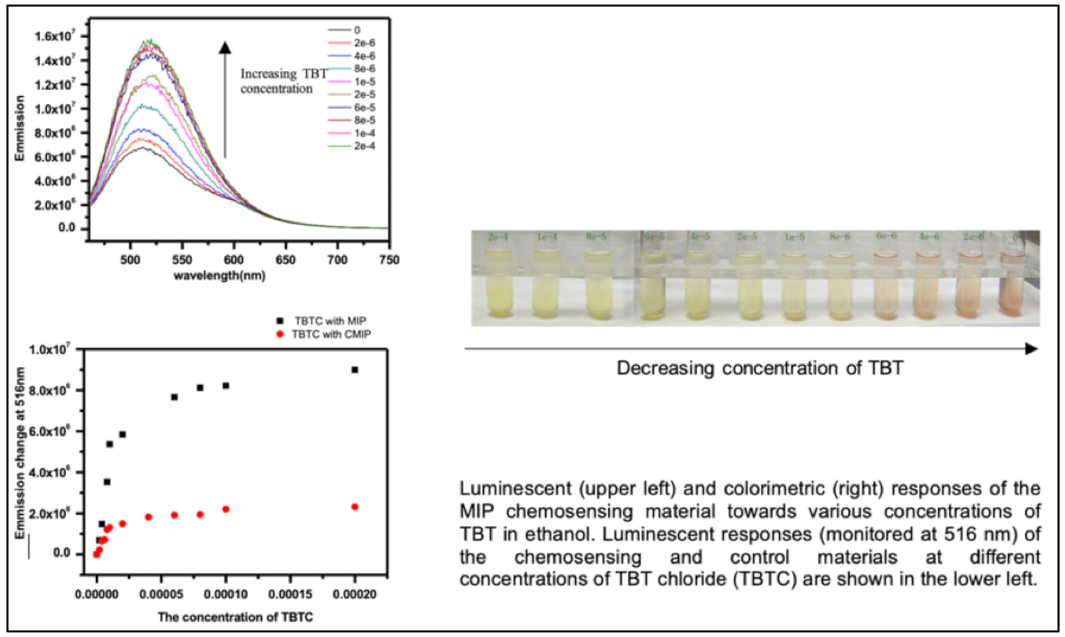


我們研究小組屬於海洋污染國家重點實驗室，致力於通過分子印跡技術(MIP)開發化學傳感材料，並且已經獲得了製造MIP和其他相關材料的大量經驗。為解決一般不與通用信號感測器相互作用的疏水性有機污染物的化學傳感的問題，我們開發了一種新型分子印跡技術，利用溶劑致變色分子報告分子來感應識別和結合非極性污染物後分子印跡受體位置微環境極性的微小變化。為了證明我們的化學傳感技術的獨特能力，我們製造了一種特殊的分子印跡聚合物材料，該材料在結合氯化三丁基錫時可以產生比色和螢光響應。這是化學感測器首次檢測到三丁基錫類物質。

Our research group at the State Key Laboratory of Marine Pollution focuses on the development of chemosensing materials via molecular imprinting (MIP) and has already acquired a lot of experiences in the fabrication of MIPs and other related materials. To tackle the challenge of the chemosensing of non-polar, hydrophobic organic contaminants that do not generally interact with commonly used signal transducers, we developed a novel molecular imprinting technology that makes use of solvatochromic molecular reporters to sense the minute changes in the polarity of the micro-environment within the molecularly imprinted receptor sites upon the molecular recognition and binding of such organic contaminants. To demonstrate the unique capability of our chemosensing technology, a special molecularly imprinted polymer material that can produce colorimetric and fluorometric responses upon the binding of tributyltin chloride is fabricated. This is the first time that tributyltin species can be detected by a chemosensor.

我們將繼續這項研究工作，為分子印跡化學傳感材料開發出更多有趣的、不依賴於與非極性疏水分析物特異性作用/反應的分子傳感策略。這些新的化學傳感機制以及開發的化學傳感材料對於現場快速篩選一些目前只能在實驗室環境中經歷分離、濃縮、純化的漫長過程才能從複雜樣品基質中檢測到的目標環境污染物非常有用。

We will continue our work to develop more intrigue molecular sensing strategies that do not require specific molecular interactions with non-polar and hydrophobic analytes for molecularly imprinted chemosensing materials. These new chemosensing mechanisms as well as the chemosensing materials developed will be very useful for the rapid, *in-situ* screening of selected environmental contaminants that are currently unable to be conveniently detected in complex sample matrices without the use of sophisticated analytical instrument after tedious ex-situ separation, pre-concentration and clean-up procedures.

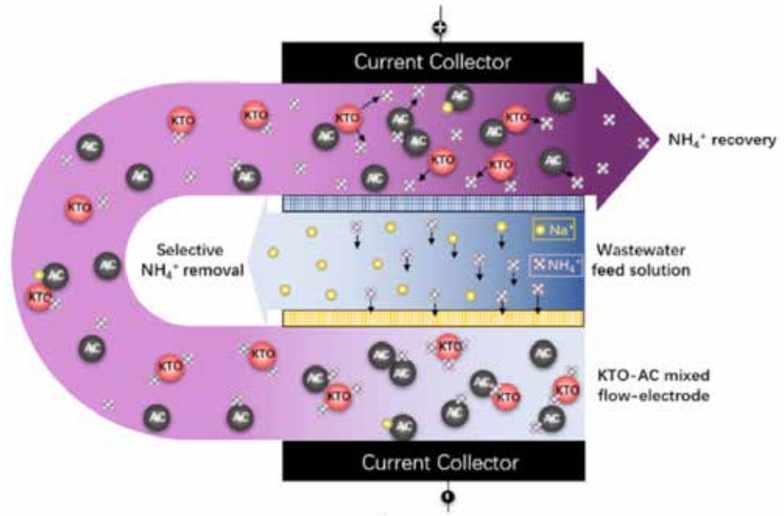


Luminescent (upper left) and colorimetric (right) responses of the MIP chemosensing material towards various concentrations of TBT in ethanol. Luminescent responses (monitored at 516 nm) of the chemosensing and control materials at different concentrations of TBT chloride (TBTC) are shown in the lower left.

Selective ammonium removal from synthetic wastewater by flow-electrode capacitive deionization using a novel $K_2Ti_2O_5$-activated carbon mixture electrode

基於新型鈦酸鉀-活性炭混合流動電極的電容去離子工藝選擇性去除合成廢水中的銨根離子

Involved Member: Prof. Xiaoyan LI



銨根離子(NH_4^+)是污水中主要的污染物之一，同時也是有價值的資源物質。流動電極電容去離子技術(FCDI)是一個無化學添加的環境友好型氨氮回收技術。然而由於廢水中鈉離子的水合半徑和銨根離子相似，會與銨根離子競爭流動電極上的吸附位點，從而降低銨根離子去除效率。本研究通過靜電噴霧和高溫煅燒工藝製備出鈦酸鉀顆粒($K_2Ti_2O_5$,KTO)，將其與活性炭粉末混合製成新型鈦酸鉀-活性炭流動電極，用於從含高鈉廢水中選擇性回收銨根離子。與採用純活性炭的FCDI工藝相比，在流動電極中摻入25 wt% 的KTO顆粒，含鈉廢水中銨根離子的選擇吸附性從2.3提高至31，銨根離子去除率從28.5%提高至64.8%，銨根離子解吸效率從35.6%增至80%，實現了對銨根離子的高效回收與電極再生。根據密度泛函理論計算結果，鈦酸鉀晶面(0 0 1)對銨根離子的吸附作用在熱力學上比鈉離子更穩定，因此對銨根離子具有選擇吸附性。

以上工作於2020年9月發表在期刊*Environmental Science & Technology*，第一作者為林琳 (Lin, L.)，通訊作者為香港大學的李曉岩教授。

Ammonium (NH_4^+) in wastewater is both a major pollutant and a valuable resource. Flow-electrode capacitive deionization (FCDI) is a promising technology for chemical-free and environmentally friendly NH_4^+ removal and recovery from wastewater. However, the coexisting sodium (Na^+) in wastewater, with a similar hydrated radius to NH_4^+, competes for the adsorption sites, resulting in low NH_4^+ removal efficiency. Here, potassium dititanate ($K_2Ti_2O_5$ or KTO) particles prepared by the electrospray method followed by calcination were mixed with activated carbon (AC) powder to form a novel KTO-AC flow-electrode for selective NH_4^+ removal over Na^+. The mixed KTO-AC electrode exhibits a much higher specific gravimetric capacitance in NH_4Cl solution than in NaCl solution. Compared with the pure AC electrode in the FCDI tests on NH_4^+ removal from synthetic wastewater, 25 wt % KTO addition in the electrode mixture increases the adsorption selectivity from 2.3 to 31 toward NH_4^+ over Na^+, improves the NH_4^+ removal from 28.5% to 64.8% and increases the NH4+ desorption efficiency from 35.6% to over 80%, achieving selective NH_4^+ recovery and effective electrode regeneration. Based on DFT calculations, NH_4^+ adsorption on the $K_2Ti_2O_5$ (0 0 1) surface is more thermodynamically favorable than that of Na^+, which contributes to the high NH_4^+ adsorption selectivity observed.

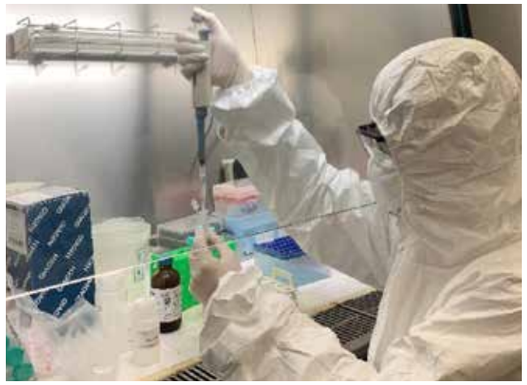
Reference:

Lin, L., Hu, J.H., Liu, J.H., He, X., Li, B. and **Li, X.Y.** (2020). **Selective ammonium removal from synthetic wastewater by flow-electrode capacitive deionization using a novel K2Ti2O5-activated carbon mixture electrode.** *Environmental Science & Technology,* 54(19), 12723-12731.

Grid monitoring of SARS-CoV-2 in sewage for an early-warning sign of community outbreak

生活污水SARS-CoV-2網點監測作為社區性爆發的預警信號

Involved Member: Prof. Tong ZHANG



至今，張彤教授帶領的研究團隊從不同地區的污水處理系統已採集1000個以上的本土污水樣本進行新冠病毒SARS-CoV-2的核酸檢測。初步研究結果表明污水監測可用作以下用途：

1. 提供COVID-19爆發的早期預警。污水的病毒檢測陽性率可以反映病毒在社區中傳播的總體情況，有可能作為醫療檢測的補充信息，用作社區爆發的早期預警。

2. 追踪社區爆發的發展趨勢。研究團隊會繼續收集和分析大量數據，對比實際醫療檢測診斷數據，構建一個系統性評估方法和探討後續跟進措施。

3. 補充對有感染集群屋苑的監測方法。研究團隊靈活調整監測計劃，在由感染集群的屋苑進行針對性的採樣和分析，為醫療檢測提供補充性的諮詢。

以上工作由香港食物及衛生局醫療衛生研究基金於2020年10月資助，該項目的負責人為香港大學張彤教授，該項檢測技術為疫情之下社區污水檢測系統提供有效方案並為提供與疫情發展相關的重要補充訊息，有助保障香港公眾健康。

Up till present, the research team led by Prof. Tong Zhang has collected more than 1000 domestic sewage samples from sewage collection systems in different areas for nucleic acid tests of the new coronavirus SARS-CoV-2. The initial results of the research have demonstrated that the sewage surveillance could be used for the following purposes:

1. Providing early warning signals for COVID-19 outbreak. The detection rate of viruses in sewage can reflect the overall spread of virus in the community, and could be used as supplementary information to complement clinical testing to provide early warning signals of community outbreak.

2. Tracking the development trend of community outbreak. The research team will continue to collect a large amount of data for analysis and make reference to the actual clinical diagnosis data to develop a systematic evaluation method and follow-up actions.

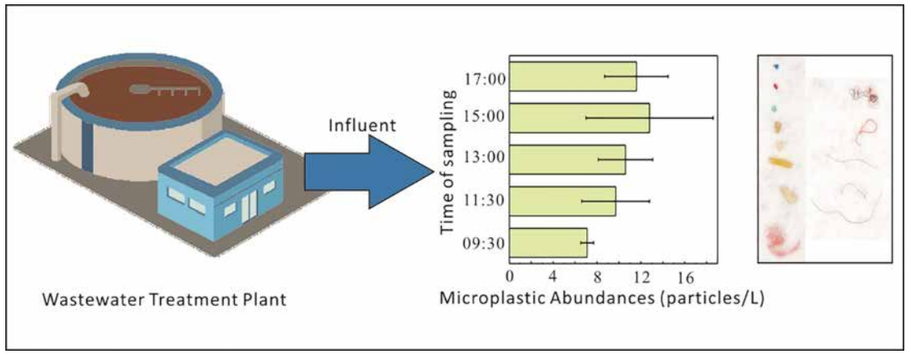
3. Complementing the monitoring of estates with infection clusters. The research team flexibly adjusted the monitoring plan, conducted targeted sampling and analysis at buildings with infection clusters, and provided complementary information for clinical tests.

Reference:

https://www.hku.hk/press/press-releases/detail/22201.html

Intra-day microplastic variations in wastewater: A case study of a sewage treatment plant in Hong Kong
污水中微塑膠的日間變化：以香港某污水廠為例

Involved Member: Prof. Paul Kwan Sing LAM



近年來，海洋微塑膠污染引起科學家和公眾的廣泛關注。污水處理廠被認為是微塑膠污染的重要來源，但大多數研究關注污水廠去除微塑膠的效率，以及污水廠出水的微塑膠排放量評估，鮮有研究關注生活污水中微塑膠含量的日內變化。若日內變化較大，則在特定時間段內對污水採樣，或使用數天採樣的平均值來調查污水中的微塑膠通量可能會造成評估誤差。本研究旨在調查香港一間具代表性的污水廠進水中微塑膠的特徵與日內變化，並對其每日處理量進行更科學的評估。結果顯示，微塑膠在污水中的豐度隨時間從7.1±6升高到12.8±5.8 particles/L，再降低到11.6±2.9 particles/L。在9:30-15:00採集的樣品中，約80%的微塑膠是聚乙烯和聚酯，而17:00採集的樣品中，大部分是聚丙烯和聚氨酯。微塑膠的日負荷變化較大，為每日6.60 $\times 10^8$ – 1.16 $\times 10^9$ particles，說明根據特定採樣週期計算的微塑膠日負荷不能準確評估污水廠的實際日負荷。

以上工作與2020年8月發表於*Marine Pollution Bulletin*期刊，香港城市大學博士生曹雅茹為第一作者，張凱博士為通訊作者。

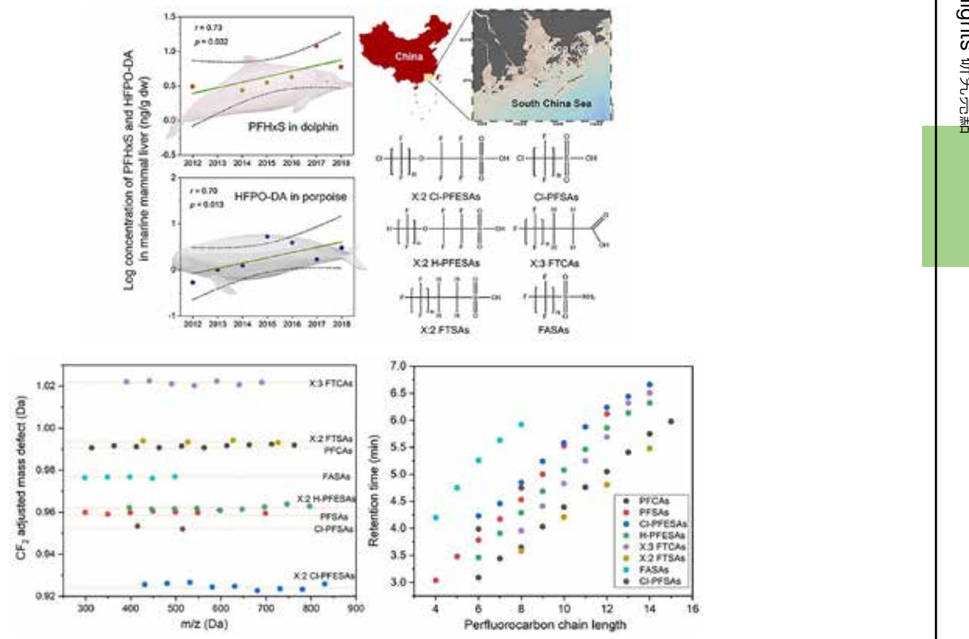
Reference:

Cao, Y., Wang, Q., Ruan, Y., Wu, R., Chen, L., Zhang, K., & **Lam, P. K.** (2020). **Intra-day microplastic variations in wastewater: A case study of a sewage treatment plant in Hong Kong.** *Marine Pollution Bulletin,* 160, 111535.

In recent decades, marine microplastic pollution has attracted extensive attention from scientific community and the public. Wastewater treatment plants (WWTPs) that are designed to treat industrial and municipal sewage via physical, chemical, and biological processes have been identified as one of the major pathways that transfers microplastics to the aquatic environment. At present, the majority of available studies of WWTPs have focused on analyzing the fates and removal efficiencies of microplastics as a whole, or by each individual treatment process, by measuring their contents in the WWTP influent, effluent, and sludge. It is plausible that the presence of anthropogenic microplastics in sewage may also be prone to change over time. Nevertheless, intra-day variations of microplastic in WWTPs have not drawn much attention. Many researchers have investigated microplastics in WWTP influent by sampling wastewater during a specific time period or by using average data for a few days of sampling, which may lead to estimation errors in actual microplastic abundances, as well as in daily microplastic loads in WWTPs. Hence, a representative secondary WWTP in Hong Kong was selected to investigate the characteristics and intra-day variations in the WWTP influent and to evaluate the daily microplastic loads. Results show that the average microplastic abundances increased from 7.1 ± 6.0 to 12.8 ± 5.8 particles/L and then dropped to 11.6±2.9 particles/L over time. Approximately 80% of the microplastics in samples collected from 9:30–15:00 were polyethylene and polyester, while most samples collected at 17:00 were polypropylene and polyurethane. Microplastic loads exhibited large intra-day variations ranging 6.60 × 10^8–1.16 × 10^9 particles/day, indicating that calculated daily microplastic loads based on a specific sampling period may inaccurately estimate the actual daily load.

Managing risks of per- and polyfluoroalkyl substances (PFASs)
全氟和多氟烷基物質（PFASs）的風險管理

Involved Members: Prof. Paul Kwan Sing LAM, Dr. James Chung Wah LAM



針對主要環境基質中存在的新興污染物(在本例中為PFASs)，我的研究團隊開發了靈敏且可靠的分析方法。我們建立了SPE-HPLC-MS/MS方法來測量海水中痕量的PFASs，方法定量限達到萬億分之一(ng/L)。這項研究首次揭示了PFASs廣泛存在於中國和韓國水域中。我們接著進行了深入研究，發現PFASs在我國多條河流、亞洲和南極洲之間的表層海水以及遠洋中均有檢出。隨後，我們開發了新的HPLC-MS/MS方法來分析短鏈的PFASs。這些研究結果證實了PFASs在全球環境中的廣泛分佈，為標準化測定方法的確立(例如HELCOM-赫爾辛基公約和ISO)奠定了紮實的基礎。

我們的分析方法十分靈敏，足以測量出遠洋中的痕量PFASs。我們參與了一項全球性的研究，該研究所獲取的重要數據為非揮發性PFASs通過洋流迁移到極地地區的這項假說提供了有力的支撐。我們靈敏且高選擇性的分析方法使痕量分析挪威北極的冰芯、地表雪和地表水樣本中的PFASs成為了可能。我們採集了位於高海拔地區的冰川樣品，這些冰川由多年以來積雪受壓縮而形成，其中的PFASs污染應主要來源於大氣遷移。因此，冰芯可用於研究該地區PFASs的遷移途徑及其在大氣中濃度隨時間的變化趨勢。

For emerging chemicals of concern, in this case PFASs, in key environmental matrices, my research team has developed sensitive, reliable, and robust analytical methods. We developed a SPE-HPLC-MS/MS procedure to measure PFASs at parts-per-trillion (ng/L) levels in seawater; this study revealed for the first time the widespread occurrence of PFASs in Chinese and Korean waters. Our further studies revealed the occurrence of PFASs in Chinese rivers, surface waters between Asia and Antarctica, and open oceans. We then developed a new HPLC-MS/MS method to analyze short-chain PFASs. These results demonstrated the ubiquitous distribution of PFASs in the global environment, which laid part of the foundation for the standardized determination methods (HELCOM - Helsinki Convention; ISO).

Importantly, our analytical method was sensitive enough for measuring PFASs in open ocean waters. We then participated in a global study, which yielded important data lending strong support to the hypothesis that non-volatile PFASs were transported to polar regions via ocean currents. Our sensitive and selective method enabled the trace analyses of PFASs in ice core, surface snow, and water samples collected from Norwegian Arctic. As glaciers were formed by the compression of fallen snow over many years, the glaciers sampled, located at high altitude, was expected to receive PFAS contamination mainly from atmospheric pathways. Therefore, ice cores in this location were used to investigate the transport pathways of PFASs and provide information on the temporal trends of atmospheric concentrations of PFASs.

在融化的冰川水中所檢測到的PFASs反映了多年來PFASs對當地尤其是大氣的污染，而表層積雪和地表水樣本所檢測到的PFASs則代表了近幾年的來自於本地和全球的PFASs污染。我們的結果全面證明了PFASs不僅能通過洋流而且能通過其上方的大氣輸送進行長距離遷移。我們的研究為聯合國環境規劃署(UNEP)水監測指南的制定做出了重要貢獻。

我的研究團隊進一步開發並驗證了生物樣本中測定PFASs的分析方法，並研究了於我國採集的人類血液以及母乳樣本中PFASs的賦存情況。其中一個重要發現是，兒童每天攝入多種超過保守參考劑量的PFASs，這表明在我國，嬰兒可能會通過攝入母乳而遭受PFASs暴露的潛在風險。我們發表了兩篇有關在水體和血液樣本中測定總氟含量的論文。使用此方法，我的研究團隊證明了當時在科學研究和/或環境監測中所測定的PFASs，實際上僅占環境中可萃取有機氟化合物中的一小部分(約10-30%)。這些發現在最近引起了科學家們尋找“未知PFASs”的廣泛興趣，進而可以對有機氟化合物進行更全面/有意義的風險評估。

為了評估PFASs對環境和公共健康的危害，我的研究團隊考察了PFASs對大鼠、雞以及原代培養的魚肝細胞的毒性作用。隨後，我們成功開發了用於測量禽蛋和鯨類組織以及自來水中PFASs的分析方法；最近，我們研究了濕地食物網中PFASs的營養生物放大作用，並研究了攝入含有PFASs的海產品對人類健康的影響。這些研究為世界衛生組織(WHO)、加拿大衛生部、美國環境保護署和OECD等多個機構發佈的健康指南做出了卓越貢獻。

對傳統的PFASs逐步淘汰已導致補償性生產和使用其替代品，例如生產和使用具有更短或更長碳鏈的PFASs以及其他結構相似的PFASs。這些新興的PFASs無可避免地會釋放到環境中。我們的研究一直關注傳統和新興PFASs的污染現狀和趨勢以及其對環境的影響。所收集的資訊被UNEP和WHO等國際機構用於管理(例如設定暴露上限或準則值)或對生產和使用這些化學品實行禁令。

Melted glacier water further reflected atmospheric and local PFAS contamination over several years, while surface snow and water samples represented recent sources from both local and global sources. Our results comprehensively demonstrated the atmospheric transport of PFASs over and above the pathway via ocean currents. Collectively, our research contributed to the water monitoring guidelines issued by the United Nations Environment Programme (UNEP).

My research team further developed and validated analytical methods to determine PFASs in biological samples. Using this method, concentrations of PFASs were analysed in human blood, as well as human breast milk samples collected from China. One important finding was that the daily intake of certain PFASs for the child exceeded the predicted conservative reference dose, indicating that there may be potential risk of certain PFASs for the infants via the consumption of breast milk in China. We published two papers on the determination of total fluorine in water and blood samples. Using this method, we demonstrated that the PFASs being targeted for scientific investigation and/or environmental surveillance at that time actually represented only a very small fraction (around 10-30%) of extractable organofluorine compounds in the environment. Recently, these findings have raised widespread interest in the search for “unknown PFASs” among researchers in this field in order that a more comprehensive and meaningful risk assessment of organofluorine compounds can be conducted.

To assess the environmental and public health risks of PFASs, we studied the toxic effects of PFASs in rats; chickens; and on primary cultured fish hepatocytes. Following on from these, we successfully developed methods for measuring PFASs in bird eggs and cetacean tissues; as well as in tap water. More recently, we have studied the trophic biomagnification of PFASs in a wetland food web and examined the health effects to humans through the consumption of aquatic foods. Taken together, these studies contributed to the health advisory opinions issued by several authorities, such as the World Health Organization (WHO), Health Canada, United States Environmental Protection Agency, and OECD.

Phasing out of the legacy (mostly 8-carbon) PFASs has resulted in compensatory production and usage of alternatives, such as shorter- or longer-chain PFASs, and other structurally similar PFASs. These emerging PFASs are inevitably released into the environment. Our research has been concerned with the status and trends as well as the environmental impact of legacy and emerging PFASs. The information collected was used to manage (e.g., setting exposure limits or guideline values) or instigate a ban, if warranted, on the production and use of these chemicals by Global International Agencies (e.g., UNEP; WHO).

Reference:

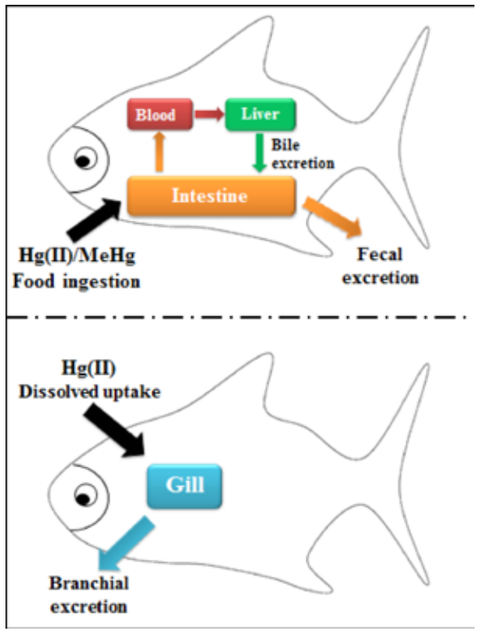
Wang, Q., Ruan, Y., Jin, L., Zhang, X., Li, J., He, Y., Wei, S., **Lam, J.C.W., Lam, P.K.S.** (2021). **Target, nontarget, and suspect screening and temporal trends of per- and polyfluoroalkyl substances in marine mammals from the South China Sea.** *Environmental Science & Technology,* 55(2), 1045–1056.

Determination of the low Hg accumulation in rabbitfish *(Siganus canaliculatus)* by various elimination pathways: Simulation by a physiologically based pharmacokinetic model

藥代動力學模擬籃子魚對汞的低累積

Involved Member: Prof. Wenxiong WANG

魚體汞對人類健康構成巨大威脅，攝入含低汞的魚類(例如籃子魚)是平衡營養和減少汞暴露的一種解決方案。可是我們對籃子魚低汞累積的潛在機制仍不清楚。本研究通過建立藥代動力學(PBPK)模型，闡明在不同暴露途徑下籃子魚對無機汞(II)和甲基汞(MeHg)的排除方式。結果表明，有效的排出是籃子魚體內汞含量低的主要原因。經過水相Hg(II)，食物相Hg(II)和MeHg暴露後，汞的排出速率常數分別為0.060、0.065和0.020d^{-1}。通過量化籃子魚排出汞的可能途徑，我們的研究表明膽汁與糞便排泄在食物相汞的重要排出方式。雖然MeHg的膽汁排泄率非常高，每天的排泄量可達到 790 ng，膽汁中的大部分MeHg會被腸道重新吸收，再循環返回肝臟，導致在魚體內的逗留時間延長。此外，魚鰓排泄是水相Hg(II)的主要排出方式，說明籃子魚對不同暴露途徑的汞有不同的排出機制。本研究對了解籃子魚維持低汞含量的獨特方式提供了重要見解。



以上工作於2020年5月發表在期刊*Environmental Science & Technology*，第一作者為 Wang, X，通訊作者為香港城市大學王文雄教授。

Mercury (Hg) in fish poses great threat to human health. Consumption of low-Hg-level fish species (e.g. rabbitfish, *Siganus canaliculatus*) could be one possible solution to balance the nutrient benefits and Hg exposure. However, the underlying mechanisms for the low Hg accumulation in rabbitfish remain unclear. This study quantitatively described the disposition of inorganic Hg(II) and methylmercury (MeHg) in rabbitfish under different exposure routes by constructing a physiologically based pharmacokinetic (PBPK) model. The results strongly suggested that effective elimination (estimated rate constant of 0.060, 0.065 and 0.020 d^{-1} for waterborne Hg(II)-, dietary Hg(II)- and MeHg-exposed fish, respectively) was the main reason for the low Hg accumulation in rabbitfish. By quantifying the possible pathways for Hg elimination, our study revealed that biliary coupled with fecal excretion played an important role in the elimination of dietary Hg. Although biliary excretion rate for MeHg was remarkable (6.8±2.2 d^{-1}) and the excreted amount per day could reach up to 790 ng, most of the MeHg in the bile was re-absorbed by the intestine and transferred back to the liver through enterohepatic circulation, leading to a prolonged retention time in fish body. Moreover, branchial excretion dominated the Hg(II) elimination following aqueous exposure, suggesting a flexible alteration on elimination pathways against different exposure scenarios. The present study provided important understanding of the unique strategies adopted by rabbitfish to maintain the low Hg levels.

Reference:

Wang, X. and **Wang, W.X.** (2020). **Determination of the low Hg accumulation in rabbitfish (*Siganus canaliculatus*) by various elimination pathways: Simulation by a physiologically based pharmacokinetic model.** *Environmental Science & Technology,* 54(12), 7440-7449.

State Key Laboratory of Marine Pollution (City University of Hong Kong) leading an international team to identify priority research questions and address pressing environmental and health issues in Asia

香港城市大學海洋污染國家重點實驗室領導的國際團隊甄別出亞洲環境的優先研究問題，並致力於解決其中最為緊迫的環境與健康問題

Involved Member: Prof. Kenneth Mei Yee LEUNG

亞洲擁有約46億人口，佔2020年全球78億人口的一半以上，對自然資源和生態環境構成了巨大壓力。聯合國預測，到2030年，亞洲將成為全球城市固體廢物的主要產生區域。亞洲的空氣、土壤和水污染以及食品安全問題一直面對重大挑戰。

Asia is a home for around 4.6 billion people, making up more than half of the world's population of 7.8 billion in 2020 and putting enormous pressure on natural resource and the environment. The United Nations have predicted that Asia will become the leading generator of global municipal solid waste by 2030. Air, soil and water pollution as well as food safety are consistently great challenges in this region.

2015年，環境毒理及化學協會(SETAC)發起「全球前瞻掃描項目」(GHSP)，旨在甄別全球最優先的環境質量和健康問題。此前，該項目已在歐洲、拉丁美洲、北美洲和大洋洲進行。最近，亞洲的工作亦已完成，相關出版物已發表。

The Global Horizon Scanning Project (GHSP) was launched in 2015 by the Society of Environmental Toxicology and Chemistry (SETAC) to identify top priority environmental quality and health issues around the world. This project has been carried out in Europe, Latin America, North America, and Oceania. This Asian effort and associated publication were recently accomplished.

亞太地區SETAC由500多名從事環境科學、環境工程、環境公共衛生和管理、以及化學品可持續利用的專業成員組成。作為GHSP的一部分，SETAC亞太地區的小組成員應邀提出領域中最重要的研究問題。通過嚴格社會科學的甄別過程，由亞洲研究人員、政府機構和環保企業領導人組成的一個多學科團隊共同確定了亞洲面臨的23個優先研究問題，旨在解決這些緊迫的環境質量問題，並實現亞洲的可持續性發展。

The SETAC Asia-Pacific Geographic Unit consists of over 500 professional members working in environmental science, environmental engineering, environmental public health and management, as well as sustainable use of chemicals. As part of the GHSP, members of SETAC Asia-Pacific Geographic Unit were invited to suggest top priority research questions in these fields. Through a rigorous social science process, a multidisciplinary team of Asian researchers, government agencies and businesses leaders jointly identified 23 priority research questions for Asia with a view to tackling these pressing environmental quality issues and achieving sustainability in this region **(Image 1; Table 1)**.

這項國際合作研究結果最近於國際學術期刊《*Environmental Toxicology and Chemistry*》中發表。香港城市大學海洋污染國家重點實驗室(SKLMP)主任兼化學系講座教授梁美儀教授是這項重要工作的領導者之一。梁教授說：「隨着亞洲人口和污染問題的日益嚴重，我們的環境面臨着前所未有的挑戰，需要通過綜合環境政策和創新科技來解決。亞洲GHSP的研究成果將為區內研究人員、資助機構和監管部門提供關鍵優先研究問題和知識空缺。希望我們的合作研究成果將有助於加快建立切實可行的解決方案，以改善亞洲的環境質量和促進可持續發展。」其他環保專家也分享了梁教授對GHSP工作影響的看法。

The results of this international effort have been published in the journal *Environmental Toxicology and Chemistry.* Professor Kenneth Leung Mei Yee, Director of State Key Laboratory of Marine Pollution (SKLMP), Chair Professor of Department of Chemistry, City University of Hong Kong, is one of the leaders for this important Asian endeavour. Leung states that, "With the growing population and pollution problems in Asia, our environments are facing unprecedented challenges that require innovative and integrative solutions through environmental policy, science and technology. Outcomes of this Asia GHSP will beneficially inform the researchers, funding agencies, and regulatory authorities regarding key research priorities and knowledge gaps in the region. We hope that our efforts will help accelerate the establishment of practical solutions for improving the environmental quality and promoting sustainability in Asia." His sentiments concerning the impact of the GHSP effort are shared by others.

Image 1: A multidisciplinary team of Asian researchers, government agencies and businesses leaders jointly identified 23 priority research questions for Asia via the GHSP.

GHSP項目的主持者、美國貝勒大學環境科學學院傑出教授Bryan Brooks回應說：「是次國際團隊提出的優先環境問題為實現更可持續的環境質量創建了一條及時而重要的研究路線圖，這對於我們共同保護人類健康、生物多樣性和生態系統服務是必不可少的。」

"The priority questions presented by Leung et al. (2020) create a timely and important research roadmap towards achieving more sustainable environmental quality, which is necessary as we work together to protect human health, biodiversity and ecosystem services." remarked by Professor Bryan Brooks, Distinguished Professor of Environmental Science and Biomedical Studies at Baylor University in the US, who has shepherded the GHSP.

SETAC全球行政總監 Charles Menzie 博士說：「SETAC為能夠支持這個國際項目感到非常自豪。SETAC亞太成員發表的這篇文章非常及時，並為將來的研究提供了方向。我祈望他們的研究成果會轉化成切實可行的解決方案，例如環境政策和國際合作等。」

"SETAC is very proud to have supported this international project. This publication by SETAC Asia-Pacific members is very timely and gives direction for future research. I hope their outcomes will turn into tangible solutions like environmental policy and international collaboration" said Dr. Charles Menzie, Global Executive Director of SETAC.

SETAC亞太地區主席、中國暨南大學環境學院遊靜教授補充說：「當中不少甄選的研究問題針對聯合國的可持續發展目標，同時亦有一些問題專門針對亞洲地區的需要。我們的研究工作為解決區域環境問題鋪平了道路。我也希望這項倡議能促進更多的國際合作。」

"Many of the identified research questions address the United Nations' Sustainable Development Goals, while some questions are specific for the Asian region. Our efforts pave the way for resolving the regional environmental problems. I also hope this initiative will escalate more international collaboration." supplemented by Professor Jing You, School of Environment, Jinan University in China, and the President of SETAC Asia-Pacific Geographic Unit.

香港城市大學SKLMP前主任、胡梁子慧講座教授林群聲對此國際項目表示祝賀。林教授說：「雖然解決這些優先研究問題並不容易，相信集合國際力量我們能進一步改善亞洲的環境質量，實現更可持續發展。我很高興我們的SKLMP參與了這一至關重要的工作。」

Professor Paul Lam, Former Director of SKLMP and Jeanie Hu Chair Professor of Science, City University of Hong Kong congratulated this international project. Lam added "Answering these priority research questions will not be easy, but this is prerequisite to achieve more sustainable environmental quality in Asia. I am very glad that our SKLMP has been part of this vital process."

The published article:

Leung, K.M.Y., Yeung, K.W.Y., You, J., Choi, K.H., Zhang, X.W., Smith, R., Zhou, G.J., Yung, M.M.N., Arias-Barreiro, C., An, Y.J., Burket, S.R., Dwyer, R., Goodkin, N., Hii, Y.S., Hoang, T., Humphrey, C., Iwai, C.B., Jeong, S.W., Juhel, G., Karami, A., Kyriazi-Huber, K., Lee, K.C., Lin, B.L., Lu, B., Martin, P., Nillos, M.G., Oginawati, K., Rathnayake, I.V.N., Risjani, Y., Shoeb, M., Tan, C.H., Tsuchiya, M.C., Ankley, G.T., Boxall, A.B.A., Rudd, M.A., Brooks, B.W. (2020). **Towards sustainable environmental quality: Priority research questions for Asia.** *Environmental Toxicology and Chemistry,* 39(8), 1485-1505. Link to the article: https://setac.onlinelibrary.wiley.com/doi/full/10.1002/etc.4788

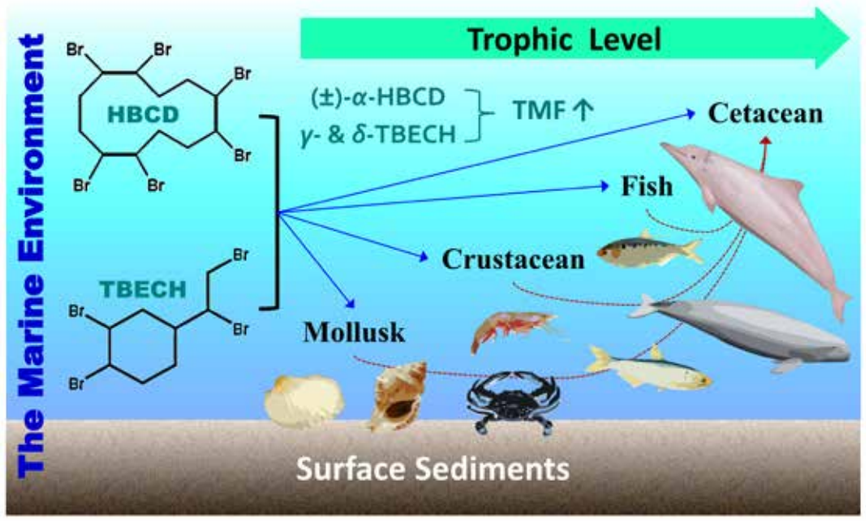
Table 1: The 23 priority questions identified by the Asian GHSP among four themes.

1	How do we develop broad screen analytical methods integrating non-target directed analysis for identifying key chemical stressors responsible for observed toxicity?
2	How do we develop methods to identify and quantify nano- and microplastics in different environmental compartments (water, sediment, soil, biota) associated with potential toxicity or interactions with other contaminants?
3	What are the terrestrial and aquatic risks of atmospheric contaminants in Asia?
4	How can we improve methods to classify, identify and separate nano-materials contaminants from their bulk counterparts and differentiate effects caused by nano-materials in the environment?
5	How can we better use field data and incorporate new big data (e.g., ecological genome) approaches for improving ecological risk assessments and decision making?
6	How can we develop and advance laboratory (e.g., *in vitro, in vivo,* analytical) and theoretical (toxicokinetic, toxicodynamic) approaches to understand (prospective, retrospective) adverse outcomes of complex chemical mixtures (e.g., pesticides, surfactants, medicines, metals)?
7	How we can improve the current approaches to assess and manage risks of micro-pollutants and emerging contaminants?
8	How can we integrate high throughput screening with next generation computational toxicology tools to support hazard and risk assessment of individual chemicals and complex mixtures?
9	How can we develop advanced biological tools to better understand and predict toxic mechanisms and interactions across species in multiple highly biodiverse compartments for risk assessment and management of chemical contaminants in Asia?
10	How can we analyse big data and develop effective risk communication approaches (e.g., report card system, real-time reporting) for environmental status (e.g., ecosystem functions and services)?
11	How can we use new developments in nanoscience and nanotechnology to advance ecotoxicological research?
12	How can we strengthen the environmental quality criteria system (e.g., water, sediment, soil, air) to adequately protect ecosystems that are experiencing multiple stressors and changing climate?
13	What are the influences of changing landscapes and climate change on the resilience of terrestrial and aquatic ecosystems, and how do we measure the ecological endpoints with reference to chemical pollution?
14	How can we develop an integrative and effective framework (e.g., environmental policy, green technologies) to manage nutrient loading and associated hypoxia in Asia?
15	How will changes to physicochemical characteristics (e.g., salinization/ion imbalance, pH, temperature, hypoxia due to enrichment) alter bioavailability and effects of chemical stressors in the environment?
16	How can we prioritize and apportion chemical stressors in complex scenarios to guide restoration efforts?
17	How can we identify adverse impacts of multiple stressors in the field to biodiversity (including multigenerational, evolutionary, and developmental), ecosystem services, and human health?
18	To what extent is seawater pH in South-East Asia impacted by terrestrial inputs (e.g., organic carbon, nutrients, other anthropogenic sources such as mining), how are these inputs changing due to human activities (including CO_2), and how does this affect vulnerable coastal ecosystems such as coral reefs?
19	How can we develop new technology and promote green chemistry for enhancing reuse of waste and preventing environmental impacts?
20	Given increasing population growth and per capita demand for seafood in Asia, how can we develop sustainable aquaculture practices while protecting environmental quality, particularly in coastal waters?
21	How can we develop innovative solid waste management programs to protect environmental quality, particularly in rural areas of less developed regions in Asia?
22	What is the extent of antibiotic pollution in the environment and associated risks of antibiotic resistance in rural and urban regions of Asia?
23	How can we develop sustainable development frameworks (e.g., green chemistry) to address, balance and manage the production (e.g., food production, forestry) and protection of ecosystem services?

Environmental occurrence, transport, fate, spatiotemporal trend, and ecological risk assessment of emerging chemicals of concern in the Pearl River Estuary and South China Sea

新興有機污染物在珠江口和南海的環境賦存、遷移、歸趨、時空變化以及生態風險評估

Involved Members: Prof. Paul Kwan Sing LAM, Dr. James Chung Wah LAM

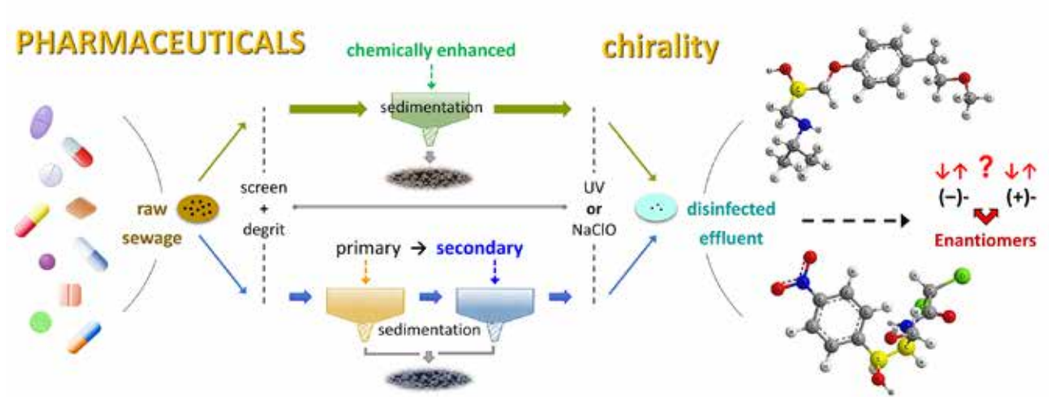


新興有機污染物(ECCs)涵蓋了廣泛種類的人造化學品，這些化學物質正在全球範圍內使用，而且它們對於現代社會而言是必不可少的。傳統環境污染物多為持久性有機污染物(POPs)，它們被逐步淘汰，導致了化學替代品的補償性生產和使用，這些替代品中很大一部分不可避免地釋放到環境中而成為了ECCs。其中一些替代品的毒性已被證實與傳統化學品相當，甚至更高，其中許多屬於內分泌幹擾物和致癌物質。ECC還包括藥物和個人護理品(PPCPs)、藻毒素、納米顆粒等，它們已在環境中被檢測到，有機會(在低濃度下)對生態和人類健康造成影響，且通常不受當前環境法規的管制。大多數ECCs的環境資料是有限的，相關的分析方法仍有待建立和完善。由於過去幾十年來珠江三角洲的重工業化和城市化進程，該地區已發現了高濃度的多種傳統環境污染物，這些污染物被釋放到珠江口，最終進入南海造成污染。

Emerging chemicals of concern (ECCs) encompass a wide range of man-made chemicals that are in use worldwide and indispensable for modern society. The phasing out of many legacy environmental pollutants, most of which are persistent organic pollutants (POPs), has resulted in the compensatory production and use of their alternatives, and these replacements constitute a large part of ECCs, being inevitably released into the environment. The toxicities of some of these replacements are evidenced to be comparable or even higher than the legacy chemicals, many of which are endocrine-disrupting and carcinogenic chemicals. ECCs also include pharmaceuticals and personal care products (PPCPs), phycotoxins, nanoparticles, etc. that have been detected in the environment and may cause ecological and human health impacts (at low levels), which typically are not regulated under current environmental legislations. Environmental data on the majority of ECCs are limited, and relevant analytical methods are not well established. Due to heavy industrialization and urbanization in the Pearl River Delta over the past decades, high levels of recalcitrant pollutants have been reported in this region, which were eventually released to the Pearl River Estuary and ended up in the South China Sea.

有鑑於此，我們開發了氣相色譜-質譜(GC-MS)和液相色譜-三重四極杆質譜(LC-MS/MS)分析方法，用於同時測定新興手性鹵化阻燃劑(HFRs)的16種立體異構體以及3種治療類別涵蓋22種立體異構體的手性PPCPs的痕量分析，這些新方法首次在全球範圍內被報導。憑藉這些方法，我們調查了香港不同污水處理系統中手性HFRs和PPCPs的賦存、質量平衡、歸趨和季節性變化，並初步鑒別了由微塑膠所承載的手性HFRs含量；我們還研究了珠江口和香港水域亞熱帶海洋食物網中這些手性ECCs的立體異構體特異性營養級動力學。我們的發現表明，HFRs和PPCPs這兩組ECCs廣泛分佈於被調查的地區的各種環境基質中，包括污水、污泥、海水、沉積物和海洋生物中。在所調查的食物網中，手性HFRs表現出營養級放大性，而手性PPCPs則展現出營養級稀釋性；香港居民，尤其是兒童，若攝入所調查的海產品，可能會面臨暴露於HFR的健康風險。

In the light of the above, we developed and validated gas chromatography–mass spectrometry (GC–MS) and liquid chromatography–triple quadrupole mass spectrometry (LC–MS/MS) methods for the simultaneous determination of 16 stereoisomers of novel chiral halogenated flame retardants (HFRs) and for the trace analysis of chiral PPCPs from 3 therapeutic classes covering 22 stereoisomers, which were reported for the first time worldwide. Using these methods, we investigated the seasonal occurrence, mass balance, and fate of chiral HFRs and PPCPs in different sewage treatment systems in Hong Kong, where a preliminary screening of chiral HFRs transported by microplastics was also conducted; we also applied these methods to study the stereoisomer-specific trophodynamics of these chiral ECCs in a subtropical marine food web in the Pearl River Estuary and Hong Kong waters. Our findings revealed that two groups of ECCs, HFRs and PPCPs, were widespread in the investigated region, present in sewage, sludge, seawater, sediment, and marine biota; chiral HFRs exhibited trophic magnification in the investigated food web, while chiral PPCPs underwent trophic dilution; Hong Kong residents, especially children, might undergo high health risk due to dietary exposure to HFRs via seafood consumption.



我們運用四極杆飛行時間質譜(QTOF)技術，開發了疑似/非靶標篩查分析方法，用於發現種類更為廣泛的新型和未知全氟和多氟烷基物質(PFASs)；憑藉這種方法，我們研究了南海兩種本土海洋哺乳動物中傳統和新興PFASs的污染狀況和濃度隨時間的變化趨勢，並鑒定了額外9種類別的44種PFASs，當中有15種PFASs被首次報導存於海洋生物中；一種新興的PFAS，6：2氯化多氟烷基醚磺酸鹽，在中國白海豚和江豚體內濃度呈逐年上升趨勢，並且可能對大多數被調查的鯨類動物造成生殖傷害方面的不利影響。

We developed and validated analytical procedures and applied suspect/non-target screening techniques using quadrupole time-of-flight mass spectrometry (QTOF) for a much wider range of new/unknown perfluoroalkyl and polyfluoroalkyl substances (PFASs); using this method, we investigated the pollution status and temporal trends of legacy and emerging PFASs in two species of resident marine mammals from the South China Sea, and 44 PFASs from 9 classes were additionally identified by QTOF, among which 15 compounds were reported for the first time in marine wildlife; an emerging PFAS, 6:2 chlorinated polyfluoroalkyl ether sulfonate, exhibited increasing temporal trends of levels in Chinese white dolphins and finless porpoises, and could have possible adverse effects in terms of reproductive injury potential on most of the investigated cetaceans.

上述的研究成果均有助於更好地理解ECCs對於生態和人類健康風險的機理和影響，並有助於為保護中國南方沿海環境而提出相應的監管措施。

All these works can benefit the understanding of the contribution and significance of ECCs as a hazard to ecological and human health, and help propose regulatory measures to protect coastal environments of south China.

Reference:

Ruan, Y., Wu, R., **Lam, J.C.W.**, Zhang, K., **Lam, P.K.S.** (2019). **Seasonal occurrence and fate of chiral pharmaceuticals in different sewage treatment systems in Hong Kong: Mass balance, enantiomeric profiling, and risk assessment.** *Water Research,* 149, 607–616.

Assessment of the coral health of *Platygyra carnosa* through *in-situ* and *ex-situ* measurements of metabolic rates

通過原位和異位的代謝率測量來評估肉質扁腦珊瑚的健康狀態

Involved Member: Dr. Leo Lai CHAN

水下視覺監測方法被廣泛應用於評估自然環境中的珊瑚礁狀況，但是對珊瑚共生體的定量測量在很大程度上僅限於共生生物的光合生理評估。雖然可用於在珊瑚表面進行常規並可重複操作的非侵入式的水下呼吸測量儀器已完成設計，但該設備的實際原位精度和精確度尚未被嚴格評估。如果這些測量對量化珊瑚代謝的季節和空間模式有幫助，評估則必不可少。我們為此系統開發了特定的實驗流程，以調查淺層珊瑚群落和檢測其代謝活動（呼吸，光合作用和生物鈣化）、晝夜循環以及光合作用-輻照度曲線。對原位和實驗室控制環境下的進修的數據分析表明，該呼吸測定係統對珊瑚群落的測量精準，並且在15分鐘的培養時間內可以高精度測量溫度、氧氣含量和酸鹼值通量，而同時對珊瑚健康無明顯不良影響。此外，雖然在河口影響和沿海海洋環境中的珊瑚的外觀或其他健康指標上沒有顯著差異，但兩者的珊瑚鈣化率存在明顯差異。這表明該系統有可能及早發現邊緣不良條件對珊瑚代謝的影響。

Underwater visual monitoring methods are used broadly to evaluate coral reef conditions in the natural environment, but quantitative measurements of the coral holobiont has been largely restricted to photo-physiological assessment of the endosymbionts. An underwater respirometer has been designed to make routine, diver-operated, non-invasive measurements at coral surfaces, but the realistic *in situ* accuracy and precision capabilities of this device have not been critically assessed; an essential step if these measurements are to be useful for quantifying spatial and seasonal patterns of coral metabolism. We developed specific protocols for this system to survey shallow coral colonies and detect metabolic profiles (respiration, photosynthesis, and biocalcification), diel cycles (day and night), and photosynthesis-irradiance curves. Analysis of data from *in situ* and laboratory-controlled conditions showed good agreement among coral colonies and high precision measurements of temperature, oxygen and pH fluxes over 15-min incubation times without noticeable detrimental effects on coral health. Moreover, marked differences were observed in coral calcification rates between estuarine-influenced and coastal marine conditions, despite the absence of significant differences in visual appearance or other health indicators, revealing the system's potential for early detection of marginally adverse conditions for coral metabolism.

耐脅迫的珊瑚物種(如扁腦珊瑚，*Platygyra* spp)被認為非常適合在邊緣珊瑚礁中生存，但是人們對它們短期暴露於異常高溫和鹽度降低的生理反應仍然知之甚少。通過使用非侵入性技術定量評估了肉質扁腦珊瑚 (*Platygyra carnosa*) 的健康狀況(例如呼吸、光合作用、生物鈣化和白化程度)，我們確定了其能量的可塑性和生理極限。儘管這些指標表明它可以在較高的溫度(25–32°C)下生存，但其總體能量在溫度大於30°C時會嚴重降低。相反，它很好地適應了低鹽度的海水(31–21 psu)，但生物鈣化卻降低了，表明其能短期適應由降水量和強度增加導致的鹽度變化。

我們的發現為氣候因素對肉質扁腦珊瑚代謝的影響提供了進一步的認識，從而更好地預測了未來氣候變化情景下其健康狀況的變化。它的簡單操作和對珊瑚生理狀態的快速量化使該呼吸計非常適合研究者、監測機構和相關珊瑚保護工作者使用。此外，這些高時空解像度的數據將有可能把局部壓力源對珊瑚健康的影響與氣候因素帶來的廣泛變化所產生的影響區分開來。

Stress-tolerant coral species, such as *Platygyra* spp., are considered to be well adapted to survive in marginal reefs, but their physiological response to short term exposure to abnormally high temperature and lowered salinity remains poorly understood. Using non-invasive techniques to quantitatively assess the health of *Platygyra carnosa*, we identified the plasticity of its energetics and physiological limits. Although these indicators suggest that it can survive at high temperature (25–32 °C), its overall energetics were seriously diminished at temperatures >30 °C. In contrast, it was well adapted to hyposaline waters (31–21 psu) but with reduced calcification, indicating a short-term adaptation for expected future changes in salinity driven by increased amounts and intensities of precipitation.

Our findings provide useful insights to the effect of these climate drivers on *P. carnosa* metabolism and thus better forecast changes in their health status under future climate change scenarios. The ease of operation and rapid quantification of the physiological status of the corals make the underwater respirometer well suited for use by reef scientists, monitoring agencies, and stakeholders in biogenic reefs conservation efforts. Moreover, the high spatial and temporal resolution of these data will have the potential to discriminate the effects of local stressors on coral health from those generated by broader changes associated with climate drivers.



References:

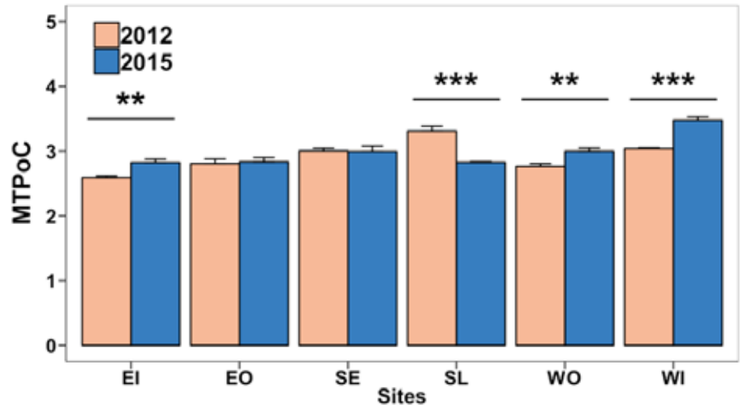
1. Dellisanti, W., Tsang, R.H.L., Ang, P., Wu, J.J., Wells, M.L. and **Chan, L.L.** (2020). **A Diver-Portable Respirometry System for in-situ Short-Term Measurements of Coral Metabolic Health and Rates of Calcification.** *Frontiers in Marine Science,* 7, 571451.

2. Dellisanti, W., Tsang, R.H.L., Ang, P., Wu, J.J., Wells, M.L. and **Chan, L.L.** (2020). **Metabolic performance and thermal and salinity tolerance of the coral Platygyra carnosa in Hong Kong waters.** *Marine Pollution Bulletin,* 153, 111005.

Stable-isotope based trophic metrics reveal early recovery of tropical crustacean assemblages following a trawl ban

基於穩定同位素的營養學指標揭示了甲殼類動物群落在實施禁止拖網捕魚後的早期復甦跡象

Involved Member: Prof. Kenneth Mei Yee LEUNG



Mean trophic positions of carnivorous crustaceans (MTPoC; mean + SEM) at the six sites in 2012 and 2015. Significant differences between years are indicated by asterisks: ** p<0.01 and *** p<0.001. Site abbreviations are described as: inner Tolo Channel (EI), outer Tolo (EO), south-eastern water (SE), southern Lamma Island (SL), outer Pearl River estuary (WO) and inner Pearl River estuary (WI).

香港六個採樣水域中的捕食類甲殼動物群落的平均營養級 (2012 vs. 2015)。年份間的顯著差異用星號表示：** p<0.01 和 *** p<0.001。採樣水域的縮寫：吐露港內部水域(EI)、吐露港外部水域(EO)、東南水域(SE)、南丫島附近水域(SL)、近珠江口西面水域(WI)以及遠珠江口西面水域

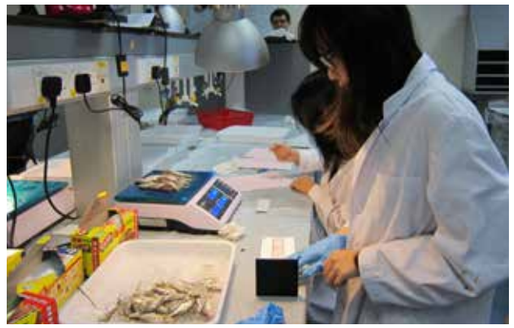
自1970年以來，過度的捕魚，包括以拖網以及其他方式的捕撈作業，不僅令香港漁業資源枯竭，更破壞了底棲生物的生境。為恢復香港枯竭的漁業資源，特區政府於2012年12月31日頒令永久禁止在本港水域內以拖網方式捕魚。本研究通過評估穩定同位素以及傳統的群落指標，監測香港海洋底棲甲殼類動物群落在禁令實施三年後的復甦跡象。研究結果表明，禁令實施後海洋底棲甲殼類動物的總密度和物種多樣性並無顯著變化，但是生物量卻減少。基於穩定同位素指標，研究發現在所有採樣地點的甲殼類動物群落生態位在禁令實施後都有所增加。與此同時，東西部水域中四個採樣點的食物鏈變得更長，其中三個採樣點的捕食類甲殼動物群落的平均營養級也顯著增加。相反，這兩個穩定同位素指標在南部水域的兩個採樣點都顯著下降。

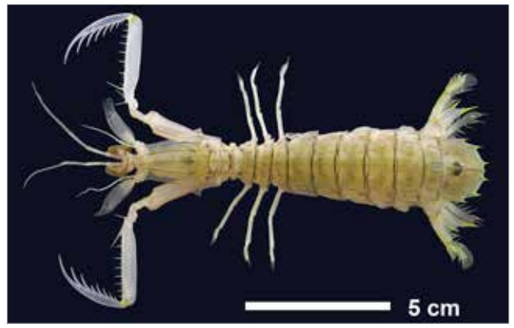
Fisheries resources in Hong Kong have been overexploited since the 1970s due to intensive bottom trawling and other fishing activities that have depleted stocks and destroyed marine habitat. To rehabilitate depleted fisheries resources, a permanent ban on trawling Hong Kong territorial waters came into force on December 31, 2012. This study used isotope-based metrics, in addition to traditional community measurements, to determine whether benthic crustacean assemblages had shown any signs of recovery three years after the trawl ban. In general, there were no changes in assemblage total abundance or species richness after the trawl ban, but a decrease in biomass was observed. Isotope-based metrics showed that trophic niches of the crustacean assemblages were, however, broader at all sites after the ban. The food chain length (FCL) at four sites in the eastern and western waters were longer after the ban, and three of them also showed increased mean trophic positions of carnivorous crustacean (MTPoC). In contrast, declines in FCL and other trophic metrics were recorded at the two southern sites.

本研究通過穩定同位素指標發現了傳統的群落指標所無法探究的甲殼類動物群落的初期復甦跡象。這一研究結果表明如果僅用傳統的群落指標來評估禁止拖網捕魚，我們可能會低估這禁令的效力。因此，我們建議將穩定同位素指標與傳統的群落指標相結合，以便更全面地評估生態系統在人為干擾以及管理干擾措施下的響應。

以上工作與2020年6月發表於*Ecological Indicators*期刊，香港城市大學博士後陶世如為第一作者，其導師梁美儀教授為通訊作者。

By using isotope-based trophic metrics, we detected early functional recovery of the crustacean assemblages that cannot be revealed by traditional community analyses, implying that the effectiveness of the trawl ban would be underestimated if the assessment was based on community measurements only. We, therefore, advocate the use of isotope-based trophic metrics in tandem with the community measurements for more comprehensive assessments of ecosystem responses to anthropogenic disturbances and management interventions designed to alleviate them.





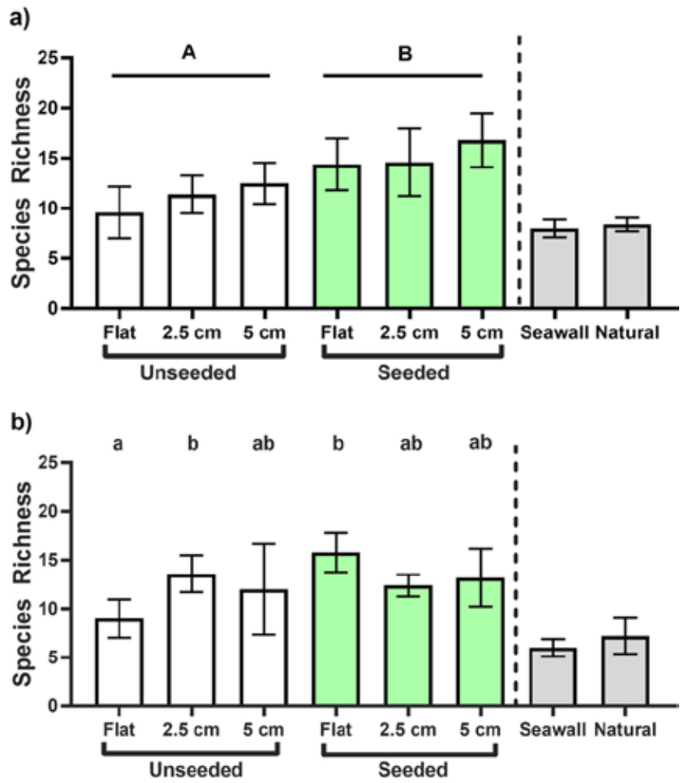
Reference:

Tao, L.S.R., Lui G.C.S., Wong, K.J.H., Hui T.T.Y., Mak Y.K.Y., Sham R.C.T., Yau J.K.C., Cheung W.W.L., **Leung, K.M.Y** (2020). **Does a trawl ban benefit commercially important Decapoda and Stomatopoda in Hong Kong waters?** *Ecosystem.* https://doi.org/10.1007/s10021-020-00574-9

Provision of refugia and seeding with native bivalves can enhance biodiversity on vertical seawalls

提供庇護所和播種本地雙殼貝類可以提高直立式海堤的生物多樣性

Involved Member: Prof. Kenneth Mei Yee LEUNG



Mean species richness (i.e., number of species) of mobile species on experimentally enhanced tiles (Flat, 2.5 cm, 5.0 cm) after 12 months using destructive sampling data in: a) Lok On Pai and b) Sham Shui Kok. Control seawall and reference natural sites using *in-situ* observations are shown for reference.

放置12個月後實驗磚塊（光滑、2.5 cm坑紋、5.0 cm坑紋）上的平均游動物種豐富度（即物種數量），a) 樂安排地區 b) 深水角地區。控制組海堤和天然區域的現場調查結果作為參照。

近期多項研究表明，改變人工海堤表面異質性可以增加生境的複雜性，進而增加可利用生境，提高物種的豐富度和數量。我們測試了不同異質性條件(模擬傳統海堤的光滑磚塊與存在2.5cm或5.0cm坑紋的磚塊)及是否播種本地石蠔(僧帽牡蠣*Saccostrea cucullata*)條件下的複雜磚塊對於潮間帶物種豐富度和數量的影響。該實驗在香港兩處直立式海堤上進行，磚塊被固定在海堤的中潮區部位12個月。結果顯示，有坑紋的磚塊比光滑磚塊具有更高的固著底上生物的物種豐富度和覆蓋度；播種了僧帽牡蠣的磚塊也能促進該物種的自然增殖。我們的研究可以證明，使用生態工程增加生境複雜性可以有效增加海堤上的潮間帶海洋生物多樣性。

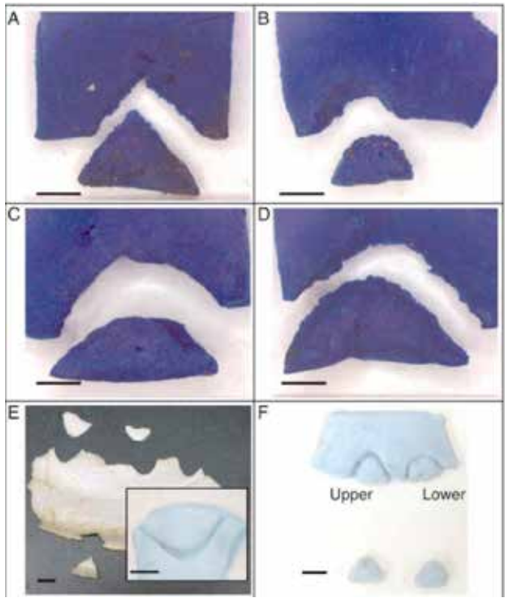
Recent studies have suggested that increasing habitat complexity of artificial seawalls by modifying surface heterogeneity could enhance exploitable habitat and therefore species richness and abundance. We tested the effects of adding complex tiles (with crevices/ledges) of different heterogeneity (i.e., flat tiles resembling the seawall vs. tiles with crevices of 2.5 cm or 5.0 cm depth) and seeding with native rock oysters, *Saccostrea cucullata* (unseeded vs. seeded) on species richness and abundances of intertidal marine organisms on two vertical seawalls in Hong Kong. Tiles were affixed to the mid-intertidal zone of the seawalls for 12 months. The results showed that the tiles with crevices had greater species richness and cover of sessile epifauna than flat tiles. Seeding tiles with *S. cucullata* also facilitated natural recruitment of the same species. Our results support the hypothesis that using eco-engineering to increase habitat complexity can effectively enhance the biodiversity of intertidal marine organisms on seawalls.

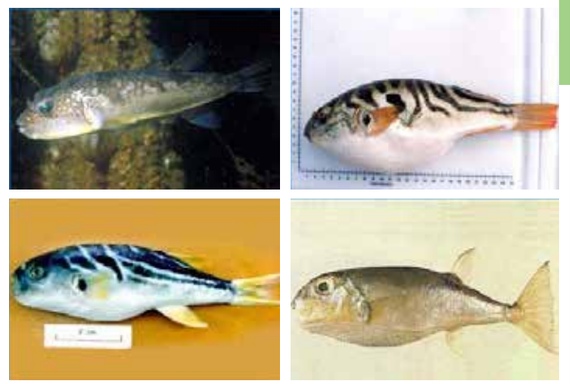
Reference:

Bradford, T.E., Astudillo, J.C., Lau, E.T.C., Perkins, M.J., Lo, C.C., Li, T.C.H., Lam, C.S., Ng, T.P.T., Strain, E.M.A., Steinberg, P.D., **Leung, K.M.Y.** (2020). **Provision of refugia and seeding with native bivalves can enhance biodiversity on vertical seawalls.** *Marine Pollution Bulletin,* 160, 111578.

Characterisation of an unexplored group of microplastics from the South China Sea: Can they be caused by macrofaunal fragmentation?
中國南海未被研究的一組微塑料的特徵：它們可能是由大型動物造成的嗎？

Involved Members: Dr. Siu Gin CHEUNG, Dr. Ball Keng Po LAI





Source from: HK Fish Net, AFCD
https://www.hk-fish.net/english/home/index.html

塑料碎片化的研究對於估算微塑料的含量很重要，但對於造成塑料碎片化的生物學原因則尚未被發現。從香港海灘收集的微塑料中，我們發現了一種以前從未被報告過的異常類型碎片。這些碎片約佔所收集的微塑料的6%(顆粒狀、泡沫橡膠、珠狀、碎片狀)，形狀呈三角形，三個側面中的至少兩面是直的，並且類似於透過擠壓形成的切口。我們將這些「被修剪過的三角形碎片」與那些隨機斷裂的三角形碎片通過客觀觀察區分開，通過與其他證據進行比較，我們相信這些「修剪過的碎片」是被大型動物咬碎的子碎片。由於動物主動咬碎通常不被認為是塑料破碎的因素，因此如果假設屬實，對於微塑料的塑料碎片化的建模研究將具有重大意義。

以上工作於2020年4月發表在期刊 *Marine Pollution Bulletin*，第一作者為 Po, B.H.K.，通訊作者為香港城市大學黎鏡波博士。

Research on plastics fragmentation is important for the estimation of amount of microplastics but the biological causes for fragmentation have not been acknowledged. From microplastics collected in beaches of Hong Kong, we revealed an abnormal type of fragment which has not been reported before. These fragments, composing about 6% of the microplastics (pellet, foam, bead, fragment) collected, were interestingly triangular in shape with at least two of the three sides being characteristically straight and resembling a cut made by compression. Objective observations have distinguished these “trimmed triangular fragments” to those triangular fragments that were fractured randomly. By comparing with additional evidence, we proposed that these trimmed fragments were the daughter pieces of macrofaunal biting. If this was so, there would be wide implications on fragmentation modeling studies for microplastics since active biting of large plastic debris has generally not been considered as a factor of plastics fragmentation.

Reference:

Po, B.H.K., Lo, H.S., **Cheung, S.G.** and **Lai, K.P.** (2020). **Characterisation of an unexplored group of microplastics from the South China Sea: Can they be caused by macrofaunal fragmentation?** *Marine Pollution Bulletin,* 155, 111151.

Coral reef diversity losses in China's Greater Bay Area were driven by regional stressors

區域環境脅迫導致中國大灣區內珊瑚礁多樣性的衰退

Involved Members: Prof. Jianwen QIU, Dr. Moriaki YASUHARA

Source from:
https://advances.sciencemag.org/content/6/40

我們海洋污染國家重點實驗室(SKLMP)的兩位成員，Dr. Moriaki Yasuhara (香港大學生物科學學院與太古海洋研究所(SWIMS))和邱建文教授(香港浸會大學生物系) 於Science Advances合作發表一篇重要研究論文，報導含香港在內的中國大灣區(Greater Bay Area, GBA)內的珊瑚變遷歷史。本研究由太古海洋研究所博士生Mr. Jonathan Cybulski (同時Mr. Cybulski也是一名國家地理探險者)和他的導師David Baker博士主持完成。研究團隊首次調查大灣區珊瑚群落的歷史分佈，通過研究發現過去幾十年大灣區曾發生珊瑚群落嚴重的大範圍衰退和多樣性喪失。他們測量了從香港周邊11個樣點收集的珊瑚化石並建立了大灣區首個珊瑚群落古生態基線。他們通過研究揭示了在受到大量人為干擾前大灣區的珊瑚群落多樣性，包括以下幾個屬：*Acropora, Montipora, Turbinaria, Psammacora, Pavona, Hydnophora, Porites, Platygyra, Goniopora and Faviids*。最為重要的是，本研究表明歷史珊瑚群落衰退可能與水質污染和近岸開發導致的生境喪失有關。此研究的結果表明漸增的開發項目所導致的水質變差和缺乏適當處理措施是目前對大灣區珊瑚生存最大的威脅。

以上成果發表在于2020年10月發表在*Science Advances*，第一作者為 Jonathan Cybulski，通訊作者為David M. Baker博士。

Our members of SKLMP, Dr. Moriaki Yasuhara (School of Biological Sciences and Swire Institute of Marine Science (SWIMS) of the University of Hong Kong) and Prof. Jianwen Qiu (Department of Biology, Hong Kong Baptist University) jointly published an important co-authored paper in *Science Advances* to report on the historical trend of corals in the marine environment of the Greater Bay Area (GBA) of China, including Hong Kong. This work was led by a PhD candidate and National Geographic Explorer, Mr Jonathan Cybulski and his supervisor Dr. David Baker from SWIMS. The research team, for the first time, investigated the historical presence of coral communities in GBA, revealing a catastrophic range collapse and loss of diversity that occurred in the last several decades. They examined fossil corals collected from over 11 sites around Hong Kong, and created the first palaeoecological baseline for coral communities in GBA. They uncovered what coral genera were present in the past well before major human impacts, and these coral genera include: *Acropora, Montipora, Turbinaria, Psammacora, Pavona, Hydnophora, Porites, Platygyra, Goniopora* and *Faviids*. Most importantly, this historical research showed that the historical collapses of the corals was likely due to water pollution and habitat loss associated with coastal development. Their results imply that poor water quality driven by increased development and lack of proper treatment is presently the greatest threat to the survival of corals in GBA.

Reference:

Cybulski, J.D., Husa, S.M., Duprey, N.N., Mamo, B.L., Tsang, T.P.N., **Yasuhara, M.**, Xie, J.Y., **Qiu, J.W.,** Yokoyama, Y. and Baker, D.M. 2020. **Coral reef diversity losses in China's Greater Bay Area were driven by regional stressors.** *Science Advances,* 6(40), eabb1046.

Research highlighted in scientific journal cover story / scientific news / press and media

Research highlighted in News Reports

Headline	Media	Date of Report
Dr. Siu Gin CHEUNG		
研究指「馬蹄蟹」誤吞膠粒會影響發育死亡率高達70%	香港東方日報網	2 Nov 2020
環保身開始：5mm 的威脅	RTHK	10 Oct 2020
綠色先鋒：濫捕絕鱟	香港東方日報網	2 Sep 2020
Hong Kong study finds hungry fish creating microplastics at faster rate than previously thought	South China Morning Post	10 Aug 2020
Dr. Brian Chin Wing KOT		
香港綠海龜誤食海洋垃圾	ECFriends 環保友	9 Dec 2020
	Tatler Hong Kong	Dec 2020
	South China MorningPost 南華早報	20 Nov 2020 22 Nov 2020 (Printed copy)
	BBC News Chinese BBC中文	17 Nov 2020
	HK01	28 Oct 2020
	TOPick hket.com	28 Oct 2020
	Headline Daily 頭條日報	27 Oct 2020
	Oriental Daily News 東方日報	27 Oct 2020
西貢發現稀有梭皮龜	Sky Post	8 May 2020
	TOPick hket.com	8 May 2020
	HK01	7 May 2020
	Oriental Daily News 東方日報	7 May 2020

Headline	Media	Date of Report
大嶼山海域七條中華白海豚陪伴幼豚屍體	Petsmao 寵毛網	22 Jun 2020
	Headline Daily 頭條日報	15 Jun 2020
	Sing Tao Daily 星島日報	15 Jun 2020
Dr. Chun Kit KWOK		
揭RNA與基因關係 城大教授奪裘槎科研獎	香港東方日報網	14 Apr 2020
	香港商報網	14 Apr 2020
	信報財經新聞	14 Apr 2020
Prof. Kenneth Mei Yee LEUNG		
科學家之路：「梁美儀教授對海洋科學與保育的熱情」 Ask Our Scientists: Leung's passion for marine science and conservation	Croucher Science Week	14 Dec 2020
"海洋健康保障與高質量創新發展" 論壇在中國海洋大學召開	現海聽濤 (news.ouc.edu.cn) http://news.ouc.edu.cn/2020/1128/c91a103549/page.htm	28 Nov 2020
海洋生物學專家梁美儀 回歸母校城大 推動跨大學科研全民保育海洋	東周刊	11 Nov 2020
Eco-engineered tiles for sea walls encourage sea life to return and thrive on the coast	The Engineering 360, powered by GlobalSpec (online international online media)	10 November 2020
城大「生態海堤」助生物多樣化	文匯報	6 Nov 2020
城大：海牆置「人工磚」改善海洋生態	大公報	6 Nov 2020
城大研人工磚塊豐富海堤生態	信報 StartupBeat 創科鬥室	6 Nov 2020
Eco-engineered tiles enhance marine biodiversity on seawalls	EurekAlert!	5 Nov 2020
	ScienceDaily	5 Nov 2020
研究發現人工生態組件有效提升海堤上的生物多樣性	香港商報網	5 Nov 2020
城大研究證海堤設人工生態磚可提升生物多樣性 數量最多增逾4倍	香港01	5 Nov 2020

Headline	Media	Date of Report
人工生態組件增海堤生物多樣性　吸引鰕虎魚海葵棲息	明報	5 Nov 2020
The radio programme "Future Tense with Antony Funnell" featured the episode entitled "Waste management: ingenuity, mindset and working with nature"	Australian Broadcast (ABC)	11 October 2020
中電與港燈支援海洋保育及漁業可持續發展 推出兩項資助計劃涉及港幣1億元	Topick (hket)	30 Sep 2020
貝類海鮮水產處理3注意　宜摘內臟除外殼 淡鹽水吐沙效果最佳	明報	10 Sep 2020
「人工海堤生態化」環節	香港電台電視《大氣候》	29 August 2020
The world's growing concrete coasts	BBC's Future Planet	12 August 2020
香港維多利亞港上世紀「臭港」變回「香港」的故事	BBC	22 July 2020
How Hong Kong cleaned up its toxic harbour	BBC	30 June 2020
梁美儀「守護海洋，守護孩子的未來」	《親子天地》395期 「人物專訪」	27 June 2020
「本地魚」環節	香港電台電視《日常8點半》	6 May 2020
港大發現防控蚊油污染海洋　吐露港水域超出安全值	東網	24 May 2020
蚊油危害海洋生物 吐露港海域濃度最高	晴報	24 May 2020
漁業提升基金 - 珍珠養殖試驗計劃	《香港機場管理局- 新聞》	23 May 2020
中華白海豚體內含高濃度毒性化合物 恐沿海洋食物鏈威脅人類健康	香港蘋果日報	12 March 2020
Prof. Tong ZHANG		
港大團隊擬檢測污水中新冠病毒助防疫	香港文匯網	8 Oct 2020

Academic Exchanges and Cooperation
學術交流與合作

Symposium on Environmental Capacity and Eco-dynamic Processes of Estuaries & 2020 Team Construction Meeting
河口灣環境容量與生態動力過程學術研討會暨2020年團隊建設推進會

南方海洋科學與工程廣東省實驗室(珠海)(以下簡稱南方海洋實驗室)“南海海岸帶變化與物質遷移”創新團隊(以下簡稱海岸帶團隊)於2020年11月7-8日在中山大學珠海校區舉辦了河口灣環境容量與生態動力過程學術研討會暨2020年團隊建設推進會。會議採用線上和線下兩種方式相結合，來自國(境)內外的科研院校及相關行業科研部門的近百名專家學者和師生共同參加了會議。

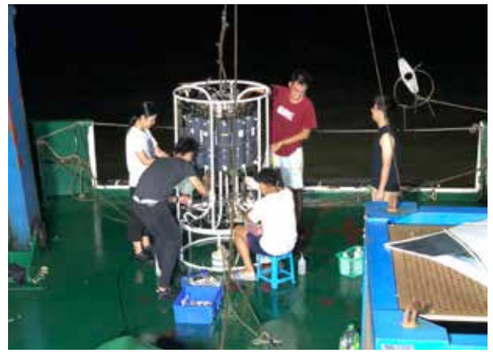
本次會議由海岸帶團隊建設推進會和學術研討會兩部分組成。海岸帶團隊建設推進會總結了2020年執行的5個綜合性航次、就珠江河口灣魚類鯨類專題調查、紅樹林海岸生態修復專題調查、海岸帶空間規劃專題調查進行了專題匯報；學術研討會共計18個口頭報告和16個展板報告。香港城市大學海洋污染國家重點實驗室主任梁美儀教授作為海岸帶團隊的核心成員，受邀進行了題為”Developing interim water quality criteria for emerging chemicals of concern for protecting marine life in the Greater Bay Area of South China”的報告。

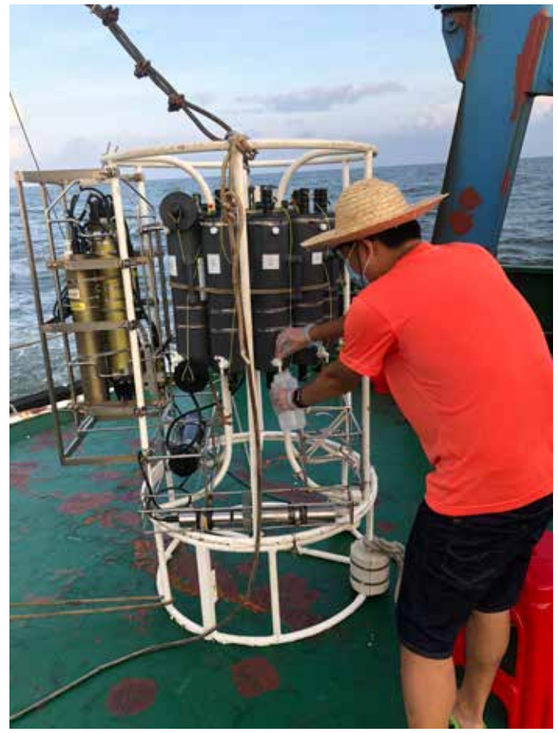
One of the innovation teams of the Southern Marine Science and Engineering Guangdong Laboratory (Zhuhai) (hereinafter referred to as the Southern Marine Lab), called “Changing Coastal Zones and Material Transfer in the South China Sea” (hereinafter referred to as the Coastal Zones Team), organized the Symposium on Environmental Capacity and Eco-dynamic Processes of Estuaries & 2020 Team Construction Meeting at Sun Yat-sen University (Zhuhai Campus) on November 7-8, 2020. The symposium was a combination of online and on-site conferencing. Nearly a hundred local and overseas experts, scholars, teachers, and students attended this symposium.

This symposium was composed of two parts: The Coastal Zones Team construction meeting and the academic seminar. At the construction meeting, 5 comprehensive cruises carried out in 2020 were introduced, and presentations were given regarding investigations on fishes and cetaceans in the Pearl River Estuary, ecological restoration of coastal mangroves, and coastal spatial planning. At the academic seminar, a total of 18 oral and 16 poster presentations were invited. Prof. Kenneth Mei Yee Leung, Director of the State Key Laboratory of Marine Pollution, City University of Hong Kong and a core member of the Coastal Zones Team, was invited to give an oral presentation entitled “Developing interim water quality criteria for emerging chemicals of concern for protecting marine life in the Greater Bay Area of South China”.

海岸帶團隊兩位首席科學家—中山大學吳加學教授和香港城市大學林群聲教授，重點就團隊標誌性成果進行了總結匯報。南方海洋實驗室主任陳大可院士，原國家自然科學基金委副主任朱作言院士，中國海洋大學趙美訓教授以及南方科技大學徐景平教授作為特邀專家出席。

The principal coordinators of the Coastal Zones Team, Prof. Jiaxue Wu from Sun Yat-sen University and Prof. Paul Kwan Sing Lam from City University of Hong Kong summarized the landmark achievements at the project. Dr. Dake Chen, Academician of Chinese Academy of Sciences and Director of the Southern Marine Lab, Dr. Zuoyan Zhu, Academician of Chinese Academy of Sciences and former Deputy Director of the National Natural Science Foundation of China, Prof. Meixun Zhao from Ocean University of China, and Prof. Jingping Xu from Southern University of Science and Technology attended this symposium as invited experts.





The Symposium on the Health Protection of the Ocean and Its High-quality Sustainable Development cum 1st Forum of Qingdao Hong Kong Marine Environment and Ecology Joint Research Centre for Young Scientists and Postgraduates

“青島香港海洋環境與生態聯合研究中心”首屆青年學者與研究生研討會召開
主題：“海洋健康保障與高質量創新發展”

2020年11月25日至26日，由中國海洋大學和香港城市大學聯合主辦的“海洋健康保障與高質量可持續發展”論壇暨“青島-香港海洋環境與生態聯合研究中心”首屆青年學者與研究生研討會在中國海洋大學召開。

During 25-26 November, 2020, Ocean University of China (OUC) and City University of Hong Kong (CityU) co-organized the Symposium on the Health Protection of the Ocean and Its High-quality Sustainable Development cum 1st Forum of Qingdao Hong Kong Marine Environment and Ecology Joint Research Centre for Young Scientists and Postgraduates in Ocean University of China.

本次會議採用線下和線上視頻會議結合的方式開展，共有來自中國海洋大學、廈門大學、香港城市大學、香港理工大學、香港科技大學、中科院生態環境研究中心、中科院海洋所、自然資源部第一海洋研究所等15家單位的近60位知名學者和200餘位學生參加。

The symposium was conducted both in face-to-face and real-time online mode, the participants in this event consisted of 60 prominent scientists and more than 200 research students from 15 academic institutes including OUC, Xiamen University (XMU), CityU, Hong Kong Polytechnic University, Hong Kong University of Science and Technology, Research Center for Eco-Environmental Sciences (RCEES), Chinese Academy of Sciences (CAS), Institute of Oceanography, CAS, and First Institute of Oceanography, Ministry of Nature Resource of the People’s Republic of China.

中國海洋大學校長 于志剛 (左) 和香港城市大學校長 郭位致辭
Prof. Zhigang Yu (left), President of OUC and Prof. Wei Guo (right), President of City U

開幕式上，中國海洋大學校長于志剛和香港城市大學校長郭位分別致辭，指出海洋健康保障和高質量創新發展的重要性和必要性，倡議兩地專家攜手合作，共商保護和可持續利用海洋和海洋資源之良策，共推海洋環境保護與可持續發展相關領域的合作交流。

At the opening ceremony, Prof. Zhigang Yu, President of OUC and Prof. Wei Guo, President of CityU gave welcome remarks, respectively. Two Presidents mentioned the importance of coastal ocean health and sustainable development. They encouraged researchers work together in many research areas of common interest.

在主題報告環節，中科院生態環境研究中心江桂斌院士，廈門大學戴民漢院士，香港城市大學梁美儀教授、林群聲教授等10位專家圍繞“海洋健康保障與高質量創新發展”的主題，分別就新型污染物治理、海岸帶-近海多界面跨圈層相互作用、生物多樣性生態工程、水生環境生物標誌物應用等熱點問題進行了報告。

Prof. Guibin Jiang (Academician of CAS) from RCEES, CAS, Prof. Minhan Dai (Academician of CAS) from XMU, Prof. Kenneth Mei Yee Leung from SKLMP, CityU, Prof. Paul Kwan Sing Lam from SKLMP, CityU and other six distinguished scholars were invited to give plenary talks on noteworthy and cutting-edge research topics such as management of emerging chemicals of concern, coastal ocean health and sustainability, ecological engineering for enhancing marine biodiversity, and applications of aquatic biomarkers.

在專題研討環節，與會專家和青年學者就海洋健康保障與高質量創新發展的內涵、目標和路徑做了進一步的交流和探討，為積極推進國家“海洋健康”相關領域發展和加快實現我國海洋可持續健康科技自立自強獻計獻策。

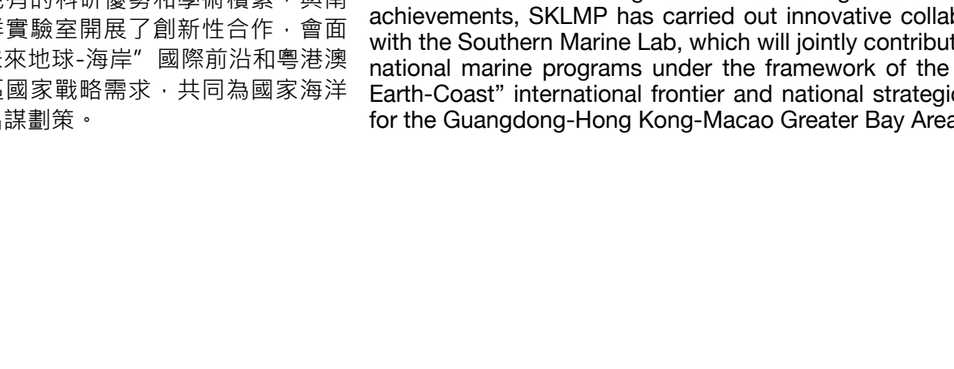
Experts and young scholars shared ideas on coastal ocean health and high-quality innovative development during the discussion session. This symposium successfully established a platform for academic exchange between distinguished scholars and young scientists.

26日，“青島-香港海洋環境與生態聯合研究中心”首屆青年學者與研究生研討會繼續圍繞“海洋健康保障與高質量創新發展”主題開展研討，會議分設的6個專題論壇、3個分會場同步進行，來自中國內地和香港的共計56位青年學者和研究生做了主題報告，線上參與人數達到200餘人。

More than 200 people attended the 1st Forum of Qingdao Hong Kong Marine Environment and Ecology Joint Research Centre for Young Scientists and Postgraduates on the November 26, 2020. A total of 56 young scholars and graduate students from both Mainland China and Hong Kong gave talks in six parallel sessions.

Exchange symposium and signing ceremony for the third batch jointly development of the Southern Marine Science and Engineering Guangdong Laboratory (Zhuhai)

南方海洋科學與工程廣東省實驗室（珠海）合作共建單位交流座談會暨第三批合作共建單位簽約儀式

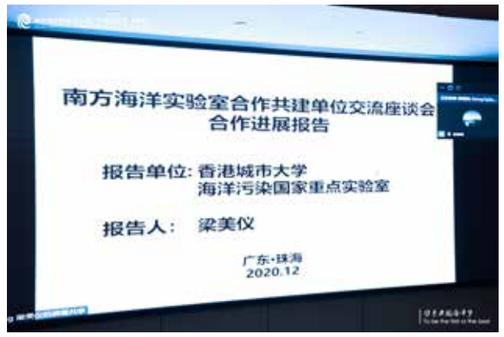


南方海洋科學與工程廣東省實驗室(珠海)(以下簡稱南方海洋實驗室)共建單位交流座談會暨第三批合作共建單位簽約儀式於2020年12月4日在中山大學珠海校區舉行。

香港城市大學(以下簡稱城大)，第二批合作共建單位之一，應邀參加了此次座談會。海洋污染國家重點實驗室(SKLMP)主任、城大化學系講座教授梁美儀，作為南方海洋實驗室“南海海岸帶變化與物質遷移”創新團隊的核心成員，代表城大介紹了成為合作共建單位以來SKLMP與南方海洋實驗室的合作進展與科研成果。梁美儀教授表示，SKLMP基於現有的科研優勢和學術積累，與南方海洋實驗室開展了創新性合作，會面向“未來地球-海岸”國際前沿和粵港澳大灣區國家戰略需求，共同為國家海洋事業出謀劃策。

The Exchange symposium and signing ceremony for the third-batch jointly development of the Southern Marine Science and Engineering Guangdong Laboratory (Zhuhai), (hereinafter referred to as the Southern Marine Lab) was held at Sun Yat-sen University (Zhuhai Campus) on December 4, 2020.

City University of Hong Kong (hereinafter referred to as CityU), one of the co-founders for the second batch jointly development of the Southern Marine Lab, was invited to participate in this symposium/ceremony. As the representative of CityU, Prof. Kenneth Mei Yee Leung, Director of the State Key Laboratory of Marine Pollution (SKLMP) and Chair Professor of Department of Chemistry, introduced the collaboration progress and research outcomes of SKLMP with the Southern Marine Lab as a core member of the Innovation Team called “Changing Coastal Zones and Material Transfer in the South China Sea”. Prof. Leung said that based on its existing research advantages and academic achievements, SKLMP has carried out innovative collaboration with the Southern Marine Lab, which will jointly contribute to the national marine programs under the framework of the “Future Earth-Coast” international frontier and national strategic needs for the Guangdong-Hong Kong-Macao Greater Bay Area.



南方海洋實驗室於2018年11月啟動建設，由珠海市人民政府舉辦，中山大學牽頭建設和管理，中國科學院陳大可院士擔任實驗室主任。南方海洋實驗室圍繞海洋環境與資源、海洋工程與技術、海洋人文與考古三大領域，已經佈局建設二十個創新團隊，建設面向國際海洋科技前沿的創新基礎平台，構築世界一流的海洋人才高地，打造創新型、引領型、突破型的大型綜合性海洋研究應用基地。

In November 2018, the construction of the Southern Marine Lab was launched, which was organized by the Zhuhai Municipal People’s Government and led/managed by Sun Yat-sen University. Dr. Dake Chen, Academician of Chinese Academy of Sciences, is currently the Director of the Southern Marine Lab. The Lab has laid out 20 innovation teams, focusing in three research areas: marine environment and resources, marine engineering and technology, and marine humanities and archaeology. The Southern Marine Lab aims to provide a basic innovation platform at the international frontier of marine technology, to build a world-class talent highland in marine sciences, and to create an innovative, leading, and breakthrough large-scale comprehensive marine research and application base.

Attendance at International Conference & Titles of Presentations
出席的國際會議與報告標題

Dr. Jinping CHENG

Antifouling Applications Using Environmental Friendly Approaches

The Symposium on the Health Protection of the Ocean and Its High-quality Sustainable Development cum 1st Forum of Qingdao Hong Kong Marine Environment and Ecology Joint Research Centre for Young Scientists and Postgraduates

25-26 Nov 2020, Online | Invited Speaker and Organizing Committee

Dr. Apple Pui Yi CHUI

Opportunities and Challenges of Coral Restoration in Marginal Coral Environment

The 6th International Marine Conservation Congress

19 Aug 2020, Online | Participant

Prof. Keith Wing Kei HO

Surface Structure Tuning Induced Enhancement of Visible-Light-Driven g-C3N4 Photocatalyst for the Abatement of Nitric Oxides

Advanced Materials Lecture Series 2020

11 Dec 2020, Webinar | Invited Speaker

Dr. Chun Kit KWOK

Mapping and Targeting RNA G-Quadruplex

NUS-CSI RNA Club Seminar

6 Jan 2020, Cancer Science Institute, National University of Singapore, Singapore | Invited Speaker

Mapping and Targeting RNA G-Quadruplex

G4 Webinar Series

2 Jul 2020, Online | Invited Speaker

Dr. Ball Keng Po LAI

Sex Differences in Transgenerational Reproductive Impairment Caused by Hypoxia

10th International Congress of Comparative Physiology and Biochemistry, Ottawa (2019)

Invited Speaker

Prof. Paul Kwan Sing LAM

Issues Associated with Use of Aquatic Biomarkers

Symposium on the Health Protection of the Ocean and Its High-quality Sustainable Development cum 1st Forum of Qingdao Hong Kong Marine Environment and Ecology Joint Research Centre for Young Scientists and Postgraduates

海洋健康保障與高品質創新發展

25 Nov 2020, Online | Invited Speaker

海洋科技創新與可持續發展研討會

3 Dec 2020, Online | Participant

Prof. Joe Shing Yip LEE

State of the World's Mangrove Forest

4th National Mangrove Congress, The Philippines

24-27 Nov 2020 | Invited Speaker

Prof. Kenneth Mei Yee LEUNG

Developing Interim Water Quality Criteria for Emerging Chemicals of Concern for Protecting Marine Life in the Greater Bay Area of South China

Symposium on Carrying Capacity and Ecological Process cum 2020 Coastal Research Consortium's Research Progress Meeting

7-8 Nov 2020, Online | Invited Speaker

Ecological Engineering for Enhancing Marine Biodiversity on Manmade Coastal Structures

The e-Forum on ecological Security and Health (eFESH) Held at Nanjing University, China

23 Nov 2020, Online and Face-to-Face | Invited Speaker

Ecological Engineering for Enhancing Marine Biodiversity on Seawalls

Symposium on the Health Protection of the Ocean and Its High-quality Sustainable Development cum 1st Forum of Qingdao Hong Kong Marine Environment and Ecology Joint Research Centre for Young Scientists and Postgraduates

25-26 Nov 2020, Online | Keynote Speaker

Prof. Nora Fung Yee TAM

The Influence of the OH Radical Precursor on Brown Carbon Formation in the Aqueous-Phase OH Radical Photooxidation of Phenolic Compounds

American Geophysical Union (AGU) Fall Meeting

1-17 Dec 2020, Online | Participant

Dr. Jin WU

Monitoring Individual Ecology from Space: Challenges and Opportunities

Planet Explore 2020

14 Oct 2020, Online | Invited Speaker

Dr. Moriaki YASUHARA

Biodiversity–ecosystem Functioning Relationships in Long-term Time Series and Palaeoecological Records: Deep Sea as a Test Bed

The 2020 Ecological Society of America Annual Meeting

3-6 Aug 2020, Online | Invited Speaker

Time Machine Biology: Fossils and Biogeography

International Humboldt Day Events

12-19 Sep 2020, Online | Invited Speaker

Panel Discussion: The Influence of Taphonomy and Diagenesis

The Micropalaeontological Society Microfossil Geochemistry Workshop

10 Nov 2020, Online | Invited Panelist

Time Machine Biology: Cross-time-scale Integration of Ecology, Evolution, and Paleoceanography

5th World Conference on Marine Biodiversity

13-16 Dec 2020, Online | Keynote Speaker

Early Career Panel Discussion

5th World Conference on Marine Biodiversity

13-16 Dec 2020, Online | Invited Panelist

Platforms and Facilities
平台設施

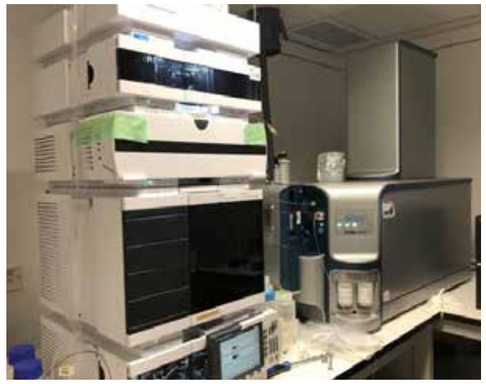
The SKLMP provides facilities and equipment for all members, and has established three research platforms.

海洋污染國家重點實驗室共建立了3個研究平台，為實驗室成員的科學研究提供必要的硬件支撐。

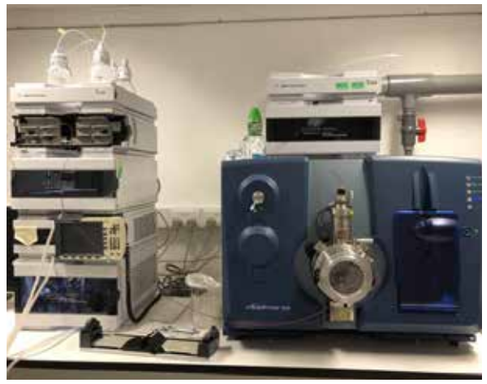
Trace and Ultratrace Level Instrumental Analysis Platform
痕量及超痕量精密儀器分析平台

Thermo Fisher Q Exactive GC Hybrid Quadrupole-Orbitrap Mass Spectrometer

Thermo Fisher TSQ 9000 Triple Quadrupole GC-MSMS



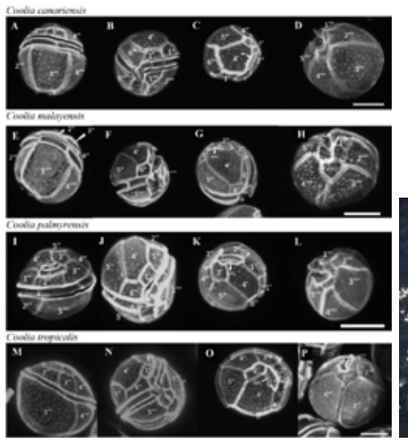
Agilent 1290 Infinity UPLC quipped with SCIEX X500R QTOF MSMS



Agilent 1290 Infinity UPLC equipped with AB SCIEX 5500 Qtrap MS

Aquatic Ecotoxicology Research Platform
水生生態毒理學研究平台

Model Organisms-Marine Medaka 模式生物-海水青鱂



(Leung et al., 2017)

Marine Algae Culture Collection 海洋藻種庫

Field-based Integrated Research Platform
海上科研多功能綜合公共平台

Tai Tau Chau Fish Raft 大頭州魚排

Research Vessel 科研用船

Public Education and Community Service
公眾教育與社會服務

Oyster SOS: Restoring Oyster Reef Ecosystems as a Community
香港富蠔計劃: 動員社區參與修復蠔礁生態

為改善水質和提高海洋生物多樣性，香港城市大學海洋污染國家重點實驗室(SKLMP)的成員在2020年聯同蠔民漁民、科研人員、學校教師、非政府環保機構、以及宗教團體，開展了一項由生態研究轉化而成的社區為本蠔礁修復項目——香港富蠔計劃。

In a cross-sectoral collaboration with oyster and fish farmers, academics, schools, NGOs, and religious groups, members of the State Key Laboratory of Marine Pollution (SKLMP), City University of Hong Kong, are translating ecological research into a community-based project called 'Oysters Save Our Seas' (Oyster SOS) that aims to improve water quality and enhance marine biodiversity through restoring oyster reefs.

為什麼是蠔?

蠔在生態系統服務上擔當關鍵角色。牠們既能形成蠔礁生境，亦可保護海岸線免受風浪侵蝕。作為濾食性動物，一隻成年蠔每天能過濾多達180公升的海水，以攝食水中的微海藻和懸浮有機物。實驗室主任梁美儀教授指出：「假如我們放了足夠數量的蠔，牠們就可透過生物過濾，有效地改善水質和減少紅潮爆發的機會。」

然而，由於過度採集和棲息地喪失，全球已有85%的蠔礁消失了。因此，計劃的目標是透過生態修復、科學研究、STEM和環境教育及公眾參與來修復香港的蠔礁。

Why Oysters?

Oysters provide crucial ecosystem services. They form reef habitats for marine life and protect shorelines against storms. As filter feeders, an adult oyster could filter as much as 180 liters of seawater a day by eating microscopic algae and suspended organic matter in the water column. As the Director of SKLMP, Prof. Kenneth Leung has noted, "If we put enough oysters, they can effectively improve water quality via biofiltration and reduce chances of harmful algal bloom."

Yet, 85% of oyster reefs are gone globally due to over-dredging and habitat loss. Hence, the goal of Oyster SOS is to restore oyster reefs through ecological restoration, scientific research, STEM & environmental education, and public engagement.

Oyster SOS Activities
香港富蠔計劃活動

計劃將和老師合作，為本地中小學設計專題研習及實地考察活動。學生能親自參與蠔礁修復及生物多樣性調查，透過切身體驗，學會欣賞及保護自然環境。

校本活動
Activities

Working with teachers, Oyster SOS will design project-based studies and field activities for local primary and secondary students where they can help restore oyster reefs and conduct biodiversity surveys. Such direct learning experience fosters students' connection and appreciation to the natural environment.

計劃會舉辦教育活動來引起公眾對蠔礁修復的關注。我們曾在香港環保電影節 (HKEFF) 中舉辦工作坊，亦將在社區夥伴的場地舉行講座和小型展覽等。我們也會從餐廳回收蠔殼，經處理後用作蠔苗生長的基質。

公眾參與
Public Engagement

Oyster SOS organises education events to raise public awareness on oyster reef restoration. We have held workshops at the Hong Kong Eco-Film Festival and will set up temporary displays and talks at local partners' venues. Oyster shells are also recycled from local restaurants to be used as substrates for oyster larvae to grow after being treated and weathered.

計劃會與蠔民團體緊密合作，在活動中介紹已列入為非物質文化遺產的本地養蠔業歷史及現況。計劃亦會與宗教團體研究在舉行放生活動時，根據指引，把原生的蠔視為放生的主要物種。

持分者參與
Stakeholder Engagement

Working with the oyster farming community, our activities will introduce the history and current status of local oyster cultivation which is one of Hong Kong's intangible cultural heritage. The project will also work with religious groups to guide the deployment of native oyster species as the main organisms for mercy releases.

計劃派出代表參加了為期7天的「大自然保護協會: 美國紐約及車薩比灣貝類養殖及蠔礁修復考察團」。透過與當地人員交流，了解美國蠔礁修復的成功和挑戰，吸取經驗在本港制定更完善的生態復修計劃。

海外交流學習
Overseas Exchange & Learning

Oyster SOS also joined a field study delegation on oyster reef restoration and oyster farming organised by The Nature Conversancy to visit oyster reef restoration sites in New York and the Chesapeake Bay, United States. Through understanding the challenges and success of their projects and exchanging know-hows with local leaders, we learnt from their experience to better plan for our restoration project.

Coral Academy
珊瑚學院

我們SKLMP的成員崔佩怡博士在2018年正式創辦了外展計劃「珊瑚學院」。在香港漁農自然護理署（漁護署）的支持下，珊瑚學院舉辦了連串大小規模的體驗活動，對公眾，尤其是中學生進行環境保育教育，撒下保育的種子。當中包括「中學工作坊—認識香港珊瑚群落及保育」，「東平洲珊瑚生態探索之旅」及「育養珊瑚校園計劃」。這些活動，旨在提高學生及公眾對香港海洋生物多樣性和珊瑚保育的認識和關注；透過親身體驗培育用於珊瑚復育計劃的珊瑚，建立參與者與本地珊瑚之間的聯繫；以及促進個人行為和生活方式的改變，以行動實踐保育。珊瑚學院亦與本地機構合作保育，包括世界自然基金會（香港分會），香港海洋公園，及珍古德協會（香港），協辦海洋環境教育活動予本地公眾及中學生。這些活動亦為中文大學的學生提供了寶貴的學習機會，使他們成為課程的導師，學以致用。

- 中文大學生命科學學院
研究助理教授 崔佩怡
海洋污染國家重點實驗室成員

Coral Academy is an outreach programme created by our SKLMP member Dr. Apple Chui and launched in 2018. With the support from the Agriculture, Fisheries and Conservation Department (AFCD), we have organized programmes of different scales for the general public and secondary school students, including the “Learn about Hong Kong Coral Communities and Conservation Workshop”, “Secondary School Coral Nursery Education Programme.”, and “Learn about Hong Kong Coral Communities and Conservation Workshop”. These programs aim to enhance secondary school students’ awareness and knowledge of the marine environmental issues, problems and solutions; to establish a connection between participants and local corals through first-hand experience of nurturing coral fragments to be used in coral restoration works; and motivate students to take action to implement environmental solutions. We have also partnered with local organisations, such as the WWF Hong Kong, Hong Kong Ocean Park and the Jane Goodall Institute Hong Kong to develop marine environmental education programs for primary and secondary schools, and the general public. Such partnerships provide valuable learning opportunities for CUHK students to engage as tutors in the programs, enhance students’ science communication skills that will be useful in their wider lives.

- Dr. Apple Chui,
Research Assistant Professor,
The Chinese University of Hong Kong
Member of SKLMP

What We Do
珊瑚學院的活動

「中學工作坊—認識香港珊瑚群落及保育」
“Learn about Hong Kong Coral Communities and Conservation Workshop”

透過珊瑚講座、漁農自然護理署《香港海洋生物多樣性》紀錄片放映、珊瑚骨展示、中文大學李福善海洋科學研究中心的導賞，讓參加者認識珊瑚及本地的海洋生物多樣性，參加者參觀珊瑚培育及研究基地後，能夠親身助養珊瑚，建立與本地珊瑚之間的聯繫，更添一份保育珊瑚的使命！

The workshop includes a coral introductory seminar, a presentation of AFCD “HK Marine Biodiversity” documentary, a showcase of coral skeletons, a visit to the coral culturing facilities at the Simon F. S. Li Marine Science Laboratory CUHK, and a first-hand adoption of a coral experience.

「東平洲珊瑚生態探索之旅」戶外體驗
“Learn about Coral Communities and Conservation in Tung Ping Chau Marine Park Workshop”

參加者不但透過珊瑚工作坊以互動方式認識本地海洋生態，更能夠在導師帶領下探索東平洲海岸公園的海岸，透過遊戲尋找海岸上的珊瑚骨及潮間帶各種小生物的痕跡。東平洲之旅緊接著中文大學李福善海洋科學研究中心的導賞及助養珊瑚，啟發新一代成為保衛海洋的一份子。

Participants can have a quick glimpse of Hong Kong’s marine ecology as well as the magnificent coral world through different interactive activities, including an introductory seminar on corals, coral identification workshops, and a guided eco-shore exploration in the marine park, observing various traces of intertidal wildlife and corals. Afterwards, participants will visit the coral culturing facilities at the Simon F. S. Li Marine Science Laboratory at CUHK, and end the day with a first-hand adoption of a coral experience.

「育養珊瑚校園計劃」
"Secondary School Coral Nursery Education Programme"

將全港中學化為珊瑚培育基地，而本地中學生及老師則組成團隊擔當起照料及紀錄珊瑚健康成長的重大任務，從體驗中學習到香港海洋生態及科學知識，同時建立保護海洋的使命感！在全年計劃中，參加團隊亦有分享保育經驗的環節，與校內外群體宣揚珊瑚保育重要性，一同見證香港的珊瑚保育工作。「育養珊瑚校園計劃」參加學校由起初的5間增至本年度15間中學，育養珊瑚的種類更多元化，全年的活動亦日趨豐富，包括海岸公園戶外生態導賞、水族館導賞、海岸清潔、校內外分享環節等，讓師生有更深入及全面的海洋保育學習體驗。

Turning local secondary schools into coral culturing stations before outplanting. This one-year programme is designed to provide students with solid knowledge and experiences in coral conservation works through school-based culturing of alive local coral fragments, which will then be outplanted for actual local coral restoration work in Hong Kong. By taking the vital role of maintaining coral tanks and monitoring coral growth and health, teams of teachers and students can learn about coral biology and ecology while establishing a sense of mission to restore coral communities and to protect the ocean. Throughout the year, there are also various conservation engagement activities, including guided eco-tours, aquarium tour, coastal clean-ups, and sharing sessions.

珊瑚學院的成果

在過往三年間，已有超過5000名來自30間中學的老師學生參與珊瑚學院舉辦的講座及活動，他們不但建立了對香港海洋生態的興趣，當中亦從參加者中聽到不少深刻而正面的感受，更立志為保育作出行為改變，相信珊瑚學院互動性強的親身體驗活動能夠在新一代心中埋下保護生態的種子，讓科學家的珊瑚保育工作走得更闊更遙遠。

Our Impact

Over 5000 students and teachers from 30 schools have participated in our programmes over the past three years. Not only did participants gain knowledge and interest towards marine lives, but also affirmative inspirations and behavioural changes in marine conservation. It is believed that the interactive activities and unique first-hand experiences offered by the Coral Academy have planted seedlings of conservation in the hearts of the new generation, allowing conservation effort done by scientists to reach broader and farther.

Hong Kong Underwater Photo and Video Competition 2020
第九屆香港潛攝大賽2020

香港本地水域有不少美麗海洋生態，海洋生物奇妙無窮。漁農自然護理署與香港潛水總會合辦第九屆香港潛攝大賽2020，香港城市大學為主辦單位之一，海洋污染國家重點實驗室一直以來大力支持和宣導該項海洋公眾教育活動，以加強公眾對海洋環境保育的意識。本次參賽作品以香港水域的海洋生物或生態為主題，大會收到歷屆最多參賽作品，共1073份參賽作品。2020年11月21日在香港城市大學舉行頒獎禮，並進行網上直播。

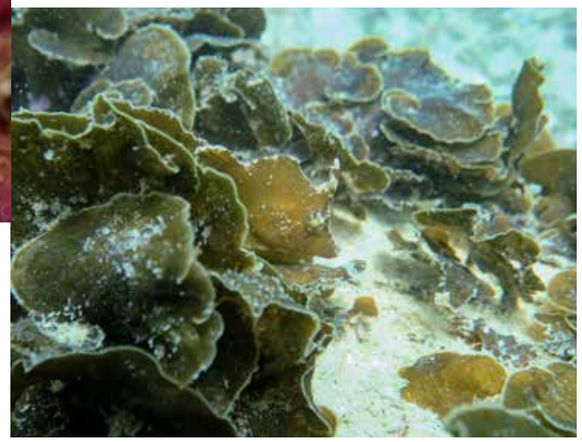
Hong Kong Underwater Photo and Video Competition 2020 is co-organised by the Agriculture, Fisheries and Conservation Department (AFCD) and Hong Kong Underwater Association (HKUA) with a view to promoting the beauty of underwater marine life and ecology in Hong Kong; and raising public awareness of the importance in the conservation of our marine environment in Hong Kong. The City University of Hong Kong is one of the organizers of this competition. SKLMP always supports public education for promoting environmental awareness. In this year, a total of 1073 photos and videos of local marine organisms and ecosystems were received. On 21 November 2020, the awards presentation ceremony was held at CityU and the event was live boardcasted through the internet.

Winning Entries in the Competition
參賽者的作品

TAN Yin Ling

LAU Pong Wing Atim

LIU Yui Chi



CHU Ving Kwan

Source: https://www.afcd.gov.hk/english/conservation/con_mar/con_mar_edu/photo_com_2020.html

Workshop on Ghost Net Clean-Up and Safety for Experienced Divers
棄置漁網清理及安全工作坊

棄置漁網清理及安全工作坊於2020年10月17日舉行，香港城市大學為主辦單位之一。該活動集結了20餘位資深潛水員，在橋咀海域清理大量棄置漁網和海底垃圾，以實際行動鼓勵公眾共同維護良好的海岸和海底環境。

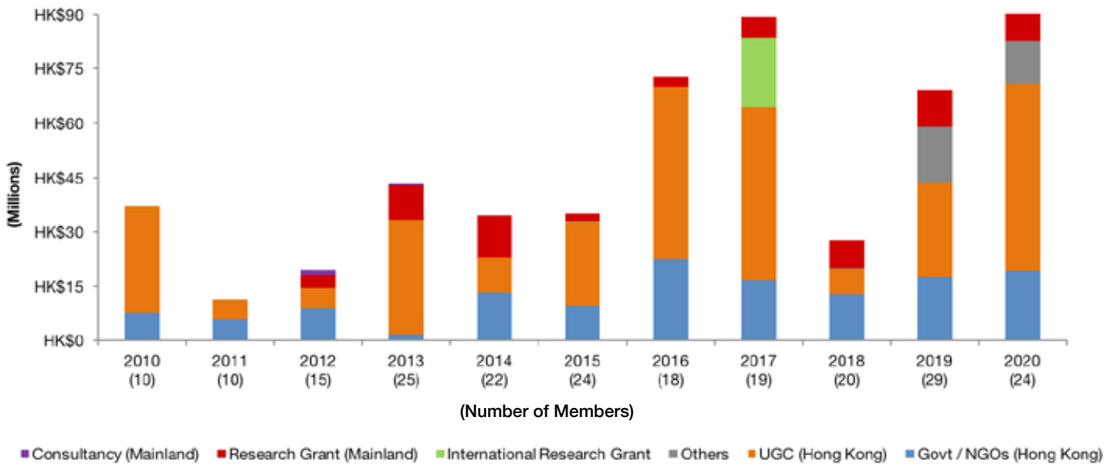
The Workshop on Ghost Net Clean-Up and Safety for Experienced divers was organised on 17 Oct 2020. The City University of Hong Kong was one of the organizers. More than 20 experienced divers joined this activity and cleaned up a large number of ghost nets and seabed garbage in the Sharp Island area. This activity aimed to encourage the public to maintain a better coastal and seabed environment with practical actions.

Overview of Research Grants
研究資助概況

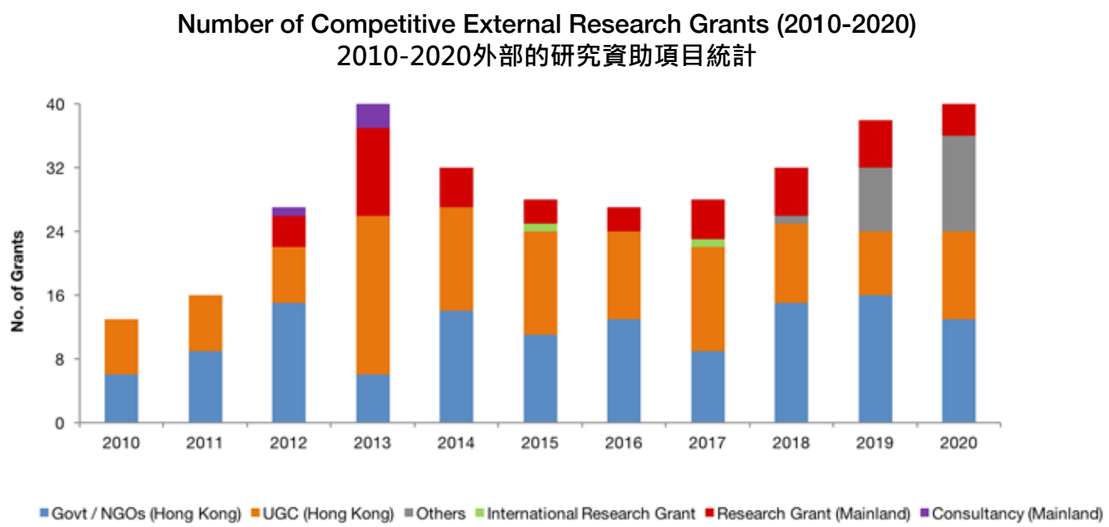
Research Grants 研究資助 *

Competitive External Research Grants
外部的研究資助

Amount of Competitive External Research Grants (2010-2020) #
2010-2020外部的研究資助總額 #



Number of Competitive External Research Grants (2010-2020)
2010-2020外部的研究資助項目統計



* Research Outputs information provided by members.
Number of members in 2010-12: CityU (13), CUHK (3), HKU (5), HKUST (6), PolyU (1), HKBU (2), XMU (1)
Number of members in 2013: CityU (18), CUHK (2), HKU (5), HKUST (5), PolyU (1), HKBU (7), XMU (1)
Number of members in 2014: CityU (18), CUHK (2), HKU (5), HKUST (5), PolyU (1), HKBU (5), XMU (1)
Number of members in 2015: CityU (17), CUHK (1), HKU (6), HKUST (5), PolyU (1), HKBU (4), XMU (1)
Number of members in 2016: CityU (16), CUHK (1), HKU (5), HKUST (5), PolyU (1), HKBU (4), EdUHK (2), XMU (1)
Number of members in 2017: CityU (14), CUHK (3), HKU (5), HKUST (5), PolyU (2), HKBU (4), EdUHK (2), XMU (1)
Number of members in 2018: CityU (14), CUHK (3), HKU (4), HKUST (6), PolyU (2), HKBU (4), EdUHK (4), XMU (1)
Number of members in 2019: CityU (18), CUHK (3), HKU (4), HKUST (6), PolyU (3), HKBU (3), EdUHK (5), XMU (1)
Number of members in 2020: CityU (20), CUHK (2), HKU (4), HKUST (5), PolyU (3), HKBU (3), EdUHK (5), XMU (1)

1CNY=1.2HKD (2020)

Grants from Hong Kong
香港科研資助

Government / Non-governmental Organization
政府部門 / 非政府組織

	Project Title * 項目名稱	Funding Agency 資助機構	Investigators # 項目負責人 (PI or PC/ Co-PI or Co-I)	Amount 金額 (HKD)
		2020		
1	Juvenile Horseshoe Crab Rearing Programme 2020/2021 馬蹄蟹校園保母計劃	Ocean Park Conservation Foundation Hong Kong 香港海洋公園保育基金	**Cheung, S.G.**	201,600
2	To Fill the Knowledge Gap in the Distribution of Juvenile Horseshoe Crabs in Hong Kong and Determine the Mortality and Growth of Laboratory-reared Juveniles After Being Released to the Wild 填補幼年馬蹄蟹在香港分佈的知識缺口和測定幼年馬蹄蟹放流後在野外的生長速度和死亡率	Environment and Conservation Fund 環境及自然保育基金	**Cheung, S.G.**	465,404
3	Modernised Production and Research Plan for Sustainable Mariculture Development 海產養殖現代化及可持續發展計劃	Agriculture, Fisheries and Conservation Department Sustainable Fisheries Development Fund 漁農自然護理署 (漁業持續發展基金)	**Fang, J.K.H.** **Kowk, K.W.H.** **Wong, K.H.** Chan, L.H.M. Leung, K.S.	6,761,630
4	Reduction of Microplastics Contaminants by Enhanced Entrapment with Environmental Bacterial Biofilms 利用環境細菌生物膜進行微型塑料污染的處理	Environment and Conservation Fund 環境及自然保育基金	**Chua S.L.** Fang J.K.H.	489,000
5	Comprehensive Health Assessments and Disease Investigation in Endangered Sea Turtles Found in Hong Kong Waters 香港水域擱淺的瀕危海龜的綜合健康評估與疾病調查	Environment and Conservation Fund 環境及自然保育基金	**Kot, B.C.W.** Lam, P.K.S. Martelli, P. Thali, M.	500,000
6	Provision of Services for Laboratory Analysis of Antibiotics in Ambient River and Marine Water Samples 提供環境河水和海水樣品中抗生素的實驗室分析服務	Environmental Protection Department Consultancy Project 環境保護署諮詢項目	**Lam, P.K.S.** Ruan, Y.F. Wu, R.B.	600,000

*項目名稱以英文譯本為準 #Person with underline is SKLMP member

	Project Title * 項目名稱	Funding Agency 資助機構	Investigators # 項目負責人 (**PI** or **PC**/ Co-PI or Co-I)	Amount 金額 (HKD)
		2020		
7	Study of the Ecological Impact on the Use of Recycled Water 對再生水利用的生態影響研究	Water Supplies Department Consultancy Project 水務署諮詢項目	**Lam, P.K.S.** Yan, M. Ruan, Y.F. Farzana, S. Zhang, K.	1,396,000
8	Impact Assessment of Mosquito-repellent Softener on Conventional Wastewater Treatment Processes and Development of Advanced Technologies for Pyrethroids Removal 驅蚊柔軟劑對傳統廢水處理工藝的影響評價及擬除蟲菊酯先進去除技術的研發	Innovation and Technology Fund 創新及科技基金	**Li, X.Y.**	898,150
9	A Study of Coral-eating Nudibranchs 捕食珊瑚的海蛞蝓的研究	Environment and Conservation Fund 環境及自然保育基金	**Qiu, J.W.**	1,060,000
10	Photosynthesis Seasonality Modelling of Forest Ecosystems: Integration of Field Observations, Multi-scale Remote Sensing and Process-based Models 結合野外觀測、多尺度遙感和過程模型模擬森林生態系統光合作用的季節動態	Environment and Conservation Fund 環境及自然保育基金	**Wu, J.**	655,710
11	Grid Monitoring of SARS-CoV-2 in Sewage for an Early-warning Sign of Community Outbreak 污水中SRAS-CoV-2的網格監測，以早期預警社區爆發的跡象	Hong Kong Health and Medical Research Fund 香港醫療衛生研究基金	**Zhang, T.** Poon, L. Tun, H.	4,540,383
12	Survey of SARS-CoV-2 Virus in Sewage (District) 污水中SARS-CoV-2病毒的檢測（地區）	Drainage Services Department of Hong Kong Consultancy Project 香港渠務署諮詢項目	**Zhang, T.** Poon, L. Tun, H.	980,000
13	Survey of SARS-CoV-2 Virus in Sewage (R&D) 污水中SARS-CoV-2病毒的檢測	Drainage Services Department of Hong Kong Consultancy Project 香港渠務署諮詢項目	**Zhang, T.**	780,000
	Subtotal			**HKD 19,327,877**

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University Grants Committee / Research Grants Council
大學教育資助委員會/研資局

	Project Title * 項目名稱	Funding Agency 資助機構	Investigators # 項目負責人 (**PI** or **PC**/ Co-PI or Co-I)	Amount 金額 (HKD)
		2020		
1	What Lies Beneath: Human and Environmental Health Risk Factors in Our Ocean – an Experimental Application of MarineGEO-Hong Kong 香港海洋之下：人類與環境健康風險因素-MarineGEO在香港的應用	Collaborative Research Fund 協作研究金	**Baker, D.** Chan, L.L. Habimana, O. Hui, J.H.L. Li, J. Panagiotou, G. Russell, B.D. Williams, G.A. Yasuhara, M.	5,316,484
2	Study on Microplastics Pollution and Its Interactions with Polycyclic Aromatic Hydrocarbons (PAHs) in Mangrove Wetlands 紅樹林濕地微塑料污染物及其與多環芳烴作用的研究	Faculty Development Scheme 教員發展計劃	**Han, J.** Cheung, S.G.	999,450
3	Nutrient Transport and Dynamics Over the Northern Slope of the South China Sea 南海北部陸坡（NSSCS）的營養鹽輸運和動力學	General Research Fund 優配研究金	**Lu, Z.M.** Gan, J.P.	332,261
4	Mapping and Targeting of RNA G-quadruplex Structures in the Human Non-coding Transcriptome 人類非編碼轉錄組中RNA G四聯體結構的定位和靶向	General Research Fund 優配研究金	**Kwok, K.C.K.**	1,253,010
5	MaElucidation of Post-transcriptional Regulatory Functions of Dhx36 in Skeletal Muscle Stem Cells and Muscle Regeneration 闡明骨骼肌幹細胞中Dhx36的轉錄後調控功能和肌肉再生	General Research Fund 優配研究金	**Wang, H.T.** Kwok, K.C.K.	1,111,376
6	Emerging Organic Flame Retardants in Marine Wildlife 海洋野生生物中新興有機阻燃劑研究	General Research Fund 優配研究金	**Lam, J.C.W.**	369,179
7	Source Contributions to and Effects of Aerosol Acidity on the Composition of Atmospheric Aerosols 氣溶膠酸度對大氣氣溶膠組成的來源貢獻及影響	Early Career Scheme 傑出青年學者計劃	**Nah, T.M.E.**	647,959

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	Project Title * 項目名稱	Funding Agency 資助機構	Investigators # 項目負責人 (**PI** or **PC**/ Co-PI or Co-I)	Amount 金額 (HKD)
	2020			
8	Novel Antibiotics from Genome Mining and Diversity-oriented Synthesis 發現新型抗生素：基因組挖掘與多樣性導向有機合成相結合的策略	Collaborative Research Fund 協作研究金	**Tong, R.B.** Guo, Z.H. Qian, P.Y.	5,250,027
9	Bioimaging of Trophic and Maternal Transfer of Silver Nanoparticles in Aquatic Organisms 水生生物中納米材料的營養與母體轉移的生物成像	General Research Fund 優配研究金	**Wang, W.X.**	1,170,000
10	Time-series Study for Better Control of Microbial Community in Activated Sludge Systems 利用時間序列研究活性污泥系統微生物群落的優化調控策略	General Research Fund 優配研究金	**Zhang, T.**	873,995
11	Assess Antibiotic Resistome Flows from Pollution Hot-spots to Environments and Explore the Control Strategies 抗生素耐藥基因的環境污染傳播機制與控制阻斷策略研究	Theme-based Research Scheme 主題研究計劃	**Zhang, T.** Li, X.D. Leung, K.M.Y. Others	3,421,3000
	Subtotal			**HKD 51,536,741**

Others
其 他

	Project Title * 項目名稱	Funding Agency 資助機構	Investigators # 項目負責人 (**PI** or **PC**/ Co-PI or Co-I)	Amount 金額 (HKD)
	2020			
1	The Local Manufacturing of Reagents Used for Online Photometric Analyzer in the Environmental and Water Monitoring Applications 本地製造應用於環境和水監測的線上光度分析儀的試劑	Endress+Hauser (HK) Limited	**Chan, L.L.**	300,000
2	Three-Dimensional Forensic Scene Investigation of Marine Vessel Interaction in Indo-Pacific Humpbacked Dolphins and Indo-Pacific Finless Porpoises in the Hong Kong Waters - Phase 2 法證重組：船隻撞擊對香港水域的中華白海豚及江豚造成的威脅 (第二階段)	Marine Ecology & Fisheries Enhancement Funds Trustee Limited (MEEF)	**Kot, B.C.W.** Dennison, S. Martelli, P. Thali, M.	1,009,439

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	Project Title * 項目名稱	Funding Agency 資助機構	Investigators # 項目負責人 (**PI** or **PC**/ Co-PI or Co-I)	Amount 金額 (HKD)
	2020			
3	Applicability of Unmanned Aerial Vehicle Technology for Collecting Biological Health Data of Local Cetaceans in Hong Kong waters 利用無人機收集香港水域鯨豚的生物健康數據	Hong Kong Branch of Southern Marine Science and Technology Guangdong Laboratory (Guangzhou) 南方海洋科學與工程廣東省實驗室 (廣州) 香港分部，開放協作研究金	**Kot, B.C.W.** Li, J. Leung, T.Y. Yan, M.	900,000
4	Effects of Microplastics and Their Enriched-environmental Pollutants on Reproductivity of Parents and Offspring 塑膠微粒及其環境污染物富集對親代及子代生殖能力的影響研究	Guangdong International Cooperation Grant	**Lai, B.K.P.** **Li, L.** **Tse, W.**	1,200,000
5	Non-target Screening and Ecological Risk Assessment of Emerging Chemicals of Concern in Marine Cetaceans from the South China Sea 新興污染物在南海鯨類中的非靶標篩選和生態風險評估	Hong Kong Branch of Southern Marine Science and Technology Guangdong Laboratory (Guangzhou) 南方海洋科學與工程廣東省實驗室 (廣州) 香港分部，開放協作研究金	**Lam, P.K.S.** **Ruan, Y.F.**	1,200,000
6	Changing Coastal Zones and Material Transfer in the South China Sea 南海海岸帶變化與物質遷移	Southern Marine Science and Engineering Guangdong Laboratory (Zhuhai) 南方海洋科學與工程廣東省實驗室 (珠海)，開放協作研究金	**Lam, P.K.S.** Ruan, Y.F. Yan, M. Zhang, K. Leung, P.T.Y.	960,000
7	Ecological Monitoring on Evaluation of the Effectiveness of the Eco-enhanced Seawall Design: Preliminary Study 初步評估生態海堤設計對提升生態價值的效能	ERM-Hong Kong Limited 香港環境資源管理顧問有限公司	**Leung, K.M.Y.**	143,100
8	LCA-based Evaluation of the Sustainability of Urban Water Facilities 基於全生命週期評價（LCA）的城市水務工程和設施環境可持續評估研究	GDH Water, Shenzhen, China 廣東粵海水務股份有限公司	**Li, X.Y.**	900,000
9	Removal Mechanisms of Selected Pharmaceuticals and Personal Care Products (PPCPs) and Endocrine Disrupting Chemicals (EDCs) by Complexus of Engineered Biochars and Algal-bacterial Consortium in Photobioreactors 利用工程生物炭和菌藻共生體系強化光合生物反應器對藥品和個人護理產品和內分泌干擾物的去除及其機理研究	Hong Kong Scholars Program (香江學者計劃)	**Tsang, C.Y.F.** Hu, X.	360,000

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	Project Title * 項目名稱	Funding Agency 資助機構	Investigators # 項目負責人 (**PI** or **PC**/ Co-PI or Co-I)	Amount 金額 (HKD)
		2020		
10	Life History Characteristics and Population Dynamics of the Four-fingered Threadfin Fish 四指馬鮫魚生活史特徵及種群資源研究	TUYF Charitable Trust	**Wang, W.X.**	3,450,000
11	Development of A Suite of Novel in Vitro Assays for Screening of Epigenetic Modifiers 一套新體外測定用以篩選影響表觀遺傳的化合物的開發	Open Collaborative Research Fund, Hong Kong Branch of Southern Marine Science and Engineering Guangdong Laboratory (Guangzhou) 南方海洋科學與工程廣東省實驗室(廣州) 香港分部，開放協作研究金	**Wu, R.S.S.** Kong, R.Y.C. Chiu, J.M.Y. Lai, B.K.P. Wong, A.	1,200,000
12	Impacts of PliocenePleistocene Global Climatic Events on Tropical Deep-sea Biota: Investigation Based on IODP Expedition 363 Western Pacific Warm Pool 上新世至更新世全球氣候事件對熱帶深海生物群的影響：基於IODP Expedition 363西太平洋暖池的調查	Faculty of Science RAE Improvement Fund, The University of Hong Kong	**Yasuhara, M.**	200,000
	Subtotal			**HKD 11,822,539**

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Grants from Mainland China
內地科研資助

Research Grant
科研項目

	Project Title * 項目名稱	Funding Agency 資助機構	Investigators # 項目負責人 (**PI** or **PC**/ Co-PI or Co-I)	Amount 金額 (CNY)
		2020		
1	On the Internal Dynamics in the South China Sea Layered Circulation 南海三層環流的內在動力過程研究	National Natural Science Foundation of China Key Program 國家自然科學基金重點項目	**Gan, J.P.**	3,010,000
2	Evaluating the Potential Role of Microplastics as a Carrier for Transporting Wastewater-borne Pathogenic Bacteria 評估微塑膠作為廢水攜帶病原菌載體的潛在作用	National Natural Science Foundation of China 國家自然科學基金	**Kong, R.Y.C.** Yu, R. Lai, B.K.P.	610,000
3	Suspect DIscovery of Novel Perfluoroalkyl and Polyfluoroalkyl Substances in Sediments and Cetaceans from the Pearl River Estuary 新型全氟和多氟烷基物質在珠江口沉積物及豚類樣品中的非靶標篩選鑒定	Shenzhen Science and Technology Innovation Commission 深圳市科技創新委員會	**Ruan, Y.F.** Lam, P.K.S. Zhang, K. Wang, Q.	300,000
4	Bioavailability of Plastic Additives Released from Microplastics 微塑料中塑料添加劑的生物可利用性研究	National Natural Science Foundation of China 國家自然科學基金	**Zhang, K.** Lam, P.K.S.	270,000
5	Application of Synthetic Biological Systems in the Perception and Recognition of Persistent Toxic Pollutants 合成生物系統在對持久性有毒污染物的感知與識別中的適用性及檢測能力	Ministry of Science and Technology of the People´s Republic of China 中華人民共和國科學技術部	**Yang, M.M.S.**	5,002,600
	Subtotal			**CNY 9,192,600**

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Progress and Outcomes of SKLMP Funded Projects
SKLMP支持的研究課題進展情況與成果

Funding support from CityU
城大內部撥款資助項目

Director Discretionary Fund (DDF)
主任資助基金

The fund is allocated by the SKLMP Director to support exploratory projects for encouraging innovation and new initiatives

	Project Title * 項目名稱	Investigators # 項目負責人 (**PI** or **PC**/ Co-PI or Co-I)	Amount 金額 (HKD)
	Mar 2019 – Feb 2022		
1	Development of in-field nutrient analyzer and its application in coral area 珊瑚區營養鹽現場快速監測儀的研製及應用	**YUAN D.X. (XMU)** CHAN, L.L. (CityU)	300,000

Funding support from the Innovation and Technology Commission
創新科技署國家重點實驗室專項基金資助項目

SKLMP Seed Collaborative Research Fund (SCRF)
SKLMP種子協作研究基金

The fund aims to promote excellent, collaborative and interdisciplinary research programs among members from the six collaborating universities

	Project Title * 項目名稱	Investigators # 項目負責人 (**PI** or **PC**/ Co-PI or Co-I)	Amount 金額 (HKD)
	Oct 2019 – Sep 2021		
1	Removal of salt and organic pollutants by solar steam using graphene materials 基於石墨烯材料的太陽蒸汽技術移除鹽和有機污染物的研究	**WAI T.C. (CityU)** LAM J.C.W. (EdUHK) YE R.Q. (CityU)	300,000
2	Toxicological assessment of organic ultraviolet filters (OUVFs) to early life stage of marine medaka (*Oryzias melastigma*) 有機紫外吸收劑對海水青鱂魚(*Oryzias melastigma*)早期生命階段的毒性評估	**HE H.Y.H. (CityU)** LAM J.C.W. (EdUHK)	300,000

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	Project Title * 項目名稱	Investigators # 項目負責人 (**PI** or **PC**/ Co-PI or Co-I)	Amount 金額 (HKD)
	Oct 2019 – Sep 2021		
3	Real-time antibiotic resistance genes and pathogen surveillance using Nanopore metagenomic sequencing 利用納米孔宏基因組測序實時監測抗生素抗性基因和致病菌	**ZHANG T. (HKU)** LEUNG K.M.Y. (CityU) LAM P.K.S. (CityU)	300,000
4	Microplastics in edible oysters and their significance in the Greater Bay Area 大灣區牡蠣的微塑膠含量及其意義	**FANG J.K.H. (PolyU)** CHEUNG S.G. (CityU)	300,000
5	Organophosphate triesters and diester in coral communities 珊瑚群落中的有機磷酸三酯和二酯現狀研究	**LAM J.C.W. (EdUHK)** CHUI A.P.Y. (CUHK) ANG P.O. (CUHK) HO K.W.K. (EdUHK) CHEANG C.C. (EdUHK)	300,000
6	Removal mechanisms of selected endocrine disrupting chemicals (EDCs) in bioreactors with biochars 利用生物炭強化生物反應器對內分泌干擾物的去除及其機理研究	**TSANG Y.F. (EdUHK)** LI X.Y. (HKU) RINKLEBE J. (UoW)	300,000
7	Assessing the coral health status under different anthropogenic pressures using *in-situ* and *ex-situ* innovative methods 使用原位和異位創新方法評估不同人為壓力下的珊瑚健康狀況	**CHAN L.L. (CityU)** QIU J.W. (HKBU)	300,000
	Jan 2018 – Dec 2020		
8	Microplastics augment the transfer of Bisphenol A and Bisphenol A analogues to marine fish 微塑膠增加雙酚A和雙酚A類似物的轉移到海洋魚類	**CHEUNG, S.G. (CityU)** WONG, C.K.C. (HKBU) LAI, B.K.P. (CityU)	240,000
	Nov 2017 – Oct 2020		
9	Ocean acidification threatens Chinese oysters: Can some species adapt within this century? 海洋酸化威脅到中國的生蠔：本世紀內有物種適應嗎？	**THIYAGARAJAN, V. (HKU)** QIU, J.W. (HKBU) QIAN, P.Y. (HKUST) CHEUNG, S.G. (CityU) DAI, M.H. (XMU)	240,000
10	How phosphate concentration affect the nitrogen uptake of phytoplankton? 磷酸鹽濃度影響浮游植物的氮吸收的機理研究	**LIU, H.B. (HKUST)** CHAN, L.L. (CityU)	240,000

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	Project Title * 項目名稱	Investigators # 項目負責人 (**PI** or **PC**/ Co-PI or Co-I)	Amount 金額 (HKD)
	Nov 2017 – Oct 2020		
11	Neurotoxicity studies of selected marine biotoxins via neurometabolomic profiling and neurobehavioral assessment on marine medaka (*Oryzais melastigma*) and zebrafish (*Danio rerio*) 利用青鱂魚及斑馬魚作為腦神經代謝分析和神經行為評估平台進行對幾種海洋生物毒素的神經毒性的研究	**LAM, M.H.W. (CityU)** LAM, J.C.W. (EdUHK)	240,000
12	Targeting astrocytes-neuronal L-lactate signaling pathway for rescuing decision-making deficit in chronic ciguatera poisoning 靶向星形膠質-神經元L-型乳酸信號通路治療慢性雪卡中毒相關的決策行為障礙	**LI, Y. (CityU)** CHAN, L.L. (CityU)	240,000

SKLMP Collaborative Research Fund (CRF)
SKLMP協作研究基金

The fund aims to promote excellent, collaborative and interdisciplinary research programs among members from the six collaborating universities

	Project Title * 項目名稱	Investigators # 項目負責人 (**PI** or **PC**/ Co-PI or Co-I)	Amount 金額 (HKD)
	Apr 2020 – Mar 2023		
1	Addressing an imminent problem presented by a new class of pollutants: Chemicals with epigenetic and transgenerational effects 揭示新一類污染物衍生的迫切問題：可引致表觀遺傳和跨代效應的化學物質	**WU R.S.S. (EdUHK)** WONG C.K.C. (HKBU) CHIU, J.M.Y. (HKBU) CHAN, T.F. (CUHK) KONG, R.Y.C. (CityU) LAI, B.K.P. (CityU)	2,100,000
2	Zoonotic transmission of antimicrobial resistance from seafood-related marine ecosystems to the coastal population in the Greater Bay Area 大灣區內細菌耐藥性從海產品相關海洋生態系統向沿海人群傳播之研究	**LI X.D. (PolyU)** ZHANG, T. (HKU) LAM, P.K.S. (CityU) LEUNG, K.M.Y. (CityU) ZHANG, J.Q. (SCDPC) JIN, L. (PolyU)	2,100,000

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SKLMP 2020 Internal Research Fund (IRF)
SKLMP 2020 內部研究經費

IRF is a seed grant allocated to SKLMP CityU members of SKLMP for attracting large outside grants and bringing members together within CityU

	Project Title * 項目名稱	Investigators # 項目負責人 (**PI** or **PC**/ Co-PI or Co-I)	Amount 金額 (HKD)
	Feb 2018 – Jan 2021		
1	Development of an immune-stimulating antimicrobial peptide feeding regime for the hybrid grouper 開發一套針對雜交石斑魚具有免疫促進的抗菌多肽餵養體系	**AU D.W.T. (CityU)** SEEMANN F. (CityU) CHAN L.L. (CityU) LAM Y.W. (CityU) WU R.S.S. (EdUHK) WANG K.J. (XMU)	300,000
2	High-resolution reconstruction of the beating marine medaka heart 高分辨率重建構造海水青鱂魚心臟	**CHENG S.H. (CityU)** WONG C.K.C. (HKBU)	300,000
3	Towards understanding population stress response in aquatic organisms: studies on rescue effect induced by ionizing radiation 水生生物之集體應激反應：電離輻射誘發之營救效應	**YU R.K.N. (CityU)** WANG W.X. (CityU)	300,000
4	Interactive effects of hypoxia- and flutamide-induced endocrine disruption in marine medaka: an ecotoxicogenomic approach for environmental risk assessment 缺氧和氟他胺對海水青鱂魚內分泌幹擾的交互作用：一種用於環境風險評估的生態毒理基因組學方法	**KONG R.Y.C. (CityU)** WU R.S.S. (EdUHK)	300,000

*項目名稱以英文譯本為準　#Person with underline is SKLMP member

Summary of the Director Discretionary Fund (DDF) Projects
DDF項目概要

Mar 2019 – Feb 2022 (On going)
Development of in-field nutrient analyzer and its application in coral area
珊瑚區營養鹽現場快速監測儀的研製及應用

D.X. YUAN, Leo L. CHAN
Funding Amount: HK$300,000

Due to the epidemic of Covid-19, we have been able to only carry out very limited research work in the past 12 months. The nutrient analyzer prototypes systems were performed several times in the laboratory to test the previous water samples from field according to the protocol. However, the data turned out to be abnormal all the time. After a systematic check including reagents, samples, accessories, we found the pipeline in the two systems was blocked by impurities. Further, the two systems were recovered and run normally after renewal of accessories and basic maintenance with satisfactory standard curves. However, field trip could not move on because of the pandemic.

An operation system upgradation with more robust function for these two prototypes of the nutrient analyzer was rescheduled in 2021. After the upgradation, the system can automatically prepare the calibration curve and calculate the nutrient concentration in the samples. In addition, more tests will be conducted in Hong Kong's waters to keep the project on track. The improved and optimized in-field nutrient analysis system will be applied to the coral areas throughout Hong Kong's waters to establish a water quality database for better protection and management of the coral ecosystem in Hong Kong.

Summary of the Seed Collaborative Research Fund (SCRF) Projects
SCRF項目概要

Nov 2017 – Oct 2020 (Completed)
Ocean acidification threatens Chinese oysters: Can some species adapt within this century?
海洋酸化威脅到中國的生蠔：本世紀內會有物種能夠適應嗎？

V. THIYAGARAJAN, J.W. QIU, P.Y. QIAN, S.G. CHEUNG, M.H. DAI
Funding Amount: HK$240,000

Aquaculture production of edible oysters is a multi-billion dollar industry. However, oysters are facing an unprecedented threat from ocean acidification (OA). This is particularly concerning for China, as they produce over 80% of the world's edible oysters using natural seeds, of which they have no control over. The importance of this emerging threat is demonstrated by a number of short-term (days) exposure studies to identify the OA-sensitive traits and mechanisms underpinning such responses. Therefore, our research activities in this project focused on long-term impacts: for example, can oysters adapt within a few generations to save their offspring from the threats imposed by OA? Our answer to these question have allowed us to predict the fate of oysters in the face of OA. Briefly, our progress is summarized as follows:

1. First, we have identified physologetic diversity of various Chinese oysters species and populations along the entire cost of China using advanced genetic analysis and bioinformatics tools.
2. Second, the effect of OA on the fitness of Hong Kong oyster population have been comparatively examined using whole-life cycle, multiple-stressor and multiple-endpoint experiments.
3. Finally, we have explored transgenerational inheritance of those OA tolerance traits through multiple generation experiments and integrated those data into physiological models of species performance based on current environmental variables in their habitat and projected under different IPCC scenarios.

Thus, we have attempted to fulfill all the three objectives using those three tasks. There was no problem during the execution.

Specifically, this interdisciplinary project, using tools borrowed from aquaculture, genomics, and molecular ecology, have addressed this knowledge gap using a commercial oyster species in south China whose genome was recently assembled at the chromosome level. The project has involved the following three related research activities:

Inheritance of commercial traits (called TGP): Thus far, most of the short-term OA studies have targeted traits that are either easy to measure (growth) or OA-sensitive process (calcification). But oyster growers and consumers are interested in the effect of OA on commercial traits such as meat quality and quantity when they are exposed for long-term. They are also concerned about the oysters' resilience to pathogens and multiple stressors in nature. Therefore, we have specifically examined the trade-offs between targeted physiological and commercial traits during transgenerational exposure to OA using two successive generations and their subsequent performance in nature. Specifically, our project has answered: When do oysters reach maturity and market size under OA? Does parental exposure to OA enhance the survival of offspring, without compromising the meat quality and quantity?

Signaling pathways for TGP: The Oyster genome is unique with over 1500 immune genes linked to certain DNA regions and over 50% of them are involved in stress tolerance. We have a good understanding of the transcriptome-wide expression patterns of these stress-related genes under OA, but we do not know how this expression pattern is transferred from parents to offspring over multiple generations. Here, we have integrated the phenotypic and the transcriptomic data of all individuals to identify OA stress-specific gene communities that are likely to have an impact on commercial traits and, importantly, to understood their role in TGP.

Inheritance of TGP: Recent discovery of DNA methylation-mediated TGP in fish and sea urchins that allow them to rapidly cope with OA gives us hope that oysters may be able adapt to OA without trade-offs. As over 26% of the oyster genome is methylated and many functional genes show differential patterns of methylation, we assumed that there exist methylation-mediated mechanisms in oysters for this rapid adaptation. We have successfully tested the hypothesize that exposure of parents to OA changes the DNA-methylation pattern, which is inheritable and provides enhanced protection to offspring. Specifically, we looked at DNA-methylation marks on known immune and stress response genes and determine whether this alteration is stable during gonad development and translated to offspring.

The whole project involved intensive interinstitutional and international collaborations.

Research Output

1. Meng, Y., Guo, Z., Fitzer, S.C., Upadhyay, A., Chan, V.B.S., Li, C., Cusack, M., Yao, H., Yeung, K.W.K., **Thiyagarajan, V.** (2018). **Ocean acidification reduces hardness and stiffness of the Portuguese oyster shell with impaired microstructure: a hierarchical analysis.** *Biogeosciences,* 15, 6833-6846.

2. Campanati, C., Dupont, S., Williams, G.A., **Thiyagarajan, V.** (2018). **Differential sensitivity of larvae to ocean acidification in two interacting mollusc species.** *Marine Environmental Research,* 141, 66-74.

3. Meng, Y., Fitzer, S.C., Chung, P., Li, C., **Thiyagarajan, V.,** Cusack, M. (2018). **Crystallographic interdigitation in oyster shell folia enhances material strength.** *Crystal Growth & Design,* 18, 3753-3761.

4. Meng, Y., Guo, Z., Yao, H., Yeung, K.W.K., **Thiyagarajan, V.** (2019). **Calcium carbonate unit realignment under acidification: A potential compensatory mechanism in an edible estuarine oyster.***Marine Pollution Bulletin,* 139, 141-149.

5. Rajan, K.C., **Thiyagarajan, V.** (2020). **Molecular adaptation of molluscan biomineralisation to high-CO2 oceans – The known and the unknown.** *Marine Environmental Research,* 155, 104883.

6. Lim, Y.K., Cheung, K., Dang, X., Roberts, S., Wang, X., **Thiyagarajan, V.** (2021). **DNA methylation changes in response to ocean acidification at the time of larval metamorphosis in the edible oyster, *Crassostrea hongkongensis.*** *Marine Environmental Research,* 163, 105217.

Nov 2017 – Oct 2020 (Completed)
How phosphate concentration affect the nitrogen uptake of phytoplankton?
磷酸鹽濃度影響浮游植物的氮吸收的機理研究

H.B. LIU, Leo L. CHAN
Funding Amount: HK$240,000

The objectives of this project is to study 1) if P-limitation affects the uptake of nitrogen of different forms by phytoplankton and 2) if such effect is species specific and is affected by environmental factors, such as light and temperature.

We have conducted a number of experiments to address the objectives of this project. To address both objectives, we have designed a set of experiments to study the effect of phosphorus concentration on the uptake of nitrate and ammonium in phytoplankton, with *Thalassiosira weissflogii* and *Amphidinium carterae*, a diatom and a dinoflagellate, at two different temperatures, 22°C and 28°C. We maintained a set of cultures with high N:P (128:1) and low N:P (16:1) ratio for each species at each temperature. Nitrate and ammonium uptake were measured by ^{15}N isotopic labelling techniques. We discovered that nitrogen uptake in *T. weissflogii* were unaffected by temperature but the concentration of phosphorus. Nitrate uptake was reduced when phosphorus is limited. While *A. carterae* were more dependent on temperature, their nitrate uptake was reduced when temperature was high. The utilizations of ammonium were unaffected in both species under different treatments. Because the Covid-19 pandemic, our South Korea collaborator's lab was closed, so a set of isotopic samples were still being analysed. Further investigations on the molecular mechanism using transcriptomic analysis are still ongoing. Because of limited budget, the effect of light on nitrogen uptake under P-limitation was not achieved.

The PI and co-I, as well as their research teams, were in contact frequently, mainly through events organized by SKLMP and local universities. Moreover, we have collaborated with Prof. XU Jie in the South China Sea Institute of Oceanology (CAS) and Prof. C.K. Kang in GIST, Korea. We have done some field experiments with Prof. Xu on the effect of P on nitrate and ammonium uptake in the shelf water of the South China Sea (paper in preparation). Prof. Kang helps us to analyze isotopic samples from our experiments that will result two co-authored papers.

Research Output

1. Liu, K.L., Chen, B.Z., Zhang, S.W., Sato, M., Shi, Z.Y., **Liu, H.B.** (2019). **Marine phytoplankton in subtropical coastal waters showing lower thermal sensitivity than microzooplankton.** *Limnology and Oceanography,* 64(3), 1103-1119.

2. Zou, D.Y., Li, Y.D., Kao, S.J., Li, M., **Liu, H.B.** (2019). **Genomic adaptation to eutrophication of ammonia-oxidizing archaea in the Pearl River estuary.** *Environmental Microbiology,* 21(7), 2320-2332.

3. Li Y.D., Zheng, L.P., Zhang Y., **Liu H.B.**, Jing, H.M. (2019). **Comparing microbial metabolism in pristine and contaminated tropical and subtropical mangrove sediments using a metagenomic approach.** *Scientific Report,* 9, 5739.

4. Shi, Z.Y., Liu, K.L., Zhang, S.W., Xu, H., **Liu, H.B.** (2019). **Spatial distributions of mesozooplankton biomass, community composition and grazing impact in association with hypoxia in the Pearl River Estuary.** *Estuarine, Coastal and Shelf Science,* 225, 106237.

5. Li, Y.D., Yan, N., Wong, T.Y., Wang, W.X., **Liu, H.B.** (2019). **Interaction of antibacterial silver nanoparticles and microbiota-dependent holobiont revealed by metatranscriptomic analysis.** *Environmental Science: Nano,* 6, 3242 – 3255.

6. Xia, X.M., Leung, S.K., Cheung, S.Y., Zhang, S.W., **Liu, H.B.** (2019). **Rare bacteria in seawater are dominant in the bacterial assemblage associated with the bloom-forming dinoflagellate *Noctiluca scintillans*.** *Science of Total Environment,* 711, 135107.

7. Li, Y.D., Jing, H.M., Kao, S.J., Zhang, W.P., **Liu H.B.** (2020). **Metabolic response of prokaryotic microbes to sporadic hypoxia in a eutrophic subtropical estuary.** *Marine Pollution Bulletin,* 154, 111064.

8. Xia, X.M., Lee, P.Y., Cheung, S.Y., Lu, Y.H., **Liu H.B.** (2020). **Discovery of euryhaline phycoerythrobilin-containing *synechococcus* and their mechanisms for adaptation to estuarine environments.** *mSystems,* 5, e00842-20.

9. Zhang, S.W., Xia, X.M., Ke, Y., Song, S., Shen, Z., Cheung, S.Y., **Liu, H.B.** (2021). **Factors influence the successive blooms induced by *Noctiluca scintillans* and *Mesodinium rubrum*.** *Science of Total Environment,* 755, 142349.

Nov 2017 – Oct 2020 (Completed)

Neurotoxicity studies of selected marine biotoxins via neurometabolomic profiling and neurobehavioral assessment on marine medaka (*Oryzais melastigma*) and zebrafish (*Danio rerio*) 利用青鱂魚及斑馬魚作為腦神經代謝分析和神經行為評估平台進行對幾種海洋生物毒素的神經毒性的研究

Michael H.W. LAM, James C.W. LAM
Funding Amount: HK$240,000

In this project, we studied the neurometabolomic perturbation caused by brevetoxin PbTx-1 on 3-months-old marine medaka (*Oryzais melastigma*), as well as that by the psychiatric drug fluoxetine on adult male zebrafish (*Danio rerio*).

PbTx-1 is the most potent brevetoxin variant known to activate voltage-gated sodium channels (VGSCs) in neurons via binding to site 5 of their α-subunit. This molecular neurotoxic mechanism is very similar to that of ciguatoxins (CTXs). Thus, we argue that we may be able to understand more about the neurotoxicity of CTXs by examining how PbTx-1 perturbs the normal distribution of small-molecule neurotransmitters in the CNS. It is also possible that we can identify certain patterns of abnormal neurotransmitter distribution that are associated with exposure to CTXs. Our approach can be regarded as a neurometabolomic assessment. To the best of our knowledge, such a metabolomic approach to neurotoxicology has not been reported in literature before. In this study, we used 3-months-old marine medaka (*Oryzais melastigma*) as the animal model. Fish were exposed to waterborne brevetoxin PbTx-1 at two sublethal dose levels (0.5 and 2.5 μg-PbTx-1 L^{-1}) for a duration of 12 hours before concentrations of 43 selected neurotransmitters and metabolites in their CNS were quantified via dansyl chloride derivatization and LC-MS/MS determination. Principle component analysis (PCA), projection on latent structure-discriminate analysis (PLS-DA) and orthogonal projection on latent structure-discriminate analysis (OPLS-DA) were employed to analyse the resultant profiling data. Neurotransmitters and metabolites related to VGSCs and *N*-methyl-D-aspartic acid receptors (NMDARs) activation, as well as cholinergic neurotransmission, were found to contribute significantly to class separation in the corresponding OPLS-DA models. Regulation of those significant neurotransmitters may not be strictly linear with respect to exposure duration and dosage. Thus, instead of adopting any one of those regulated species as exposure biomarkers for PbTx-1, a multivariate approach to quantify dosage-dependent profile changes is, in fact, more appropriate to generated sensitive biomarkers for screening purposes. Indeed, we applied the Shared and Unique Structures Plot (SUS-plot) to correlate OPLS-DA models at different exposure dosages and to extract consistently regulated variables to construct the exposure biomarkers in the form of multivariate predictive scores. The identified multivariate biomarkers for male and female medaka fish were able to predict acute sub-lethal exposure to PbTx-1 with good sensitivity and specificity (male fish: sensitivity 94.7%, specificity 80.0%; female fish: sensitivity 91.4%, specificity 83.3%). We also discovered that neurotransmitter profiles in the CNS of medaka fish that should have recovered from exposure to PbTx-1 have shown long-term neurological impacts even after the exposure has been discontinued.

There are increasing concerns about the occurrence of pharmaceuticals in our aquatic environment. Several reports have already demonstrated that behaviors of aquatic life were altered by exposure to environmental levels of neuroactive pharmaceutical contaminants. Many such neuroactive pharmaceuticals excreted by human cannot be removed effectively by conventional wastewater treatment processes and are discharged to the aquatic environment. While we have already developed the neurometabolomic platform to evaluate neurological impacts of neuroactive agents, there is still a knowledge gap between the molecular mechanisms of neurotoxicity and the behavioural phenotypes of the exposed organisms. Thus, we continue our work with the development of neurometabolomic platforms to bridge this gap via targeted neurometabolomic profiling to assess neurobehavioral changes (determined by novel tank diving test) induced by subacute exposure to neuroactice agents. In that work, we adopt adult zebrafish (*Danio rerio*) as the animal model and a well-known antidepressant fluoxetine as the neuroactive agent. We have developed a neurometabolomic study workflow combined with novel tank diving test. Procedures of novel tank diving test was optimized to accommodate the facilities and the metabolomics study workflow. We have also refined our LC-MS quantitative analytical protocol to expand the scope of our neurotransmitter profiling to cover 53 small-molecule neurotransmitters in the CNS of zebrafish. Adult fish were exposed to 5 concentrations of fluoxetine (ranging from environmental realistic concentration to common laboratory study concentration) for a period of 14 days. Afterwards, novel tank test was conducted to evaluate behavioral effects of the drug to the fish. Immediate after behavioral test, the whole brain tissue of the fish was dissected and was subjected to the neurometabolic profiling procedures. Swimming behavior of the fish in novel tank diving test was recorded, and the videos were analysed with a tracking software and neurobehavioral endpoints were quantitated. Multivariate statistical techniques including principal component analysis (PCA), partial least squares (PLS) and orthogonal-partial least squares (OPLS) were utilized to analyse the perturbation of the targeted neurometabolic profiles of the CNS of fish and to correlate with the behavioral changes induced by the drug. Levels of fluoxetine and norfluoxetine in the brain tissue of fish were also measured. Results of our study provide metabolomics information to link the neurological effects of neuroactive chemicals with their *in vivo* neurobehavioral impacts. We envision that with further verification, our dual neurometabolomic and neurobehavioural profiling approach can become a new tool for ecotoxicological risk assessment of neuroactive contaminants.

Most of the research work were conducted in CityU by the PI.

Research Output

1. Yau, M.S., Lei, E.N.Y., Ng, I.H.M., Yuen, C.K.K., **Lam, J.C.W., Lam, M.H.W**. (2019). **Changes in the neurotransmitter profile in the central nervous system of marine medaka (*Oryzias melastigma*) after exposure to brevetoxin PbTx-1 – A multivariate approach to establish exposure biomarkers.** *Science of the Total Environment,* 673, 327 – 336.

Nov 2017 – Oct 2020 (Completed)

Targeting astrocytes-neuronal L-lactate signaling pathway for rescuing decision-making deficit in chronic ciguatera poisoning

靶向星形膠質-神經元L-型乳酸信號通路治療慢性雪卡中毒相關的決策行為障礙

Y. LI, Leo L. CHAN

Funding Amount: HK$240,000

Ciguatera poisoning is the most frequently reported seafood-toxin illness that manifests in complex and long-lived neurological symptoms which are more severe in repeated exposure. However, very few studies have been conducted in animal models to investigate the nature of central nervous system damage and the underlying mechanisms for behavioral deficits after exposure to ciguatoxin. Previously, we showed a single dose of Pacific ciguatoxin-1 (P-CTX-1) induced severe visceral pain, and anterior cingulate cortex (ACC) synaptic plasticity. Reactive astrogliosis was identified supporting the concept that neuron and astroglia signals may play roles in ciguatera poisoning. However, the induction of LTP was occluded in acute P-CTX-1 rats suggesting emotional and cognitive dysfunctions in ciguatera poisoning. By examining a rat model with chronic repeated exposure to sub-clinic dosage of P-CTX-1, we observed development of anxiety and decision making deficits in rats after one-month exposure to the toxins. Nonetheless, the underlying molecular mechanisms are poorly understood.

The brain requires continuous supply of oxygen and energy-yielding substrates involving glucose. A growing body of evidence suggests that L-lactate, byproduct of astrocytic glycolysis, plays a critical role in cognition processing. Astrocytes respond to all forms of CNS damage and disease by undergoing cellular, molecular and functional changes. Our preliminary data showed markedly reactive astrogliosis occurs in ACC in chronic P-CTX-1 rats. We hypothesized that impaired L-lactate release casually involved in cognitive deficit in chronic ciguatera poisoning. We find failure of L-lactate release in an activity-dependent manner in chronic ciguatera poisoning. Theta burst stimulation (TBS) which used to elicit LTP can reliably induce increase in lactate concentration in control rats, but not in P-CTX-1 rats. Further, P-CTX-1 rats exhibited significant lower lactate level immediately after the cognitive behavioral task (rat gambling task RGT). Next, exogenous L-lactate infusion into ACC repairs the impairments of LTP and decision-making performance in P-CTX-1 rats.

Using multi-electrodes recording in both BLA and ACC of freely behaving rats, spike-field coherence (SFC) analysis revealed chronic ciguatera poisoning led to disruption of ACC spike timing to BLA local theta oscillation. Cross-correlation analysis revealed that ciguatera poisoning was associated with suppressed synchronization between the BLA and ACC, indicating reduced neuronal communications between these two regions under chronic ciguatera poisoning.

Disruption of the flow of L-lactate from astrocytes to neurons severely impairs the local and broad spatial scales of interaction of ACC neuronal network, disturbs functionally coherent assemblies and damages the decision making ability in chronic ciguatera poisoning.

Jan 2018 – Dec 2020 (Completed)

Microplastics augment the transfer of Bisphenol A and Bisphenol A analogues to marine fish
微塑料增加雙酚A和雙酚A類似物的轉移到海洋魚類

S.G. CHEUNG, Ball K.P. LAI, Chris K.C. WONG
Funding Amount: HK$240,000

We collected MP samples from 11 sandy beaches in Hong Kong, scattered from western to southern waters. 30 pieces of MPs were selected for FTIR analysis to characterize the chemical identities. The most abundant polymers were PP (mean = 40.7 ± 15.1%), PE (38.6 ± 13.9%), followed by PS (13.6 ± 11.0%) and PET (1.53 ± 3.12%). These findings were partly consistent with our previous study that PP, PE and PET being the most dominant polymer types in Hong Kong (Lo et al., 2018). This study, however, found that PET was only comprised of low proportion among other polymer types.

Then, the level of BPA, BPB, BPF and BPS on the microplastic was measured using LC–MS/MS analysis. our results showed that the mean BPA concentrations ranged from 82.4–989 ng g-1. The highest BPA concentration was found at TO, followed by TLW and YO. Around 10-fold difference was found when comparing the most contaminated (TO) and the cleanest (SPW) beaches, but statistical analysis showed that there was no significant difference among all the sites (one-way ANOVA, $p = 0.604$). This can be attributed to the intra-variability within each site, in which the standard deviations were extremely high for each set of samples. The high variability between replicates can be explained by the characteristics of MPs.

Since there was insignificant spatial difference of BPA concentrations in MPs, the hypothesis of Pearl River Estuary being the most important source of BPA-sorbed microplastic is therefore rejected. This is evident since the closest beach to the proximity of the mouth of Pearl River Estuary was HPN, and it only showed relatively moderate level of BPA-sorbed MP concentration when compared with other sites. Surprisingly, the most polluted site was TO, where it is a rural area as a fishing village and famous tourist spot. Comparatively high BPA level in MPs was also detected at adjacent beach YO. To the best of our knowledge, currently there is no study has been conducted to quantify BPA concentrations in the environment of these areas. These in turn alarm us to pay a closer attention on the undeveloped areas for potential pollution, as many remote areas with minimal population have already received huge numbers of MPs (Barnes et al., 2009). Also, the coastal zone of TO and YO are the important habitats for Indo-Pacific humpback dolphin Sousa chinensis, which the population size has been decreasing in the past few decades with continuous pollution (Sanganyado et al., 2018). TLW located at the western Victoria Harbour contained the second highest of BPA contaminated MPs, which could be related to discharge of sewage treatment plant. Sewage treatment plants are the known source of both BPA (Wang et al., 2019) and microplastic (Murphy et al., 2016) as they cannot fully eliminate the pollutants. There is one sewage treatment work adopted chemically enhanced primary treatment process that the outfall is right next to TLW. Previous study by Man et al. (2018) evaluated that this treatment process did not perform well to remove many organic pollutants, including BPA. This also explains the occurrence of BPA analogues (i.e. BPB; BPF; BPS) at TLW but not being detected at other sites. Similarly, LK and MW which located at western Victoria Harbour may be also affected by the discharge from the sewage treatment plant. For the eastern and southern beaches, the BPA concentrations ranged from 82.4–223 ng g-1, thus all these sites considered as lower range among all other sites. However, this does not imply that these sites were cleaner than the others since our results showed statistical insignificance when all the sites are considered. Therefore, source identification may be necessary for future work, although it would be technically difficult to differentiate whether the BPA is addictive during production or adsorbed after being released in the environment. To explore if there is any association of polymer types and BPA contents in MPs, the concentration of BPA was correlated with each polymer type. However, there was no clear correlation being found between every polymer type and BPA concentrations in MP (Pearson's $r = 0.112–0.233$, $p > 0.05$), suggesting that there were other factors superimposing the effect of sorption behavior of different polymers.

In summary, there was no spatial difference of BPA concentrations in MPs collected on beaches of Hong Kong. This indicated that the riverine input from the Pearl River Estuary was not the only source, while local point source, such as discharge from the sewage treatment plant, may also contribute to the pollution. Therefore, more research effort should be made to explore the potential impacts of BPA posed by MPs in some sites thought to be clean. This baseline study provides a foundation for future ecotoxicological assessment in Hong Kong and similar environment considering BPA in MPs.

Research Output

1. Po, B.H.K., Lo, H.S., **Cheung, S.G., Lai, K.P.** (2020). **Characterisation of an unexplored group of microplastics from the South China Sea: can they be caused by macrofaunal fragmentation?** *Marine Pollution Bulletin,* 155, 111151.

2. Lo, H.S., Po, B.H.K., Li, L., Wong, A.Y.M., **Kong, R.Y.C.**, Li, L., **Wong, C.K.C., Cheung, S.G., Lai, K.P.** (2021). **Bisphenol A and its analogues in sedimentary microplastics of Hong Kong.** *Marine Pollution Bulletin,* 164, 112090.

Oct 2019 – Sep 2021 (On going)
Removal of salt and organic pollutants by solar steam using graphene materials
基於石墨烯材料的太陽蒸汽技術移除鹽和有機污染物的研究

T.C. WAI, James C.W. LAM, R.Q. YE
Funding Amount: HK$300,000

Scope of investigation: 1) Fabricate a graphene-based device for solar steam generation and 2) Study the effect of surface hydrophobicity of graphene for water evaporation.

Results Achieved: (1) Achieve >90 % broad solar spectrum absorption and >80% solar steam generation efficiency, and (2) Reduce the salinity of sea/river water to the level of drinkable water defined by the World Health Organization (i.e. below 103 mg/L).

Research Output

1. **Ye, R.Q.**, Tour, J.M. (2019). **Graphene at fifteen.** *ACS Nano,* 13, 10, 10872–10878.

2. Huang, L.B., Su, J.J., Song, Y., **Ye, R.Q.** (2019). **Laser-induced graphene: En route to smart sensing.** *Nano-Micro Letters,* 12, 157.

3. Huang, L.B., Xu, S.Y., Wang, Z.Y., Xue, K., Su, J.J., Song, Y., Chen, S.J., Zhu, C.L., Tang, B.Z., **Ye, R.Q.** (2020). **Self-reporting and photothermally enhanced rapid bacterial killing on a laser-induced graphene mask.** *ACS Nano,* 14, 9, 12045–12053.

4. Huang, L.B., Ling, L., Su, J.J., Song, Y., Wang, Z.Y., Tang, B.Z., Westerhoff, P., **Ye, R.Q.** (2020). **Laser-engineered graphene on wood enables efficient antibacterial, anti-salt-fouling, and lipophilic-matter-rejection solar evaporation.** *ACS Applied Materials & Interfaces,* 12, 51864–51872.

5. Song, Y., Zhang, J.J., Zhu, Z.H., Chen, X., Huang, L.B., Su, J.J., Xu, Z.T., Ly, T.H., Lee, C.S., Yakobson, B.I., Tang, B.Z., **Ye, R.Q.** (2021). **Zwitterionic ultrathin covalent organic polymers for high-performance electrocatalytic carbon dioxide reduction.** *Applied Catalysis B: Environmental,* 284, 119750.

Oct 2019 – Sep 2021 (On going)
Toxicological assessment of organic ultraviolet filters (OUVFs) to early life stage of marine medaka *(Oryzias melastigma)*
有機紫外吸收劑對海水青鱂魚*(Oryzias melastigma)*早期生命階段的毒性評估

Henry Y.H. HE, James C.W. LAM
Funding Amount: HK$300,000

Scope of investigation:
a. Market research and literature review
Market research was carried out regarding the composition of sunscreen products commonly available in the cosmetic industry. Specifically, we acquired the following information: (1) compound classification, (2) function, (3) maximum dosage by EU and/or FDA and (4) existing reports of healthy impacts on humans, animals and the environment.

b. Range-finding tests of selected OUVFs
The range-finding tests of organic ultraviolet filters (OUVFs) oxybenzone (BP-3), octinoxate (EHMC) and octocrylene (OC) were carried out following OECD 236. Several lethal and sub-lethal endpoints in embryonic developmental stages were photographed and examined during daily observation.

c. Real-time RT-PCR method development
We searched for possible mode of action and genes that play important roles in these biological processes in which the selected OUVFs potentially impact invertebrates. Primers for each gene were designed using the Primer 3 program, to be used in real-time RT-PCR.

Results achieved:
a. Sunscreens on the market
In total, we found 18 physical or chemical UV-filters that are widely used as UV absorbent, penetration enhancer, pigment, etc., among 47 sunscreen products covering 24 brands. In these UV- filters, oxybenzone (BP-3), octinoxate (EHMC), octocrylene (OC), octisalate (EHS), homosalate (HMS) and avobenzone (BMDM) have shown high usage frequency and evidence of health risks.

b. Effects of selected OUVFs on marine medaka embryos
Hatching rate decreased following exposure to oxybenzone (BP-3), with estimated EC50 2636 μg/L. No obvious hatching failure was observed for embryos exposed to octinoxate (EHMC) or octocrylene (OC) at tested concentrations.

c. Primer design
Primer pairs for the following genes were designed and proposed to be utilized in real-time RT- PCR: *18s rRNA* (control), *CYP1A, ERα, ERβ, ERγ, ARα, ChgH, ChgL, VTG1, VTG2,* etc.

The progress of the project is delayed. The student is working hard to catch up. However, extension (1-year) may be needed for the completion of this project.

Dr. James Lam is currently supervising the student on development of chemical analysis method for OUVF and OUVF transformation products.

The project was meant to start in the last quarter of 2019. Due to the social events happened in Hong Kong society at that time, the beginning of the project was postponed to the first quarter of 2020 when COVID-19 pandemic broke out. The student was finally admitted in September 2020 and set out with this project then. Although the progress of this project was affected by inevitable social factors, the student is now pushing it ahead actively.

Future plan:
a. Determination of photooxidation behavior and product of OUVFs
b. Assessment of toxicity of OUVFs photooxidation product in vivo and in vitro

Oct 2019 – Sep 2021 (On going)
Real-time antibiotic resistance genes and pathogen surveillance using Nanopore metagenomic sequencing
利用納米孔宏基因組測序實時監測抗生素抗性基因和致病菌

T. ZHANG, Kenneth M.Y. LEUNG, Paul K.S. LAM
Funding Amount: HK$300,000

The objectives of this study are to rapidly reveal the genetic backgrounds and hosts of antibiotic resistance genes (ARGs) using Nanopore metagenomic sequencing and to establish a workflow for real-time absolute quantification of ARGs and hosts, especially for those potential ARG-bearing pathogens. The specific objectives and scopes are summarized below:

(1) To reveal the genetic location and hosts of resistance genes along the wastewater treatment process (e.g., influent and effluent).
(2) To construct the internal standards (termed as “spike-ins”) for absolute quantification of resistance genes and putative pathogens using Nanopore metagenomic sequencing.
(3) To track the hosts of ARGs and their fates along the treatment process (i.e., from influent to effluent).
(4) To develop an absolute quantification framework for real-time resistance genes and putative pathogen surveillance.

Absolute quantification framework for real-time ARGs and putative pathogen surveillance
We developed an absolute quantification framework that combines cellular spike-in (*E. coli K12 MC1061-Rif+::mClover3-Km+*) and then implemented this workflow to achieve rapid ARGs and putative pathogen surveillance.

ARGs profiles and the absolute abundances
ARGs detected in 3 sets of CAS WWTP samples in this study were of high diversity and, in total, 361 different ARGs (belonging to 16 different ARG types) were characterized, where influent samples harbored 225 ± 44 ARGs and effluent samples harbored 108 ± 9 ARGs. The absolute abundances of the detected ARGs in the influents were in the range of 4.38×10^{7} ARGs/L to 2.04×10^{10} ARGs/L, and in the range of 2.92×10^{6} ARGs/L to 1.24×10^{9} ARGs/L for the effluents. Among all the 3 influent samples, 174, 248, and 252 ARGs were detected for ST_Oct, ST_Nov, and YL_Nov, respectively, at levels above the limits of quantification. For all the effluent samples, the diversity of ARGs above the limits of quantification decreased slightly to 106, 117, and 100 for ST_Oct, ST_Nov, and YL_Nov, respectively.

ARGs persistent in WWTPs
In total, 82, 100, and 82 ARGs were persistent along the CAS treatment process (present in both the influent and effluent) in ST_Oct, ST_Nov, and YL_Nov WWTPs, respectively. Within these ARGs, 47 of them, mainly resisting to beta-lactam, aminoglycoside, MLS and tetracycline, were common persistent ARGs found across all these 3 sets of full-scale CAS WWTP samples accounting for 62.9% to 74.8% of the total absolute ARG abundance for all influent and effluent samples.

Absolute abundance of key potential pathogens in the WWTPs
Overall, average concentration of these 71 key potential pathogens in the influent was $2.94\text{*}10^{6} \pm 1.40\text{*}10^{6}$ cells/L influent, and $9.41\text{*}10^{4} \pm 2.33\text{*}10^{4}$ cells/L effluent. And the total absolute abundance of these 71 key potential pathogens was $1.59\text{*}10^{9} \pm 4.62\text{*}10^{8}$ cells/L in the influent and $1.64\text{*}10^{7} \pm 3.35\text{*}10^{6}$ cells/L in the effluent, accounting for 0.87 ± 0.49% and 0.29 ± 0.14% of the total bacterial population in the influent and effluent, respectively.

Rapid microbial profiling achieved by Nanopore metagenomic sequencing 1-hour data
We achieved rapid characterization of the WWTP influent and effluent microbial profiles by Nanopore metagenomic sequencing (Figure 1). Absolute abundances of the top abundant species in the influent samples measured at 1 and 24 hour demonstrated high similarity (log-transformed Pearson’s r in the range of 0.848 and 0.886). As for the effluent samples, the absolute abundances measured at 2 and 24 hours had an acceptable similarity (log-transformed Pearson’s r in the range of 0.767 and 0.823). These results indicated the real-time capacity of Nanopore sequencing for revealing the microbial consortium in the influent and effluent samples permitting rapid wastewater-based epidemiological surveillance. Interestingly, the first ARG and putative pathogen were identified within a minute (Figure 1), which is expected to achieve real-time tracking of resistance genes and pathogens in different samples.

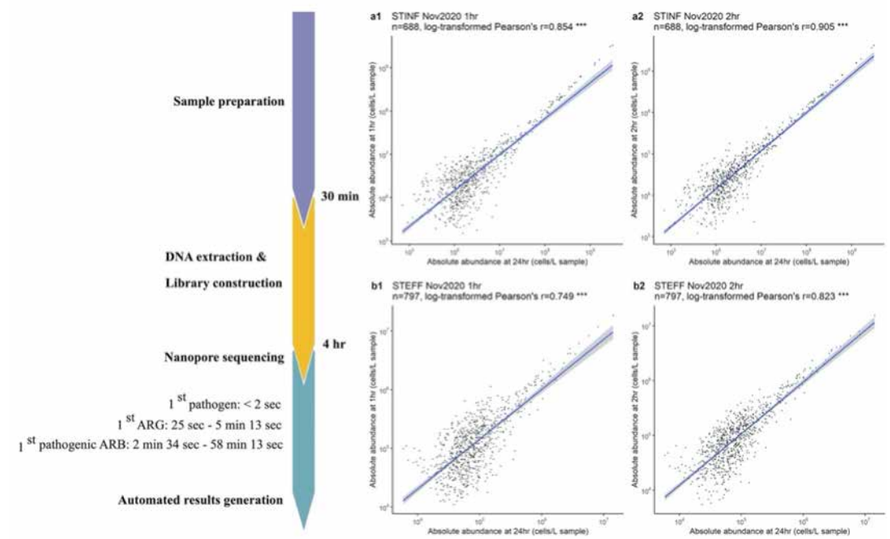

Figure 1. Rapid microbial profiling achieved by Nanopore metagenomic sequencing 1-hour data (Samples from ST WWTPs were plotted for visualization purpose).

Research Output

1. Che, Y., Yang, Y., Xu, X.Q., Břinda, K., Polz, M.F., Hanage, W.P., **Zhang, T.** (2021). **Conjugative plasmids interact with insertion sequences to shape the horizontal transfer of antimicrobial resistance genes.** *PNAS,* 118, 6.

Oct 2019 – Sep 2021 (On going)
Microplastics in edible oysters and their significance in the Greater Bay Area
大灣區牡蠣的微塑膠含量及其意義

James K.H. FANG, S.G. CHEUNG
Funding Amount: HK$300,000

The progress has been successful. No problem has been encountered, apart from the slight delay due to the situation of COVID-19. All required oyster samples have been collected from six sites in the Greater Bay Area. Extraction and analysis of microplastics from the oyster samples have been completed. Currently we are processing the data of microplastics in terms of number, particle size, shape and polymer type. The human ingestion rates of microplastics will be estimated through consumption of oysters. Using these data and information, our goal is to submit a manuscript to *Environmental Pollution*. Research findings will be presented in the SKLMP annual meeting in March 2021.

Oct 2019 – Sep 2021 (On going)
Organophosphate triesters and diester in coral communities
珊瑚群落中的有機磷酸三酯和二酯現狀研究

James C.W. LAM, Apple P.Y. CHUI, P.O. ANG, Keith W.K. HO, C.C. CHEANG
Funding Amount: HK$300,000

Coral ecosystems have been identified as one of the most productive ecosystems because of the important ecological services it provides. Not only it acts as important sea defence against natural disasters, it also supports diverse marine lives that provides various human activities including fisheries and tourism. Yet, these important ecosystems have been facing serious human-induced impacts, including climate change and the associated ocean acidification, and chemical pollution.

In fact, contaminations of persistent organic pollutants (POPs) and other toxic substances in the marine environment have garnered more concern over the past years because of their ubiquity, persistence, bioaccumulative properties, as well as high toxicities on living organisms. Occurrences of these compounds in coral communities have also been identified. For example, recent research have detected polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), chlorinated paraffins, and ultraviolet (UV) filters in various coral communities around the globe, indicating this is an issue that is of considerable concern.

Of these toxic substances, OPFRs, PFAS, and PBDEs are three major groups of highly concerned contaminants in the marine environment. While the contamination and adverse effects of these chemicals have been widely identified in various marine ecosystems, information regarding the pollution of these contaminants in corals has been scarce.

In view of that, this study aimed to study the occurrences and ecological risks associated with OPFRs, PFAS, and PBDEs in the coral communities in Hong Kong. Contamination of OPFRs was analysed with coral colonies and eggs of Acropora spp. and Platygyra acuta; while contaminations of PFASs and PBDEs were studied using two coral species, namely Porites spp. and Pavona decussata, collected from four selected sites in the eastern waters of Hong Kong. Target analytes in corals individuals were quantified with ultra-performance liquid-chromatography coupled with triple quadrupole tandem mass spectrometry operated in negative mode. In addition to determining the concentrations of these compounds in corals, ecological risk assessments of PFASs and PBDEs were carried out using hazard quotient approach.

The total OPFR concentrations in all samples ranged from 14.97 to 689.21 ng/g d.w. (dry weight), which TMP was found to be the most predominant analyte among all detected compounds (colony: 26.7-31.8%; eggs: 35.8-53.8%). Comparing the two investigated species, colonies of Acropora spp. had significantly higher concentrations of total OPFRs than that of Platygyra acuta. On the other hand, total concentrations of PFAS and PBDEs in coral communities ranged from <DL to 4.7 ng/g d.w. and 14.7 ng/g d.w. to 224.6 ng/g d.w., respectively. Contamination levels of PFASs and PBDEs were generally higher in the wet season than in the dry season, which could be attributed to the elevated industrial activities along the Pearl River in summer. A spatial variation was also identified for PFASs. Moreover, both HQs calculated based on concentrations of each PFASs residue were well below unity, while the best-case and worst-case HQ for PBDEs ranged from 0.00-2.31, and 0.61-4.43, respectively. These results from ecological risk assessments demonstrated that the risks imposed to corals by the two PFASs were negligible, whereas the high levels of PBDEs in corals can pose threats to these organisms. These findings reflected that PBDEs and their alternatives are still of great concern.

More coral samples will be collected in this year for the analysis of target analytes

Research Output

1. Ruan, Y.F., Lin, H.J., Zhang, X.H., Wu, R.B., Zhang, K., **Leung, K.M.Y., Lam, J.C.W., Lam, P.K.S.** (2020). **Enantiomer-specific bioaccumulation and distribution of chiral pharmaceuticals in a subtropical marine food web.** *Journal of Hazardous Materials,* 394, 122589.

2. Tang, L.Z., Liu, M.Y., Hu, C.Y., Zhou, B.S., **Lam, P.K.S., Lam, J.C.W.**, Chen, L.G. (2020). **Binary exposure to hypoxia and perfluorobutane sulfonate disturbs sensory perception and chromatin topography in marine medaka embryos.** *Environmental Pollution,* 266, 115284.

3. Hu, C.Y., Tang, L.Z., Liu, M.Y., **Lam, P.K.S., Lam, J.C.W.**, Chen, L.G. (2020). **Probiotic modulation of perfluorobutanesulfonate toxicity in zebrafish: Disturbances in retinoid metabolism and visual physiology.** *Chemosphere,* 258, 127409.

4. **Chen, L.G., Lam, J.C.W.,** Tang, L.Z., Hu, C.Y., Liu, M.Y., **Lam, P.K.S.,** Zhou, B.S. (2020). **Probiotic modulation of lipid metabolism disorders caused by perfluorobutanesulfonate pollution in zebrafish.** *Environmental Science & Technology,* 54, 7494–7503.

5. Tang, L.Z., Song, S.W., Hu, C.Y., Liu, M.Y., **Lam, P.S.K.**, Zhou, B.S., **Lam, J.C.W.**, Chen, L.G. (2020). **Parental exposure to perfluorobutane sulfonate disturbs the transfer of maternal transcripts and offspring embryonic development in zebrafish.** *Chemosphere,* 256, 127169.

6. Tang, L.Z., Song, S.W., Hu, C.Y., **Lam, J.C.W.**, Liu, M.Y., Zhou, B.S., **Lam, P.K.S.**, Chen, L.G. (2020). **Unexpected observations: Probiotic administration greatly aggravates the reproductive toxicity of perfluorobutanesulfonate in zebrafish.** *Chemical Research in Toxicology,* 33, 1605-1608.

7. Liu, M.Y., Song, S.W., Hu, C.Y., Tang, L.Z., **Lam, J.C.W., Lam, P.K.S.**, Chen, L.G. (2020). **Dietary administration of probiotic Lactobacillus rhamnosus modulates the neurological toxicities of perfluorobutanesulfonate in zebrafish.** *Environmental Pollution,* 265, 114832.

8. Tang, L.Z., Liu, M.Y., Song, S.W., Hu, C.Y., **Lam, P.K.S., Lam, J.C.W.**, Chen, L.G. (2020). **Interaction between hypoxia and perfluorobutane sulfonate on developmental toxicity and endocrine disruption in marine medaka embryos.** *Aquatic Toxicology,* 222, 105466.

Oct 2019 – Sep 2021 (On going)
Removal Mechanisms of Selected Endocrine Disrupting Chemicals (EDCs) in Bioreactors with Biochars
利用生物炭強化生物反應器對內分泌干擾物的去除及其機理研究

Chris Y.F. TSANG, X.Y. LI, J. RINKLEBE
Funding Amount: HK$300,000

The proposed study aims to evaluate the removal mechanisms of selected EDCs under dynamic redox conditions in different engineered biochar-enhanced bioreactors. The synergistic effects of engineered biochars on treatment performance and microbial community in the biochar-enhanced bioreactors during microbial immobilization and operation will also be investigated. Finally, we will propose suspended-growth and attached-growth bioreactors using the modified/optimised engineered biochars with improved efficiency, controllability, and stability for removal of selected EDCs, thus realising stable and efficient biological processes for real applications in drinking water purification and sewage treatment facilities.

The activities are (1) to design, prepare, and produce engineered biochars; (2) to modify protocols for engineered biochar characterisation; (3) to validate and modify protocols for EDC analysis; (4) to evaluate the removal mechanisms of selected EDCs in bioreactors with engineered biochars; and (5) to identify the key EDC-degrading bacteria and investigate the synergistic effects of engineered biochars on microbial community in the biochar-enhanced bioreactors.

Research Output

1. Zhang, M., Shen, J.L., Zhong, Y.C., Ding, T., Dissanayake, P.D., Yang, Y., **Tsang, Y.F.**, Ok, Y.S. (2020). **Sorption of pharmaceuticals and personal care products (PPCPs) from water and wastewater by carbonaceous materials: A review.** *Critical Reviews in Environmental Science and Technology (in press).*

2. Hu, X., Deng, Y., Zhou, J., Liu, B., Yang, A.J., Jin, T., **Tsang, Y.F.** (2020). **N- and O self-doped biomass porous carbon cathode in an electro-Fenton system for Chloramphenicol degradation.** *Separation and Purification Technology,* 251, 117376.

3. Cheng, Y.L., Kim, J.G., Kim, H.B., Choi, J.H., **Tsang, Y.F.**, Beak, K. (2021). **Occurrence and removal of microplastics in wastewater treatment plants and drinking water purification facilities: A review.** *Chemical Engineering Journal,* 410, 128381.

Oct 2019 – Sep 2021 (On going)
Assessing the coral health status under different anthropogenic pressures using in-situ and ex-situ innovative methods
使用原位和異位創新方法評估不同人為壓力下的珊瑚健康狀況

Leo L. CHAN, J.W. QIU
Funding Amount: HK$300,000

This study aims to assess the health status of corals living in Hong Kong waters combining in-situ observations of metabolic rates (respiration, photosynthesis and calcification) with *ex-situ* proteomic analysis of coral tissue and mucus. The coral species belonging to *Platygyra carnosa* and *Pavona decussata* have been selected as the most common stress-tolerant corals capable to survive to adverse conditions of elevated temperature and low salinity. Our interest is to investigate how these corals can modulate their metabolism during stress conditions by measuring the metabolic rates and quantifying the protein content in the tissue.

Protocols for a diver-portable respirometry system have been developed to assess the coral health and measure the calcification rates, and the information on the metabolism of *P. carnosa* corals has been unveiled for the first time (Dellisanti et al. 2020). Moreover, a workflow of protein extraction from stony coral tissue and protein sample treatment before bottom-up coral proteomics research has been recently proposed. By using it, the proteome coverage of corals could be raised to 3000 proteins, making a more comprehensive molecular mechanism investigation in protein level possible (Ma et al., in prep.). These studies are pioneers in the field of coral research and the findings will add useful knowledge to coral metabolic responses exposed to natural environmental conditions.

This project is involving a cross-universities collaboration between City University of Hong Kong, Hong Kong Baptist University, Chinese University of Hong Kong, University of Maine (USA).

Research Output

1. Dellisanti, W., Tsang, R.H.L., Ang, P., Wu, J.J., Wells, M.L., **Chan, L.L.** (2020). **A diver-portable respirometry system for in-situ short-term measurements of coral metabolichealth and rates of calcification.** *Frontiers in Marine Science,* 7, 571451.

Summary of the Collaborative Research Fund (CRF) Projects
CRF項目概要

Apr 2020 – Mar 2023 (On going)
Addressing an imminent problem presented by a new class of pollutants: Chemicals with epigenetic and transgenerational effects
揭示新一類污染物衍生的迫切問題：可引致表觀遺傳和跨代效應的化學物質

Rudolf S.S. WU, Chris K.C. WONG, Jill M.Y. CHIU, T.F. CHAN, Richard Y.C. KONG, Ball K.P. LAI
Funding Amount: HK$2,100,000

Using the marine medaka (*Oryzias melastigma*) as a fish model, this project aims to test the hypothesis that F0 exposed to environmental realistic concentration of some EDCs can cause epigenetic alterations associated with transgenerational reproductive impairment in both males and females in the subsequent generations (F1 to F3).

Five EDCs (BDE47, EE2, BP3, TDCPP, TCS) which commonly occur in coastal waters of Hong Kong and coastal waters of China in elevated concentrations were selected to test the above hypothesis.

Laboratory culture of marine medaka (*Oryzias melastigma*) was set up in our laboratory environment for experiment. Adult fish were divided into three batches: The first batch was kept in filtered seawater (Seawater Control), the second batch was exposed to environmental realistic concentration of each of the above 5 EDCs (Treatment), and the third batch was exposed to DMSO (Solvent control) for 3 months covering the growth phase and entire reproductive cycle.

Growth, fecundity (gonad weight and gonadal somatic index), sperm count, sperm motility, egg production, fertilization success of F0 in each of the above control and treatment groups were determined, to assess and compare the Darwinian fitness traits.

In each group, histological studies were carried out to examine gonad development, body burden of chemical in muscle was determined by GC, sex hormones (T, 11-KT, E2 and T/E2) in serum were determined. RNA was extracted to determine expression of reproduction-associated genes and proteins in the brain (GnRH, GnRH-R), pituitary (FSHβ, LHβ) and gonads (StAR, CYP11a, CYP11β, CYP17, CYP19a, CYP21, 3βHSD, 17βHSD, FSH-R, LH-R, HMGR).

F1 juveniles produced from each of the above control and treatment were harvested. F1 of seawater control and solvent control were reared under the same condition as their respective F0. F1 produced by the F0 Treatment groups were split into two groups: One group was reared under the same treatment condition as their F0 parent (F1 Treatment), whereas the other group was returned to sea water (F1 Transgenerational).

Apr 2020 – Mar 2023 (On going)
Zoonotic transmission of antimicrobial resistance from seafood-related marine ecosystems to the coastal population in the Greater Bay Area
大灣區內細菌耐藥性從海產品相關海洋生態系統向沿海人群傳播之研究

X.D. LI, T. ZHANG, Paul K.S. LAM, Kenneth M.Y. LEUNG, J.Q. ZHANG, L. JIN
Funding Amount: HK$2,100,000

We undertook a sampling programme at a typical mariculture farm in Sai Kung under the Hong Kong Accredited Fish Farm Scheme. The samples included seawater, surface sediment, fish feed, and major cultured fish species consumed by local residents, including *Siganus canaliculatus, Trachinotus blochii, Epinephelus coioides, Lutjanus sebae, Epinephelus Fuscoguttatus,* and *Epinephelus Lanceolatus*.

The evaluation of phenotypic resistances of pathogens or other bacteria isolated from fish tissues (edible tissues and gut contents), seawater and sediment was performed by antimicrobial susceptibility testing following standard procedures of the disk diffusion method on Mueller-Hinton agar according to the CLSI or EUCAST guideline. The pathogen species isolated from fish edible tissue all belonged to *Staphylococcus*, including *S. haemolyticus* from *Trachinotus blochii, S. aureus* from *Epinephelus coioides,* and *S. epidermidis* from *Lutjanus sebae. Enterococcus hirae* was isolated from the gut content of *Epinephelus Fuscoguttatus x Epinephelus Lanceolatus. Proteus mirabilis* was identified from fish feed. *Acinetobacter radioresistens* and *Enterococcus durans* were isolated from surface seawater. Most of the pathogen species isolated were resistant to 1-3 antibiotics tested. Fish edible tissue could be the main habit of pathogens with AMR compared with the fish gut. Whole genome sequencing was performed for the isolated resistant pathogens or bacteria strain on the PacBio RS II platform.

Metagenomic sequencing was performed for the total genomic DNA extracted from fish tissues (edible tissue and gut contents), seawater and sediment. We identified 22 types of antibiotic resistant genes (ARGs) in fish edible tissues and environmental samples, with the predominance of multidrug and MLS resistance genes, which generally agreed with the phenotypic screening results. The ARG profiles of most fish edible tissues were similar to those in surface seawater. Bacterial communities were consistent among fish edible tissue samples and distinguished from their counterparts in environmental samples. The dominant phyla in fish edible tissue were *Proteobacteria* and *Firmicutes. Proteobacteria, Bacteroidetes,* and *Cyanobacteria* dominated the seawater bacterial communities, while *Proteobacteria, Firmicutes, Actinobacteria* and *Bacteroidetes* were dominant in sediment.

The taxonomic composition of defined ARG hosts was similar as bacterial community in each sample, which suggests that the pattern of resistant bacteria in these samples was influenced by bacterial community. The dominant antibiotic categories encoded by ARGs in resistant phyla were multidrug and glycopeptide, while the main MGE types are integrase, recombinase and transposase. The strong correlation between ARGs and MGEs indicates ARGs in these resistant taxonomies had a high mobility potential. *Proteobacteria* as the dominant ARG host had the highest relative abundance of resistome and mobilome among the defined resistant bacterial communities in fish edible tissue samples and environmental samples. Compared to environmental samples, ARG hosts with MGEs accounted for a larger proportion in fish edible tissue samples, suggesting the potential mobility of ARGs in fish edible tissues.

Two common resistant bacterial species, namely *Pseudomonas azotoformans* and *Pseudomonas fluorescens,* were identified in both fish edible tissue samples and environmental samples. *P. azotoformans* has been found in food chain sections (e.g. the slaughterhouse) and may cause food-borne diseases. *P. fluorescens* has been suggested to be linked with the rise of Crohn's disease. The occurrence of these two resistant bacteria as well as pathogens mentioned above in fish edible tissue samples alarmed coastal population in Great Bay Area the seafood-related safety problem via daily seafood consumption. The same ARG-MGE carrying contigs were shared by *P. azotoformans* in different fish edible tissue samples. Contig carrying the combination genes of cAMP-vanR-IS630 was detected in *P. azotoformans* in *Epinephelus coioides* and *Lutjanus sebae*. Another shared antibiotic resistome, PvrR-IS3, was found in *P. azotoformans* from *Epinephelus coioides* and *Lutjanus sebae*. These shared gene cassettes provided opportunities for the potential transmission of ARGs among microbiome in mariculture products.

Crassostrea hongkongensis is another popular seafood consumed by local residents in the Great Bay Area (GBA) and this oyster is one of the key commercial species in the Pearl River Estuary (PRE). In collaboration with Prof. Wenxiong Wang, we collected samples of adult oysters and seawater at 8 sites along the eastern and western coastlines of the PRE. We will continue to assess the phenotypes and genotypes of AMR in oyster samples and make a comparison in AMR status of mariculture products in the GBA. Additionally, the transferability of bacterial resistance in oyster samples will be evaluated and compared with that in fish samples. We hope to elucidate the dynamics of the dissemination and transfer of bacterial resistance mediated by seafood from mariculture or marine ecosystem to coastal population based on the above information.

Summary of the Internal Research Fund (IRF) Projects
IRF項目概要

Mar 2018 – Feb 2021 (On going)
Development of an immune-stimulating antimicrobial peptide feeding regime for the hybrid grouper
開發一套針對雜交石斑魚具有免疫促進的抗菌多肽餵養體系

Doris W.T. AU, F. SEEMANN, Leo L. CHAN, Y.W. LAM; Rudolf S.S. WU, K.J. WANG
Funding Amount: HK$300,000

The hybrid grouper (*Epinephelus* sp. x sp.) is a commercial important aquaculture species in Hong Kong and South China. The project aimed at the reduction of antibiotic use in grouper aquaculture and enhancement of juvenile survival. Three major grouper antimicrobial peptides (AMPs): β-defensin, piscidin (ecPis-3) and hepcidin (EC-hepcidin1) were suggested to be tested for their immune-stimulatory potency under a prophylactic feeding regime and under different pathogen challenge scenarios, including bacteria *Edwardsiella tarda* (edwardselliosis), red grouper necrosis virus (RGNNV) and the parasite *Cryptocaryon irritans* (white spot disease) (Objective 1).

EC-hepcidin has been established and developed by Prof Wang K.J. Milestones to be completed in the first year comprised the recombinant protein production of two other selected AMPs (β-defensin, piscidine-3) and AMP feeding trials with subsequent challenge with the pathogenic *Edwardsiella tarda* bacteria.

Recombinant AMP protein production:
Synthetic peptide production is commercially available, but remains at a high cost. To reduce the budget of AMPs feeding experiments, it is necessary to generate recombinant AMPs using the BL21 cells (*Escherichia coli*). Three plasmids (pET Biotin His6mCherry LIC; pET28:GFP, pETmRuby2 LIC) were used for each AMP: beta-defensin and piscidin3 protein expression in BL21 cells. Genes were inserted into plasmids through restriction enzyme cutting for pET:GFP (HindIII) or ligation independent cloning for pET Ruby2 and pETmCHerry (LIC; https://www.addgene.org/protocols/lic/). In the end, a set of 3 plasmids was done for each gene. Transformation of plasmids into BL21 competent cells followed the protocol (https://www.addgene.org/protocols/bacterial-transformation/). AMP insert was combined to vector with fluorescent tag (mCherry, mRuby and GFP) to stabilize the short AMP protein (ca. 200 base pairs only) and to aid in vvisualization of protein expression. Bacteria growth and protein harvest as well as Western blot for protein quantification followed the procedures in Pan et al. (2012).
Problem encountered: While the bacterial production of ecPis-3 is close to completion. Recombinant production of β-defensin was not successful due to improper protein folding after production through the bacteria, which would affect its functionality as an AMP and render it not desirable for mass production and feeding application.

Host Resistance Assay and AMP feeding trials:
Host resistance assays were conducted on juvenile hybrid grouper using the *E. tarda* (3 replicate run, LC60 = $1.8x10^8$ cfu/ml). *In vitro* test for ecPisc3 was also completed using the MIC assay. The effectiveness of ecPisc 3 administration for bacterial infection is being tested. The proteomics profiles will be measured for skin mucus and plasma in experimental fish. The levels of AMPs and other major immune proteins will be quantified and correlated with post-pathogen challenge fish survival. The parasite *Cryptocaryon irritans* is not available for experiment due to problem in getting approval and transportation of parasite from Mainland.

Essential information regarding the optimal AMPs feeding regime as immune-stimulating feed additive in the hybrid grouper will be gained. The findings will also provide new insights into the immunomodulatory and antimicrobial capacities of fish AMPs. This novel study will potentially contribute to a significant reduction of antibiotics administration in aquaculture.

Feb 2018 – Jan 2021 (On going)
High-resolution reconstruction of the beating marine medaka heart
高分辨率重建構造海洋青鱂魚心臟

S.H. CHENG, Chris K.C. WONG
Funding Amount: HK$300,000

We first compared the heart repair process of medaka and zebrafish after cryoinjury in this study. The scar volumes of medaka and zebrafish were measured by Picro-Sirius Red staining, by which the collagen fiber (scar) was marked with red, and the muscle fibers and cytoplasm were marked with yellow. As shown in Fig. 1, the collagen deposition was dark red compared with the healthy tissue. At 1 day post cryoinjury (dpc), there was no significant difference between the percentage of the scar volume of medaka (29.35%, Fig. 1 Aa) and zebrafish (26.58%, Fig. 1 Ae). At 7 dpc, the scar volume of zebrafish was declined to 19.65% (Fig. 1 Af), which showed that it was under repair, whereas the scar volume of medaka was increased compared to that of 1dpc (Fig. 1 Ag). This excessive fibrotic response of medaka was also reported by Ito et al. (Ito et al., 2014). At 30 dpc, the scar volume of both medaka and zebrafish became smaller. However, at 90 dpc, as shown in Figure 1 Ad, unlike zebrafish which only had a few collagen fibers, a permanent scar was shaped in medaka heart. These results showed the different repair progresses of medaka and zebrafish after cryoinjury. The excessive fibrotic deposition might prevent the heart regeneration of medaka.

As GATA4 plays a pivotal role in heart development, homeostasis and regeneration7, 8, we further investigated the expression levels of GATA4 in the hearts of medaka and zebrafish after cryoinjury. At 4dpc, both zebrafish and medaka showed higher expression of GATA4 compared with uninjured group (data not shown), indicating that GATA4 is required for the injury repair after cryoinjury. At 7dpc, we found higher expression level of GATA4 in medaka even though it cannot regenerate the lost cardiomyocytes (Fig. 2A, B). Our data suggested that GATA4 is required for the heart repair but cannot induce heart regeneration by its own. Thus, we need to test other factors participated in the regenerative process.

Proliferation of the dedifferentiated cardiomyocytes occurs during zebrafish heart regeneration9. In this study, we used embryonic cardiomyocyte heavy chain (embCMHC) to stain the dedifferentiated cardiomyocytes. As shown in Fig. 3, there is no embCMHC in the heart of medaka after cryoinjury, indicating the loss of heart regenerative ability of it.

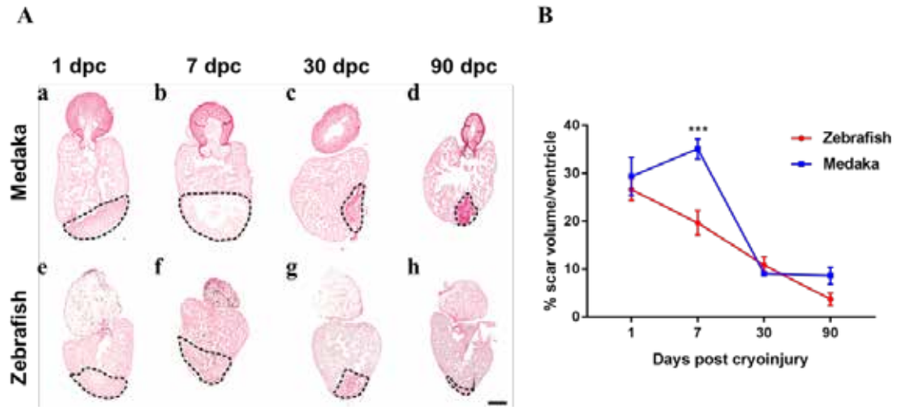

Fig. 1. Comparison of heart repair process of zebrafish and medaka after cryoinjury. (A) Representative images of heart sections of medaka and zebrafish stained by Picro-Sirius Red over time. Black dotted lines showing the injured area. (B) Percentages of the scar volume in ventricle over time (n = 3-5 hearts; multiple t test with Holm-Sidak method, ***P < 0.001). Scale bar: 200 μm. Data are presented as mean ± standard error of mean (SEM).

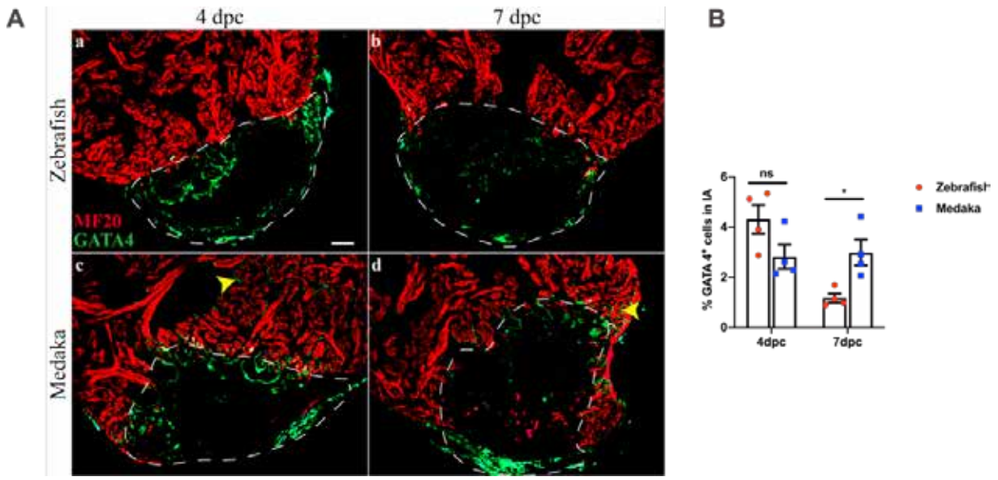

Fig. 2. The expression of GATA4 in zebrafish and medaka heart after cryoinjury. (A) Representative paraffin sections of zebrafish and medaka heart at 4 days post cryoinjury (dpc) and 7 dpc were co-immunolabelled with anti-GATA4 (green) and MF20 (Red). The expression of MF20 was lost in the injury area (IA, white dashed line bounded area) of both zebrafish and medaka in 4 and 7 dpc. In zebrafish, the expression of GATA4 was limited in the injury area in 4 and 7 dpc. However, in medaka, the expression of GATA4 was mainly induced in injury area, and in the normal cardiac tissue, where MF20 was still expressed, the expression of GATA4 was also detected in 4 and 7 dpc (indicated by yellow arrowhead). Scale bar: 100 μm. (B) Bar charts showing the percentage of GATA 4+ cells in panel A (n=4). Data are presented as mean ± standard error of mean (SEM). The difference was analyzed by multiple t tests with Holm-Sidak method, ns, no significant difference, *P < 0.05.

Research Output

1. Liu, C.C., **Cheng, S.H.**, Lin, S.J. (2019). **Illuminating the dark depths inside coral.** *Cellular Microbiology,* 22, e13122.

2. Manno, F.A.M., Pan, L.L., Mao, Y.Q., Su, Y., Manno, S.H.C., **Cheng, S.H.**, Lau, C., Cai, Y.L. (2020). **Assessing the Autonomic and Behavioral Effects of Passive Motion in Rats using Elevator Vertical Motion and Ferris-Wheel Rotation.** *Journal of Visualized Experiments,* 156, e59837.

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4. Xu, S.S., Xie, F.J., Tian, L., Fallah, S., Babaei, F., Manno, S.H.C., Manno III, F.A.M., Zhu, L., Wong, K.F., Liang, Y.M., Ramalingam, R., Sun, L., Wang, X., Plumb, R., Gethings, L., Lam, Y.W., **Cheng, S.H.** (2020). **Estrogen accelerates heart regeneration by promoting the inflammatory response in zebrafish.** *Journal of Endocrinology,* 245, 1, 39-51.

5. Manno, S.H.C., Manno, F.A.M., Tian, L., Khan, M.S., Ahmed, I., Liu, Y.C., Li, V.W.T., Xu, S.S., Xie, F.J., Hung, T.F., Ma, V., Cho, W., Aldape, B., **Cheng, S.H.**, Lau, C. (2020). **Spectroscopic and microscopic examination of teeth exposed to green tea at different temperatures.** *PLoS One,* 15, 12, e0244542.

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Feb 2018 – Jan 2021 (On going)
Towards understanding population stress response in aquatic organisms: studies on rescue effect induced by ionizing radiation
水生生物之集體應激反應：電離輻射誘發之營救效應

Peter K.N. YU, W.X. WANG
Funding Amount: HK$300,000

The present project studied the radiation-induced rescue effect (RIRE) caused by ionizing radiation (using X-ray photons in the present work). Radiation-induced rescue effect (RIRE) in cells/organisms refers to the phenomenon where irradiated cells (IRCs)/ irradiated organisms receive help from feedback signals produced by partnered bystander unirradiated cells (UIRCs)/ unirradiated organisms or from the conditioned medium (CM) that has previously conditioned the UIRCs/ unirradiated organisms.

In the present project, we explored the role of poly (ADP-ribose) polymerase 1 (PARP1) regulation in RIRE and the positive feedback loop between PARP1 and nuclear factor-kappalight-chain-enhancer of activated B cell (NF-κB) in RIRE using various cell lines, including HeLa, MCF7, CNE-2 and HCT116 cells.

We first found that when the IRCs (irradiated with 2 Gy X-ray) were treated with CM, the relative mRNA expression levels of both tumor suppressor p53-binding protein 1 (53BP1) and PARP1, the co-localization factor between 53BP1 and γH2AX as well as the fluorescent intensity of PARP1 were reduced. We also found that IRCs treated with the PARP1 inhibitor, Olaparib (AZD2281) had a higher 53BP1 expression. These results illustrated that PARP1 was involved in RIRE transcriptionally and translationally. We further revealed that treatment of IRCs with CM together with Olaparib led to significantly lower mRNA expression levels and fluorescent intensities of NF-κB, while treatment of IRCs with CM together the NF-κB inhibitor BAY-11-7082 led to significantly lower mRNA expression levels as well as fluorescent intensities of PARP1. These results illustrated that PARP1 and NFκB were involved in the positive feedback loop transcriptionally and translationally. Thus, the results supported the occurrence of a PARP1–NF-κB positive feedback loop in RIRE.

In the period of the project, we faced two major unexpected problems, which had significantly slowed down our progress, and had forced us to deviate from the original plans of the project.

The first problem was on the maintenance of our zebrafish colony. Our planned experiments relied on healthy and well-trained zebrafish to regularly lay good-quality eggs. However, due to social events and COVID-19 pandemic, laboratory services were frequently interrupted, so the feeding pattern as well as the pattern of our zebrafish colony to lay eggs at specific time of the day were seriously upset. As a result, we could not regularly obtain sufficient number of embryos for our experiments. And even when we occasionally obtained a sufficient number of embryos, the quality of the embryos was not good enough.

The second problem was on the culture of the embryonic zebrafish fibroblast (ZF4) cells. This cell line was newly acquired for our laboratory, which had never been used in our laboratory before. The culture medium and protocol were different from those employed for other cell lines. Unfortunately, the ZF4 cells were not successfully cultured in our laboratory, probably due to our inexperience, and probably also due to the challenges brought about by frequent interruptions of laboratory services as a result of social events and COVID-19 pandemic.

As a contingency plan, we performed the planned experiments using cell lines with which we had previous experience, including HeLa, MCF7, CNE-2 and HCT116 cells. Moreover, due to frequent interruptions of laboratory services, we only focused on one type of ionizing radiation (i.e., X-ray photons). Nevertheless, we believe that the investigations as per the original objectives were not compromised by using these alternative cell lines, and only one type of ionizing radiation.

As explained in the sub-section on “Problems encountered” above, as a contingency plan, we performed the planned experiments using HeLa, MCF7, CNE-2 and HCT116 cells, instead of the originally planned ZF4 cells and zebrafish embryos, and using only one type of ionizing radiation (i.e., X-ray photons). As such, the Revised Objectives of the project have become:

1. To study the dose responses of rescue effect in HeLa, MCF7, CNE-2 and HCT116 cells induced by X-ray photons;

2. To study the involvement of the NF-κB pathway in the rescue effect in HeLa, MCF7, CNE-2 and HCT116 cells induced by X-ray photons.

Discussions were carried out through phones and emails; no formal meetings were arranged.

Research Output

1. **Yu, K.N.** (2019). **Radiation-induced rescue effect.** *Journal of Radiation Research,* 60, 163-170.

Publications
論文專著

Feb 2018 – Jan 2021 (On going)
Interactive effects of hypoxia- and flutamide-induced endocrine disruption in marine medaka: an ecotoxicogenomic approach for environmental risk assessment
缺氧和氟他胺對海洋青鳉魚內分泌幹擾的交互作用：一種用於環境風險評估的生態毒理基因組學方法

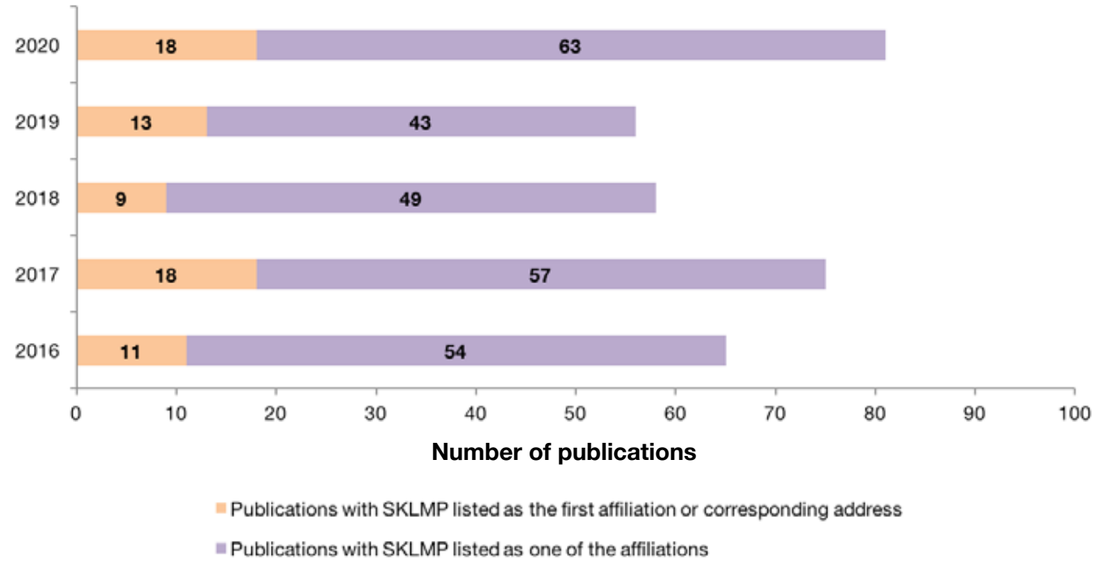
Richard Y.C. KONG, Rudolf S.S. WU
Funding Amount: HK$300,000

The differential effects of flutamide were re-analysed and assessed in 3- and 4-month male fish to ascertain their anti-androgenic effects. Flutamide treatment at 3.2 mg/mL did not significantly affect the testis lobule width of 3-month-old male fish but showed a 25% reduction in testis lobule width in 4-month-old fish compared to the control group which confirmed that flutamide exposure decreased the overall number of spermatogenic cells in more sexually mature (4-month old) fish. Gene expression analysis using qPCR of male testes indicated upregulated expression of several genes involved in steroid biosynthesis: *CYP17A1, 17β-HSD1, 17β-HSD7, CYP11A,* and steroid receptor genes *ARα* and *ERβ* but reduced expressed of *11β-HSD* in 3-month old fish, suggesting that flutamide promoted steroid hormone synthesis in 3-month old male medaka. In contrast, expression of *17β-HSD3, 17β-HSD7, ERβ,* and *FSHR* was reduced by up to 5-fold relative to the control group, suggesting that flutamide exposure decreased steroid hormone production in 4-month old male medaka. We have extended our study to anti-androgenic polychlorinated biphenyls (PCBs) and hydroxy-PCBs (OH-PCBs) using cell-based assays and mRNA transcriptome analyses. We are presently drafting a manuscript on the PCB and OH-PCB study for submission to *Environmental Science & Technology* for publication with SKLMP as the main affiliation.

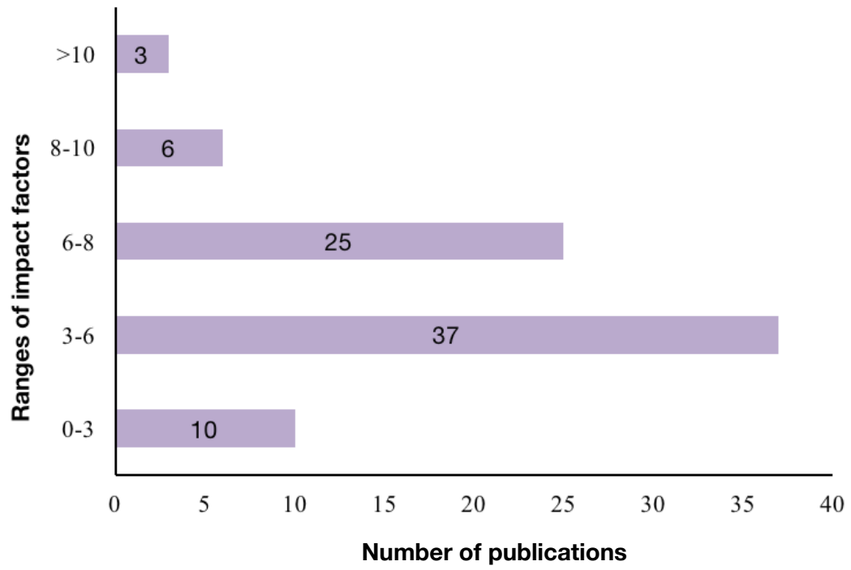
Research Output

1. **Lai, K.P.**, Tam, N., Wang, S.Y., Lin, X., Chan, T.F., **Au, D.W.T., Wu, R.S.S., Kong, R.Y.C.** (2020). **Hypoxia causes sex-specific hepatic toxicity at the transcriptome level in marine medaka (*Oryzias melastigma*).** *Aquatic Toxicology,* 224, 105520.

Number of SCI publications of SKLMP members (2016-2020)
2016 - 2020年SKLMP成員的SCI論文數目



Publications with SKLMP in different ranges of impact factors (2020)
2020年SKLMP論文的不同影響因子範圍



Publications with SKLMP listed as the first affiliation or corresponding address
以SKLMP為第一或通訊作者單位的期刊論文

1. Dellisanti, W., Tsang, R.H.L., Ang, P., Wu, J.J., Wells, M.L., & **Chan, L.L.** (2020). **A Diver-Portable Respirometry System for in-situ Short-Term Measurements of Coral Metabolic Health and Rates of Calcification.** *Frontiers in Marine Science,* 7, 571451.

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4. Yan, N., Tsim, S.M.J., He, X.W., Tang, B.Z., & **Wang, W.X.** (2020). **Direct Visualization and Quantification of Maternal Transfer of Silver Nanoparticles in Zooplankton.** *Environmental Science & Technology,* 54, 10753-10761.

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6. Yan, M., Mak, M.Y.L., **Cheng, J.P.**, Li, J., Gu, J.R., Leung, P.T.Y., & **Lam, P.K.S.** (2020). **Effects of dietary exposure to ciguatoxin P-CTX-1 on the reproductive performance in marine medaka *(Oryzias melastigma)*.** *Marine Pollution Bulletin,* 152, 110837.

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10. Dellisanti, W., Tsang, R.H.L., Ang, P., Wu, J.J., Wells, M.L., & **Chan, L.L.** (2020). **Metabolic performance and thermal and salinity tolerance of the coral Platygyra carnosa in Hong Kong waters.** *Marine Pollution Bulletin,* 153, 111005.

11. Wang, Q., Ruan, Y.F., Lin, H.J., & **Lam, P.K.S.** (2020). **Review on perfluoroalkyl and polyfluoroalkyl substances (PFASs) in the Chinese atmospheric environment.** *Science of the Total Environment,* 737, 139804.

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4. Manno, F.A.M., Pan, L.L., Mao, Y.Q., Su, Y., Manno, S.H.C., **Cheng, S.H.**, Lau, C., Cai, Y.L. (2020). **Assessing the Autonomic and Behavioral Effects of Passive Motion in Rats using Elevator Vertical Motion and Ferris-Wheel Rotation.** *Jove-Journal of Visualized Experiments, 156,* e59837.

5. Xu, X.Y., Wong, C.Y., **Tam, N.F.Y.**, Liu, H.M., & **Cheung, S.G.** (2020). **Barnacles as potential bioindicator of microplastic pollution in Hong Kong.** *Marine Pollution Bulletin*, 154, 111081.

6. Tang, L.Z., Liu, M.Y., Hu, C.Y., Zhou, B.S., **Lam, P.K.S., Lam, J.C.W.**, Chen, L.G. (2020). **Binary exposure to hypoxia and perfluorobutane sulfonate disturbs sensory perception and chromatin topography in marine medaka embryos.** *Environmental Pollution,* 266, 115284.

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10. Xing, Y.M., Yin, L.Y., Zhao, Y.N., Du, Z.L., Tan, H.Q., Qin, X., **Ho, W.K.**, Qiu, T.Y., & Li, Y.G. (2020). **Construction of the 1D Covalent Organic Framework/2D g-C3N4 Heterojunction with High Apparent Quantum Efficiency at 500 nm.** *ACS Applied Materials and Interfaces*, 12 (46), 51555-51562.

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Book Chapters

1. **Cheang, C.C.,** Yiu, W.H., Ang, P.O. Jr., To, W.L., & Chow, W.K. (2020). **Field Guide to Seaweeds of Hong Kong.** *AFCD.*

2. **Gan, J.,** Hu, J. **and** Liu, Z. (2020). **The first scientific assessment of ocean and climate change.** *Ocean Press, Beijing.*

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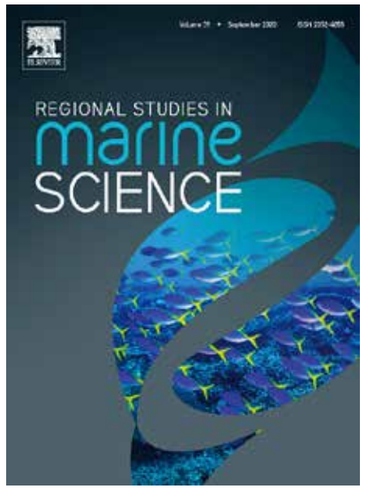
Books and Journal Special Issues
專著與期刊專輯

Field Guide to Seaweeds of Hong Kong
香港海藻圖鑑

海藻是海洋中重要的自然資源。除了對社會具有重要的經濟價值外，海藻還在海洋生態系統中發揮著重要作用。藻類學是海洋生物學的活躍領域之一，香港也一直是遠東其中一個最重要的藻類學研究地方。香港是數種海洋大型藻類的模式標本地，例如某些馬尾藻和多管藻品種。最近的香港海藻名錄和圖鑑分別於2006年和1984年發布。這本新的海藻圖鑑的發布是一次本地海藻名錄的更新，是次更新基於最近由漁農自然護理署委任SKLMP成員蔣志超博士(香港教育大學副教授)進行的一次全港性海藻調查。在書中介紹的30種海藻中，有8種是香港新記錄。這本新的海藻圖鑑不僅對香港、甚至於對附近地區的藻類學研究作出了重要貢獻。

Seaweed is an important natural resource from the ocean. Apart from its significant economic values for the society, seaweed plays an important role in marine ecosystems. While phycology is one of the active fields in marine biology, Hong Kong has long been one of the most important places for phycological studies in the Far East. Hong Kong is the type locality of several marine macroalgal species such as those in the genera Sargassum and Polysiphonia. The last checklist and guidebook of Hong Kong seaweed were published in 2006 and 1984, respectively. The new photo guidebook serves as an update of the local seaweed inventory based on a recent territory-wide survey being commissioned by the Agriculture, Fisheries and Conservation Department and conducted by our SKLMP member Dr. Chi Chiu Cheang (Associate Professor of the Education University of Hong Kong). Among the 30 species introduced in the book, 8 of them are new records for Hong Kong. This guidebook contributed significantly to the phycological study not just in Hong Kong but also for the region.

The World Harbour Project Special Issue Part II — Global harbours and ports: Different locations, similar problems?
世界海港項目專刊第二部分-全球海港和港口：不同的地點存在類似的問題嗎？



URL for the WHP-II Special Issue:
https://www.sciencedirect.com/journal/regional-studies-in-marine-science/special-issue/10F0QS1CTRL

世界海港計劃（WHP）是一項全球合作夥伴關係，包括6大洲的36個沿海城市，由130多名科學家合作開展研究項目，共同解決港口的環境問題。香港也是這項全球倡議的一部分。濱海城市的沿岸海洋環境面臨著同樣的挑戰，例如城市化和自然棲息地的喪失、生物多樣性的保育、水質、受污染的沉積物、生物入侵、可持續性、多用戶和多種用途，這些挑戰預計將隨著城市人口的不斷增長而增加。此外，隨著全球氣候變化，海平面上升和洪水氾濫的風險越來越大，沿海海岸線也面臨挑戰。WHP的願景是：“通過創新和提高對共同價值觀和威脅的了解，幫助建立具有韌性和生產力的全球港口。” 知識交流是WHP的關鍵要素之一。鼓勵合作夥伴分享他們在制定用於解決沿海水域各種環境問題的知識和經驗。2016年，一系列關於WHP中11個合作城市的生物物理、經濟和社會學狀態的論文發表在《Regional Studies in Marine Science》（RSMA）期刊的專刊上，這專刊非常受歡迎，到目前為止在RSMA各專刊中被引用最多。為了覆蓋更多城市，WHP在RSMA再推出第二卷專刊，其中包括10篇文章，增加了另外8個合作城市，以及一些旨在提高學生和社區對城市化海洋問題理解的教育計劃的主題論文。我們SKLMP主任是本期特刊的客座編輯之一，同時他也是WHP督導委員會的成員，並領導水和沉積物質量項目工作組。

The World Harbour Project (WHP) is a global partnership, including 36 coastal cities on 6 continents, with over 130 scientists collaborating on research projects for jointly tackling environmental issues in harbours and ports. Hong Kong is also part of this global initiative. Coastal marine environments of urbanized coastal cities face similar challenges such as urbanization and loss of natural habitats, biodiversity conservation, water quality, contaminated sediments, biological invasion, sustainability, multiusers and multiple uses, that are expected to increase as the populations in these cities continue to grow. In addition, coastal shorelines are also challenged by the increasing risk of sea level rise and flooding associated with global climate change. The vision of the WHP is, “To help build resilient and productive global ports and harbours, through innovation, and increased understanding of shared values and threats”. Knowledge exchange is one of the key elements of the WHP. Partners are encouraged to share their knowledge and experience in development of best practices that can be applied to solve various environmental issues in coastal waters. In 2016, a series of papers reviewing the biophysical, economic and sociological state of 11 of the WHP’s partner cities was published in Regional Studies in Marine Science (RSMA) as a special issue that was a very popular and among the most cited special issues in the journal. To extend the coverage of more cities, this second volume in RSMA, which consists of 10 articles, was accomplished with an additional 8 partner cites, and several topic specific papers on educational initiatives designed for enhancing students and the community’s understanding of urban marine issues. Our SKLMP Director is one of the guest editors of this special issue, while he is also a member of the steering committee of the WHP, and co-leading the workgroup on water and sediment quality projects.

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