



# BECoME 2015

## *International Conference on Biodiversity, Ecology and Conservation of Marine Ecosystems 2015*

# PROGRAMME & ABSTRACT

1-4 June 2015

*The University of Hong Kong*

Organizers:



Sponsor:



Croucher Foundation  
裘權基金會



**International Conference on Biodiversity, Ecology and  
Conservation of Marine Ecosystems 2015  
(BECOME 2015)**

**1-4 June 2015  
Hong Kong**

Programme and Abstracts

Principal sponsors:

Environment and Conservation Fund, The Government of the  
Hong Kong Special Administrative Region, China

The Croucher Foundation, Hong Kong

Sponsors:

The Swire Group Charitable Trust, Hong Kong

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Ecosystems Limited

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The Marine Biological Association of Hong Kong

Organizers:

School of Biological Sciences and

The Swire Institute of Marine Science,

The University of Hong Kong

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## PREFACE

**A Message from the Organizing Committee of  
the International Conference on  
Biodiversity, Ecology and Conservation of Marine Ecosystems  
(BECOME 2015)  
1-4 June 2015**

On behalf of the Organizing Committee, I would like to welcome and thank you for joining the first International Conference on Biodiversity, Ecology and Conservation of Marine Ecosystems (BECOME 2015), held at The University of Hong Kong, Hong Kong, China. I am very pleased to report that this conference has attracted over 280 participants from 26 countries and has received over 200 abstracts, with 13 keynote lectures, 10 invited lectures, 94 regular oral presentations (i.e., 117 talks in total) and 88 poster presentations.

Given the unique geology and hydrography of Hong Kong's marine environment, with its combined influences of freshwater and sediment input from the Pearl River and oceanic currents of the South China Sea, Hong Kong boasts a great diversity of marine habitats ranging from mudflats and mangroves, to sandy bays and rocky reefs. These diverse habitats, in turn, support a rich marine biodiversity, comprising over 6,000 identified species from more than 34 phyla. More species remain to be identified, and the biology and ecology of many of the identified marine species remains largely unknown, while some are protected, endemic or rare species meriting conservation status.

Despite Hong Kong's fairly long coastline, its territorial sea area is relatively small (1,650 km<sup>2</sup>) and, as such, is heavily utilized for a variety of, often conflicting, services; such as ship navigation routes, ports/marinas/piers, provision of seawater for cooling and toilet flushing, disposal of partially treated wastewater discharge and contaminated surface runoff, fishing grounds and recreational uses (e.g. swimming and diving). These anthropogenic needs most strongly conflict with the need to conserve local marine biodiversity, in terms of species but importantly local habitats including the need to increase Hong Kong's marine protected areas (MPAs) and, notably, conserve the habitat of the Chinese white dolphin. With the ever-increasing local human population, and demands for land to build housing and associated infrastructure (e.g. bridges and causeways, cargo ports, the third runway for the airport etc.), reclamation is frequently proposed as a convenient option to meet these needs. There is much debate, for example, about whether we should sacrifice ~ 650 hectares of natural marine habitat and convert it into the third runway for our airport so as to bring economic benefits; whether we should convert the natural shore at Lung Mei, Tai Po into an artificial beach as a means to promote

tourism and develop the local economy; and whether the area around the Hoi Hai Wan Marine Park should be developed as a residential zone. These conflicts between coastal development and marine conservation are not unique to Hong Kong, but also commonly occur in most coastal cities around the world. It is, therefore, possible for us to share and learn with other countries or regions about how we can conserve marine biodiversity while balancing development and conservation.

To achieve this target, requires wide-scale collaboration, both globally but also within home-states. In order to build such capacity in marine ecology and biodiversity conservation in Hong Kong, a team of over 25 marine scientists conjointly established the Joint University Consortium for **B**iodiversity, **E**cology and **C**onservation of **M**arine **E**cosystems (i.e., **BECOME**) in January 2013. Members of **BECOME** have already played important roles in their contribution to Hong Kong's Biodiversity Strategy and Action Plan (BSAP) as part of the Hong Kong Special Administrative Region (HK SAR) Government's response to the international Convention on Biological Diversity, and have combined forces to tackle important conservation issues in Hong Kong. The **BECOME** team has recently been awarded a HK\$4.3 million grant to study the marine biodiversity and ecology of Tolo Harbour and Channel. Through this project, the team will not only establish a comprehensive species database of the area, but also develop guiding principles and standards for future ecological surveys in different coastal habitats to ensure the quality of marine ecological surveys as stipulated by the Environmental Impact Assessment Ordinance.

To address the overfishing problem in Hong Kong, our Government has implemented a territory-wide trawling ban since 31 December 2012, and is considering the establishment of more MPAs. These proposed MPAs include the marine parks at Brothers Islands and southwest regions of Lantau Island, and the fisheries protection areas at Port Shelter and Tolo Harbour.

Given the implementation of Hong Kong's BSAP and these new conservation measures initiated by our Government, this **BECOME 2015** Conference is very timely, and highly relevant to Hong Kong, the South China region, and indeed globally. There are five main objectives of this conference, namely:

- To provide a platform for knowledge transfer and idea exchange;
- To foster international collaborations in research and education among participants from academia, government and business;
- To identify knowledge gaps and prioritize research areas;
- To train young scientists and environmental practitioners; and
- To solicit experts' advice and share their experience on some of the pressing practical issues relevant to marine biodiversity conservation and fisheries management in Hong Kong.

With the generous financial support from the Environment and Conservation Fund of the HK SAR Government and from The Croucher Foundation, we have been able to invite 22 marine scientists from overseas and Mainland China to attend the **BECOME 2015** Conference where they will share their knowledge, experience and the latest developments in their respective fields with participants from academia,

government, and the private sector. The range of topics to be covered is very wide including global marine fisheries; ecological impacts of fishing; marine biodiversity in China and the Western Pacific; open ocean ecosystems; hydrothermal vents; connectivity between biodiversity and ecosystem functions; evolution and biogeography; biological invasion; marine protected areas and habitat restoration; conservation of mangrove systems and marine mammals; anthropogenic impacts and climate change; management strategies for biodiversity conservation; and environmental education. The subsequent conference themes of **BECOME 2015** Conference are closely linked to these topics, focusing on Environmental Education; Human Impacts; Climate Change Impacts; Ecosystem Functions; Evolution and Biogeography; Biodiversity Data Sharing and Management; Regional and Global Biodiversity Patterns; Strategies for Biodiversity Conservation; Marine Mammal Conservation, and Fisheries and Marine Resources Management.

To promote and foster regional and international collaboration, the afternoon of the third day of **BECOME 2015** is dedicated to four breakout sessions, including (1) Regional Collaboration for Environmental Education, (2) Climate Change Impacts on Intertidal Communities, (3) Building Blue Networks via international projects such as the World Harbour Project and MarineGEO, and (4) Biodiversity Data Sharing and Management. It is anticipated these breakout sessions will catalyse, build and strengthen international research teams to tackle the corresponding issues and generate greater impacts from our research endeavours.

As you may notice, the **BECOME 2015** registration fee is, given today's trends, very reasonable. This was a deliberate policy, to encourage more people to join this meeting from Southeast Asia region, especially students and younger people who will be 'the scientists of the future'. This approach was only possible through the vision and financial support of our sponsors, and we would especially like to thank them for their generous support, specifically:

- The HK SAR Government via the Environment and Conservation Fund;
- The Croucher Foundation, Hong Kong;
- The Swire Group Charitable Trust, Hong Kong;
- Ocean Park Conservation Foundation Hong Kong;
- Ecosystems Limited;
- Garland Science, Taylor & Francis Group;
- The Marine Biological Association of Hong Kong;
- School of Biological Sciences, The University of Hong Kong, and
- The Swire Institute of Marine Science, The University of Hong Kong.

We would also like to specially thank Dr. Christine Loh (Undersecretary for the Environment, the HK SAR Government), Mr. David Foster (Director of The Croucher Foundation) and Prof. Peter Mathieson (President of The University of Hong Kong) for officiating at the opening ceremony of **BECOME 2015** Conference. We are very thankful to all of the invited speakers and scholars for their excellent presentations, intellectual exchange of ideas, and efforts to make this conference a big success. We are also grateful to Dr. Danny Lau (Umeå University, Sweden) and

Dr. Matthew Perkins (HKU) for taking up the challenge to design and co-teach **BECOME**'s Technical Workshop on 'Advanced Food Web and Trophodynamic Studies' to be held on 4 June 2015. Additionally, we would like to take this opportunity to thank the many staff and students of the School of Biological Sciences, in particular, Ms. Helen Leung, Ms. Tracy Wong, Dr. Kevin Ho, Ms. Lanche Kwan and Ms. Esther Liu for their tremendous hard work and dedication in organizing this conference. Dr. Luaine Bandounas (Elsevier) is gratefully acknowledged as she has kindly agreed to publish the conference proceedings of **BECOME 2015** Conference as a special issue in the peer-reviewed journal, *Regional Studies in Marine Science*.

Finally, I would like to end this message with a quote from the President of Harvard University, Prof. Drew G. Faust who said: "*We are gathering great minds under a single roof so they can BECOME greater together.*" I hope you have a productive conference, enjoy your time in Hong Kong, and **BECOME** greater after attending this conference!

Yours sincerely,



Professor Kenneth Mei Yee Leung  
Chairman, Organizing Committee  
**BECOME 2015 Conference**

## ACKNOWLEDGEMENTS

The Organizing Committee of **BECOME 2015** Conference gratefully acknowledges the following organizations for their generous support and donations to this conference:

### Principal Sponsors:

- The Hong Kong SAR Government via the Environment & Conservation Fund
- The Croucher Foundation, Hong Kong

### Gold Sponsors:

- The Swire Group Charitable Trust, Hong Kong
- Ocean Park Conservation Foundation Hong Kong

### Silver Sponsors:

- Ecosystems Limited
- Garland Science, Taylor & Francis Group
- The Marine Biological Association of Hong Kong



Croucher Foundation  
裘槎基金會



## ORGANIZING COMMITTEE

### **Chairman**

Prof. Kenneth M. Y. Leung      The University of Hong Kong

### **Members**

Dr. Put O Jr. Ang                      The Chinese University of Hong Kong  
Dr. David Baker                      The University of Hong Kong  
Dr. Karen K. Y. Chan                Hong Kong University of Science and Technology  
Dr. Chi Chiu Cheang                The Hong Kong Institute of Education  
Dr. S. G. Cheung                      City University of Hong Kong  
Prof. K. H. Chu                        The Chinese University of Hong Kong  
Dr. Jerome H. L. Hui                The Chinese University of Hong Kong  
Dr. Kevin W. H. Kwok                The Hong Kong Polytechnic University  
Dr. Karen K. M. Lee                Civic Exchange  
Dr. Hong-Bin Liu                      Hong Kong University of Science and Technology  
Dr. Jian-Wen Qiu                      Hong Kong Baptist University  
Dr. Kwok Ho Tsoi                      The Hong Kong Institute of Education  
Prof. Gray A. Williams                The University of Hong Kong

**INVITED KEYNOTE SPEAKERS** (in alphabetical order)

<b>Dr. Joanne Banks</b>	World Harbour Project, Sydney Institute of Marine Science, Australia
<b>Prof. Stuart Bearhop</b>	University of Exeter, UK
<b>Dr. Benny K. K. Chan</b>	Biodiversity Research Center, Academia Sinica, Taiwan
<b>Prof. T. Y. Chan</b>	Institute of Marine Biology National Taiwan Ocean University, Taiwan
<b>Dr. Suchana Apple Chavanich</b>	Department of Marine Science, Chulalongkorn University, Thailand
<b>Dr. Yung-Hui Chen</b>	Department of Science Education National Museum of Marine Biology and Aquarium, Taiwan
<b>Dr. Loke Ming Chou</b>	Tropical Marine Science Institute, National University of Singapore
<b>Prof. Ross A. Coleman</b>	Coastal and Marine Ecosystems Group, School of Biological Sciences, The University of Sydney, Australia
<b>Prof. Mark J. Costello</b>	Institute of Marine Science, The University of Auckland, New Zealand
<b>Prof. Yun-Wei Dong</b>	State Key Laboratory of Marine Environmental Science, Xiamen University, China
<b>Prof. Emma Johnston</b>	University of New South Wales and Sydney Institute of Marine Science, Australia
<b>Prof. Jong Seong Khim</b>	School of Earth and Environmental Sciences, Seoul National University, Korea
<b>Dr. Danny C. P. Lau</b>	Department of Ecology and Environmental Science, Umeå University, Umeå, Sweden
<b>Prof. Jae-Seong Lee</b>	Department of Biological Science, Sungkyunkwan University, South Korea
<b>Prof. Kenneth M. Y. Leung</b>	The Swire Institute of Marine Science and School of Biological Sciences, The University of Hong Kong, Hong Kong SAR, China

<b>Prof. Xinzheng Li</b>	Institute of Oceanology, Chinese Academy of Sciences, China
<b>Dr. Ryuji Machida</b>	Biodiversity Research Center, Academia Sinica, Taiwan
<b>Prof. Wenhua Liu</b>	Marine Biology Institute, Shantou University, Shantou Guangdong 515063, China
<b>Prof. Brian Morton</b>	The Swire Institute of Marine Science and School of Biological Sciences, The University of Hong Kong, China
<b>Prof. Dianna K. Padilla</b>	Department of Ecology and Evolution Stony Brook University, USA
<b>Prof. Daniel Pauly</b>	Aquatic Ecosystems Resource Laboratory, The University of British Columbia, Canada
<b>Prof. Kwang-Tsao Shao</b>	Biodiversity Research Center, Academia Sinica, Taiwan
<b>Prof. Simon Thrush</b>	Institute of Marine Science, The University of Auckland, New Zealand

## POINTS TO NOTE FOR ORAL AND POSTER PRESENTATIONS

### **Keynote Lectures**

There will be 40 minutes, including 5 minutes for discussion, for each keynote lecture. Keynote lectures will take place at the Rayson Huang Theatre, HKU Main Campus (Location map, please refer to page 80)

### **Oral Presentations**

For each presentation, 20 minutes will be allocated including discussion.

Presentations will be given at the Rayson Huang Theatre / P1 / P2 / P3 / P4, HKU main campus. A cordless presenter, projector, Windows 7 and Microsoft PowerPoint 2013 will be available at the venue.

Speakers are encouraged to use USB Flash Disk or Memory Stick to load their presentation files. You are requested to report to the registration desk, and hand your presentation files to the technician AT LEAST 3 hours before the start of your session.

Please meet with your session chairperson at the presentation venue 10-15 minutes prior to the commencement of the session.

### **Poster Presentations**

Each participant will be allocated a poster space of 140 cm (height) x 80 cm (width). Poster boards will be on display in the foyer of the Rayson Huang Theatre from 13:00 of 1 June to 14:00 of 3 June.

### **Notice of Programme Change**

Necessary programme changes will be posted on the conference notice board near the registration desk.

### **Conference Registration Desk**

The registration desk is open during the following periods:

Sunday, 31 May 2015	16:00-18:00
Monday, 1 June 2015	08:15-21:00
Tuesday, 2 June 2015	08:30-18:00
Wednesday, 3 June 2015	08:30-18:30
Thursday, 4 June 2015	08:30-13:30

Keynote		Invited		1 June 2015 (Monday)					
Venue		Rayson Huang Theatre							
0815	0915	Registration							
0915	0950	Opening Ceremony							
0950	1020	Coffee Break							
1020		1100		<b>Keynote Lecture</b> Chairperson: Gray A. Williams					
1100		1140		<b>Daniel Pauly</b>					
1140		1220		<b>Simon Thrush</b>					
1220		1230		<b>Kwang-Tsao Shao</b>					
1230		1330		Introduction to Breakout Session					
1230		1330		Lunch					
Venue		P1		P2		P3		P4	
Parallel Sessions		<b>Biodiversity Patterns</b> Chairpersons: Jong Seong Khim & Benny K.K. Chan		<b>Fisheries &amp; Marine Resources Management</b> Chairpersons: Simon Thrush & Put O. Ang Jr.		<b>Biodiversity &amp; Mammal Conservation</b> Chairpersons: Suchana Apple Chavanich & Jerome H.L. Hui		<b>Human Impacts</b> Chairpersons: Kevin K.H. Kwok & Jian-Wen Qiu	
1330	1350	<b>Benny K.K. Chan</b>		Ka Yan Ma		<b>Suchana Apple Chavanich</b>		Ichiro Takeuchi	
1350	1410	<b>Jong Seong Khim</b>		Samuel Mamauag		Sergio Licea		Nicolas Duprey	
1410	1430			Jorge Palma		Terence P.T. Ng		James C.W. Lam	
1430	1450	^Maria Santos		Samantha Lee		Leszek Karczmarski		Meng Chuan Ong	
1450	1510	Xiaoshou Liu		Julia W.Y. Chan		Tzu-Hao Lin		Seongjin Hong	
1510	1530	Kok Ben Toh		^Yanny K.Y. Mak		Shiang-Lin Huang		Kevin W.H. Kwok	
1530	1550	Li-Zhe Cai		^Lily S.R. Tao		David Gallacher		Keita Kodama	
1550	1610	Kingsley J.H. Wong		^Calton S.W. Law		Samuel K. Hung		^Elizaldy Maboloc	
Venue		Rayson Huang Theatre							
1610	1645	Coffee Break							
1645		1725		<b>Keynote Lecture</b> Chairperson: Put O. Ang Jr.					
1725		1805		<b>Xinzheng Li</b>					
1805		2030		<b>Mark J. Costello</b>					
1805		2030		Reception and Poster Presentation					

Keynote		Invited		2 June 2015 (Tuesday)			
Venue		Rayson Huang Theatre					
		<b>Keynote Lecture</b> Chairperson: Karen K.Y. Chan					
0900		0940		<b>Dianna K. Padilla</b>			
0940		1020		<b>Emma Johnston</b>			
1020		1030		Introduction to Breakout Session			
1030		1105		Coffee Break			
Venue		P1	P2	P3	P4		
Parallel Sessions		<b>Biodiversity &amp; Evolution</b> Chairpersons: Ka Hou Chu & Ryuji Machida	<b>Biodiversity Conservation</b> Chairpersons: Jian-Wen Qiu & Tin Yam Chan	<b>Climate Change Impacts</b> Chairpersons: Gray A. Williams & Emma Johnston	<b>Ecosystem Functions</b> Chairpersons: Stuart Bearhop & Matthew Perkins		
1105		Jerome H.L. Hui	Partick C. Cabaitan	Laurent Seuront	<b>Danny C.P. Lau</b>		
1125		Kauresh D. Vachhrajani	Adriana Ressurreicao	Moriaki Yasuhara	Tak Cheung Wai		
1145		James D. Reimer	^Christine Mae Edullantes	Fang Zhang	Alexander Y. Bobyrev		
1205		Keryea Soong	^Jessica M. Savage	David J. Marshall	^Kwan Ting Wong		
1225		^Chong Chen	Richard Stafford	Karen K.Y. Chan	Jeong Ha Kim		
1245		1345		Lunch			
Venue		P1	P2	P3	P4		
Parallel Sessions		<b>Biodiversity &amp; Evolution</b> Chairpersons: Ka Hou Chu & Ryuji Machida	<b>Human Impacts</b> Chairpersons: Karen Lee & Dianna K. Padilla	<b>Climate Change Impacts</b> Chairperson: Gray A. Williams	<b>Ecosystem Functions</b> Chairpersons: Stuart Bearhop & Siu Gin Cheung		
1345		<b>Jae-Seong Lee</b>	Christopher D. McQuaid	^Ginger W.K. Ko	Jian-Wen Qiu		
1405			^Siti Zarina Zainul Rahim	^Richard N. Muallil	Chung Yin Joey Leung		
1425		^Archer T.L. Wong	José-Pedro Andrade	^Apple P.Y. Chui	^Joemark Narsico		
1445		Haiwei Luo	^Juan C. Astudillo	D. Ramadoss	^Abe Hiroya		
1505		^Tsz Huen Wu	Tao Yan	^Tsz Yan Ng	^Sofya S. Zvonareva		
1525		<b>Ryuji Machida</b>	Shengyan Tian	^Hung-Kai Chen	Clarissa M.L. Fraser		
Venue		Rayson Huang Theatre					
1545		1620		Coffee Break			
		<b>Keynote Lecture</b> Chairperson: David M. Baker					
1620		1700		<b>Tin Yam Chan</b>			
1700		1740		<b>Wenhua Liu</b>			
1740		1800		<b>Ross A. Coleman</b>			
1800		1900		Transport to the Conference Dinner Venue			
1900		1930		Cocktail Session			
1930		2200		Conference Dinner			

Keynote		Invited		3 June 2015 (Wednesday)			
Venue		Rayson Huang Theatre					
		<b>Keynote Lecture</b> Chairperson: Kenneth M.Y. Leung					
0900	0940	<b>Brian Morton</b> <b>Stuart Bearhop</b> <b>Kenneth M.Y. Leung</b> Introduction to Breakout Session					
0940	1020						
1020	1040						
1040	1050						
1050	1125	Coffee Break					
Venue		P1	P2	P3	P4		
Parallel Sessions		<b>Marine Ecology</b> Chairpersons: Kwok Ho Tsoi & Yung-Hui Chen	<b>Biodiversity Conservation</b> Chairpersons: Brian Morton & Li-Zhe Cai	<b>Climate Change Impacts</b> Chairpersons: Karen K.Y. Chan & Yun-Wei Dong	<b>Ecosystem Functions</b> Chairpersons: Joanne Banks & Danny C.P. Lau		
1125	1145	^Donna M. Guarte	<b>Loke Ming Chou</b>	<b>Yun-Wei Dong</b>	Hong Zhou		
1145	1205	Annabelle del Norte-Campos	Karen Araño-Tagulao		Yim Ling Mak		
1205	1225	Nico. J. Smit	Sivasankaran Bijoy Nandan	Thamasak Yeemin	Bong-Oh Kwon		
1225	1245	Sergio Licea	Judith C. Klein	Brisneve Edullantes	Mei Lin Neo		
1245	1345	Lunch					
Venue		P1	P2	P3	P4		
Breakout Groups		<b>Environmental Education</b> Leaders: Kwok Ho Tsoi & Chi Chiu Cheang	<b>Climate Change Impacts</b> Leader: Gray A. Williams	<b>Building Blue Networks</b> Leaders: Joanne Banks & David M. Baker	<b>Biodiversity Data Sharing &amp; Management</b> Leaders: Mark J. Costello & Kwang-Tsao Shao		
1345	1405	Chi Chiu Cheang	Gray A. Williams	<b>Joanne Banks &amp; Emma Johnston</b>	Mark J. Costello		
1405	1425	Kwok Ho Tsoi	Bayden Russell		Kwang-Tsao Shao		
1425	1445	Ma Shan Cheung	Yun-Wei Dong	David M. Baker	Wenhua Liu		
1445	1505	<b>Yung-Hui Chen</b>	Vengatesen Thiyagarajan		Forum		
1505	1525	Wai Chin Li	Forum	Forum	Forum		
1525	1545	Forum					
Venue		Rayson Huang Theatre					
1545	1620	Coffee Break					
1620	1720	Chairpersons: Kenneth M.Y. Leung & Simon Thrush					
1720	1800	Summary from Breakout Groups					
		Prize Presentation & Closing Ceremony					

## CONFERENCE DINNER

2 June 2015 (Tuesday)

Cuisine Royale

7/F, Hopewell Centre, 183 Queen's Road East, Wan Chai

19:00          Cocktail Session

19:30-22:00   Conference dinner



**International Conference on Biodiversity, Ecology and  
Conservation of Marine Ecosystems (BECOME 2015)**

**Opening Ceremony (9:15-9:50 am)**

Venue: Rayson Huang Theatre, The University of Hong Kong

*Programme Rundown*

**Opening Address on behalf of the Organizing Committee**

Professor Kenneth M. Y. Leung  
Chairman  
Organizing Committee

**Welcoming Remarks**

Professor Peter W. Mathieson  
Vice-Chancellor and President  
The University of Hong Kong

**Officiating Address**

Mr. David Foster  
Director  
The Croucher Foundation

**Officiating Speech**

Dr. Christine Loh Kung-wai, JP, OBE  
Under Secretary for the Environment  
Environment Bureau, Hong Kong SAR Government

**Group Photograph**

Rayson Huang Theatre, The University of Hong Kong

# Schedule of Keynote Lectures

**1 June 2015, Venue: Rayson Huang Theatre**

1020-1100

**Toward a Re-estimation of the World's Global Marine Fisheries Catch**

Daniel Pauly

Fisheries Centre, The University of British Columbia, 333-2202 Main Hall Vancouver, B.C., Canada V6T 1Z4

1100-1140

**Disturbance of the Seafloor by Fishing; Implications for the Effects of Other Stressors and Recovery of Ecosystem Functions**

Simon Thrush

Institute of Marine Science, University of Auckland, New Zealand

1140-1220

**Status and Challenges of Marine Protected Areas in Taiwan**

Kwang-Tsao Shao

Biodiversity Research Center, Academia Sinica, Taiwan

1645-1725

**Progress of Study on Marine Biodiversity in China**

Xinzheng Li

Institute of Oceanology, Chinese Academy of Sciences, Qingdao 266071, China

1725-1805

**Conservation of Biodiversity and Natural Resources through Marine Reserves and Marine Protected Areas Respectively**

Mark J. Costello

Institute of Marine Science, Leigh Marine Laboratory, University of Auckland, New Zealand

## 2 June 2015, Venue: Rayson Huang Theatre

0900-0940

### **Introduced Species and Challenges for Restoring and Preserving Marine Biodiversity**

Dianna K. Padilla

Department of Ecology and Evolution, Stony Brook University, Stony Brook, NY 11794-5245, United States of America

0940-1020

### **Muddy Waters: Biodiversity, Bioinvasion and Ecosystem Functioning in Multiply Stressed Coastal Systems**

Emma Johnston

University of New South Wales, Australia

1620-1700

### **Ecology of Hydrothermal Vents off Kueishan Island, Northwestern Taiwan**

Tin Yam Chan

Institute of Marine Biology, National Taiwan Ocean University, Keelung 20224, Taiwan

1700-1740

### **Chinese White Dolphin (*Sousa chinensis*) in China: Status and Future**

Wenhua Liu, Yinglin Wu, Derun Lin, Jingzhen Wang and Miao Bao

Marine Biology Institute, Shantou University, Shantou, Guangdong 515063, China

1740-1820

### **Discipline Insularity: Researchers in Marine Ecology May Not be Reading as Widely as They Should**

R.A. Coleman, J. Gacutan, I. Loughland, D. Luo, L. Pettit and A. Thran

Coastal and Marine Ecosystems Group, School of Biological Sciences, Marine Ecology Laboratories, The University of Sydney, Sydney, Australia

### **3 June 2015, Venue: Rayson Huang Theatre**

0900-0940

#### **Mangrove Biodiversity and Conservation in a Southern Chinese Megalopolis**

Brian Morton

School of Biological Sciences, The University of Hong Kong, Hong Kong SAR, China

0940-1020

#### **What to Eat and Where to Go: Individual-based Studies of Foraging Behaviour and their Role in Conservation**

Stuart Bearhop

Centre for Ecology and Conservation, School of Biosciences, University of Exeter, Cornwall Campus, Penryn, Cornwall, TR10 9EZ, United Kingdom

1020-1040

#### **Retinoic Acids Produced by Marine Algae and Cyanobacteria Can Trigger Change of Sex of the Marine Gastropod *Reishia clavigera***

G.J. Zhou, Kevin K.Y. Ho, Jack C.H. Ip, Zhen Wang, Shan Liu, X.R. Xu, J.Y. Hu, John P. Giesy and Kenneth M.Y. Leung

The Swire Institute of Marine Science and School of Biological Sciences, The University of Hong Kong, Hong Kong SAR, China

# Schedule of Invited Lectures & Oral Presentations

\* Invited Lecture

Abstracts of presentations can be downloaded from the conference website:  
[www.biosch.hku.hk/become/abst\\_all.html](http://www.biosch.hku.hk/become/abst_all.html)

**1 June 2015, Venue: P1**

**Biodiversity Pattern**

1330-1350

**\*Comparative Phylogeography and Cryptic Diversity of Intertidal Barnacles in the NW Pacific**

B.K.K. Chan, L.M. Tsang, G.A. Williams, T.H. Wu and K.H. Chu

Biodiversity Research Center, Academia Sinica, Taipei 115, Taiwan

1350-1430

**\*The Korean Tidal Flat of the Yellow Sea: A Review on Coastal Ecosystem, Biodiversity, and Management**

Jong Seong Khim

School of Earth and Environmental Sciences & Research Institute of Oceanography, Seoul National University, Seoul 151-742, Republic of Korea

1430-1450

**Diversity of Order Zoantharia (Cnidaria: Anthozoa) in Brazil**

Maria Eduarda Alves dos Santos, James D. Reimer, Marcelo V. Kitahara and Alberto Lindner

Federal University of Paraná, Brazil

University of the Ryukyus, Japan

1450-1510

**Quantitative Distribution of Intertidal Macrofaunal Assemblages in Fildes Peninsula, King George Island, South Shetland Islands, Southern Ocean**

Xiaoshou Liu, Lu Wang, Yuanzi Huo, Shuai Li and Zhinan Zhang

College of Marine Life Sciences, Ocean University of China, Qingdao 266003, China

1510-1530

**A Review of Singapore's Marine Soft Bottom Macrobenthic Biodiversity**

Kok Ben Toh and Loke Ming Chou

Tropical Marine Science Institute, National University of Singapore, Singapore

1530-1550

**Species Diversity of Benthic Macrofauna in Shenzhen Bay**

Li-Zhe Cai, Xin-Wei Chen, Su-Jing Fu, Xi-Ping Zhou, Lu-Lu Yan, Wen-Jun Li, Guo-Qiang Li and Jia-Li Zeng

Key Laboratory of the Ministry of Education for Coastal and Wetland Ecosystems,  
Xiamen University, Xiamen, 361102, China

College of the Environment and Ecology, Xiamen University, Xiamen, 361102, China

1550-1610

**Biodiversity Inventory of Decapod Crustaceans in Hong Kong: A Preliminary Review**

Kingsley J.H. Wong

Life in Nature Ltd, Hong Kong SAR, China

**1 June 2015, Venue: P2**

**Fisheries & Marine Resources Management**

1330-1350

**40 Years of Artificial Reefs - What Does the Science Tell Us about Their Application in Fisheries Management?**

Y.J. Sadovy de Mitcheson, K.Y. Ma and W.C. Ng

Marine Science Laboratory, The Chinese University of Hong Kong, Shatin, Hong Kong SAR, China

1350-1410

**Demographic Attributes of the Orange-spotted Grouper *Epinephelus coioides*, an Ontogenetically Moving Fish Species from Mangroves to Coral Reefs in the Philippines**

S.S. Mamauag and P.M. Alino

Marine Environment and Resources Foundation, Inc., Marine Science Institute,  
University of the Philippines, Diliman, Quezon City 1101, Philippines

1410-1430

**Artificial Holdfast Units: Assessing Their Usefulness for the Recovery and Conservation of Seahorse Populations in the Ria Formosa Lagoon, South Portugal**

Jorge Palma, Miguel Correia and José P. Andrade

CCMar, Universidade do Algarve, F.C.T., Edificio 7, Campus de Gambelas, 8005-139 Faro, Portugal

1430-1450

**Marine Spatial Planning - a Planning Tool for Sustainable Use of Marine Resources in Hong Kong**

Samantha Lee

WWF-Hong Kong, Hong Kong SAR, China

1450-1510

**The Use of Fisheries Baseline Survey Findings for the Information of Fisheries Resources Conservation Management in Hong Kong**

S.W.Y. Wong, J.W.Y. Chan, M. Putnam and K.C. Tse

Mott MacDonald Hong Kong Limited, Hong Kong SAR, China

1510-1530

**Effects of the Trawling Ban on Demersal Fish Communities in the Marine Environment of Hong Kong, South China**

Yanny K.Y. Mak, L.S.R. Tao, K.K.Y. Ho, M. Perkins, W.W.L. Cheung, Y. Sadovy de Mitcheson, G.A. Williams, D. Dudgeon and K.M.Y. Leung

The Swire Institute of Marine Science and School of Biological Sciences, The University of Hong Kong, Hong Kong SAR, China

1530-1550

**Effects of the Trawling Ban on the Diversity of Demersal Crustaceans (Orders: Decapoda and Stomatopoda) in the Marine Environment of Hong Kong, South China**

Lily S.R. Tao, K.J.H. Wong, Y.K.Y. Mak, K.K.Y. Ho, M. Perkins, G.A. Williams, D. Dudgeon and K.M.Y. Leung

The Swire Institute of Marine Science and School of Biological Sciences, The University of Hong Kong, Hong Kong SAR, China

1550-1610

**Reproductive Biology and Fisheries of Seabreams (Family: Sparidae) in Hong Kong and Adjacent Waters**

C.S.W. Law and Y. Sadovy de Mitcheson

The Swire Institute of Marine Science and School of Biological Sciences, The University of Hong Kong, Hong Kong SAR, China

**1 June 2015, Venue: P3**  
**Biodiversity & Mammal Conservation**

1330-1350

**\*Marine Biodiversity in the Western Pacific Region: Present Status, Threats, Conservation, and Restoration**

Suchana Apple Chavanich and Wenxi Zhu

Reef Biology Research Group, Department of Marine Science, Faculty of Science, Chulalongkorn University, Bangkok, Thailand

1350-1410

**Diatoms (Bacillariophyceae) of the Southern Gulf of Mexico: Data-Base (1979-2010)**

S. Licea, J.L. Moreno-Ruiz and R. Luna

Instituto de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México. Circuito Exterior s/n Ciudad Universitaria Código postal 04510. México D.F. Apartado postal 70-305, Mexico

1410-1430

**A Comprehensive Literature Review of Marine Biodiversity in Hong Kong**

Terence P.T. Ng, Martin C.F. Cheng, Gray A. Williams and K.M.Y. Leung

The Swire Institute of Marine Science and School of Biological Sciences, The University of Hong Kong, Hong Kong SAR, China

1430-1450

**Humpback Dolphins in Hong Kong and the Pearl River Delta: What to Do When Everything Goes Wrong?**

Leszek Karczmarski

The Swire Institute of Marine Science and School of Biological Sciences, The University of Hong Kong, Hong Kong SAR, China

1450-1510

**Seasonal Changes in Habitat Use of Indo-Pacific Humpback Dolphins at an Estuary**

Tzu-Hao Lin, Chia-Yun Lee, Tomonari Akamatsu and Lien-Siang Chou

Institute of Ecology and Evolutionary Biology, National Taiwan University, Taiwan

1510-1530

**Implications of Long-term Loss of Coastal Habitats on Indo-Pacific Humpback Dolphins in Chinese Waters**

Shiang-Lin Huang and Leszek Karczmarski

The Swire Institute of Marine Science and School of Biological Sciences, The University of Hong Kong, Hong Kong SAR, China

1530-1550

**Marine Mammal Habitat Assessments: Tackling Data Gaps, Data Deficiencies and Tight Timelines**

Anna Hall, Bill Gorham, David Gummesson and David Gallacher

AECOM, Rm 1501-10, 15/F Grand Central Plaza, Tower 1, 138 Shatin Rural Committee Road, Shatin, Hong Kong SAR, China

1550-1610

**Impacts of Coastal Development on the Indo-Pacific Humpback Dolphins (*Sousa chinensis*) in Hong Kong**

Samuel K. Hung

The Hong Kong Dolphin Conservation Society, Hong Kong SAR, China

**1 June 2015, Venue: P4**

**Human Impacts**

1330-1350

**Evaluating the Color Succession of the Hard Coral, *Acropora tenuis*, Using Digital Color Imaging Under Different Light Intensities**

Ichiro Takeuchi, K. Hirayama, K. Chikamatsu, K. Takayama and A. Iguchi

Faculty of Agriculture, Ehime University, 3-5-7 Tarumi, Matsuyama, Ehime, Japan

1350-1410

**Reefs of Tomorrow: Nutrients Drive Coral Biodiversity in an Urbanized Seascape**

N. Duprey, M. Yasuhara, T. Kim, M.H. Li, M. Wong and D.M. Baker

The Swire Institute of Marine Science, School of Biological Sciences, and Department of Earth Science, The University of Hong Kong, Hong Kong SAR, China

1410-1430

**Temporal Trends of Perfluoroalkyl Substances (PFASs) in Marine Mammals of South China**

James C.W. Lam, J. Lyu, K.Y. Kwok and P.K.S. Lam

State Key Laboratory in Marine Pollution, City University of Hong Kong, Hong Kong SAR, China

1430-1450

**Potential Risk Assessment of Heavy Metals by Consuming Shellfish Collected from Muar Estuary, Johore, Malaysia**

M.C. Ong, N. Ismail, W.Y. Chai, S.L. Gan and B. Joseph

School of Marine and Environmental Sciences, Universiti Malaysia Terengganu, 21030 Kuala Terengganu, Terengganu, Malaysia

1450-1510

**Environmental Damages and Ecological Recoveries after the Hebei Spirit Oil Spill, Taean, Korea**

S. Hong, J.S. Khim, J. Ryu, S.G. Kang, W.J. Shim and U.H. Yim

School of Earth and Environmental Sciences & Research Institute of Oceanography, Seoul National University, Seoul, Republic of Korea

1510-1530

**Acclimation Cost of Common Environmental Stress to Copepod *Tigriopus japonicus***

K.W.H. Kwok, J.-S. Lee and K.M.Y. Leung

Department of Applied Biology and Chemical Technology, The Hong Kong Polytechnic University, Hung Hom, Hong Kong SAR, China

1530-1550

**Present Status of the Megabenthic Community in the Coastal Areas of Fukushima Prefecture, Japan after the Great East Japan Earthquake**

K. Kodama, T. Aramaki, A. Tanaka, T. Ohara, H. Shiraishi and T. Horiguchi

Center for Environmental Risk Research, National Institute for Environmental Studies, Japan

1550-1610

**Stress Responses of Zooxanthellae in Juvenile *Tridacna gigas* Exposed to Reduced Salinity**

Elizaldy Maboloc, Juliana Janet Puzon and Ronald Vilanueva

The Marine Science Institute, College of Science, University of the Philippines, Diliman, 1101 Quezon City, Philippines

**2 June 2015, Venue: P1**  
**Biodiversity & Evolution**

1105-1125

**Ancestral Whole Genome Duplication in the Marine Chelicerate Horseshoe Crabs**

Nathan J. Kenny, Ka Wo Chan, Wenyan Nong, Zhe Qu, Ignacio Maeso, Ho Yin Yip, Ting Fung Chan, H.S. Kwan, Peter W.H. Holland, Ka Hou Chu and Jerome H.L. Hui  
Simon F.S. Li Marine Science Laboratory, School of Life Sciences, The Chinese University of Hong Kong, Hong Kong SAR, China

1125-1145

**An Annotated Checklist of Marine Brachyuran Crabs of India**

J.N. Trivedi, D.J. Trivedi, G.M. Soni and K.D. Vachhrajani  
Marine Biodiversity and Ecology Lab., Department of Zoology, Faculty of Science, The M. S. University of Baroda, Vadodara-390002, Gujarat, India

1145-1205

**Population Structure on a Local Geographical Scale: *Dendropoma* spp. Snail-worm Genetics in Palau**

Julien Lorion, K. Yoshiwo, C. Kitalong, L. Rehm and James Davis Reimer  
Molecular Invertebrate Systematics & Ecology Laboratory, Graduate School of Engineering and Science, University of the Ryukyus, 1 Senbaru, Nishihara, Okinawa, Japan 903-0213; Palau International Coral Reef Center, Koror, Palau

1205-1225

**Becoming a Marine Organism**

K. Soong, N.C.N. Chen, S.Y. Chen, G.Y. Wu and C.G. Chang  
Department of Oceanography, National Sun Yat-sen University, Kaohsiung, Taiwan

1225-1245

**Dragon Heart and Dragon Scales: Internal and External Anatomy of the 'Scaly-foot Gastropod' (Mollusca: Gastropoda: Neomphalina)**

C. Chen, J.T. Copley, K. Linse, A.D. Rogers and J.D. Sigwart  
Department of Zoology, University of Oxford, The Tinbergen Building, South Parks Road, Oxford OX1 3PS, United Kingdom

1345-1425

**\*Identification and Expression of Defensomes in Oxidative Stress-induced Damage in Aquatic Organisms (rotifer, copepods, fish) and Evolutionary Consideration on Defense Mechanisms**

Jae-Seong Lee

Department of Biological Science, College of Science, Sungkyunkwan University, Suwon 440-746, Republic of Korea

1425-1445

Spatial and Seasonal Variations in Community Structure and Trophic Dynamics of Benthic Communities of Marine Molluscs in Hong Kong's Coastal Waters before the Trawling ban

A.T.L. Wong

School of Biological Sciences and The Swire Institute of Marine Science, The University of Hong Kong, Hong Kong SAR, China

1445-1505

**Nonadaptive Evolution of a Globally Abundant Ocean Bacterial Lineage**

H. Luo and J. Tang

Simon F. S. Li Marine Science Laboratory, School of Life Sciences, The Chinese University of Hong Kong, Hong Kong SAR, China

1505-1525

**Strong Genetic Structure and Hybridization Between Two Discrete Lineages of *Parazacco spilurus* (Cyprinidae) in Hong Kong**

Tsz Huen Wu, I-Shiung Chen and Ka Hou Chu

School of Life Sciences, The Chinese University of Hong Kong, Hong Kong SAR, China

1525-1545

**\*Zooplankton Distribution in Ocean Currents**

Ryuji Machida

Biodiversity Research Centre, Academia Sinica, Taiwan

**2 June 2015, Venue: P2**  
**Biodiversity Conservation**

1105-1125

**Effects of Marine Reserves on Reef Fish Recruitment in the Philippines**

Patrick C. Cabaitan, Hazel O. Arceo, Cleto L. Nañola, Renmar Jun S. Martinez,  
Melchor R. Deocadez and Porfiro M. Aliño

The Marine Science Institute, College of Science, University of the Philippines,  
Diliman, Quezon City 1101, Philippines

1125-1145

**The Value of Marine Ecotourism in the Open Sea: The Azores Case-study**

A. Ressurreicao, F. Cardigos, E. Giacomello, T. Dentinho and R.S. Santos

Marine and Environmental Sciences Centre, Department of Oceanography and  
Fisheries, University of the Azores, Rua Prof. Dr. Frederico Machado 4, 9901-862  
Horta, Azores, Portugal

1145-1205

**Aspects on the Reproductive Ecology of the Sea Cucumber *Stichopus cf. horrens* in  
Masinloc, Zambales, Northwest Philippines**

C.M. Edullantes and M.A. Juinio-Meñez

Marine Science Institute, University of the Philippines, Diliman, Quezon City,  
Philippines

1205-1225

**Improved Health and Resilience in Unprotected Reefs in Cambodia**

J.M. Savage, P.E. Osborne and M.D. Hudson

Centre for Environmental Sciences, Faculty of Engineering and the Environment,  
University of Southampton, United Kingdom

1225-1245

**Embedding Predictive Tools into Marine Environmental Management Policy and  
Legislation**

Richard Stafford and Tilak Ginige

Department of Life and Environmental Sciences, Bournemouth University, United  
Kingdom

**2 June 2015, Venue: P2**

**Human Impacts**

1345-1405

**The Importance of Sub-specific Diversity: The Outcome of Interaction between Invasive and Indigenous Mussels Differs between Native Lineages**

C.D. McQuaid, F. Porri and M.B. Hall

Department of Zoology & Entomology, Rhodes University, Grahamstown, South Africa

1405-1425

**Biofilm Ecology on Antifouling Surfaces in Tropical Marine Environments**

S.Z. Zainul Rahim and S.L.M. Teo

Department of Biological Sciences, National University of Singapore, Singapore

1425-1445

**Assigning *Hippocampus guttulatus* Recruits to the Populations of Origin Using Microsatellites: Results from a Field Study in the Ria Formosa (South Portugal)**

J.P. Andrade, C. Madeira, M.T. Correia and J. Palma

Centre of Marine Sciences, University of the Algarve, Portugal

1445-1505

**Seasonality Can Lower Biotic Resistance to Ascidian Invasion in Subtropical Marine Fouling Communities**

Juan C. Astudillo, K.M.Y. Leung and Tim C. Bonebrake

The Swire Institute of Marine Science and School of Biological Sciences, The University of Hong Kong, Hong Kong SAR, China

1505-1525

**The Fouling of *Lepas* Barnacles on Immobilized Offshore Installations**

T. Yan, J. Li, J.D. Gu, W.H. Cao and W.X. Yan

South China Sea Institute of Oceanology, Chinese Academy of Sciences, Guangzhou, China

1525-1545

**Macrobenthic Community Changes During Large Scale Reclamation (from 2007 to 2011) in Tianjin Coastal, China**

Shengyan Tian, Chunzheng Song, Tong Zhang and Xianbin Liu

Tianjin Key Laboratory of Marine Resources and Chemistry, College of Marine Science and Engineering, Tianjin University of Science and Technology, Tianjin 300457, China

**2 June 2015, Venue: P3**

**Climate Change Impacts**

1105-1125

**Some Like It Hot, But Some Don't: Behavioral Flexibility as an Adaptation to Thermal Stress in an Era of Global Warming**

Laurent Seuront and Terence Ng

Centre National de la Recherche Scientifique, Laboratoire d'Océanologie et de Géosciences, UMR 8187 LOG, 28 avenue Foch, BP 80, 62930, Wimereux, France

1125-1145

**Temperature Impacts on Deep-Sea Biodiversity**

M. Yasuhara and R. Danovaro

School of Biological Sciences, Swire Institute of Marine Science, and Department of Earth Sciences, The University of Hong Kong, Hong Kong SAR, China

1145-1205

**A Jellyfish Species Can be Used as an Indicator of the Yellow Sea Cold Bottom Water**

Fang Zhang and Song Sun

Key Laboratory of Marine Ecology and Environmental Sciences, Institute of Oceanology, Chinese Academy of Sciences, Qingdao 266071, China

1205-1225

**Adapting to Fluctuating Marine Acidification: Physiological and Behavioural Responses of Tropical Estuarine and Coastal Gastropods (Rapaninae: Muricidae)**

Sorya Proum and David J. Marshall

Faculty of Science, Universiti Brunei Darussalam, Jalan Tungku, Brunei Darussalam

1225-1245

**Sublethal Impacts of Ocean Acidification on Larval Urchins: Inter- and Intra-specific Comparisons and Implications for Population Dynamics**

Karen K.Y. Chan

Division of Life Science, Hong Kong University of Science and Technology, Clear Water Bay, Hong Kong SAR, China

1345-1405

**Interactive Effects of Ocean Acidification, Elevated Temperature and Reduced Salinity on Early-Life Stages of The Pacific Oyster *Crassostrea gigas***

G.W.K. Ko, D. Ramadoss, C. Campanati, V.B.S. Chan, J. Havenhand and V.

Thiyagarajan

The Swire Institute of Marine Science and School of Biological Sciences, The University of Hong Kong, Hong Kong SAR, China

1405-1425

**Social-ecological Conditions and the Vulnerability to Climate Change of Coral Reef Fisheries in the Philippines**

R.N. Muallil, S.S. Mamauag, M.R. Deocadez, R.S. Martinez, F. Panga, R. de Ramos and P.M. Aliño

Marine Science Institute, University of the Philippines Diliman, 1101 Quezon City, Philippines; Mindanao State University – Tawi-Tawi College of Technology and Oceanography, 7500 Bongao, Tawi-Tawi, Philippines

1425-1445

**Effects of Temperature and Salinity on Early Embryogenesis of *Acropora valida***

A.P.Y. Chui and P.O. Ang

School of Life Sciences, The Chinese University of Hong Kong, Shatin, N.T., Hong Kong SAR, China

1445-1505

**Climate Change Drivers Alter Microbial Biofilm Biodiversity: Implications on Larval Recruitment**

V. Thiyagarajan, D. Ramadoss, Ackley Lane and Stanley Lau

The Swire Institute of Marine Science and School of Biological Sciences, The University of Hong Kong, Hong Kong SAR, China

1505-1525

**Impact of Temperature and Salinity on the Onset of Symbiosis between Scleractinian Coral *Acropora valida* and Various Subclades of *Symbiodinium***

T.Y. Ng and P.O. Ang

Marine Science Laboratory, The Chinese University of Hong Kong, Hong Kong SAR, China

1525-1545

**The Temporal Change of Marine Endosymbiosis: Evidence from the Lipidomics of Lipid Bodies in a Hermatypic Coral**

Hung-Kai Chen, Li-Hsueh Wang, Anderson B. Mayfield, Yi-Jyun Chen, Wan-Nan U. Chen, Chan-Shing Lin and Chii-Shiarng Chen

Department of Marine Biotechnology and Resources, National Sun Yat-Sen University, Kaohsiung, Taiwan

**2 June 2015, Venue: P4**

**Ecosystem Functions**

1105-1125

**\*Contrasting Responses in Biodiversity, Food-chain Length and Fish Production to Disturbances in Boreal Lakes**

Danny C. P. Lau, Tobias Vrede and Willem Goedkoop

Climate Impacts Research Centre, Department of Ecology and Environmental Science, Umeå University, Umeå, Sweden

1125-1145

**Do We Have Harmful Benthic Dinoflagellates in Coral Communities in Hong Kong?**

T.C. Wai, K.F. Yiu, C.Y. Chen, C.Y. Ma, L.L. Chan, C.K. Lu, P.O. Ang and P.K.S. Lam  
State Key Laboratory in Marine Pollution, City University of Hong Kong, Hong Kong SAR, China

1145-1205

**Study of Contingency between the Spatial Distributions of Gray Whales and Their Feeding Objects Offshore North-East Coast of Sakhalin Island**

Y.A. Kriksunov, A.R. Alyautdinov, A.Y. Bobyrev and S.V. Chistov

Faculty of Biology, Moscow State University, Russia

1205-1225

**Interactive Corallivorous Activities of *Diadema setosum* and *Drupella* spp.: a Laboratory Based Evaluation**

K.T. Wong and P.O. Ang

Marine Science Laboratory, Chinese University of Hong Kong, Hong Kong SAR, China

1225-1245

**Feeding Behaviors of Sea Urchin, *Strongylocentrotus nudus*: Preference and Optimal Diet Model**

Jeong Ha Kim, Kwon Mo Yang and Byung Hee Jeon

Department of Biological Sciences, Sungkyunkwan University, Suwon, Republic of Korea

1345-1405

**Bioerosion and Growth of Massive Corals in Hong Kong**

J.Y. Xie, C.P. Dumont, N.F. Goodkin and J.W. Qiu

Department of Biology, Hong Kong Baptist University, Hong Kong SAR, China

1405-1425

**Modelling the Emergence of Complex Phage-Bacteria Infection Networks - From Marine Ecosystems to Dynamic Models**

Chung Yin Joey Leung and Joshua Weitz

School of Biology and School of Physics, Georgia Institute of Technology, Atlanta, GA, United States of America

1425-1445

**Assessing Coral to Algal Phase Shifts in Marcos and Magsaysay Reefs Pangasinan, Philippines**

J. Narsico, F. Ravelo, L. Diaz, M. Tanedo, A. Torres, E. Candelaria, A. Guerrero, D.A. Valino, Sinsona and R. Villanueva

Biology Program, Sciences Cluster, University of the Philippines Cebu, Gorordo Avenue, Lahug Cebu City, Philippines; The Marine Science Institute, College of Science, University of the Philippines Diliman, Quezon City, Philippines

1445-1505

**Effects on Primary Producer Diversity on Material Cycle and Shellfish Aquaculture in a Subarctic Lagoon in Hokkaido, Japan**

Abe Hiroya and J. Kishi Michio

Graduate School of Environmental Science, Hokkaido University, Japan

1505-1525

**Symbiotic Fauna of the Natural and Artificially Planted Scleractinian Coral  
*Pocillopora meandrina***

S.S. Zvonareva, Y.V. Deart and T.A. Britayev

A.N. Severtsov Institute of Ecology and Evolution, Russian Science Academy, Russia

1525-1545

**Does Low Tide Behaviour of a Keystone Grazer Influence High Tide Foraging?**

Clarissa M. L. Fraser and Ross A. Coleman

Coastal and Marine Ecosystems, School of Biological Sciences, University of Sydney, Sydney, Australia; The Swire Institute of Marine Science, The University of Hong Kong, Hong Kong SAR, China

**3 June 2015, Venue: P1**

**Marine Ecology**

1125-1145

**Comparing Coral Reef Conditions before and after Typhoon Haiyan in  
Concepcion, Iloilo, Philippines**

D.M. Guarte, W.L. Campos and E. Abian

OceanBio Laboratory, College of Arts and Sciences, University of the Philippines Visayas, Miagao, Iloilo, Philippines

1145-1205

**Multispecies and Multi-Gear Fisheries in the Iloilo River, West Central Visayas,  
Philippines**

Annabelle del Norte-Campos and Wilfredo L. Campos

Marine Biology Laboratory, College of Arts and Sciences, University of the Philippines Visayas, Miagao, Iloilo, Philippines

1205-1225

**Blood Parasite Biodiversity of Reef Associated Fishes of the Eastern Caribbean,  
with Comments on Their Ecology Relevance**

Courtney A. Cook, Paul C. Sikkell, Lance P. Renoux and Nico J. Smit

Water Research Group, Unit for Environmental Sciences and Management, North-West University, Potchefstroom, South Africa

1225-1245

**Phytoplankton from the Southern Coast in the Gulf of México: Biodiversity, Ecology and Biogeography (2005-2014)**

J.L. Moreno-Ruiz, S. Licea and R. Luna

Universidad Autónoma Metropolitana-Xochimilco, Calzada del Hueso 1100, Col. Villa Quietud, C.P. 04960, México, D.F., Mexico

**3 June 2015, Venue: P2**

**Biodiversity Conservation**

1125-1145

**\*Coral Restoration in Singapore's Sediment-challenged Sea**

Loke Ming Chou

Tropical Marine Science Institute, National University of Singapore, Singapore

1145-1205

**Biodiversity and Conservation of Macao's Mangroves**

K. Araño-Tagulao and S.K. Chan

Institute of Science and Environment, University of St. Joseph, Macao SAR, China

1205-1225

**Phenology and Litterfall Dynamics Structuring Ecosystem Productivity in a Tropical Mangrove Stand on South West Coast of India**

Rani Varghese, S. Sreelekshmi, C.M. Preethy and S. Bijoy Nandan

Department of Marine Biology, Microbiology & Biochemistry, School of Marine Sciences, Cochin University of Science and Technology, Cochin 682016, India

1225-1245

**Links between Benthic Invertebrate Community Structure and Abiotic Factors in Fragmented Mangrove Habitats**

Judith C. Klein, Duong Thi Thuy, Séraphine Grellier, Nguyen Dinh Tu, Nguyen Thanh Hien and Nguyen Vu Thanh

Institute of Research for Development, UMR MARBEC, University of Montpellier, France

**3 June 2015, Venue: P3**  
**Climate Change Impacts**

1125-1205

**\*Human Activities on Biogeography of Rocky Intertidal Species along China Coast**

Y.W. Dong, X.W. Huang, W. Wang, J. Wang and S. S. Yu

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

1205-1225

**Resilience to Climate Change Induced Coral Bleaching Events in the Andaman Sea**

T. Yeemin, M. Sutthacheep, M. Yucharoen, W. Klinthong, K. Sangmanee, W. Samsuvan, J. Putthayakool and M. Thummasan

Marine Biodiversity Research Group, Department of Biology, Faculty of Science, Ramkhamhaeng University, Huamark, Bangkok 10240, Thailand

1225-1245

**Climatological Mixed Layer Dynamics and Its Impact on Phytoplankton Biomass in an Altered River Estuary**

Brisneve Edullantes and Yongsik Sin

Biology Program, Sciences Cluster, University of the Philippines Cebu, Philippines

**3 June 2015, Venue: P4**  
**Ecosystem Functions**

1125-1145

**Structure and Dynamics of Nematode Assemblages on the Marginal Sea Sediments of the Northern Yellow Sea: Relationships with Seasonal Changes in Cold Water Mass**

Hong Zhou, Qing Yu and Zhinan Zhang

College of Marine Life Science, Ocean University of China, Qingdao, China

1145-1205

**Benthic and Epiphytic Toxic Algae (BETA): an Emerging Threat to Coral Ecosystems**

Yim Ling Mak, Jiajun Wu, Tak-Cheung Wai, Lai Leo Chan and P.K.S. Lam  
State Key Laboratory in Marine Pollution (SKLMP), City University of Hong Kong,  
Hong Kong SAR, China

Shenzhen Key Laboratory for Sustainable Use of Marine Biodiversity (SUMB),  
Research Centre for the Oceans and Human Health (H2O), City University of Hong  
Kong; Shenzhen Research Institute, Nanshan District, Shenzhen, China

1205-1225

**Benthic Microalgal Diversity and Primary Production in Korean Tidal Flats**

Bong-Oh Kwon, Jong Seong Khim, Jinsoon Park, Seongjin Hong and Jongseong Ryu  
School of Earth and Environmental Sciences & Research Institute of Oceanography,  
Seoul National University, Republic of Korea

1225-1245

**More Than Just a Pretty Mantle: the Ecological Importance of Giant Clams  
(Bivalvia: Cardiidae: Tridacninae) on Coral Reefs**

M.L. Neo, W. Eckman, K. Vicentuan, S.L.M. Teo and P.A. Todd

Tropical Marine Science Institute, National University of Singapore, Singapore

# Schedule of Breakout Groups

\* Invited Lecture

Abstracts of presentations can be downloaded from the conference website:  
[www.biosch.hku.hk/become/abst\\_all.html](http://www.biosch.hku.hk/become/abst_all.html)

**3 June 2015, Venue: P1**

**Breakout session: Environmental Education**

1345-1405

**Sources of Environmental Knowledge on Shark Conservation among Primary Students in Hong Kong - A Preliminary Study**

Kwok Ho Tsoi, Sau Ying Chan and Chi Chiu Cheang

Department of Science and Environmental Studies, The Hong Kong Institute of Education, Hong Kong SAR, China

1405-1425

**A Scenario-Based Learning Strategy for Constructing the Concepts of Biological Classification and Marine Biodiversity in a Teacher Training Workshop**

Kwok Ho Tsoi, Sau Ying Chan and Chi Chiu Cheang

Department of Science and Environmental Studies, The Hong Kong Institute of Education, Hong Kong SAR, China

1425-1445

**The Use of Innovative Programmes in Marine Environmental Education**

M.S. Cheung and S.H. Ching

Eco-education & Resources Centre, Hong Kong SAR, China

1445-1505

**\*From a Museum in Marine Biology to an Educational Park in Marine Science**

Yung-Hui Chen

Department of Science Education, National Museum of Marine Biology and Aquarium, Pintung 944, Taiwan

1505-1525

**Marine Conservation Education for Primary and Secondary Schools**

Wai Chin Li, Wing Kuen Chow, I Ha Eva Loi, Chi Chiu Cheang, Lincoln Fok, Yiu Fai Tsang and Kwok Ho Tsoi

Department of Science and Environmental Studies, The Hong Kong Institute of Education, Hong Kong SAR, China

**3 June 2015, Venue: P2**

**Breakout session: Climate Change Impacts**

1345-1405

**The Challenges of Defining Winners and Losers: Understanding Global Climate Change Requires Global Scientific Responses**

Gray A. Williams

The Swire Institute of Marine Science and School of Biological Sciences, The University of Hong Kong, Hong Kong SAR, China

1405-1425

**Unexpected Ecosystem Change: the Role of Multiple Stressors and Underlying Mechanisms**

Bayden D. Russell

The Swire Institute of Marine Science and School of Biological Sciences, The University of Hong Kong, Hong Kong SAR, China

1425-1445

**Climate Change and Intertidal Ecosystems: the Ecological Relevance of Energy-Related Biomarkers in Response to Environmental Stresses**

Yun-Wei Dong

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

1445-1505

**Does a Synergy between Proteomics and Mechanics Benefit Climate Change Research?**

Vengatesen Thiyagarajan

The Swire Institute of Marine Science and School of Biological Sciences, The University of Hong Kong, Hong Kong SAR, China

**3 June 2015, Venue: P3**

**Breakout session: Building Blue Networks**

1345-1445

**\*Building Teams to Better Understand the World's Harbours: Introducing the Sydney Harbour Research Program and the World Harbour Project (WHP)**

Joanne Banks<sup>1</sup> and Emma L. Johnston<sup>2</sup>

<sup>1</sup>Sydney Institute of Marine Science, Australia

<sup>2</sup>Evolution and Ecology Research Centre, University of New South Wales, Sydney, NSW, 2052, Australia

1445-1505

**MarineGEO and Tennenbaum Marine Observatories Network**

David M. Baker

The Swire Institute of Marine Science, School of Biological Sciences and Department of Earth Sciences, The University of Hong Kong, Hong Kong SAR, China

**3 June 2015, Venue: P4**

**Breakout session: Biodiversity Data Sharing & Management**

1345-1525

**Biodiversity Data Sharing and Management**

Mark. J. Costello and Kwang-Tao Shao

Institute of Marine Science, Leigh Marine Laboratory, University of Auckland, New Zealand

1425-1445

**Current Status and Perspective of Digital Archives of Taiwan Fishes**

Kwang-Tsao Shao, Hsin Hua Lin, Yung Chang Lin and Pai Lei Lin

Biodiversity Research Center, Academia Sinica, Taipei, Taiwan

1445-1505

**Interprovincial Conservation on Marine Biodiversity - A Case in Dongshan-Nan'ao Area**

Wenhua Liu, Yinglin Wu, PingLi, Derun Lin and Mei Zhuang

Marine Biology Institute, Shantou University, Shantou, Guangdong, China

Abstracts of Keynote &  
Invited Lectures

## **Toward a Re-estimation of the World's Global Marine Fisheries Catch**

Daniel Pauly

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The *Sea Around Us*, based at the University of British Columbia, in Vancouver, Canada, and its international network of collaborators, has over the last 12 years engaged in the bottom-up reconstruction of the marine fisheries catch of all maritime countries of the world, including their overseas territories, for the years 1950 to 2010. The result of these reconstructions, which include all catches usually neglected in official statistics, e.g., catch estimates from subsistence and illegal industrial fisheries, are presented for selected countries and regions, with emphasis on East and Southeast Asia.

An important finding is that while reconstructed catches are generally higher than reported catches in most of the world, including East and Southeast Asia, the official fisheries catches from these two regions tend to display unrealistic exponential increases, suggesting that the fisheries statistical reporting systems of several countries respond to political incentives as much as to the actual development of their fisheries. The important role of accurate fisheries statistics is re-iterated, along with basic methods to generate such statistics.

## **Disturbance of the Seafloor by Fishing; Implications for the Effects of Other Stressors and Recovery of Ecosystem Functions**

Simon Thrush

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Coastal marine ecosystems are generally systems of high value and multiple use. One of the major stressors in many coastal ecosystems is physical disturbance of the seafloor associated with trawl and dredge fisheries. This form of disturbance can vary in its intensity and spatial and temporal extent, but frequently involves the removal of large, long-lived functional important species. Many of these species elevate the complexity of seafloor habitats, biodiversity and the potential for the delivery of multiple ecosystem functions. These habitat and functional changes can influence the ability of impacted seafloor communities to respond to other stressors and thus affect the quality of the ecosystem in terms of other uses and values. Using examples of seafloor impacts, I will illustrate how cumulative effects can emerge at different space and time scales, with the potential loss of resilience in valued ecosystems and rapid transitions in ecosystem structure and function. Changes in ecosystem interaction networks can also provide insight into threshold effects. The implication of these analyses of real world marine ecosystems is that rapid transitions occur and marine governance, policy and management need to be framed to enhance adaptive capacity, multi-functionality and the ability to respond to ecological surprises

## **Status and Challenges of Marine Protected Areas in Taiwan**

K.T. Shao

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The "Biodiversity Promotion Plan," approved by Taiwan's Executive Yuan was revised based on the "Aichi Target" which designated 10% of the total coastal and marine areas to be protected areas by 2020. The Fishery Agency (FA), the agency appointed to be in charge of MPAs in Taiwan, decided to use the 12 nm "territorial seas," including "inner waters," as the denominator (6.5 M hectares). However, the numerator was in dispute. FA treated all the regulated fishing areas as MPAs as long as fishing was banned for one single fishing season, one target species, or one fishing method. As a result, the MPA ratio in Taiwan has reached 46%. It is significantly higher than the 7% recognized by the academic community and NGOs. Thus, the new initiative is to ask for increasing the number and area of real "no-take" zones.

The enforcement of MPAs is much more important than to increase their ratio; otherwise, they become just "paper parks." There are only a few examples of well-managed MPAs in Taiwan. In general, Taiwan has to overcome the following problems for MPA management: lacking post boards on sites; border lines and boundaries of MPAs unclear; lack of surveys or monitoring programs; no effective managing plans; people do not abide by laws, and punishment not carried out due to fear of retaliation or pressure from elected representatives, etc.

While there are many obstacles, the future of MPAs in Taiwan is promising. In recent years, Taiwan has added many MPAs (e.g. 36 national important wetlands, Guan-Hsin algal reef wildlife protected area, Important Habitat for Chinese White Dolphin, and Southern Four Islets National Park). Several important conservation laws (e.g. Environmental Education Law, Wetland Protection Law and Coastal Management Law) were all approved by Legislative Yuan. A new coordinated "Marine Conservation Agency" will be established soon.

## Progress of Study on Marine Biodiversity in China

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This presentation will briefly introduce the progress of researches on marine biodiversity in mainland China with the following aspects:

1. **The comprehensive investigations of marine biodiversity in mainland China since 1950's.** The important explorations to China seas include "The Comprehensive Resource Investigation of Chinese Coast and Shallow Waters" in 1959-1960 which was usually called "National Oceanic Investigation", it is the largest scale marine biodiversity investigation in the country up to date; "The China-Vietnam Cooperative Expedition of Marine Resource to Beibu Bay (Gulf of Tonkin)" in 1959-1962; "The Second Comprehensive Resource Investigation of Chinese Coast and Shallow Waters" in 2004-2009; etc.
2. **The study of taxonomy and systematics of marine biota in China.** The main publications and achievements will be introduced, including the books, papers, and the species numbers of the marine organism groups reported from China seas, as well as some projects of marine biodiversity.
3. **The marine ecological research in China seas.** Some large projects of marine ecology will be mentioned in this part.
4. **The marine biodiversity conservation in China.** Fifteen national marine natural conserves established between 1980-2000 will be introduced in this part.

Finally, some suggestions and prospects of the author on the biodiversity research for China seas will be presented.

## **Conservation of Biodiversity and Natural Resources through Marine Reserves and Marine Protected Areas Respectively**

Mark J. Costello

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Countries are taking measures to reduce human impacts on marine biodiversity, including reducing pollution, controlling fisheries, and conservation of endangered species. Thus all the ocean is protected to some extent. There are almost 9,000 places designated as 'Marine Protected Areas' (MPA) covering < 3% of the ocean. The Convention on Biological Diversity aims to have all ocean resources harvested sustainably by 2020, both inside and outside MPA.

All kinds of fishing, commercial, subsistence and recreational, alter food webs and ecosystems because they remove top predators. Thus only 'no-take' Marine Reserves conserve biodiversity from populations to ecosystems. Marine Reserves provide greater public, economic, educational, and scientific benefits to society (than MPA) because they showcase more natural ecosystems and act as scientific and fishery management 'controls' for the effects and performance of fishery management measures elsewhere.

Only 6% of MPA, representing < 0.2% of the ocean area, prohibit fishing; and less than one quarter of coastal countries have designated any Marine Reserves. That 94% of MPA allow fishing means they cannot maintain biodiversity in a natural condition and could be more accurately called special fishery management areas. Furthermore, the proportion of MPA that are Marine Reserves has halved since 1970. Thus, contrary to use by international organisations, the growth in number of MPA is not a measure of conservation of biodiversity from populations to ecosystems. What is an MPA has become so loosely defined as to obfuscate conservation progress. The conservation of biodiversity should focus on monitoring the establishment and enforcement of no-take Marine Reserves; not MPA. This would bring clarity to what marine biodiversity is being protected, and simplify management.

## **Introduced Species and Challenges for Restoring and Preserving Marine Biodiversity**

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Maintenance of biodiversity and ecosystem services provided by diverse communities is a priority for the protection of marine systems globally. However, human impacts including introduced species, habitat destruction and overharvesting of native species create server challenges for the maintenance of local biodiversity. Presently, marine protected areas and reserves are the primary tools used for protecting biodiversity, but there is growing interest in restoration. Restoration can be a tool to replenish depleted fisheries, particularly those species that can provide substantial ecosystem services such as bivalves. Bivalves provide important services such as filtration and control of harmful algal blooms as well as habitat for local biodiversity. Such restoration can be faced with conflicts between desires to replace a fishery, and the desire to restore ecosystem services, including suggestions of the use of nonnative species introductions without consideration of the risks. In all cases, collaborations among scientists, conservation organizations, and local governments and managers are important and are growing more common, facilitating the likelihood of success of preservation, protection and restoration of biodiversity. But, the increasing threats caused by the spread of nonnative species still remains understudied in marine systems, particularly their effects in marine reserves and protected areas, as well as their impacts on restoration. To date, several studies suggest that introduced species may be more abundant in marine reserves than comparable control areas, which may threaten these important tools for preserving biodiversity.

## **Muddy Waters: Biodiversity, Bioinvasion and Ecosystem Functioning in Multiply Stressed Coastal Systems**

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Estuaries are among the most highly disturbed of all aquatic environments due to their proximity to urban, agricultural and industrial activity. Aquatic communities are exposed to multiple stressors and it is vital that the ecological consequences are identified and distinguished using a range of observational and manipulative techniques. I will present our research, combining the disciplines of ecology and ecotoxicology, to identify drivers of marine invasion success, the plasticity of environmental niche space, stressor interactions and contaminant impacts on ecosystem functioning. In addition, I will detail how molecular approaches (targeted gene, metagenomics and meta-transcriptomics) are enhancing our capacity to observe biodiversity, community connectivity and ecological change.

## Ecology of Hydrothermal Vents off Kueishan Island, Northwestern Taiwan

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Kueishan Island located in northeastern Taiwan, is known worldwide for its relatively shallow hydrothermal vents at depths of 10–400 m. Several vent endemic fauna have been discovered, with the dominant species being a crab *Xenograpsus testudinatus* and the only species distributed in both the shallow and deeper vents. The vent ecology of Kueishan Island has been actively studied recently even though without the aid of sophisticated underwater collecting tools. Behavioral study revealed that *X. testudinatus* in the shallow vent (15–30 m deep) may feed on the zooplankton killed by the vent plumes and are highly mobile. Gut content and stable isotope analysis also revealed that shallow-water vents host no chemosynthetic fauna, but green and red algae, epibiotic biofilm on crustacean surfaces, and zooplankton form the base of the trophic system. Suspension-feeding sea anemones and the generalist omnivorous vent crab *X. testudinatus* occupy higher trophic levels. The deeper hydrothermal vent (200–300 m deep) is a chemoautotrophic-based system. The vent mussel *Bathymodiolus taiwanensis* forms a chemosynthetic component of this trophic system. Bacterial biofilm, surface plankton, and algae form the other dietary fractions of the deeper vent fauna. The vent hermit crab *Paragiopagurus ventilatus* and the vent crab *X. testudinatus* are generalist omnivores. The vent-endemic tonguefish *Symphurus multimaculatus* occupies the top level of the trophic system. The assemblages of *X. testudinatus* from shallow and deeper vents exhibited distinct stable isotope values, suggesting that they feed on different food sources. Moreover, the shallow vent *Xenograpsus* assemblages displayed large variations in their stable isotope values, suggesting that the highly mobile *Xenograpsus* may transfer energy between the vent and the adjacent non-vent environment. A survey on the macrofauna and macroflora community inhabiting the shallow-water vents showed that positively buoyant vent fluid exhibits a more pronounced impact on the surface water than on the bottom layer. Species diversity increased with horizontal distance from the vent, and the upward trend continued for a distance of 2000 m, indicating that the vent fluid may exert a negative impact over several kilometers. The community structure off Kueishan Island displayed numerous transitions along the horizontal gradient, which were broadly congruent with changes in environmental conditions. The reduced pH value near the vent area was revealed to be the major abiotic factor affecting nearby organisms.

## **Chinese White Dolphin (*Sousa chinensis*) in China: Status and Future**

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In China, Indo-Pacific humpback dolphins are known as Chinese white dolphins (*Sousa chinensis*, CWDs) which are historically distributed from the mouth of the Yangtze River to the north border of Vietnam. The overall stock of CWDs in Chinese waters is now roughly known, with ~2500 individuals in Pearl River Estuary (PRE), <100 individuals in Xiamen, ~1485 individuals in Zhanjiang, ~200 individuals in Jiangmen and <300 individuals in Taiwan. This species commonly occurs in estuaries which are influenced by freshwater discharges from rivers. Stranding cases or sightings of CWDs had been increasingly recorded in many estuaries in China which were understudied, including Yangtze River Estuary, Oujiang River Estuary, Dongshanxi River estuary, Minjiang River estuary, Quanzhou Bay, and Moyangjiang River estuary. By combining local ecological knowledge (LEK) and standardized field surveys, our results indicated that mobility of CWDs is somewhat limited and the chance for different dolphin groups to meet and mate among different estuary regions is relatively low, although the preliminary genetic data suggested that there may exist some genetic exchange between the populations of Xiamen and PRE.

CWDs mainly inhabit in urbanized estuarine areas where they are inevitably facing a number of anthropogenic threats such as collision with marine vessels, pollution, harmed or caught by fishing gears, diminishing of their food due to overfishing etc. However, the precise significance and extent of all these threats to CWD populations are still largely unknown. Also, our knowledge on their movement patterns, home range, distribution and habitat requirements is rather limited. This keynote lecture will specifically discuss the established and emerging threats that are affecting this species, including chemical pollutants (trace elements and persistent organic pollutants), noise pollution, habitat degradation, prey depletion, vessel collision and climate change. Ecological risks of these threats on CWDs in Chinese waters will be assessed and evaluated based on a comprehensive analysis of available scientific data from diverse sources. In the future, more concerted efforts should be placed in developing a holistic conservation management plan for CWDs such as various ways to reduce the aforementioned threats and implement marine spatial planning. In a large spatial scale, it is important to continuously monitor the population dynamics of CWDs while updating the spatial and temporal changes, in terms of the intensity of the anthropogenic threats, in different estuary areas of China. The results of such an integrated monitoring will help us to identify the driving forces for altering their population dynamics.

## **Discipline Insularity: Researchers in Marine Ecology May Not Be Reading as Widely as They Should**

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A common dictum to budding marine ecologists when they start their career in research is to read widely and not just on the topic area of a given project. So, it appears that we have a classic case of “do as I say, not as I do” where professional marine ecologists do not follow their own pedagogical advice. An observation was made that some coral-reef biologists appeared less knowledgeable about equivalent research having been done on in rocky systems. So, using a systematic analysis of the literature, we tested the hypothesis that researchers working on recruitment ecology in marine systems would cite literature from their own system rather than across the wider range of marine ecology. We examined 8 journals (Nature, Science, Proc. Roy. Soc. B., JEMBE, Mar. Ecol. Progr. Ser., Ecology and J. Anim. Ecol.) over the period 2004-2014. The results indicated that this bias did in fact exist, but was much worse for researchers publishing results from studies on coral reefs than those working on rocky reefs. This study highlights that in spite of being in an unprecedented period in scientific history, where information has never been more freely available, researchers are still being parochial with respect to knowledge.

## **Mangrove Biodiversity and Conservation in a Southern Chinese Megalopolis**

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The focus of the southern Chinese province of Guangdong is the Pearl River, draining a vast area (~453,700 km<sup>2</sup>) of China. The river is >100 km wide at its mouth, with Macau and Hong Kong flanking western and eastern banks, respectively. The Pearl is the second largest river in China, with an estimated flow of ~10,000 m<sup>3</sup> second.

Guangdong's population of >110 million is 7.8% of China's total. Its capital, Guangzhou, is the third largest Chinese city. The modern Guangdong city of Shenzhen has become the 10<sup>th</sup> most populous city and is China's economic powerhouse. The population of the Pearl River Delta Economic Zone, the world's first Mega City, or megalopolis, has an urban population of >150 million. This does not, however, include Macau and Hong Kong, with residents of 0.5 and 7.2 million, respectively, but with transient populations of >130 million. With a land area of only 1,104 km<sup>2</sup>, the Alpha+ City of Hong Kong has, in Kowloon, a population density of ~44,000 km<sup>-2</sup>, making it the most dense human conurbation ever known. The Pearl's delta is, therefore, home to >160 million people, but regional goals for 2020 include three new cities, the expansion of road, rail, seaport and airport infrastructures and the construction of the 50 km long Hong Kong-Zhuhai-Macau Bridge - across the Pearl.

Since the end of the last ice age, sea levels have risen in southern China by >10 metres and, because of the vast amounts of silt deposited by the river (~86 million tonnes each year), the Pearl's estuarine flanks are, or were, bordered everywhere by mangroves - these here close to the northern limits of the species' ranges and representing the most populous and diverse community within China. These tall plants, in stabilising the river's banks, accumulate up to 5 cm of silt annually, protecting shorelines from typhoons but also facilitating natural coastal reclamation. Only two areas of such mangroves are protected in the Pearl's estuary: Mai Po in Hong Kong and opposite it, at Shenzhen, in China.

The eastern, Mirs Bay, waters of Hong Kong, away from the Pearl, however, support a second mangrove community of conspecific plant species but of 'bonsai' proportions. The associated species complex is different from that of the Pearl and Mai Po mangroves. Mountain streams draining into the bay are part of Hong Kong's East and West Sai Kung Country Parks and home to two marine parks at Li Chi Wo and Hoi Ha. Hitherto protected by sparse, village-based, communities, these eastern mangroves are now too under development threats.

## **What to Eat and Where to Go: Individual-based Studies of Foraging Behaviour and their Role in Conservation**

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Autecological approaches to conservation have received criticism in some circles (and with good reason). However individual based studies are key to identifying where/how population regulation may be occurring and understanding why/how individual animals make decisions about where to forage (both pre-requisite to any attempts at conservation). Here I will discuss data from two individual based study systems: the Northern gannet *Morus bassanus* (a marine piscivore) and the light bellied Brent goose *Branta bernicla hrota* (a marine herbivore) to highlight the value gained from such approaches. The gannet system has generated a much better understanding of how the seascape is being used during long-distance foraging flights, what factors might underpin habitat selection and the scale at which marine fisheries exert an influence on such behaviour. The goose system has allowed us to look across the entire annual cycle and to show that carry-over effects of winter habitat selection are a key determinant of productivity. Both sets of findings would profoundly influence the manner in which any conservation efforts would be directed.

## Retinoic Acids Produced by Marine Algae and Cyanobacteria can Trigger Change of Sex of the Marine Gastropod *Reishia clavigera*

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Since the 1980s, development of superimposition of male sexual characteristics on females (imposex) in marine gastropods such as *Nucella lapillus* and *Reishia clavigera* has been assumed to be caused by exposure to anthropogenic, organotin compounds, such as tributyltin (TBT) and triphenyltin (TPT) in the marine environment. Organotin compounds can directly bind to retinoid X receptor (RXR), which triggers formation of male-type genitalia in female *N. lapillus* and *R. clavigera*. However, a growing number of studies have suggested that retinoic acids (RAs) can also cause growth of male sexual organs in female gastropods. For example, a previous study demonstrated that size of pseudo-penis and vas deferens sequence index of female *R. clavigera* increased significantly after exposure to 9-*cis*-RA. A recent study showed that freshwater cyanobacteria can produce such teratogenic RAs in Lake Tai (Chinese: *Taihu*). This study tested three novel hypotheses: (1) marine microalgae and cyanobacteria can produce RAs; (2) such algal RAs can trigger imposex in *R. clavigera* and (3) toxicity of mixtures of RAs and TPT is synergistic. Concentrations of intra- and extra-cellular RAs were measured in 37 species of marine algae and cyanobacteria. Most of these species can synthesize RAs in unialgal or axenic cultures under laboratory conditions and RAs, in particular all-*trans*-RA, were detected in samples of epiphytic algae and phytoplankton collected from 24 locations along the coastal waters of Hong Kong. The gastropods, *R. clavigera* were exposed separately to TPT, all-*trans*-RA, a mixture of TPT and all-*trans*-RA, and two cyanobacteria cultures for 60 days under controlled laboratory conditions. Treatment with all-*trans*-RA exacerbated imposex in female gastropods while both all-*trans*-RA and cyanobacteria cultures caused up-regulation of various imposex-related and stress-related genes, such as RAR, CYP and HSP genes in gonad and digestive gland. Exposure to the mixture of TPT and all-*trans*-RA resulted in greater severity of imposex in female gastropods, and up-regulation of all studied genes. Mortality caused by TPT and all-*trans*-RA was greater than additive. This study, for the first time, demonstrates that algal RAs are abundant in coastal environments, they can cause abnormal development in marine gastropods, and their toxic effects can be augmented by TPT. The current results have profound implications on revising thinking about causes and magnitudes of imposex and regulation of synthetic chemicals that can cause it.

## Comparative Phylogeography and Cryptic Diversity of Intertidal Barnacles in the NW Pacific

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The NW Pacific is a global marine hotspot, yet patterns of species diversity are still poorly documented. To address this knowledge gap, four intertidal barnacle species (*Chthamalus malayensis*, *C. moro*, *Capitulum mitella* and *Tetraclita*) were used as models to address firstly whether cryptic species are prevalent in the NW Pacific and how did they originate; and secondly whether the phylogeographic histories and gene flow patterns are similar among co-distributed species. Molecular analysis showed that all four barnacle species contain several cryptic species or distinct genetic lineages/clades in the NW Pacific. *Chthamalus malayensis* contains three distinct clades, with the Taiwan clade endemic in Taiwan, the South China clade abundant in southern China and the Indo-Malay clade distributed in Indo-Malaysian waters. There are three COI lineages in the insular species, *Chthamalus moro*, including the Ogasawara lineage dominant in the Ogasawara Island, the Ryukyus lineage mainly found in Okinawa and a southern lineage present in Taiwan and Borneo waters. The stalked barnacle *Capitulum mitella* comprises three distinct lineages which occur in Okinawa, Taiwan and South China respectively. *Tetraclita squamosa* is distributed along the South China coast, and is now joined by the recently described *T. kuroshioensis* which is common in Japan, Taiwan and the Philippines. There are also several undescribed insular *Tetraclita* species present in the Philippines and surrounding waters. The distribution patterns of cryptic lineages of these barnacles show that diversification was a result of allopatric isolation associated with changes in sea level during the Pleistocene, however, there is no common or general phylogeographic pattern among the four species complexes. The observed phylogeographic patterns are, therefore, attributed to interactions between species biology, demographic history and the complex hydrology in the NW Pacific waters which interact to drive the observed patterns of species distribution of these intertidal barnacles.

## **The Korean Tidal Flat of the Yellow Sea: A Review on Coastal Ecosystem, Biodiversity, and Management**

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The present article provides a regional overview of the Korean tidal flat extensively developed along the West Sea of Korea, encompassing oceanographic features, geology, and biology. In particular, the Korean tidal flat was fully described in the aspects of spatial scale (viz. size), geographical distribution, biodiversity, and local culture. A particular emphasis was given to explain the framework of the coastal management in Korea, in terms of a legal aspect, by highlighting reclamation versus protection issues. First, we described the Yellow Sea by sketching the boundary, ocean and tidal currents, discharges from the major rivers, sedimentology, and the cooperative surveys between Korea and China. Next, the West Sea of Korea, where the offshore boundary often neighbored rather close to coastal zone because of the associating traditional livelihoods, was described to point out certain characteristics of hydrography, coastal landscape, tidal channels, tide, and sedimentary process. Then the Korean tidal flat which is the main topic of this article was introduced by highlighting the geographical distribution, biodiversity of benthic diatoms and macrozoobenthos, artisanal fisheries, and local culture in aspect of ecosystem services in tidal flats. Meantime, the issue of reclamation was mini-reviewed by tracking the chronicle development, aerial coverage, and deteriorated environmental impacts on the coastal ecosystem. Herein, the untiring efforts towards protection of the Korean tidal flat are also included in viewpoints of legal framework and the designation of protected areas.

## **Marine Biodiversity in the Western Pacific Region: Present Status, Threats, Conservation, and Restoration**

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The Western Pacific region is one of the world's centers of biological diversity, and has the highest marine biodiversity in the world. In recent years, it has become clear that there are several, both small and large scale changes occurring in marine biodiversity. Some of the most striking changes are due to anthropogenic activities, natural phenomena, and poor land management practices. Examples of anthropogenic activities and natural phenomena include pollution release, overfishing, destructive fishing practice, coastal development, introduction of non-indigenous species, unsustainable tourism, climate change, ocean acidification, and tsunami. Coral bleaching is also rapidly becoming a regional concern. Increasingly, international and national programs have been initiated to protect and conserve marine biodiversity. The need for a strategic approach to restoration to maximize the effectiveness of conservation efforts has also become urgent. This talk will give an overview and insight of the present status, threats, conservation, and restoration of marine biodiversity in the Western Pacific region. How multi-disciplinary approaches and identification of scientific gaps can be applied to the success of conservation plan and management strategies for marine biodiversity in the region will also be discussed.

## **Contrasting Responses in Biodiversity, Food-chain Length and Fish Production to Disturbances in Boreal Lakes**

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Species biodiversity and food-web stability are important for ecosystem functioning. Yet, they may respond to disturbances differently, leading to challenges in holistic ecological conservation of disturbed ecosystems. By analyzing long-term monitoring data and stable isotopes of organisms from multi-trophic communities, we show contrasting responses in biodiversity, food-chain length (FCL) and fish production of small boreal lakes to anthropogenic acidification, lime application and algal invasion of *Gonyostomum semen*. *Gonyostomum* contributed 77–98% phytoplankton biovolume in acidic lakes, <1–79% in limed lakes, and 0–30% circumneutral (reference) lakes. Diversity and evenness of phytoplankton, macroinvertebrates and fish decreased with increasing *Gonyostomum* biovolume, i.e. biodiversity was higher in circumneutral and limed lakes than in acidic lakes. Yet, isotopic data revealed that FCL was shorter in limed lakes ( $4.02 \pm 0.44$ ) than in circumneutral ( $4.57 \pm 0.20$ ) and acidic lakes ( $4.47 \pm 0.33$ ). Limed lakes also had the lowest fish production. Among all lakes, fish trophic position (TP) and FCL increased with TP of littoral macroinvertebrate predators, reflecting the importance of littoral pathways and trophic linkages at lower consumer levels on whole-lake functioning. Overall, our findings indicate that (1) disturbance can be the determinant of FCL variation among similar-sized ecosystems and (2) trophic structure and/or complexity underlie biodiversity effects of multi-trophic communities on ecosystem functioning, and they should be integrated in environmental assessments and conservation managements.

## **Identification and Expression of Defensomes in Oxidative Stress-induced Damage in Aquatic Organisms (Rotifer, Copepods, Fish) and Evolutionary Consideration on Defense Mechanisms**

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To compare defense mechanism of aquatic organisms in response to environmental stressors, we firstly identified entire set of cytochrome P450 (CYP) genes and G-protein coupled receptors (GPCRs) from RNA-seq and whole genomic DNA databases of the rotifer *Brachionus koreanus*, the copepods *Tigriopus japonicus* and *Paracyclopsina nana*, and the marine medaka *Oryzias melastigma*. Also we compared the sensitivities of these aquatic organisms on oxidative stress damage-induced toxicity by heavy metals, heavy oil spillage, endocrine disrupting chemicals, nanoparticles, and UV-B and gamma radiation. To address the defense mechanism of these oxidative stress-induced DNA and cellular damages, we examined p38, ERK, JNK signaling pathways in response to exposure of these environmental stressors in these aquatic organisms. In the view of evolution, the machinery of defense mechanism in rotifer shows the primitive type of components compared to copepods and fish. In this presentation, I will discuss about comparison of these aquatic organisms in response to oxidative stress-induced DNA and cellular damages over evolution.

## **Zooplankton Distribution in Ocean Currents**

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Plankton are organisms that passively drift in water currents. However, each plankton species has its own biogeographic distribution. How do different populations and species of plankton achieve their biogeographic distributions within the open ocean, where water currents disperse and mix different populations and species? To answer this question, we are currently performing meta-transcriptomic analysis of zooplankton community samples. Using this method, we can determine nucleotide sequences of high-resolution (population level) marker regions without amplification bias from zooplankton community samples. In the face of global warming, it is also important that we are able to assess the spatial distribution of zooplankton species and populations in a limited time and with limited resources. We have collected zooplankton samples from several locations in the tropical to subtropical North Pacific. PolyA<sup>+</sup> RNA was purified from total RNA, and cDNA libraries were constructed from the purified products. Illumina sequencing libraries were further constructed from the cDNA. Those libraries were sequenced by MiSeq (Illumina) at the Sequencing Core Facility of the Biodiversity Research Centre, Academia Sinica. We are currently processing these sequences with several informatics pipelines. Output data will be presented at the meeting.

## **Coral Restoration in Singapore's Sediment-challenged Sea**

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Singapore's coral reefs have been exposed to five decades of increased sedimentation that reduced underwater visibility from over 10m in the early 1960s to under 2m today. The lower depth limit of scleractinian coral growth moved up from 10m to 6m, while live coral cover decline is less apparent now than in the early decades of augmented sediment loading. Coral community structure has changed with dominance shifting to more low-light tolerant species such as *Pectinia* and *Echinopora*. Reef restoration to increase coral cover of degraded reefs and initiate colonization of non-reef areas is considered to be viable following observations of predictable mass spawning events, recruitment and vigorous growth, but the techniques employed need to account for the high sediment conditions and destabilized reef substrate. The deployment of fibreglass artificial reef units increased opportunities for coral establishment, and supported at least 106 reef taxa, including 29 scleractinian genera after 10 years. *In situ* coral nurseries comprising mesh-net platforms raised above the reef floor prevented sediment accumulation and smothering, and enabled the rearing of coral fragments and juveniles with reduced mortality. This included the nurturing of 'corals of opportunity' (naturally fragmented pieces of live coral lying on the reef bed as well as recruits settled on loose rubble), which would otherwise be killed by sedimentation. Transplants of massive or encrusting species displayed higher survival over branching ones. The overall outcomes indicated that transplant sites, methodology and species were key to influencing the success of transplantation efforts. Restoration strategies need to be adapted to changed environmental conditions caused by anthropogenic disturbances.

## **Human Activities on Biogeography of Rocky Intertidal Species along China Coast**

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Intertidal rocky shore is one of the most vulnerable ecosystems in the scenario of global change. Based on long-term environmental monitoring and modelling predication, most coastal areas in China have had and will suffer from global warming, ocean acidification and extreme climate events. Furthermore, with the development of coastal economy, more and more artificial structures, including harbors, dams and bridges, are constructed along the China coast. These artificial structures, especially seawalls on the muddy shores, will provide suitable substrate for rocky shore species, and potentially play crucial roles as stepping-stones for species distribution shifts. There are clear biogeographic barriers for some rocky shore species along China coast. Phylogeographic studies of some widely distributed intertidal limpets and snails showed the populations can be divided into southern and northern groups with Yangtze River estuary as a barrier. The formation of the barrier is due to multiple factors, including historical events, ocean current, freshwater discharge and substrate. One of the most important factors for formation of the barrier is the unsuitable substrate in the Yangtze River Delta. From Lianyungang, Jiangsu Province to Qidong Jiangsu, there are extensive muddy shores, which can affect the distribution of rocky shore species. The construction of artificial structure on the muddy shore can provide suitable habitats for rocky shore species. So it is important to know the roles of these artificial structures on the biogeography of rocky intertidal species along China coast.

## **From a Museum in Marine Biology to an Educational Park in Marine Science**

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National Museum of Marine Biology and Aquarium (refer as NMMBA) is a social education organization to carry out the mission in educating the public in marine biology especially in the context of marine biodiversity. In 2012, NMMBA has established an education center to enhance the public awareness on marine ecology in respond to the implementation of Act of Environmental Education in Taiwan. To meet such goal, we have integrated three pavilions (e.g. Coral Kingdom pavilion) and the 'backyard' of museum, such as husbandry center, to establish an educational park for the public. In this park, the public is allowed to visit the different facilities and the outdoor spaces that were not, at least not often, open to the public ever before. In such a way, we have successfully expanded NMMBA as a museum in marine biology to become an educational park in the context of marine science by leading the public to explore the different types of marine environments and experience beauties and mysteries of ocean. Our mission is not only to prompt the marine environmental education but also to enhance the eco-tour industry in Hengchun Peninsula. In this article, we would like to share the experience in marketing the concepts in public education, strategies to carry out programs in environmental education and the status of this educational park as the reference for those people or organizations that are interested in carrying out similar mission in marine environmental education.

## **Building Teams to Better Understand the World's Harbours: Introducing the Sydney Harbour Research Program and the World Harbour Project (WHP)**

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The distribution of the global population is increasingly skewed towards coasts – 44% live within 150 km of the coast. As a result coastal urbanization is rapidly expanding with the development of 'mega-cities' (>10,000,000 people) and 'mega-harbours' that are hubs of global trade, such as Hong Kong, Shanghai, Singapore and New York. Harbours and ports are important socio-economic complexes that often also support high ecosystem values.

Worldwide many harbours and ports have been exposed to intense and sustained anthropogenic pressure and the environmental legacy of shipping and industry, traditionally associated with harbours and ports, is merging with more general coastal pressures such as residential development, fishing, boating and other recreational uses. In this presentation we will introduce Sydney Harbour and the World Harbour Project. We first introduce two efforts to build research and outreach teams to better understand the world's harbours. The Sydney Harbour Research Program – established by the Sydney Institute of Marine Science in 2012 – is a multidisciplinary program to understand the ecosystems of Sydney Harbour and how they respond to human activities so that governments, businesses and communities can preserve the natural, economic and social values of the Harbour. We will present our review of the diversity, structure and stressors facing this iconic harbour and how we are addressing major knowledge gaps. Following this we will introduce the World Harbour Project (WHP). Established in 2014, the WHP aims to support the development of resilient urban ports and harbours through a global network of collaborating scientists.

Investigations of the socio-economic aspects of harbour development, environmental degradation and ecosystem restoration will form an important component of the WHP, as will educational outreach and dialogue and collaboration with managers, industry and governments. We will provide brief case studies from 6 of the current 20 partner cities - Chesapeake Bay, Hong Kong, Rio de Janeiro, Shanghai, Singapore, and Vigo and introduce each of our four WHP working groups: WG1 – Water and Sediment Quality, WG2 – Green Engineering, WG3 – Multiple Uses and Users, and WG4 – Education including initial results from the work currently underway, from the production of review papers to the design of global sampling protocols and the recruitment of postgraduate and postdoctoral positions.

# Abstracts of Oral Presentations

*Biodiversity Patterns***Diversity of Order Zoantharia (Cnidaria: Anthozoa) in Brazil**

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Zoantharians are an order of benthic cnidarians that have a cosmopolitan distribution and play an important ecological role in many marine ecosystems. Although widespread in the southwestern Atlantic, research on Brazilian zoantharian species richness and distribution patterns are lacking. In order to address this gap, in this study we conducted shallow-water coastal and oceanic island samplings in parallel to an extensive literature review in order to produce baseline knowledge of the order Zoantharia from Brazil. In addition, mitochondrial 16S ribosomal DNA and cytochrome oxidase subunit 1 (CO1) sequences from sampled specimens were determined in order to clarify and compare their identity to reports/specimens from other regions. Our results confirm the presence of at least 15 species of Zoantharia in Brazil, including the first occurrence records of *Palythoa* aff. *clavata* and *Zoanthus* aff. *pulchellus*. Moreover, range extensions were confirmed for *Palythoa caribaeorum*, *P. grandiflora*, *P. variabilis*, *Zoanthus pulchellus* and *Parazoanthus swiftii*. Species distributions are at least partly due to their physiological and/or ecological traits, and environmental factors may be the causes for the southern limits of *Zoanthus* and *Palythoa* spp. in Atlantic. All genera recorded in Brazil have previously been reported from the Caribbean of which has also higher zoantharian diversity than Brazil. Furthermore, in contrast to other hexacorallian orders, up to now there are no reports of Brazilian endemic zoantharian species. However, zoantharians have not yet been exhaustively studied in Brazil, and more information is needed to make final conclusions on this observation. The present study forms a much needed baseline for further surveys in the Southwestern Atlantic, where it is very likely that Zoantharia species richness is still underestimated.

*Biodiversity Patterns***Quantitative Distribution of Intertidal Macrofaunal Assemblages in Fildes Peninsula, King George Island, South Shetland Islands, Southern Ocean**

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The intertidal macrofaunal assemblages of Antarctic coastal areas have long been thought to be scarce and are not studied enough. To evaluate the quantitative distribution of intertidal macrofaunal assemblages, spatial distribution pattern of macrofauna was investigated in January to February, 2013 in the intertidal zone of Fildes Peninsula, King George Island, South Shetland Islands, Southern Ocean. At the 20 sampling sites, a total of 34 species of macrofauna were identified, including 9 species of Mollusca, 9 species of Annelida, 9 species of Arthropoda, 3 species of Platyhelminthes, 1 species of Nemertinea), 1 species of Sipuncula, 1 species of Cnidaria and 1 species of Echinodermata. The average density, biomass, Shannon-Wiener diversity index ( $H'$ ) were 2112 ind./m<sup>2</sup>, 26.95 g wwt./m<sup>2</sup>, and 0.81, respectively. Two macrofaunal assemblage groups were divided. One was dominated by Annelida, *Lumbricillus* sp. and the other was dominated by Mollusca, *Nacella concinna*, *Margarilla antarctica* and *Laevilacunaria antarctica*, Annelida, *Lumbricillus* sp., Arthropoda, *Melita* sp., Platyhelminthes, *Plagiostomum* sp.. A total of 14 dominant species were recognized, which belonged to 4 functional groups by their feeding resources, namely herbivorous grazers, omnivorous grazers type 1 (saprophagous and herbivorous grazers), omnivorous grazers type 2 (herbivorous and sarcophagous grazers) and sarcophagous grazers. Results of correlation analysis between dominant species abundance and biomass, functional groups and environmental variables showed that abundance had significant positive correlations with water temperature, sediment phaeophorbide and organic matter contents while the biomass and functional groups had significant positive correlations with water temperature and sediment organic matter content.

*Biodiversity Patterns*

**A Review of Singapore's Marine Soft Bottom Macrobenthic Biodiversity**

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Macrobenthos in marine sediments contribute important roles to ecosystem processes. However, the marine soft-bottom habitat remains one of the least understood in Singapore. The island nation supports one of the busiest ports in the world within its limited marine territory. Extensive coastal development such as land reclamation has obliterated many nearshore benthic habitats and exposed the offshore benthic systems to increased sedimentation. The vast majority of soft-bottom macrobenthos research literature was generated from a systematic, long-term monitoring programme from 1985 to 1996, which revealed a total of 298 faunal families from near and offshore sites associated with coral reef, mangrove and estuarine habitats. Studies in the subsequent two decades remained limited and confined to the period between 1998 and 2002. Some of these examined the impact of coastal reclamation, sedimentation and petroleum hydrocarbons on macrobenthic communities, while a biodiversity survey in a marina recorded 24 macrobenthic faunal families. An update of the state of soft-bottom habitats by comparing with previous studies is needed to determine community structure change in response to the various coastal development in the past decades. Understanding the responses is necessary for managing the still apparently rich biodiversity of Singapore's marine soft bottom communities.

*Biodiversity Patterns*

**Species Diversity of Benthic Macrofauna in Shenzhen Bay**

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Shenzhen Bay is located at 113°53'-114°05'E and 22°30'-22°39'N with an area of 75 km<sup>2</sup>. There are two nature reserves in Shenzhen Bay. They are Guangdong Neiningding Futian Mangrove Nature Reserve and Mai Po Nature Reserve. According to the history references and the monitoring data of benthic macrofauna from 1994 to 2014, a total of 342 species of benthic macrofauna (not including insect) were recorded, including 1 Porifera, 4 Cnidaria, 3 Platyhelminthes, 3 Nemertea, 67 Polychaeta, 18 Oligochaeta, 2 Sipuncula, 72 Gastropoda, 55 Bivalvia, 97 Crustacea, 1 Bryozoa, 1 Ascidiacea and 18 Actinopterygii. The benthic macrofauna in Shenzhen Bay consist of both marine and fresh species, and most of them are the euryhaline animals. Different groups of the benthic macrofauna can be found in different habitats within Shenzhen Bay. In mangrove habitat, some of them are epifauna and infauna, and some of them are arboreal fauna. Most of the benthic macrofauna that had been recorded before 1995 were Mollusca and Crustacea. But most of the benthic macrofauna that had been recorded after 1995 were Polychaeta. The species composition of benthic macrofaunal community has been changed due to the influence of economic development and urbanization processes. For example, there were significant changes in sediment deposition, disappearance of oyster cultivation and water and sediment pollution in the bay. Such urbanization processes are jointly leading to ecosystem degradation, reduction of mangrove coverage, diminishment of tidal mud flats, and hence losing its normal ecosystem functions in this important wetland area.

*Biodiversity Patterns*

## **Biodiversity Inventory of Decapod Crustaceans in Hong Kong: A Preliminary Review**

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As an early frontier of biodiversity research along coasts of China, investigations on decapods crustaceans initiated early in the 1850s, largely as a result of the United States *North Pacific Exploring Expedition* (1853-1856), second in the East Asian region after Japan merely three decades ago in the 1820s. Preliminary survey of records among literature reviews 501 species, including Dendrobrachiata (33), Stenopodidea (2), Caridea (106), Axiidea (3), Gebiidea (4), Achelata (7), Anomura (47) and Brachyura (299), of intertidal, estuarine and shallow shelf species, to depths of less than 50 metres within the boundaries of Hong Kong waters. For the period of over 150 years, knowledge increased as step-like accumulations, derived from results of substantial pieces or series of work, emergences of which often intimately related to prevailing political and economical conditions of Hong Kong and Mainland China.

*Fisheries & Marine Resources Management*

## **40 Years of Artificial Reefs What Does the Science Tell Us About Their Application in Fisheries Management?**

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After 40 years the use of artificial reefs (ARs) as a fishery management tool, globally, to enhance or recover fishery resources through the provision of additional food and shelter, though popular and appealing, remains controversial. This controversy, running since the mid-1980s, hinges on the question of whether ARs actually enhance fishery production, or simply attract and concentrate fishes that are passing or that come from nearby natural reefs, making them easier to catch (when ARs are not fully protected from fishing) and thereby exacerbating fishing pressure. The distinction between attractions and enhancement is obviously important in a heavily exploited and otherwise little managed fisheries, including the situation in Hong Kong, especially given the high costs of some AR deployment programmes.

It is highly relevant to review what is known of the outcomes of AR deployment where fishery management is the objective. By fishery management we apply Bortone's definition for the case of ARs that "...to be of use to fishery managers, artificial reefs should be designed, regulated, and prescribed in a way that allows an assessment of their effectiveness as a management option for altering some aspect of the fishery". This aspect should include improvement or recovery of fishery resources and, to be meaningful, be assessed scientifically."

Scientific evidence from 40 years shows that although AR deployment can result in increased biodiversity and abundance on ARs there is little evidence for fishery improvement. However, for several species, including several lobsters, specially designed and carefully deployed ARs appear to reduce mortality and show promise for fishery management.

*Fisheries & Marine Resources Management*

**Demographic Attributes of the Orange-spotted Grouper *Epinephelus coioides*, an Ontogenetically Moving Fish Species from Mangroves to Coral Reefs in the Philippines**

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Demographic attributes of *Epinephelus coioides* were examined in two bays in the Philippines to examine the processes that are associated with the geomorphology of their habitats, exposure to monsoonal winds, water circulation pattern, other environmental factors (temperature and tides) as well as fishing intensity. Experimental fishing of *E. coioides* fry showed recruitment was mainly noted at mangroves near creeks and was five times higher in the highly embayed Calauag Bay compared to the more open Tayabas Bay. Recruitment pattern coincided with the monsoons in both bays but bi-modal in Calauag compared to a single peak in Tayabas. Temperature negatively correlated with recruitment whereas tides showed positive correlation. Ontogenetic habitat shift was demonstrated empirically in *E. coioides* through the progression of ages and sizes from mangroves at creeks (until 3 yrs. old attaining maximum mean size of 19 cm TL) to reefs (older than 3 yrs. old and larger than 19 cm TL) in both bays. There were larger sizes at age and older fish in Calauag than in Tayabas. Variations in recruitment, juvenile and sub-adult abundances were also likely influenced by fishing intensity since sites in Tayabas were subjected to higher fishing pressure. Ontogenetic movement of *E. coioides* from mangroves at creeks (i.e., recruitment) to reefs (i.e., adult home range) helped in understanding the need for maintaining the interconnectedness and health of their associated habitats. Variations in their population dynamics and related physico-chemical processes i.e., tidal cycle, salinity and habitat condition, have implications on their recruitment and ontogenetic development. Maintaining the connectedness, health, and integrity of the mangrove, seagrass and coral reefs e.g., marine protected area (MPA) that include these habitat continuum, would be crucial to the sustainable grouper fisheries in each bay.

*Fisheries & Marine Resources Management*

**Artificial Holdfast Units: Accessing Their Usefulness for the Recovery and Conservation of Seahorse Populations in the Ria Formosa lagoon, South Portugal**

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A significant decline in the seahorse populations in the Ria Formosa (south Portugal) was recently reported and holdfast availability suggested as a particularly important variable that influences the abundance of the long-snouted seahorse *Hippocampus guttulatus* and the short-snouted seahorse *H. hippocampus*. In order to test the usefulness of artificial holdfast units (AHU) for the recovery of seahorse habitats, four different artificial holdfasts (S1-S4) were initially tested in laboratory for seahorse preference under different conditions and different holdfast densities. Seahorses, both juveniles and adults, preferred the holdfast S4, consisting of a "Codium-like" polyethylene nautical rope, even when submitted to different water flows. Preferred holdfast density was 156 holdfast.m<sup>-2</sup>, and most of seahorses were observed grasping at the base of these structures (0-10cm in height). Later on, based on the information collected in the first experiment, several of these structures were built and deployed in the lagoon at four locations with distinct environmental characteristics and surveyed for seahorse abundance during a 6 months period. All AHUs were colonized by seahorses within a month after deployment, reaching a maximum density of 13.1 seahorse m<sup>-2</sup> at one of the sites. Results suggest that these AHUs have the potential to aggregate seahorses in damaged habitats and promote their recovery, improving local habitats and overall biodiversity. The results also provide useful guidance for the use of artificial structures to improve degraded seahorse habitats in other similar situations, as part of management plans (including the creation of marine protected areas (MPAs)) for seahorse population recovery and conservation.

*Fisheries & Marine Resources Management*

## **Marine Spatial Planning - a Planning Tool for Sustainable Use of Marine Resources in Hong Kong**

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In Hong Kong, only less than 2% of marine water is designated as protected areas, with the rest of waters receive little or no protection. Many ecologically sensitive areas suffer from a lack of adequate policy legislation and management, while coastal development, habitat destruction and degradation are continuous threats. These threats have had a major and cumulative impact on the various marine species populations and habitats for years.

In order to better conserve our valuable marine and seabed area and at the same time cater for the growing human usage, the government should start considering the development of coastal and marine spatial planning exercise for striking a balance of seabed use between human development and conservation of the sea in Hong Kong waters.

Marine Spatial Planning (MSP) is a proactive, operational process to manage human activities on the ocean. It can also help to introduce an ecosystem-based management approach to the planning and management of marine areas. MSP analyzes and allocates space and resources in the most appropriate way to minimize conflicts and find synergies among sectors. While identifying the most efficient, effective, and equitable way to plan and manage the use of our sea and coasts in a clear fashion, MSP has an important function to support environmental protection and the sustainable provision of important ecosystem goods and services. MSP shares information and maps conflicts and compatibilities so that all sectors and stakeholders benefit by reducing conflict and identifying complimentary uses.

Instead of using a fragmented and reactive approach to solve the problems, it is time to end the unplanned use of our sea resources, and to implement the MSP, in which a public process of analyzing and allocating the spatial and temporal distribution of human activities in marine areas, and to achieve ecological, economic, and social objectives.

## **The Use of Fisheries Baseline Survey Findings for the Information of Fisheries Resources Conservation Management in Hong Kong**

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The western marine waters of Hong Kong are influenced by the Pearl River Estuary, where the waters are less saline but with high turbidity especially during wet season. The fisheries resources are dominated by croakers and mantis shrimps. The eastern marine waters are comparatively more saline, and support higher abundance of anchovy, rabbitfish and seabream. The HK SAR Government has implemented territory-wide trawl ban (including pair, stern, shrimp and hang trawling) since 31 December 2012, with the aim to protect marine resources and ecosystem and facilitate their rehabilitation. In addition, the government has also committed to establish marine parks, designate marine fish culture zones and implement a suite of fisheries enhancement measures to promote sustainable fisheries and facilitating the recovery of the marine habitats for the recolonization of marine resources. Baseline fisheries information is essential in assessing the effectiveness of these measures. However, there are limited fisheries resources baseline studies in Hong Kong in the last decade which can provide a clear and updated picture of the fisheries species distribution and trends, as well as areas of known important spawning and nursery grounds for commercial fisheries.

As such, comprehensive fisheries surveys including fish trawl, purse seine, hand line, gill net, ichthyoplankton and post-larvae, fishermen interview and artificial reef dive surveys have been conducted between November 2012 and November 2013 in the western waters of Hong Kong for verifying the findings from previous studies and for ground truthing the information collected based on interview with the fishermen. The top ten fisheries species in the study area were identified and the commercial values of the catches were evaluated. The distribution of prey species for Chinese White Dolphin was also investigated. These survey results provided valuable information for conservation management plan during the early planning and investigation stage of studies.

## **Effects of the Trawling Ban on Demersal Fish Communities in the Marine Environment of Hong Kong, South China**

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Fishery resources in Hong Kong have been over-exploited since the 1970s. In 2010, there were still around 400 trawlers operating in local waters. These trawlers non-selectively catch marine organisms of all sizes, while exerting severe physical damage to the benthic ecosystem. To mitigate the associated impacts of overfishing and trawling, the Government of the Hong Kong Special Administrative Region has imposed a territory-wide trawling ban across local marine waters since 31 December 2012. This study aims to investigate if the trawl-ban policy is effective to facilitate recovery of demersal fish resources, in terms of species diversity, abundance and biomass, in Hong Kong. Under an approved scientific permit, trawl surveys were conducted using a commercial shrimp trawler in eastern (EW), western (WW) and southern waters (SW) of Hong Kong from July 2012 to November 2014. A total of 244 fish species from 75 families were encountered. The fish communities in July-September (wet season) and October-November (dry season) between 2012 (pre trawl-ban), 2013 and 2014 (post trawl-ban) were compared. The results showed that there were significant differences in community structure of the demersal fishes among the three years and the three zones. In both wet and dry seasons, there was significantly higher Shannon's diversity index ( $H'$ ) in 2012 and 2013 than in 2014. Significantly higher biomass and species richness of the fishes were also recorded in the dry season of 2013 when compared to 2012 and 2014. Spatially, the abundance, biomass and level of disturbance in EW were significantly higher than those of WW and SW, but the species richness,  $H'$  and evenness index ( $J'$ ) of EW were the lowest among the three zones. The current trawl surveys will be continued until May 2016. Trophic levels and population dynamics of selected fish species will also be studied to verify if there is ecosystem recovery brought by the trawl-ban.

## **Effects of Trawling Ban on the Diversity of Demersal Crustaceans (Orders: Decapoda and Stomatopoda) in the Marine Environment of Hong Kong**

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Bottom trawling has been demonstrated to be one of the most destructive fishing methods to marine benthic communities. Since the 1970s, marine fishery resources in Hong Kong, especially large predatory species, have been overexploited by non-selective fishing gears including bottom and pelagic trawlers. This fishing down the trophic level has resulted in a benthic ecosystem primarily dominated by small herbivorous and omnivorous fishes and crustaceans. To mitigate such impacts, the Government of the Hong Kong Special Administrative Region has implemented a territory-wide trawling ban in local waters since 31 December 2012. This study aims to investigate whether crustacean resources, in particular of the orders Decapoda and Stomatopoda, could recover after the implementation of the trawling ban in Hong Kong waters. During July to November 2012 (before trawl ban) and June 2013 to November 2014 (after trawl ban), 60 surveys were conducted at eastern, western and southern coastal water zones of Hong Kong using a commercial shrimp trawler (with scientific research permit). A total of 210 crustacean species from 36 families were recorded. Community structures of crustaceans significantly differed among the three zones with a salinity gradient being low at the western waters and high at eastern water. Species richness, evenness index and Shannon's diversity index were the lowest during both wet (July to September) and dry (October to November) seasons in the eastern zone, and a lower biomass was recorded in the eastern zone during the wet season. Differences of community structure were identified among years 2012 (before trawl-ban), 2013 and 2014 (after trawl-ban) based on the results of multivariate statistical analysis. During the wet season, overall abundance of crustaceans from all three zones in 2014 was higher than that in 2012, while biomass, species richness, species diversity and evenness indices, and Warwick statistic remained unchanged. The current study will be continued until May 2016. Trophic levels and population dynamics of selected crustaceans will also be studied in order to evaluate the effectiveness of the trawl-ban policy in facilitating ecosystem recoveries.

*Fisheries & Marine Resources Management*

## **Reproductive Biology and Fisheries of Seabreams (Family: Sparidae) in Hong Kong and Adjacent Waters**

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Understanding the reproductive biology of fish species can provide important information to develop fishery management strategies and advance conservation. Seabreams (Family: Sparidae) have long been important food fishes in Hong Kong yet little is known of their fishery status and biology. Many seabreams have interesting and diverse sexual patterns including hermaphroditism (i.e. adult sex change). Sex change can make certain species particularly susceptible to unmanaged fishing and may require specific management action. A study on the reproductive biology of three seabream species (*Acanthopagrus schlegelii*, *Evyinnis cardinalis* and *Pagrus major*) that are important in the local capture fishery is being conducted. Fish samples were collected from wet markets and also from trawler surveys carried out by the Hong Kong government. The reproductive cycle, sexual maturity and sexual patterns were determined by both histology and gonadosomatic index. Part of the information on local fisheries status was collected by market surveys and on-going fishermen interviews. Results show that the three study species have similar spawning seasons, mainly during the winter-spring period from November to March. Protandrous hermaphroditism was found in *A. schlegelii* while *E. cardinalis* and *P. major* exhibit gonochorism. Market surveys revealed considerable numbers of juveniles on sale and fully-mature individuals of were particularly rare for large species such as *P. major*, suggesting growth and possible recruitment overfishing. Adults of *P. major* were mainly available in wet markets during the spawning seasons suggesting there may be spawning migration. Together with information from fishermen interviews, Hong Kong is very likely to be the important spawning and nursery grounds of the species. Management options are suggested.

*Biodiversity and Mammal Conservation*

## **Diatoms (Bacillariophyceae) of the Southern Gulf of Mexico: Data-Base (1979-2010)**

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This study is based on a relational data-base of 368 diatoms species with 14801 entries obtained during long-term oceanographic surveys in the Southern Gulf of Mexico. A checklist list of planktonic diatoms collected from 22 oceanographic cruises is recorded. Taxonomic notes are given for some species. Material for this study consists of selected water and net samples obtained at 647 sites from June 1979 to May 2010. Water samples were taken with a CTD rosette at different depths; quantitative analyses were obtained by the Utermöhl method. Net Samples were collected using a 20 and 35 µm meshsized plankton nets with vertical towing. *Chaetoceros* (40 spp), *Thalassiosira* (20 spp), *Nitzschia* (17 spp), *Amphora* (16 spp), *Coscinodiscus* (14 spp) and *Diploneis* (13 spp) were the most diverse genera in net samples. *Asterionellopsis glacialis*, *Bacteriastrum delicatulum*, *B. elongatum*, *B. hyalinum*, *Cerataulina pelagica*, *Chaetoceros didymus*, *C. lorenzianus*, *C. radicans*, *Coscinodiscus perforatus*, *C. radiatus*, *Delphyneis surirella*, *Hemiaulus hauckii*, *H. sinensis*, *Leptocylindrus danicus*, *Minidiscus trioculatus*, *Odontella aurita*, *O. mobiliensis*, *Paralia sulcata*, *Proboscia alata*, *Pseudo-nitzschia pseudodelicatissima*, *P. pungens*, *P. subfraudulenta*. *Thalassionema nitzschioides*, *Thalassiosira eccentrica*, *T. oceanica*, *T. partheneia* and *Thalassiothrix lomgissima* were the most frequent and abundant species in water samples. A species checklist and blooms for some species is given. Twelve species are new records for this region.

*Biodiversity and Mammal Conservation*

## **A Comprehensive Literature Review of Marine Biodiversity in Hong Kong**

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With the implementation of the Convention on Biodiversity (CBD), local and regional species inventories are becoming increasingly important for biodiversity assessments, marine resource monitoring and management, yet such inventories are often incomplete or compromised by not being updated by experts. The South China Sea, for example, is among the world's most species-rich marine areas but it is also one of the areas where species information is poorly categorized. Hong Kong's marine biota is relatively well explored and documented among the South China Sea region, and this study integrates most available species information to construct a species inventory. The coastline of Hong Kong is characterized by a range of diverse habitats such as wetlands, mudflats, mangroves, seagrass beds, rocky shores, boulder shores, sandy shores, rocky reefs and soft sub-tidal seabeds which support an enormous array of marine life. Despite having a small marine area (1,651 km<sup>2</sup>), a total of close to 6,000 marine species were recorded in Hong Kong waters. Most of these species were reported during the 1980s and 1990s, but new species continue to be discovered. Even though Hong Kong's marine area is only about 0.03% of that of China, the number of marine species recorded in Hong Kong already accounts for ~26% of the total recorded for China seas. In terms of number of species per unit marine area, Hong Kong shows a disproportionately high marine biodiversity (at least a few hundred times higher) when compared with many other regions. Presumably, Hong Kong also contributes to a considerable amount of the species recorded in the South China Sea, but such results are confounded by the lack of knowledge and inventories on marine biodiversity in the region. Our findings are concordant with those of the Census of Marine Life, reaffirming that Hong Kong lies within the world's marine biodiversity hotspot. Information from our study will make an important contribution to biodiversity conservation in Hong Kong, especially in light of the recent implementation of the HK SAR Government's Biodiversity Strategy and Action Plan (BSAP) under the CBD.

*Biodiversity and Mammal Conservation*

## **Humpback Dolphins in Hong Kong and Pearl River Delta: What to Do When Everything Goes Wrong...?**

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Indo-Pacific humpback dolphins *Sousa chinensis* inhabit shallow coastal waters of tropical and subtropical Indo-Pacific. The continuous survival of known remaining populations is a subject of conservation concern. In Hong Kong (HK) and Pearl River Delta (PRD), the dolphin population is thought to number over 2,500 individuals, which makes it the world's largest. One could assume that with this numbers, the PRD population might be strong enough to resist demographic stochasticity and environmental pressures. However, living on a doorstep of the world's busiest seaport/airport and several densely populated urban centres with major costal infrastructural developments, comes with challenges to the long-term survival of free-ranging dolphins. There are few other small cetacean populations that face the range and intensity of human-induced pressures which exist within the PRD. With the application of predictive demographic models, we estimate a continuous decline of the PRD dolphin population at -2.5% per annum, a rate at which 74% of the current population is likely be lost within the lifespan of three generations of these animals. Furthermore, our recent mark-recapture analyses indicate that population parameters and structure of the animals inhabiting HK waters have long been seriously misunderstood; while our spatiotemporal analyses show that only a minute proportion of the dolphin key habitats are given any form of protection. The only viable habitat refuge for the dolphins within HK waters has not been prioritised for any form of managed conservation. The local/regional status assessment classifies humpback dolphins as endangered under IUCN Red List criteria; however, the current rate of decline is likely to further accelerate in a near future. As it stands at present, the case of Indo-Pacific humpback dolphins in Hong Kong represents an explicit example of misguided management and failure of ineffective conservation strategy. A complete re-think of the fundamental conservation management approach is urgently needed.

*Biodiversity and Mammal Conservation*

## **Seasonal Changes in Habitat Use of Indo-Pacific Humpback Dolphins at an Estuary**

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River estuaries are ecotone environments where freshwater and seawater mix together. Seasonal rainfall is likely to influence the salinity, turbidity, and development of estuarine fronts, thus alter the distribution of aquatic animals at an estuary. Indo-Pacific humpback dolphin is a coastal species that use estuaries as their core habitat. According to previous studies, the distribution of humpback dolphins in their estuarine habitat moved seaward during wet seasons. In addition, circling movement associated with the hunt for epipelagic fish increased during flooding tides. However, it remains unclear how seasonal rainfall influences the estuarine habitat use of humpback dolphins. During July 2009 and October 2014, acoustic data loggers were deployed at the Xin Huwei River estuary, Taiwan to record ultrasonic pulsed sounds. Biosonar clicks of humpback dolphins were detected using an automatic detection algorithm. The temporal variations of humpback dolphin behavior were investigated in terms of detection rate, occurrence pattern within the tidal cycle, echolocation behavior. The behavior of humpback dolphins significantly varied among the four monitoring sections and two periods (wet and dry seasons). The tide related occurrence was evident at the entire monitoring area during wet seasons, however, the similar occurrence pattern was only observed at the inner and outer estuary during dry seasons. In addition, long distance biosonars were much frequently detected at the inshore and offshore sections. During drought periods, the inshore and offshore sections are less likely to be influenced by the mixtures between freshwater and seawater. Our results suggest the river runoff may play an important factor in shaping the estuarine habitat use of humpback dolphins. Therefore, it is necessary to consider the interception of river runoff in the conservation management of humpback dolphins in an estuarine habitat.

*Biodiversity and Mammal Conservation*

## **Implications of Long-term Loss of Coastal Habitats on Indo-Pacific Humpback Dolphins in Chinese Waters**

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In China, coastal habitats have substantially changed in recent decades due to rapid urbanization, industrialization, massive coastal developments and intense land utilization. For the Indo-Pacific humpback dolphin *Sousa chinensis*, a shallow-water coastal species, the destruction and fragmentation of inshore habitats may have long-term consequences affecting their distribution, habitat-use, and population viability. In this study we measure the extent of habitat loss due to land reclamation, coast modification, harbour construction, and marine-farming in Chinese waters in the past four decades; we focus on the west Taiwan coast (WTC), Xiamen Bay and adjacent waters (XB), Pearl-River-Estuary (PRE), and the northern Beibu Gulf (NBG); sites with known baseline data on humpback dolphin populations. Analyses of satellite imagery, from Landsat-1 in 1970s through Landsat-8 in 2013, indicate that in the four survey areas, a total 1279 km<sup>2</sup> of native coastal habitats were subjected to land reclamation, coastal developments and marine-farming, approximating 223 km<sup>2</sup> in WTC, 120 km<sup>2</sup> in XB, 792 km<sup>2</sup> in PRE, and 145 km<sup>2</sup> in NBG. In all four areas, coastal habitats have been either degraded, severely altered, fragmented, or completely destroyed. Consequently, the current distribution of humpback dolphins in these areas and their pattern of habitat utilisation are unlikely to represent their optimal strategy but are compromised by current environmental conditions. For a species completely reliant on limited key habitats within their restricted shallow-water inshore distribution, the long-term loss of critical habitats is likely to affect their population viability. As our analyses did not cover the entire range of humpback dolphins in Chinese waters due to limited data access, the true total area of habitat loss is likely greater than the estimate presented here. Long-term implications of habitat destruction on the persistence of humpback dolphins in Chinese waters should be a cause of major conservation concern.

## **Marine Mammal Habitat Assessments: Tackling Data Gaps, Data Deficiencies and Tight Timelines**

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Marine resource management requires a thorough understanding of species distribution and habitat use spatial patterns. As regional scales increase, spatial heterogeneity and data complexity can complicate or hinder assessments. For marine mammals, knowledge gaps can be significant. Data gaps can result from pelagic distributions, political boundaries and that scientific study of these taxa is relatively new. Dedicated field studies are usually desired, but are expensive and sometimes impractical due to remote locations or timelines. Recognizing these challenges, we undertook a large-scale study in the remote northern waters of British Columbia, Canada to identify spatial habitat patterns for humpback whales (*Megaptera novaeangliae*), fin whales (*Balaenoptera physalus*), blue whales (*Balaenoptera musculus*), sei whales (*Balaenoptera borealis*), grey whales (*Eschrichtius robustus*), harbour porpoise (*Phocoena phocoena*), Dall's porpoise (*Phocoenoides dalli*), Steller sea lions (*Eumatopias jubatus*), northern elephant seals (*Mirounga angustirostris*) and northern fur seals (*Callorhinus ursinus*). Our goal was to identify important habitats for either single species or multi-species assemblages. Results of a literature review were evaluated within a habitat criteria matrix that incorporated migration paths, feeding areas, reproductive habitats, and contemporary or historical areas of aggregation. There was significant variation in the amount of data available for each species, and we intentionally included data rich and data poor species. Important areas were identified for all species in spite of the data and knowledge gaps, with several locations identified as important for multiple taxa. This was the first undertaking of its kind in northern British Columbia. Our results provide new insight into the regional habitat use patterns for 10 marine mammal species with vastly different life histories and conservation statuses, providing a basis for addressing conservation, marine resource planning and management concerns. The approach used in this study can be readily adopted to support marine mammal conservation and management in other regions.

*Biodiversity and Mammal Conservation*

## **Impacts of Coastal Development on the Indo-Pacific Humpback Dolphins (*Sousa chinensis*) in Hong Kong**

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As an iconic flagship species in the marine ecosystem of western Hong Kong waters, the Indo-Pacific humpback dolphins (*Sousa chinensis*) are greatly affected by anthropogenic impacts, which have resulted in a significant decline in their estimated abundance in the past decade. Since early 2012, the construction of a 40-km long Hong Kong-Zhuhai-Macau Bridge (HZMB) has commenced in Hong Kong and Guangdong Province, and the bridge alignment spans across the Pearl River Delta where the humpback dolphin population inhabits. Within the territorial waters of Hong Kong Special Administrative Region, the various potential impacts from the reclamation works, bridge pier piling activities and other construction activities associated with HZMB construction on the local humpback dolphins have been examined in details through a dedicated dolphin monitoring programme. Comparisons on monitoring data collected between the baseline period (2010-11) and the first three years of construction period (2012-14) revealed some apparent changes in dolphin distribution, encounter rate, abundance, habitat use and individual range use in response to the bridge construction works. Additional bored piling monitoring programme also indicated significant increase in vessel activities and ambient noise levels as well as changes in dolphin behaviours near the work sites. From these results, it appeared that the existing mitigation measures are not adequate to address the various impacts arisen from the HZMB construction activities. In light of various infrastructure projects being proposed within dolphin habitats in Hong Kong in the next decade, the Hong Kong Administration should give a high priority in ensuring the humpback dolphin's continuous utilization of Hong Kong waters as part of their range, with the critical need of a presumption against further reclamation around Lantau waters. This presumption against reclamation could only be relaxed when research effort has managed to establish the threshold of development pressure and other on-going threats that the local dolphin population can cope with.

*Human Impacts***Evaluating the Color Succession of the Hard Coral, *Acropora tenuis*, Using Digital Color Imaging Under Different Light Intensities**I. Takeuchi<sup>1</sup>, K. Hirayama<sup>1</sup>, K. Chikamatsu<sup>1</sup>, K. Takayama<sup>1</sup> and A. Iguchi<sup>2</sup><sup>1</sup>Faculty of Agriculture, Ehime University, 3-5-7 Tarumi, Matsuyama, Ehime 078-0566, Japan<sup>2</sup>Okinawa National College of Technology, 905 Henoko, Nago, Okinawa 905-2193, Japan

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Coral reefs around the world are suffering from various anthropogenic threats including high water temperature, ocean acidification, artificial chemicals, etc. Thus, the establishment of quantifying coral conditions is one of the urgent research subjects for coral ecosystem studies. The present study was undertaken to understand color succession in the hard coral, *Acropora tenuis*, reared under the different light intensities in the laboratory. *Acropora tenuis*, a representative species of hard coral in the Indo-Pacific region, is widely used for physiological studies. The branches of *A. tenuis*, were exposed to four light intensities at PPFDs of 50, 100, 150 and 300  $\mu\text{mol m}^{-2}\text{s}^{-1}$  for 30 days. The color of the coral, in RGB (R, red; G, green; B, blue) values, was recorded at an interval of 1-2 days for using a digital single-lens reflex camera. Each R, G and B value can range from 0 to 255; the black is represented by R=G=B=0, and the white by R=G=B=255. RGB values of each PPFD regime increased to close to the values for white with increase in light intensity. The results obtained in the present study help establish fundamentals for evaluating the coral condition based on the color succession.

*Human Impacts*

**Reefs of Tomorrow: Nutrients Drive Coral Biodiversity in an Urbanized Seascape**

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Marine ecosystems have experienced dramatic changes since the 1850s in response to human activities. This epoch, often referred to as the Anthropocene, has witnessed the punctuated loss of reef-building corals worldwide. Coral reef degradation may induce subtle changes which remain un-witnessed; this is particularly true when the water quality is altered. Deteriorated water quality hampers coral larvae recruitment, amplifies bio-erosion, favors coral diseases and reduces the threshold of thermal bleaching, leading to local or regional coral species extinctions.

Hong Kong SAR waters host more than 80 hard coral species which thrive at the edge of strong gradients of water quality. Thus, HK's coral communities provide an interesting scenario to document the impact of water quality on hard coral biodiversity. This GIS-based study investigates the coral species richness patterns and their link with water quality parameters (dissolved inorganic nitrogen & phosphate, particulate suspended matter, salinity and dissolved oxygen). Two biodiversity "hotspots" including more than 70% of the total species were identified. One was located on the very northeastern part of Hong Kong waters (Mirs Bay), and the other one was located on the entrance of Port Shelter. The spatial analysis revealed that the gradients of hard coral species richness were following the water quality gradients. The nutrient concentrations (nitrogen and phosphorus) appeared to be the main drivers of coral species richness.

The biodiversity patterns and the water quality thresholds calculated in the present study provide invaluable information about the future of coral reefs under high anthropogenic stress. It also provides a useful baseline for coral reefs conservation and management.

*Human Impacts*

## **Temporal Trends of Perfluoroalkyl Substances (PFASs) in Marine Mammals of South China**

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Perfluoroalkyl substances (PFASs) is a large class of highly fluorinated organic chemicals which are used as surfactants and surface protectors in numerous industrial and commercial applications. Over the past decades, studies have indicated that these persistent chemicals are widespread presence in human and environment, and they are also bioaccumulative and toxic to the animals. As a consequence, one of the most recalcitrant homologues of PFASs – perfluorooctane sulfonate (PFOS) and related compounds have been included in the list of the Stockholm Convention on persistent toxic pollutants (POPs) in 2009. Although these chemicals are banned or voluntarily phased out in the developed countries, PFOS and PFOS-related chemicals are still produced in China currently. This may influence future global distribution patterns and trends. As Pearl River Delta (PRD) region is one of the most heavily industrialized and urbanized regions in China, it is conceivable that this region is contaminated by PFASs. Our recent monitoring study carried out in South China Sea has revealed that the highest total PFAS concentrations in seawater were observed at the mouth of PRD. In addition, the concentrations in this study were found to be two times higher when comparing to the PFOS concentrations measured nine years ago at the same sampling locations. PFASs have been emerged as global environmental contaminants, however, the information on PFASs, particularly the changes in levels and patterns, is still very limited in the region. This study therefore aims to examine temporal trends in PFAS concentrations in two species of marine mammals, the Indo-Pacific humpback dolphin *Sousa chinensis* and finless porpoise *Neophocaena phocaenoides*, in the PRD region of China. The changes in levels and composition profiles over time may be able to reflect the current national manufacturing practices and usage patterns of PFASs.

*Human Impacts***Potential Risk Assessment of Heavy Metals by Consuming Shellfish Collected from Muar Estuary, Johore, Malaysia**

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Concentration of Cd, Pb, Cu, Zn, Hg and As in 300 shellfish including oyster, green-lipped mussel, cockles, clams and green-lipped mussel collected from Muar Estuary were analysed for heavy metals concentration using a fast and sensitive Inductively Coupled Plasma Mass Spectrometer (ICP-MS). Results showed that the concentration of heavy metals in shellfish ranged at the following sequence: Zn>Cu>As>Pb>Cd>Hg. Generally the average concentrations of all heavy metals studied were below and comparable with the limit set by Malaysian Food Regulation, European Commission, Ministry of Public Health Thailand and China National Standard and Malaysia Food Regulation. Metals concentrations in the soft tissue were assessed for human safety consumption according to Provisional Tolerable Weekly Intake (PTWI) and Provisional Tolerable Daily Intake (PTDI). The weekly and daily intake of heavy metals through the consumption of these shellfish were estimated based on both of the metal concentration in shellfish and the consuming amounts of shellfish. The calculated daily intakes of these metals through consuming the shellfish were 0.122 (Cd), 0.137 (Pb), 0.102 (Cu), 1.20 (Zn), 0.005 (Hg) and 0.905 (As), which below the limit set by Joint FAO/WHO Expert Committee on Food Additives. In addition, the target hazard quotients (THQ) were used to evaluate the potential risk of heavy metals in shellfish on human body. The highest THQ values of Pb and Cd were observed in the species of oyster and clam. However, the results indicate that the intake of heavy metals by consuming shellfish collected from Muar estuary do not present an appreciable hazard risk on human surrounding area health, but attention should be paid to consuming those with relatively high THQ values such as oyster and clam. Due to their accumulation capacity of heavy metals, these shellfish had the potential of being used as bio-monitor to control the aquatic contamination by these elements.

*Human Impacts*

**Environmental Damages and Ecological Recoveries after the Hebei Spirit Oil Spill, Taean, Korea**

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The Hebei Spirit oil spill (HSOS) in December 7, 2007 spilled approximately 10,900 tons of crude oil in about 10 km off the Taean coasts in South Korea. We first summarize and overview, in the present study, the current status of environmental and ecological effects of the HSOS focusing on i) pollution status for surrounding environment (water, sediment, and porewater), ii) biological effects on living organisms, iii) potential toxic effects in vitro and in vivo, and finally iv) human health risk. In particular, ecological impacts followed by the recoveries of coastal ecosystem are intensively addressed. Water quality seemed to be rapidly recovered considering the background levels of oil pollution indices, while oil impacted sediments experienced fairly long history of contamination. Meanwhile, the benthic epifauna mapping in the worst impacted area of Taean indicated that the coastal organisms are fairly recovered after five years of the HSOS. However, it should be noted that residual oils are still found in some inner part of small bays and mud dominant regions in Taean area which would cause the potential toxic effects on coastal organisms. Finally, the current understandings and limitations of such effects from the HSOS are further discussed highlighting, i) long-term effects of residual oils, ii) identification of certain toxic chemicals in residual oils, iii) weathering characteristics of spilled oils, iv) possible effects from the unknown hydrocarbons in oils, and v) recovery of community level responses to the HSOS.

*Human Impacts***Acclimation Cost of Common Environmental Stress to Copepod  
*Tigriopus japonicus***

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Anthropogenic stress and climate change pose major challenges to survivorship of organisms. Acclimation to these changes often incurred energy costs to organisms and led to decrease in fitness. This presentation will make use of two studies, using copepod *Tigriopus japonicus*, to examine whether development of resistance to two common stressors (copper and thermal stress) can be acquired and whether fitness cost is involved. *T. japonicus* inhabits shallow supratidal tidepools that subject to extreme environmental conditions and has good tolerances to a wide range of stresses. For copper, *T. japonicus* (F0) were acclimated to three concentrations (0, 10, and 100  $\mu\text{g Cu l}^{-1}$ ) and offspring (F1 and F2) of each treatment were subsequently acclimated at these three concentrations, respectively. Cu resistance of the copepod was increased even after one generation of acclimation to 100  $\mu\text{g Cu l}^{-1}$ . Acquired Cu resistance had a fitness cost, as intrinsic population growth rate of this Cu resistant lineage was significantly lower than the control in clean seawater. For thermal stress, thermal tolerance of a temperate South Korea population (SK) and a sub-tropical Hong Kong population (HK) were compared. Copepods (F0; 27 pairs each) were raised in 3 temperatures: 15, 20 and 25°C for 30 days and offspring (F1 and F2) of each treatment were subsequently acclimated at these three temperatures, respectively. As suspected, F0 SK copepods have lower thermal tolerance than F0 HK copepods as reflected by their mean lethal temperatures (LT; SK: 42.9°C, HK: 45.3°C). After acclimation to the 3 test temperatures, LT of both F0 populations shifted accordingly but similar difference remained. Interestingly, F1 individuals of both populations raised in the same temperature have less difference LTs than the F0 parents. Despite this, the reproductive output of F1 SK copepods under 25°C were less than the HK group and the difference in output was larger than that observed their F0 parents. The overall results suggested that stress tolerance in *T. japonicus* is plastic but may involve some initial cost on the Darwinian fitness of the population.

*Human Impacts***Present Status of the Megabenthic Community in the Coastal Areas of Fukushima Prefecture, Japan After the Great East Japan Earthquake**

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The Great East Japan Earthquake and the subsequent major tsunami that occurred on March 11, 2011 have caused serious aftermath in the regional coastal ecosystem, i.e., land subsidence, alteration of substrate as well as vegetation and community structure of inhabiting marine organisms. Besides, disastrous accidents at the Fukushima Daiichi Nuclear Power Plant (1F) have caused leaks of radioactive cooling water into the sea, arising great concerns about adverse effects on marine organisms. Investigation of the present status of megabenthic community is essential to evaluate the effects of the natural and anthropogenic disasters on marine organisms. In this study, we conducted fisheries-independent trawl surveys to reveal the community structure of megabenthic species (fishes, crustaceans, mollusks and echinoderms) after the disastrous events in the coastal areas of Fukushima Prefecture, Japan. The surveys were conducted in January, July and October 2013, and January and July 2014 at three latitudinal transects set along the coastal line; off Soma (north), off the 1F (central), and off Iwaki (south). Each transect was composed of three sites of different depth (10, 20 and 30m). We collected megabenthic species and investigated their spatio-temporal changes during the survey period. Although high abundance and biomass were occasionally evident due to outbreak of small shrimps or large elasmobranchs, no significant temporal changes were detected in both abundance and biomass (two-way ANOVA,  $P > 0.05$ ). Meanwhile, significant difference in biomass among sites was evident (Tukey's test,  $P < 0.05$ ); Higher biomass due to dominance of elasmobranchs, flatfishes, puffers or echinoderms was found in north and south transects, while biomass in central transect was relatively low compared to other transects. Extremely low abundance and biomass of crustacean was evident at 30 m depth in the south transect. Factors affecting changes in the megabenthic community will be discussed in relation to environmental conditions.

*Human Impacts*

**Stress Responses of Zooxanthellae in Juvenile *Tridacna gigas* Exposed to Reduced Salinity**

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Storm events are common in tropical regions and predicted to increase in frequency and intensity attributed to global climate change. The iconic giant clams thriving in shallow coral reef areas in the Indo-Pacific region could experience salinity fluctuations during these events characterized by extreme precipitation. Given the limited ecotoxicological studies on the effects of osmotic stress in tridacnids, this study investigated the acclimatization potential to different salinities, i.e., 18, 25 and 35‰ (control) for 14 days in juvenile *Tridacna gigas*. Results showed significant decrease in the chlorophyll a and c concentrations in giant clams at 18‰. This may be caused by the marked increase in number of degenerating zooxanthellae. There were no significant differences in the pigment concentration in clams exposed to 25‰ compared to control except on Day 10. The zooxanthellae density, however, decreased significantly on Day 1 in both low salinity treatments, although bleaching was not observed. Symbiont cell enlargement was also observed at both low salinity treatments, affecting pigment concentrations at 18‰ but not at 25‰. This study shows that zooxanthellae in giant clams were affected at 18‰ and 25‰, but exposure to the latter displayed acclimation response as indicated by recovery in the various measured parameters (pigment concentration, zooxanthellae density, cell size and percent degenerating zooxanthellae) after 14 days of exposure. High mortality rates were incurred at 18‰, with no survivor after 4 days of exposure.

*Biodiversity & Evolution*

## **Ancestral Whole Genome Duplication in the Marine Chelicerate Horseshoe Crabs**

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Horseshoe crabs are marine arthropods that can be found in the coastal area. In the last several decades, as a consequence of the loss of habitat and their relatively slow growth rate, the population of horseshoe crab has been rapidly declining worldwide. In animals, whole genome duplication (WGD) is generally thought to confine to the last common ancestor of vertebrates, which has also been postulated as a major evolutionary force that contributed to the vertebrates speciation and diversification of morphological structures. By sequencing genomes from three of the four extant species of horseshoe crabs - *Carcinoscorpius rotundicauda*, *Limulus polyphemus* and *Tachypleus tridentatus*, we unexpectedly discovered the existence of WGD in the horseshoe crabs, which provides evidence of ancient WGD in the invertebrate lineage, and warrants their conservation value. BIOENV correlation analysis revealed that YSCWM had the greatest impact on the community and functional structures of nematode assemblages in summer, but the effect declined with the decline of YSCWM in autumn and winter when water depth and food supply in the sediments and from the overlying water column became more important environmental factors.

**An Annotated Checklist of Marine Brachyuran Crabs of India**J.N. Trivedi, D.J. Trivedi, G.M. Soni and K.D. VachhrajaniMarine Biodiversity and Ecology Lab., Department of Zoology, Faculty of Science,  
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India has the coastline of 7516.6 km which is occupied by 9 coastal states and 2 island territories. The coastal areas of India support variety of marine habitats, marine flora and fauna. So far, more than 16225 marine species are reported from Indian waters in which more than 3095 species of plants and 13130 species of animals are reported. Among marine macro fauna, brachyuran crabs of sub phylum crustacea are one of the highly diverse groups. Studies on brachyuran crabs' fauna of India has glorious history starting from Fabricius (1775) till date. Out of 3498 species of crustacean species reported from India, more than 705 species are of brachyuran crabs. Since appropriate listing of marine brachyuran crabs of India is not prepared yet; present study was carried out. Literature published on the marine brachyuran crab fauna of India was reviewed extensively and several coastal areas of the country were surveyed during past four years for brachyuran crab collection. The state wise occurrence of the species was noted and recent taxonomy of the species was adopted from Ng et al. (2008) and Boxshell et al. (2015). Information about availability of the specimen in different Indian museums is also given with the checklist. Total 732 species of marine brachyuran crab belonging to 312 genera and 56 families are reported from Indian waters out of which 347 species and 624 species occurred on the west and east coast of India, respectively. In state wise comparison, maximum and minimum diversity is reported from Tamilnadu (364 species) and Andhra Pradesh (53 species), respectively. Total 107 and 384 species were recorded endemic to west and east coast of India, respectively. Present study provides crucial information on brachyuran crab fauna of India which could be useful for future studies and for marine conservation policy in India.

**Population Structure on a Local Geographical Scale:  
*Dendropoma* spp. Snail-worm Genetics in Palau**

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Palau coral reef ecosystems have been the object of a remarkable management and conservation effort in the last decades. Currently, Palau encompasses more than 25 Marine Protected Areas (MPAs). These MPAs have been designed mostly on the basis of traditional knowledge and political considerations. Biological data such as species community structure and population connectivity are therefore urgently needed to enhance the design of these MPAs and provide Palauans with science-grounded conservation policies. Marine snail-worms of the genus *Dendropoma* (Mollusca: Gastropoda: Vermetidae) are abundant and widely distributed across the Palauan archipelago. They brood their eggs and are expected to be poorly dispersive. High levels of genetic structure may thus be expected even at small spatial scales. For our study, we collected 180 specimens from 15 locations. The analyses of COI mtDNA data support the existence of at least three species of snail-worms in Palau. One species was identified as *Dendropoma maximum* while the two other species are likely new to science. One of these undescribed species is widely distributed across Palau and is genetically highly structured even between locations separated by less than 40 km. We argue that snail-worms are an excellent biological model to study population structure and gene flow in marine invertebrates without requiring the deployment of micro-satellite or SNPs genetic markers.

**Becoming a Marine Organism**

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One definition of a marine organism is whether it disperses by the sea in the broad sense. Here, we report the dispersal (adaptations) of three species, all with terrestrial ancestors, in intertidal and shallow waters of Dongsha Atoll, South China Sea. The turtle grass, *Thalassia hemprichii*, no longer relies on seeds for long distance dispersal, rather, the lacunae in their leaves and stems are filled with gas and allow dislodged plants to float. They could remain floating for months and maintain the capability to grow in a suitable habitat, hopefully in a far away place. Even seedlings with leaves could float if they do not anchor themselves in time. The function of seeds, in contrast to its land ancestors, is to fix to the substrate as soon as possible. The earthworm, *Pontodrilus litoralis*, has a wide distribution in the world. It is euryhaline and could survive for a long time relying on seawater. It is able to live in the crevices of drifting wood for months. Wood provides lodging, travel and food. The marine midge, *Pontomyia oceana*, inhabits shallow reefs and has a planktonic stage of 2-3 days, which disperses individuals; they are unlikely to encounter one another during their short adult stage of 1-2 hours once dispersed in the sea. Floating wood may be used to make their long distance travel practical. The larvae could settle and develop on wood surface en masse. The wood keep developing larvae and pupae together as a dispersing unit until the last hour when emergence and mating occurs, luckily in a new suitable location. One common trait in all these 3 examples in shallow waters is that the originally "benthic" stage turns out to be the stage traveling.

**Dragon Heart and Dragon Scales: Internal and External Anatomy of the 'Scaly-foot Gastropod' (Mollusca: Gastropoda: Neomphalina)**

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The emblematic 'scaly-foot gastropod' from deep-sea hydrothermal vent ecosystems of the Indian Ocean is distinctive for the dermal scales covering its foot. These iron-sulphide coated sclerites, and its nutritional dependence on endosymbiotic bacteria, are both noted as specialist adaptations to the extreme vent environment.

Despite striking external similarities, the 'scaly-foot gastropod' sclerites were found to be secreted by a starkly different mechanism from polyplacophoran (chiton) scales. This convergence highlights the ability of molluscs to adapt mineralised dermal structures, supported by extensive early fossil record of molluscs with scleritomes. We report a true operculum from all three known populations; marked differences in underlying epithelium suggest that the sclerites do not originate from operculum multiplication.

We also present evidence for further specialist adaptations of the 'scaly-foot gastropod', through dissection and 3D tomographic reconstruction of the internal anatomy. Our investigations reveal a large unganglionated nervous system, a reduced digestive system, and that it is a simultaneous hermaphrodite. Of particular interest is the hypertrophied circulatory system. A well-developed ctenidium supported by extensive blood sinuses provides oxygen for the host but the circulatory system is enlarged beyond the scope of other similar vent gastropods. It has a remarkably voluminous heart representing approximately 4% of the body volume, with a very muscular ventricle. This proportionally giant heart primarily supplies the highly vascularised oesophageal gland. Thus we infer the elaborate cardiovascular system most likely evolved to oxygenate the endosymbionts in a hypoxic environment and/or to supply them with hydrogen sulfide.

This study exemplifies how understanding of an organism can be greatly enhanced by detailed anatomical investigations. All remarkable adaptations of the 'scaly-foot gastropod' can equally be viewed as beneficial to its endosymbionts. As a result of specialisation to resolve energetic needs in a chemosynthetic environment, this dramatic dragon-like species has become a carrying vessel for its bacteria.

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## **Spatial and Seasonal Variations in Community Structure and Trophic Dynamics of Benthic Communities of Marine Molluscs in Hong Kong's Coastal Waters before the Trawling ban**

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To rectify the detrimental impact of overfishing and destruction of benthic ecosystems, a territory-wide trawling ban has been imposed in Hong Kong's coastal marine waters since 31 December 2012. It is anticipated that the local benthic marine ecosystem will gradually recover after the trawl-ban. Using stable isotope analysis (SIA), this study aims to compare trophic dynamics of benthic molluscan communities of eastern, southern and western waters of Hong Kong before and after the trawling ban. The results of this study will also serve as a baseline for studying long-term ecosystem recovery. Trawling surveys were conducted using a commercial shrimp trawler in each of the three zones during wet and dry season in 2012 (pre trawl-ban) and 2014 (post trawl-ban). In total, 17 species of molluscs were collected for the SIA. They included predators (e.g. the Japanese spineless cuttlefish *Sepiella japonica*), filter feeders (e.g. the undulate clam *Paphia undulata*) and scavengers (e.g. the burned nassa *Nassarius siquijorensis*). Mantle tissues of cephalopods, and the muscular foot of bivalves and gastropods were dissected and subjected to the SIA. The results consisted of nitrogen and carbon contents, as well as isotopic ratios of nitrogen ( $\delta^{15}\text{N}$ ) and carbon ( $\delta^{13}\text{C}$ ) for the tissue sample of each species. Bases on the samples collected in 2012, the results revealed clear spatial and seasonal variations in the isotopic signatures of the molluscan species. At present, we are still running the SIA for the samples of 2014, and the results shall be available soon. In our presentation, the overall results will be discussed with reference to a more holistic picture of the benthic ecosystem by considering observed changes in diversity and abundance of other coexisting taxonomic groups such as fishes and crustaceans.

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## **Nonadaptive Evolution of a Globally Abundant Ocean Bacterial Lineage**

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It has been believed that the most abundant planktonic ocean bacteria are the fittest taxa in the oligotrophic seawater. Using single-cell genome sequencing, we obtained partial genomic sequences of 4 uncultivated cells affiliated with the ecologically relevant *Roseobacter* clade. These single cells consistently display streamlined and G+C-poor genomes compared to their cultured relatives. A nonstationary Bayesian phylogenomic model resolved these single cells into a new clade (hereafter *SAG-O19*), in which no representatives have been in culture. Using newly developed population genetic models controlling for base frequency difference among lineages, we show an inflation of the ratio of nonsynonymous to synonymous nucleotide substitution rate in *SAG-O19*, along with an accelerated replacement of nonsynonymous nucleotide leading to physicochemically dissimilar amino acids. While members of this lineage are among the most abundant *Roseobacters*, an excess of slightly deleterious mutation strongly supports a predominant role of genetic drift driving their evolution. Therefore, not all genetic diversity among ocean bacterioplankton has adaptive value.

**Strong Genetic Structure and Hybridization between Two Discrete Lineages of *Parazacco spilurus* (Cyprinidae) in Hong Kong**Tsz Huen Wu<sup>1</sup>, I-Shiung Chen<sup>2</sup> and Ka Hou Chu<sup>1</sup><sup>1</sup>School of Life Sciences, The Chinese University of Hong Kong, Hong Kong SAR, China<sup>2</sup>Institute of Marine Biology, National Taiwan Ocean University, Keelung 202, Taiwan

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The incorporation of genetic analyses into ecological surveys is recognized as a promising means to reveal species endemism and cryptic diversity, especially in identifying lineages that cannot be differentiated morphologically. Using a multi-locus approach, we investigated the population genetic structure of the freshwater cyprinid fish, *Parazacco spilurus* (Günther, 1868) at its type locality Hong Kong. Two genetically distinct lineages are revealed with the detection of hybridization between them.

Analysis on two mitochondrial genes (control region and cyt b) in over 120 individuals collected from 25 localities reveals an evident genetic structure of *P. spilurus* (Günther, 1868) in Hong Kong. Two genetically distinct lineages with about 8% of sequence divergence are recovered with strong support, and they show discrete distributions in Hong Kong with little or no overlap. The major lineage occurs in most of the sampling sites, including Lantau Island and Hong Kong Island, while the other lineage shows a relatively restricted distribution, in a few streams located in the northeastern part of Hong Kong. The two lineages coexist in only one stream in this area. Genetic analysis based on bi-parentally inherited nuclear protein-coding gene (Rag-1) reveals two discrete haplotype groups that correspond to the two mitochondrial lineages recovered. Yet hybrids between the two lineages are detected at the stream where the two lineages coexist. We speculate that the Plover Cove Reservoir in the northeastern part of Hong Kong might have facilitated the mixing and hybridization between the two lineages, as its construction in 1968 has connected streams that were originally isolated.

*Biodiversity Conservation*

## **Effects of Marine Reserves on Reef Fish Recruitment in the Philippines**

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Marine protected areas (MPAs) are utilized as effective management tools to preserve biodiversity and mitigate the impacts of anthropogenic disturbances especially overfishing. However, there remains a need to assess the influence of MPAs on reef fish recruitment. This study examined the recruitment patterns in six sites in the Philippines with varying intensities of fishing pressures (high in Balingasay and Carot; moderate in Masinloc, Mabini and Verde; and low in Tubbataha), and the consistency of recruitment in MPAs. Underwater visual censuses of fish recruits were conducted inside and outside the MPAs (~200m away from the MPA boundary) of these sites. Recruitment depicted variability between monitoring periods and sites. Interestingly, recruitment was stable in a pristine reef, e.g., Tubbataha, which signified a constant supply of recruits. The abundance of fish recruits in Tubbataha was fivefold higher than the recruits in other locations. On the other hand, sites that were experiencing greater fishing pressure exhibited lower recruitment. However, fish recruits had increased inside the MPAs relative to the outside, in some monitoring periods, particularly on reefs (i.e., Balingasay and Mabini) that have been protected for a longer period. The influence of MPAs on fish recruitment appeared to depend on their sizes, locations, duration of protection and effective management measures.

*Biodiversity Conservation*

**The Value of Marine Ecotourism in the Open Sea: The Azores Case-study**

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Spatially resolved valuations of ecosystems services are politically important to inform management approaches to resolving the needs of different marine stakeholders and conservation drivers. Recreational uses of marine ecosystems contribute to human wellbeing and generate significant economic benefits to local economies yet a comprehensive understanding of their socioeconomic importance remains poorly quantified due to a lack of systematic evidence collation. This is even more pronounced when compared with other traditional marine uses (i.e. commercial fisheries), which are the target of monitoring programs that span several decades. The lack of comprehensive information on marine recreational uses means that these are poorly represented when defining sustainable and integrated management plans. This study presents an assessment of the socioeconomic impact and spatial distribution of marine ecotourism activities (whale watching, diving and big game fishing) in the Azores archipelago (northeast Atlantic). Data were collected through a series of questionnaire surveys of the clients and managers of marine-tourism businesses in the Azorean islands. Our results suggest that every year c. 40035 tourists engaged in marine tourism activities generating approximately 64€ million to the regional economy. Results also indicate that such revenues are comparable to that of commercial fisheries for the same region. Most of these activities occur around the coasts of the islands yet offshore seamounts are of considerable importance especially for diving and big game fishing. The spatial distribution of each activity can differ greatly over time as a result of differences in the environment and rivalry with other uses emphasizing the need for monitoring and evaluation. These values add a new dimension to arguments in support of marine conservation and call attention to the comprehensive integration of marine ecotourism activities in management plans.

*Fisheries & Marine Resources Management*

**Aspects on the Reproductive Ecology of the Sea Cucumber *Stichopus cf. horrens* in Masinloc, Zambales, Northwest Philippines**

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The reproductive ecology of the coral reef associated sea cucumber *Stichopus cf. horrens* was investigated. Its lunar spawning periodicity was determined through in situ observations in a marine protected area (MPA), complemented with gonadal analysis of adjacent populations. In addition, its spawning behaviour and in situ fertilization success rate were also documented and estimated, respectively. Monthly mass spawning of *Stichopus cf. horrens* was observed three to five days after the third quarter of the moon phase from 22:00 h to 02:00 h with highest density ( $1 \pm 1 - 19.33 \pm 5.51$  ind per  $100 \text{ m}^2$ ) of spawning individuals observed during the fourth day. A suite of spawning behaviour were employed by *Stichopus cf. horrens* to increase its reproductive output which includes the following: a) synchronous spawning, b) movement to higher locations, c) formation of small aggregations and d) nocturnal spawning when lunar luminance is minimal or absent. Fertilization success ranged from 55 to 91%. Furthermore, findings of the gonad analysis showed spent individuals four and five days after the third quarter of the moon phase which corroborates with the field observations. Gametogenesis was observed to be fast; development from spent to mature stages took only about two weeks. The presence of previtellogenic oocytes observed in the spent tubules and the fast gametogenic development may indicate that the species is capable of spawning every month. Combining the results of the in situ observations and gonadal analysis showed that *Stichopus cf. horrens* has a predictable and regular spawning lunar pattern three to five days after the third quarter of the moon phase. Results of this study provide information that are critical for the management of the species. Findings of this study also demonstrate the importance of protected areas in maintaining viable spawning populations especially for commercially important sea cucumbers.

*Biodiversity Conservation*

**Improved Health and Resilience in Unprotected Reefs in Cambodia**

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Coral reef health directly relates to its resilience in the face of environmental change. Many human populations worldwide depend on marine resources. It is important to understand how to increase reef health and resilience, to mitigate the impacts of climate change. Marine protected areas are considered the best way to protect marine environments, promoting improved health, resilience, and supporting dependent communities. The effectiveness of marine management strategies is typically assessed by inside/outside or before/after comparisons, with positive benefits attributed to implemented management systems. Long-term changes in unprotected systems have rarely been studied. This assessment compared reef composition data from an unprotected archipelago in Cambodia, in 2001 and 2013. Results showed an increase in hard coral cover; coupled with a reduction in dead coral and macro-algae, suggesting an overall increase in coral reef health. An increase of up to 80% hard coral cover was detected at some sites, however there was no discernable change in fish or invertebrate populations, most likely due to continued fishing pressure. The study also indicated that effective, informal protection occurred due to the cultural value of the area; a site in the first assessment displayed considerably better health than the rest of the archipelago. This health that was maintained in the second assessment, indicating that informal protection enhances resilience. However, evidence suggested tourism caused a decline in reef health at another location. This study provides an optimistic outlook for the future of coral reefs; suggesting that recovery may be possible without formal management intervention.

*Biodiversity Conservation*

## **Embedding Predictive Tools into Marine Environmental Management Policy and Legislation**

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Marine environmental protection has shown a marked change from behavioural regulation to policy and legislation designed to directly protect ecosystem biodiversity, function and services. However, the effectiveness of such policies and legislation are difficult to interpret without regular monitoring, and (at least in the absence of additional legislation) damage to an ecosystem must occur before preventative action can be taken. Here we present a tool based on Bayesian belief networks for predicting the effects of various activities on marine communities which 1) provides information at the level of detail required by most policy and legislation worldwide; 2) can be developed and parameterised by any existing data and expert opinion; 3) is intuitive to use, and management scenarios can be explored independently by scientists, policy makers, enforcers and stakeholders; 4) provides accurate and robust predictions of marine systems, including at the ecological community level. We propose that more effective marine environmental management can be obtained by embedding the use of such predictive tools into the direct protection policy and legislation which exists or is being developed at present.

*Human Impacts*

**The Importance of Sub-specific Diversity: the Outcome of Interaction Between Invasive and Indigenous Mussels Differs Between Native Lineages**

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The Definitions of biodiversity can be extended beyond species to include genetic diversity, yet the direct benefits of conserving genetic diversity have generally been suggested, rather than demonstrated. Here we examined the interaction between an invasive marine mussel and an indigenous species, including the effect of genetic resolution. The intertidal Mediterranean mussel, *Mytilus galloprovincialis*, has become invasive on every continent on the planet except Antarctica, encountering a variety of native mussel species. In South Africa, it has effectively displaced the indigenous mussel species on the cool-temperate west coast, but on the warm-temperate south coast it interacts with a different indigenous species, *Perna perna*. *Perna* and *Mytilus* show partial habitat segregation by height on the shore, while overlapping and co-existing in the middle of the zone occupied mussels. On the south coast, *Mytilus* reaches a distributional limit towards the east that coincides with a phylogeographic break in *Perna*. This limit lies precisely in the region where two genetic lineages of *Perna*, an eastern and a western lineage, overlap. In situ competition and translocation experiments indicate that *Mytilus* is capable of living farther east than it presently occurs. However, on that part of the shore where the two species can co-exist in mixed mussel beds, it is outcompeted by the eastern lineage of *Perna* and not the west lineage with which it presently co-exists. These results provide a clear example of a hidden benefit of genetic diversity with the spread of *Mytilus* towards the east held in check not by abiotic conditions, but by interaction with a different genetic lineage of *Perna*.

*Human Impacts*

## **Biofilm Ecology on Antifouling Surfaces in Tropical Marine Environments**

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Tropical coastal systems experience high fouling pressures due to environmental conditions and high seeding biodiversity. Fouling begins with the formation of a microbial biofilm “slime” that can induce or retard subsequent settlement of various marine organisms based on its age, composition and density. Surface properties, temperature and other factors can all play a role in altering the early biofilm. In this work, we established the temporal variations in the early biofilm community of anti-fouling (AF) coatings, using Singapore as a model for tropical waters. Although minor seasonal trends were observed, surface chemistry plays the largest role in determining biofilm development. Microbial films have also been shown to influence invertebrate larval settlement, yet the reverse interaction has not been studied. Settlement of organisms upon biofilms could alter its community development and has the potential to affect subsequent recruitment. Here we examined the effects of diatom and larval settlement on surrounding biofilm development. Biofilm abundance was analysed via confocal laser scanning microscopy (CLSM) and diversity via terminal restriction fragment length polymorphism (TRFLP). Understanding biofilm “slime” community development and its interaction with other marine organisms can help inform both anti-fouling and restoration ecology solutions.

*Human Impacts*

**Assigning *Hippocampus guttulatus* Recruits to the Populations of Origin Using Microsatellites: Results from a Field Study in the Ria Formosa (South Portugal)**

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The deployment of Artificial Holdfast Units (AHU) has been demonstrated as an effective tool for creating holdfast and sheltering conditions for *Hippocampus guttulatus* in the Ria Formosa (South Portugal). Preliminary results obtained with a pilot-scale AHU showed a high settlement rate, with recorded densities of up to 13.1 individuals.m<sup>-2</sup>. With the present study, we aim to understand whether the AHU's contributed to attract new *H. guttulatus* recruits or concentrate those previously existing in these areas. Prior to the deployment of the AHU's in a total of four focal sites, a sample of the skin filaments was collected from each *H. guttulatus* (n= 70) sighted in those locations. The same sampling protocol was later carried out on the recruits (n=14) sighted in one pilot-scale AHU since its deployment. Upon DNA extraction the variation of 13 highly polymorphic microsatellite loci isolated for *H. guttulatus* (or obtained by cross-amplification in *H. hippocampus*) has been analyzed. PCR reactions with labeled primers were performed using standard procedures and amplified products were run on an ABI PRISM 3130 XL Genetic Analyser<sup>®</sup>. Based on the genetic data, ONCOR software package was used to estimate the population of origin of recruits. Preliminary results indicate that more than 90% of the recruits at the AHU were assigned to the sites located up to 500 meter apart. No assignment has been demonstrated for the other sampled locations, situated further away from the AHU.

*Human Impacts*

## **Seasonality Can Lower Biotic Resistance to Ascidian Invasion in Subtropical Marine Fouling Communities**

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Environmental conditions determine the performance of marine species. Seasonal variation of physicochemical conditions in the environment can modify the intensity of biological interactions within communities, especially in regions with strong seasonality. However, the implications of seasonality for biotic resistance by predation are poorly understood. Here, through the use of experimental recruitment panels and predation exclusion cages, we examine 1) whether the antagonistic subtropical seasonality (tropical and temperate conditions) in Hong Kong can affect the abundance of the non-native ascidia *Ciona intestinalis* and other common ascidians (invasive elsewhere) in fouling communities, 2) whether the seasonality can affect predation on the ascidians, and 3) additionally, whether human disturbances in environmental conditions (i.e., habitat alteration and low seawater quality) can affect predation and invasion. The results of our experiments indicate that the seasonality has a strong influence in the recruitment and abundance of species in the communities which are also influenced by high predation in the wet season. The non-native ascidia *C. intestinalis*, with temperate life-history characteristics, benefits from a temporal niche opportunity under cold temperate conditions in the dry-winter season and becomes common within the subtropical communities during this time. Predation also had little impact on ascidian abundance during the dry-winter season. *C. intestinalis* benefits from disturbed environments where it monopolizes the community, though the mechanism behind this remains unclear. We argue that the seasonality, as an important ecological factor for community ecology dynamics, must also be considered in the context of biological invasion. Seasonality may play a key role in regulating and possibly facilitating the invasion of non-native species into marine communities.

*Human Impacts*

## **The Fouling of *Lepas* Barnacles on Immobilized Offshore Installations**

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The natural habits of the stalked barnacles in the genus *Lepas* are drifting, floating and mobile objects, including all sorts of driftwood, plastic debris, ships and buoys, as well as marine animals and algae. However, in the northern South China Sea, the *Lepas* barnacles were observed on immobilized offshore installations and disappear gradually in the fouling communities over time. To further understand the reasons and elucidate the settlement mechanism of the *Lepas* barnacles, a field observation was conducted for more than 10 years.

The large fixed marine installations for the study are located in offshore areas southeast of the Zhujiang (Pearl) River Delta and west of Hainan Island, respectively. The distance from shore to all of them is more than 100 km. The observation and sampling were conducted in the intertidal zone of the legs and support members of the jacket and damper of boat landing of the fixed offshore platforms. Samples were collected randomly and stored in 5% formalin or 75% ethanol solution before further identification and examination were made. The wet weights of *Lepas* barnacles and the sizes of their capitulums, including length and width, were measured individually and recorded.

The results indicated that although the stalked barnacles of the genus *Lepas* present a pseudopelagic planktonic life and usually do not occur in the fouling community colonizing on fixed offshore structures, in fact, they can settle on any objects, regardless of floating/drifting/mobile or fixed. Due to the lack of the competition ability compared with other organisms, they normally are replaced by more competitive species with large body size, rapid growth rate and longer lifespan. Meanwhile, the *Lepas* barnacles can settle on fixed offshore installations even after the building of the structure for several years as long as the submerged surfaces of the installations still showing 'clean' visibly.

*Human Impacts*

## **Macrobenthic Community Changes During Large Scale Reclamation (from 2007 to 2011) in Tianjin Coastal, China**

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Coastal reclamation is of major importance to urban development, land-use expansion and sustainable economic development. More than two-thirds of the seashore area along Tianjin coastal was reclaimed for industrial and port developments since 2007 to 2011. Such large scale coastal reclamation has led to serious environmental and ecological problems, including the loss and fragmentation of coastal habitats, in the intertidal zone and in near-shore, estuarine, and marine waters. The overall effect of coastal reclamation involved a major reduction in the abundance and diversity of species, particularly in the macrobenthos. One direct impact of reclamation is mass macrobenthos death. During the large scale reclamation, over 2 thousand Km<sup>2</sup> of sea area were occupied, which destroy the habitat of macrobenthos, and lots of macrobenthos were lost. Almost 35 macrobenthic species were found during the spring survey in 2005 and the autumn survey in 2006. However, no more than 10 macrobenthic species were found in the near-shore survey after 2006.

*Climate Change Impacts*

**Some Like It Hot, But Some Don't: Behavioral Flexibility as an Adaptation to Thermal Stress in an Era of Global Warming**

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There is now ample evidence of the ecological impact of recent climate change, from polar terrestrial to tropical marine environments. The responses of both flora and fauna span an array of ecosystems and organizational hierarchies, from the species to the community levels. Organisms, populations and ecological communities do not, however, respond to approximated global averages. Instead, regional changes, which are highly spatially heterogeneous, are more relevant in the context of ecological response to climatic change. Specifically, the variability in thermal stress observed on wave-swept rocky intertidal ecosystems at scales pertinent to individual organisms in rocky intertidal ecosystems is increasingly shown to be greater than along latitudinal gradients. As a consequence, the physiological and behavioral abilities of intertidal organisms to dampen temperature fluctuations are potentially a critical adaptive and evolutionary force to face the increasingly stressful conditions they experience in an era of global change. In this context, we explore both in situ and ex situ a range of behavioral adaptations that are shown to decrease the impact of thermal stress in intertidal gastropods. These questions have been assessed through measurements of body temperature in a range of gastropod species from diverse environments under extreme levels of thermal stress such as Australia, Portugal, Hong Kong and South Africa. These adaptations include shell standing, cooling towers, aggregation, habitat selection, and appear to vary with specimen size and color. The implications of these observations are discussed in the general context of the scenarios predicting future climate conditions.

*Climate Change Impacts*

**Temperature Impacts on Deep-Sea Biodiversity**

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Temperature is considered to be a fundamental factor controlling biodiversity in marine ecosystems, but precisely what role temperature plays in modulating diversity is still not clear. The deep ocean, lacking light and in situ photosynthetic primary production, is an ideal model system to test the effects of temperature changes on biodiversity. Here we synthesize current knowledge on temperature–diversity relationships in the deep sea. Our results from both present and past deep-sea assemblages suggest that, when a wide range of deep-sea bottom-water temperatures is considered, a unimodal relationship exists between temperature and diversity (that may be right skewed). It is possible that temperature is important only when at relatively high and low levels but does not play a major role in the intermediate temperature range. Possible mechanisms explaining the temperature–biodiversity relationship include the physiological-tolerance hypothesis, the metabolic hypothesis, island biogeography theory, or some combination of these. The possible unimodal relationship discussed here may allow us to identify tipping points at which on-going global change and deep-water warming may increase or decrease deep-sea biodiversity. Predicted changes in deep-sea temperatures due to human-induced climate change may have more adverse consequences than expected considering the sensitivity of deep-sea ecosystems to temperature changes.

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## **A Jellyfish Species Can Be Used as an Indicator of the Yellow Sea Cold Bottom Water**

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In recent years, the ecological role of gelatinous zooplankton especially jellyfish and ctenophore within coastal marine ecosystems with high production has been increasingly concerned globally. In order to investigate the biodiversity of large jellyfishes, cruises were conducted in 2006 and 2007. Based on the in situ bottom trawl data, we identified one jellyfish species which was never recorded before, and the genus and species name of which besides Ulmaridae have not been determined. Semi-qualification on seasonal geographical distribution of biomass/ abundance of this large jellyfish in the Yellow Sea are studied, the abundance/ biomass is up to the highest (2780 ind. km<sup>-2</sup>, 1807 kg km<sup>-2</sup>) in October, and they mainly distributed in the middle part of the Yellow Sea. We concluded that Ulmaridae was clearly adapted to cool temperatures and higher salinities (7.7–11.9°C and salinity 30.9–33.9), which occurred in the middle part of the YS. Considering Ulmaridae was adapted to temperatures and salinities consistent with the character of the Yellow Sea Cold Bottom Water (YSCBW), and their occurrence exactly corresponded with the area of YSCBW, even in different seasons, therefore, this species can be used as an indicator of YSCBW. Therefore, the annual and seasonal distribution pattern and biomass of the indicator species Ulmaridae could respond to the spread and retreat of the YSCBW forced by climate change.

*Climate Change Impacts*

**Adapting to Fluctuating Marine Acidification: Physiological and Behavioural Responses of Tropical Estuarine and Coastal Gastropods (Rapaninae: Muricidae)**

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Studies of diverse situations for marine acidification potentially contribute to understanding ecological responses to carbonate acidification of the oceans (OA). Here we investigate physiological and behavioural responses of intertidal gastropod whelks (populations and species) that experience fundamentally different acidity and salinity regimes. We considered two extreme estuarine populations of the euryhaline *Indothais gradata* (Rapaninae, Muricidae) that experience tidally-fluctuating pH ranging between 6.5 and 8.2 units, and a closely-related stenohaline rocky-shore species, *Reishia biturbercularis*. Under acute mineral acidification at two salinities (12 or 25 psu) in the laboratory, the *Indothais* populations maintained similar high levels of cardiac performance down to a remarkably low pH (4.54 - 5.14 units), well below that of the *Reishia* snails (6.7 pH units). CO<sub>2</sub>-acidification however elevated the pH threshold in the *Indothais* snails (6.3 pH units), presumably through an effect of environmental hypercapnia. Physiological and behavioural responses to long exposure (6-12 h) of combinations of stable pH (4, 5 or 6 units) and salinity (12 and 25 psu) revealed a distinct temporal component to acclimatory differences between the *Indothais* populations. The landward population (BD) showed unique slow recovery of depressed heart rates (HRs) and organism activity following abrupt transfer to the experimental conditions. The seaward population showed sustained HR depression and a greater sensitivity to the lower salinity, and, when free to move, these snails became active faster and readily moved to the air-water interface (escape response). The different population responses match differences in tidal variation in water chemistry experienced. This investigation further revealed the importance, when studying gastropods, of identifying isolation behavior in extreme physical environments. Physiological (and metabolic) depression associated with this behavior, to avoid exposure to stressful conditions rather than in response to stress, has different implications for energy balance, fitness and adaptation than stress-related physiology.

*Climate Change Impacts*

**Sublethal Impacts of Ocean Acidification on Larval Urchins:  
Inter- and Intra-specific Comparisons and Implications for  
Population Dynamics**

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Ocean acidification (OA), the reduction in seawater pH associated with dissolution of atmospheric carbon dioxide, is threatening marine biodiversity. Often, the impact of acidification does not manifest as outright mortality but as sublethal effects. Many marine invertebrates have sedentary adults and rely on their planktonic larval stage for dispersal. Larval experience, including exposure to stressful acidification conditions, during early development can be carried over and impact subsequent life history stages. Using an integrative approach, we compared the larval responses of several key ecosystem engineering echinoderms to elevated pCO<sub>2</sub> levels. In addition to growth and metabolic assays, we focused on swimming of larval echinoderms because this performance metric has significant population-level implications: Larvae swim to adjust their vertical positions, which shapes the environmental conditions, e.g., temperature, food abundance, and advective currents, they encounter, and ultimately affect their survival and transport. OA could, however, alter swimming behaviors through changes in overall morphology and hence biomechanics, metabolic activities, or neurotransmissions. In general, we found that a reduction in pH led to a reduction in growth rate, our observations suggested that sensitivity varied significantly between species. For instance, despite adults of the brittlestar *Amphiura filiformis* experience low pH in the sediment, their larvae suffered extremely high mortality (>70%) in a week long exposure, a much higher rate compared to the other echinoids studied. Larval purple urchin *Strongylocentrotus purpuratus* underwent budding (release of blastula-like particles) under low pH and the frequency of budding varied between maternal lineages. Across all three species of larval echinoid studied, *S. purpuratus*, *S. droebachiensis*, and *Dendraster excentricus*, swimming speeds were not impacted by acidification and changes in overall shapes were recorded, suggesting a strong evolutionary pressure to maintain swimming in a varying environment. Our results highlighted the plasticity in larval responses and hence potential to adapt to environmental changes.

*Climate Change Impacts*

**Interactive Effects of Ocean Acidification, Elevated Temperature and Reduced Salinity on Early-Life Stages of The Pacific Oyster *Crassostrea gigas***

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Ocean acidification (OA) effect is a serious concern in southeast Asia, which produces >80% of the world's oysters. Because climate-related stressors rarely act alone, OA effect on oysters in combination with warming and reduced salinity are needed to consider. Here, the interactive effects of these three climate-related stressors on the larval growth of the Pacific oyster, *Crassostrea gigas*, were examined. Larvae were cultured in combinations of temperature (24°C and 30°C), pH (8.1 and 7.4), and salinity (15 psu and 25 psu) for 58 days to the early juvenile stage. Decreased pH (pH 7.4), elevated temperature (30°C) and reduced salinity (15 psu) significantly delayed pre- and post-settlement growth. Elevated temperature lowered the larval lipid index, a proxy for physiological quality, and negated the negative effects of decreased pH on attachment and metamorphosis only in a salinity of 25 psu. The negative effects of multiple stressors on larval metamorphosis were not due to reduced size or depleted lipid reserves at the time of metamorphosis. Our results supported the hypothesis that the *C. gigas* larvae are vulnerable to the interactions of OA with reduced salinity and warming in Yellow Sea coastal waters now and in the future.

*Climate Change Impacts***Social-ecological Conditions and the Vulnerability to Climate Change of Coral Reef Fisheries in the Philippines**

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Coral reef fisheries provide the livelihood of millions of population in the Philippines. However, overfishing and other anthropogenic disturbances, which are further aggravated by impacts of climate change, are seriously threatening the sustainability of coral reef fisheries in the country. In this study, we assessed the social-ecological conditions of coral reef fisheries in more than 50 coastal municipalities in the Philippines. We also developed a tool called Climate Change Vulnerability Assessment Tool for Coral Reef Fisheries (CCVA-CoReFish) to determine the vulnerability of the fisheries to impacts of climate change. CCVA-CoReFish follows the Intergovernmental Panel for Climate Change's (IPCC) framework of vulnerability assessment (VA), where Vulnerability is a function of Sensitivity, Exposure and Adaptive Capacity. It is also patterned from another VA tool we developed called the Tool for Understanding Resilience of Fisheries (VA-TURF), which is designed mostly for localized (i.e. among villages within a municipality) VA. CCVA-CoReFish, on the other hand, is designed to cover much larger spatial scales in order to allow comparison of vulnerability levels among sites that are spatially far from one another (i.e. among municipalities). Like VA-TURF, CCVA-CoReFish also uses three sub-components, namely, (i) fisheries, (ii) coral reef ecosystems, and (iii) socioeconomic, both for Sensitivity and Adaptive Capacity components. For Exposure component, CCVA-CoreFish uses more parameters in addition to wave exposure such as sea level rise and sea surface temperature, which are more relevant for VA assessment<sup>3</sup> over large spatial scales. Results of our study can provide insights to inform policy makers especially in the prioritization of management actions that can effectively and efficiently address the threats of climate change on coral reef fisheries and the millions of highly fishery-dependent population in the country.

*Climate Change Impacts***Effects of Temperature and Salinity on Early Embryogenesis of  
*Acropora valida***A.P.Y. Chui and P.O. Ang

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The early life stages of many animals are often more susceptible to stresses than their adult counterparts. Therefore, these stages may be the bottleneck for successful maintenance of their populations in the future. Given the projected increase in the frequency of storms due to global climate change, increased exposure of coral early life stages to variation in salinity due to heavy rainfall is conceivable. To better understand the possible consequences of the co-occurrence of salinity and temperature stresses on reef building corals in marginal environment, laboratory based experiments were conducted to determine the effects of changes in temperature and salinity on early embryonic developmental success of the newly fertilized eggs of *Acropora valida*, under different temperatures [24, 27, 30°C] and salinities [33, 30, 28, 26psu].

In the present study, rate of embryonic development of *A. valida* was comparable at 27 and 30°C. However, lowered temperature (24°C) significantly decelerated the rate of development. In addition, both temperature and salinity had a significant effect on the percentage of abnormally developing embryos. Under 27°C and 30°C, the percentage of developmental abnormalities was generally low in salinities that ranged from 33 to 28psu, significant increase was observed at 26psu treatment. Similar patterns were also observed at 24°C except that increase in abnormal embryonic development was already observed at a higher salinity of 28psu. These results demonstrated that elevated temperature (30°C), at least that within the average annual maximum, will not cause any developmental failure in this coral species. On the other hand, reduced salinity has the potential to negatively impact the reproductive success of this coral species, and would ultimately lead to substantial decline in sexual recruitment. These results are important for a better understanding of the possible consequences of climate change on reef building scleractinian corals in a marginal environment like Hong Kong.

*Climate Change Impacts*

**Climate Change Drivers Alter Microbial Biofilm Biodiversity:  
Implications on Larval Recruitment**

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The majority of benthic marine invertebrates have complex life cycles, during which the swimming (pelagic) larvae must select a suitable substrate, attach to it, and then metamorphose into benthic adults. This irreversible pelagic-benthic transition is mediated by microbial biofilms.

Because microbial components of biofilms are sensitive to environmental change including climate change, the physiology and composition of biofilm community can reflect local environmental conditions to settling larvae. Many invertebrate larvae are able to distinguish between biofilms of varying density, composition, physiological condition and growth phase, suggesting that microorganisms therein serve as important signposts for larvae seeking a particular kind or class of substratum. Increased dissolution of CO<sub>2</sub> into coastal waters, causes a reduction in seawater pH and carbonate ion concentration, this process is referred to as "ocean acidification" (OA). Emerging environmental stressors such as OA, hot summer with high precipitation and projected scenarios of climate change call for quantitative studies of the effects of OA on biofilm-larval interaction. Recent studies highlights that biofilm communities can adapt to climate change through altered composition. How such altered microbial biodiversity would affect larval recruitment? Recently, a few larval biologists, in collaboration with microbial ecologists, have begun to address this question. This talk will discuss those literatures and unpublished results from our group. According to ours and others recent results, OA appears to disturb microbial biofilm formation process thereby poses a threat to biofilm-larval interaction in future ocean. Our results suggests that future studies should understand how the projected OA and/or extreme changes in environmental conditions alter biofilm and in turn how those changes affect larval settlement and habitat selection.

*Climate Change Impacts*

**Impact of Temperature and Salinity On the Onset of Symbiosis  
Between Scleractinian Coral *Acropora valida* and Various  
Subclades of *Symbiodinium***

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Reef-building scleractinian corals form mutualistic symbiosis with dinoflagellate of the genus *Symbiodinium*, commonly known as zooxanthellae. For coral species that establish symbiosis through horizontal transmission, each new generation must uptake zooxanthellae from the environment. While most coral species form symbiosis with only one single type of zooxanthellae in adult stage, the larvae or juvenile corals appear to be more flexible during the onset of symbiosis.

Impact of temperature (24°C, 27°C, 30°C, 32°C) and salinity (22psu, 27psu, 32psu) on the establishment of coral-algal symbiosis between scleractinian coral *Acropora valida* and three different subclades of *Symbiodinium*, C1, C15 and D8-12, were investigated. Results showed that recruits of *Acropora valida* could be infected by all the three subclades, though only subclade C1 could be found in adult *Acropora valida* in Hong Kong. Recruits provided with *Symbiodinium* D8-12 showed the highest infection percentage in the first 20 days after infection under all temperatures. Though slower, C1 and C15 *Symbiodinium* could still achieve high infection percentage as D8-12 after 32 days, except under 32°C. High temperature (32°C) impaired infection ability of C1 and C15 but not D8-12. Lowered salinities showed little effect on infection percentage.

Mortality of recruits after infection was also monitored. Increased temperature (32°C) caused higher mortality in all subclade treatments and most salinity treatments. Lowered salinity had little effect on mortality. Though having a higher infection percentage, recruits infected with *Symbiodinium* D8-12 did not show a significant difference in mortality from *Symbiodinium* C1 infected recruits under elevated temperature, suggesting that the more thermal tolerant clade D *Symbiodinium* may not be able to help corals to survive if the sea surface temperature continues to increase under the threat of global climate change.

*Climate Change Impacts***The Temporal Change of Marine Endosymbiosis: Evidences from the Lipidomics of Lipid Bodies in a Hermatypic Coral**

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Mutualistic associations are abundant and essential in the marine environment, with the best known being the endosymbiosis between *Symbiodinium* and corals. Understanding the metabolic relationships of endosymbiosis is the most importance. Lipid bodies (LBs) in the gastroderm of hermatypic corals have been identified as the marker organelle for this regulation. Previous studies showed that the endosymbiosis might be dynamic state, based on the fact that the morphology, composition and distribution of LBs varied over the diel cycle. Herein, we focus to examine the lipidomic change of fatty acid moiety from different cell compartments, including the coral host cells, LBs and *Symbiodinium* from sunrise to midnight, in order to understand the temporal change of endosymbiotic regulation. First, among all major lipid species, i.e., wax esters, sterol esters, triacylglycerols, cholesterols, free fatty acids, they exhibited different diel variability in individual compartment of coral. Second, the fatty acid moiety of LBs revealed a dynamic change; an increase in fatty acid concentration at sunrise, and a decrease at sunset. Although the temporal change of fatty acid concentration in host cells and LBs revealed a contrary variation, the results of PCA analysis shown that fatty acid composition of LBs were closed to host cells, and *Symbiodinium* had larger variability over the time. Finally, we now confirm previous study and present detail character of wax ester variation over the diel cycle. Moreover, the fatty acid moiety of TAG in *Symbiodinium* was similar to host cells in daily period. It is evident that there are three different pathways for LB biogenesis: (i) lipogenesis from host cells, (ii) trafficking from *Symbiodinium* then metabolized by host cells and (iii) direct trafficking from *Symbiodinium*. Collectively, these data reveal that not only *Symbiodinium* have a very important bearing, but also coral host was a prominent part in lipid metabolism of endosymbiosis.

*Ecosystem Functions***Do We Have Harmful Benthic Dinoflagellates in Coral Communities in Hong Kong?**

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Among the marine phytoplankton, dinoflagellates, which are often associated with outbreaks of biotoxins, fish kills and also anoxia/ hypoxia events in marine habitats, are the most important causative agents for harmful algal blooms (HABs) and seafood poisoning. Hong Kong is believed to be one of the worst HABs affected areas in the world, among the five major groups of biotoxins produced by marine phytoplankton, four groups are mainly produced by dinoflagellates. Dinoflagellate species that can cause these biotoxin-related food poisonings, including diarrhetic shellfish poisoning, neurological shellfish poisoning, paralytic shellfish poisoning and ciguatera fish poisoning, can all be found in Hong Kong waters. Therefore, it is important to monitor the occurrence of HABs, and biodiversity and distribution of dinoflagellates in local marine habitats.

In the past decades, numerous research studies have focused on phytoplankton biodiversity and ecology, harmful algal blooms and food poisoning associated with dinoflagellates. A database and monitoring programme of red tides (i.e. algal blooms), namely Hong Kong Red tide Information Network by, have also been well established in Hong Kong since 1975 by Hong Kong Government and still maintained by Agricultural, Fisheries and Conservation Department (AFCD). We, therefore, have a well-developed database of biodiversity and ecology of phytoplankton in Hong Kong. However, this monitoring programme and database mainly focus on pelagic forms of diatoms and dinoflagellates, there is still a knowledge gap of benthic dinoflagellates in Hong Kong.

Our study aims to conduct baseline ecological studies and document the biodiversity, habitat and substrate associations of marine benthic dinoflagellates in Hong Kong. The findings would be useful baseline reference for further studies including isolation of benthic dinoflagellates for culture collection, genetic resources development, toxin detection, and relationships between benthic dinoflagellate and environmental changes, and also long-term monitoring and risk assessment of bloom-forming and toxic benthic dinoflagellates in subtidal ecosystems.

*Ecosystem Functions***Study of Contingency between the Spatial Distributions of Gray Whales and Their Feeding Objects Offshore North-East Coast of Sakhalin Island**Y.A. Kriksunov<sup>1</sup>, A.R. Alyautdinov<sup>2</sup>, A.Y. Bobyrev<sup>3</sup> and S.V. Chistov<sup>2</sup><sup>1</sup>Faculty of Biology, Moscow State University, Russia<sup>2</sup>Faculty of Geography, Moscow State University, Russia<sup>3</sup>Institute of Ecology and Evolution, Russian Academy of Sciences, Russia

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The subject of this research is the gray whale *Eschrichtius robustus* that inhabits the northern parts of the Pacific Ocean. The gray whale of the Okhotsk-Korean (or Western) population is classified as critically endangered according to ISEP criteria; current estimate of the total population numbers is approximately 150 specimens. The main feeding area where western gray whales spend their summer-fall period, constitutes a narrow (with depths no greater than 50 m) sea area that runs alongside the coastline over approximately 100 km, and is located in the north-eastern part of the Sakhalin Island. Unlike other cetaceans, the gray whale feed on benthos – the primary components of their ration are bottom-dwelling crustaceans belonging to the groups of *Amphipoda* and *Isopoda*. Systematic research into the western gray whale, initiated by a group of oil companies working offshore Sakhalin, has been going on since 1997. We analyzed the contingency between the spatial distributions of the western gray whales and the biomass of the benthic organisms serving as their food source over the period of 2002-2012. The analysis was conducted using GIS technologies. Cartographic alignment of whale occurrence distribution and the abundance of food benthos demonstrate the high degree of their spatial contingency, thus indicating the important role of the food factor in the formation of the whale spatial distribution. Maximum values of cumulative yearly estimates of sighted gray whales are associated with the areas with the maximum density of benthos. The analysis of the contingency dynamics carried out with an account of the specifics of forage benthos distribution shows that most attractive for whales are shallow vast fields with high and relatively evenly distributed *Amphipoda* biomass.

*Ecosystem Functions*

## **Interactive Corallivorous Activities of *Diadema setosum* and *Drupella* spp.: a Laboratory Based Evaluation**

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Sea urchins are primarily recognized as herbivores and bioeroders in coral reefs. However, the sea urchin *Diadema setosum* commonly found in Hong Kong waters was also reported to be corallivorous. Details of this third role are, however, not well documented. The interaction of sea urchin corallivory with another well-known corallivore, the gastropod *Drupella* spp., is also not well established.

A laboratory based experiment was carried out to evaluate this interaction. Fragments of *Platygyra acuta*, the living tissue of which was observed to be damaged or consumed by the sea urchins in the field, were placed under low (2 ind. m<sup>-2</sup>) and high densities (16 ind. m<sup>-2</sup>) of *Diadema setosum* in controlled condition. After 25 days, 100% of the corals placed under low urchin density survived with limited damage observed. In contrast, only 70 % of corals placed under high urchin density survived and over half of these remaining corals showed an over 15% decrease in intact live tissue area. Large area of live tissue was damaged and the coral skeleton was also observed to be crushed or consumed in the process.

These coral fragments were then exposed to prey choice experiment using the gastropod corallivore *Drupella* spp. These snails were exposed to control corals, and corals previously subjected to the impact of low and high densities of sea urchins for 12 hours at nighttime. *Drupella* spp. were found to be significantly attracted to seriously damaged corals (> 50% damaged area) previously exposed to high density of sea urchins.

These results suggest that sea urchin damaged corals can further be subjected to corallivory by *Drupella* spp. Both urchins and snails are often found together on colonies of *Platygyra* spp. in northeastern Hong Kong waters where the coral species are dominant. The vulnerability of these corals to attacks and damage from these two corallivores could have serious implication on their continuous dominance in the area and can pose a serious conservation problem.

*Ecosystem Functions***Feeding Behaviors of Sea Urchin, *Strongylocentrotus nudus*:  
Preference and Optimal Diet Model**

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A common sea urchin, *Strongylocentrotus nudus*, is the representative herbivore in the east coast of Korea, and their high density has been presumably responsible for urchin barrens in the subtidal areas. This research is carried out to address a few questions regarding the urchin's feeding behaviors including food preference, attractiveness and optimal diet model. Six seaweed species are selected as the potential foods, *Undaria pinnatifida*, *Pachymeniopsis elliptica*, *Sargassum confusum*, *Prionitis cornea*, *Dictyopteris divaricate*, and *Ulva pertusa*. Exp. 1 investigated their food preference using multi-choice cages in flowing seawater tanks after 6-day starvation period. *Undaria pinnatifida* (58.97g) was the most preferred species, followed by *P. elliptica* (33.17g) and *S. confusum* (28.88g), calculated as actual consumption. No other species was consumed significantly. Exp. 2 was then attempted using urchins eaten only *U. pinnatifida* for 7-days to see any difference in preference in relation with optimal diet model. In the first stage of 5 days, *P. elliptica* (7.32g) and *S. confusum* (6.71g) were selectively consumed. However, in the second stage of 5 days, only *P. elliptica* (17.12g) was consumed. Regarding the preference difference depending on urchin size, the larger group (average 101.23g/urchin) preferred *U. pinnatifida* (76.68g), followed by *S. confusum* (37.66g) and *P. elliptica* (34.40g), whereas the smaller urchins (34.01g) preferred *U. pinnatifida* (41.27g), followed by *P. elliptica* (31.94g), *S. confusum* (20.11g). The larger urchins grew 3.56% and the smaller urchins grew 7.68% for 10 days of experiment. Exp. 3 was designed to investigate their attractiveness using 3 groups of urchins: starved group, *Undaria*-eaten group, all-eaten group. In the starved group, the preference of attractiveness was shown *U. pinnatifida* (21 urchins stayed during the beginning 6 hours), *U. pertusa* (18), *P. elliptica* (14), *P. cornea* (5), *S. confusum* (3). In the *Undaria*-eaten group, *U. pertusa* (22), *S. confusum* (11), *U. pinnatifida* (1). In the all-eaten group, only *P. elliptica* (8) was attracted by urchins. Our results indicate that sea urchins most preferred *Undaria* basically, but their 1st choice can be changed according to past feeding history or optimal diet model. Differences between actual consumption rate and attractiveness indicate the possibility of containing defensive chemicals in some species of macroalgae.

*Ecosystem Functions*

**Bioerosion and Growth of Massive Corals in Hong Kong**

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Coral community development reflects the balance between coral erosion and growth. Such a balance has been disrupted by severe bioerosion at some localities in Hong Kong. We report the results of an ongoing study aiming to quantify the bioerosion and growth of massive corals in local waters through: 1, field surveys to determine the pattern of bioerosion by quantifying boreholes on live massive corals and sedimentation rate from 33 sites across Hong Kong; 2, collection of coral samples from 10 sites to determine the patterns of coral growth and internal bioerosion along estuarine to oceanic and sheltered to exposed gradients; and 3, exposure of dead coral skeleton under the two environmental gradients in the field to quantify changes in calcium carbonate (accretion vs. erosion). These surveys and experiments will help us better understand the status and causes of coral erosion and growth, and provide useful information for a better management of coral ecosystems in this region.

*Ecosystem Functions*

## **Modelling the Emergence of Complex Phage-Bacteria Infection Networks – from Marine Ecosystems to Dynamic Models**

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Bacteriophage are ubiquitous in marine ecosystems ranging from the ocean surface to deep sea sediments. The interactions of phage and bacteria strongly influence global biogeochemical cycles, microbial diversity and carbon cycle in marine food webs. Such large-scale effects are thought to be the result of the cumulative effects of specific pairs of interactions among viruses and hosts. Instead, a recent series of studies have revealed intriguing patterns of cross-infection amongst phage and bacteria (see the review in Weitz et al., *Trends in Microbiol*, 2013). Phage-bacteria infection networks can exhibit a nested pattern, where relatively highly-resistant bacteria are infected by generalist phages and relatively susceptible bacteria are infected by generalist and specialist phages (Flores et al., *PNAS* 2011). Cross-infection networks of marine bacteria and phage exhibit modular patterns with groups consisting of phages and bacteria that interact strongly within the group but not between groups (Flores et al., *ISME J* 2013). The mechanism for the emergence of these patterns is not well understood. Here, we propose a simple model of phage-bacteria infection networks that takes into account the conflict of interest between phages and bacteria, i.e. infection is beneficial to the phages but (usually) detrimental to the bacteria. We show that our model can dynamically generate nested and modular networks, as well as a coexistence of nestedness and modularity that has been observed empirically. Our results indicate that nestedness and modularity in phage-bacteria infection networks can be generated by basic principles. We discuss ways to extend these principles to the study of complex marine ecosystems.

*Ecosystem Functions*

**Assessing Coral to Algal Phase Shifts in Marcos and Magsaysay Reefs  
Pangasinan, Philippines**

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The population outbreak of corallivores *Acanthaster planci* have cause eminent damage to coral tissues near Magsaysay and Marcos Islands, Pangasinan, Philippines last 2010. The predation eventually led to the death of several coral colonies. Along with the deterioration of the coral tissues, an increase in nutrient conditions were also observed. This eventually promoted the proliferation of brown macroalgae, notably *Sargassum*, *Padina*, *Hormophysa*, *Turbinaria*. After four years, an initial assessment in these areas was conducted to study the health of these coral reef ecosystems. A survey on the coral and algal abundance, cover and diversity and a fish visual census were conducted in each reefs. Physico-chemical parameters such as salinity, temperature and water clarity, water motion and sedimentation rates were also measured. We observed that Marcos coral reef have greater percentage macroalgal composition and cover than the Magsaysay coral reef. The findings suggest a coral-algal phase shift in the Marcos reef while the Magsaysay reef retained a coral dominated community.

*Ecosystem Functions***Effects on Primary Producer Diversity on Material Cycle and Shellfish Aquaculture in A Subarctic Lagoon In Hokkaido, Japan**Abe Hiroya and J. Kishi Michio

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Seagrass beds constitute extremely productive ecosystems in shallow coastal areas and have complex structure. Various primary producers (i.e., phytoplankton, seagrass, epiphyte and microphytobenthos) exist and these biomasses greatly varied seasonally. Moreover, dense shellfish aquaculture activities are seen in seagrass beds (oyster) and in tidal flats (clam). Due to complexity of seagrass ecosystems, in situ observation of all primary producer dynamics and evaluation of roles for each primary producer in material cycle are difficult. There have been few numerical models dealing with the role of multiple primary producer. So, we developed three-dimensional ecosystem model (pelagic-benthic coupling): 1) to describe fluctuations of each primary producer biomass and production, 2) to clarify relationships between seagrass beds and sustainable shellfish aquaculture, 3) to evaluate responses to environmental change arising from global warming and anthropogenic effect. We conducted numerical simulation focusing in a subarctic lagoon (Akkeshi Lake), in eastern Hokkaido, the northern island of Japan, where wide eelgrass beds (*Zostera marina*) are spread and shellfish aquaculture farms are popular. Focusing attention on microalgae chlorophyll a (Chl-a) biomass per unit area, epiphyte showed high standing stocks compared with pelagic phytoplankton (over 10 times higher) during summer in eelgrass beds, while microphytobenthos constituted of most standing stocks in tidal flats. In the lake, contribution of pelagic phytoplankton was low due to shallow depth and high grazing pressure by suspension-feeding bivalves. Primary production showed the same trend as biomass. Moreover, suspended microphytobenthos occupied high ratio in the water column production. Oyster and clam growth were sustained mainly by dead epiphyte and suspended microphytobenthos, respectively, in lake. This model can be used to evaluate 1) the relationship between microalgal diversity and ecosystem function (primary production), and 2) sustainable shellfish aquaculture.

*Ecosystem Functions*

**Symbiotic Fauna of the Natural and Artificially Planted  
Scleractinian Coral *Pocillopora meandrina***

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Branching corals are inhabited by rich multicellular symbiotic fauna that play an important role in host's life. This fauna consists of species with different level of fidelity to their host (obligate and facultative symbionts).

The goal of our study was to find correlation between species composition, species number and abundance of symbiotic fauna on planted corals and duration of its exposition, and comparison of fauna of planted corals with that of natural corals.

Our experiment situated in Nha Trang Bay, Vietnam. Forty triangular frames were mounted at the depth of 3-5 meters. In spring of 2012 three fragments of natural *Pocillopora meandrina* were attached to each frame by wire. In autumn of 2012 and spring of 2013 one coral head was picked from each frame (80 heads totally). Also 28 natural coral heads were examined. Extent of corals was measured and symbionts were washed from it. Then number of individuals of each species that were bigger than 3 mm on each head was counted.

Average extent of coral heads almost two folded. Totally 34 species were found, 30 of which were decapod crustaceans. Average species number and abundance of obligate symbionts per coral were higher in 2013 than in 2012 and the highest in natural colonies. Natural corals had higher species richness and abundance of facultative symbionts than planted corals, while there was no difference between 2012 and 2013 in planted corals. Difference between 2012, 2013 and natural colonies in regard to obligate symbiotic fauna is possibly caused by duration of exposition period, the number of settled larvae of symbiotic organisms increases in time. Differences in facultative symbiotic fauna, that can move freely over the bottom between natural corals, are caused by design of our experimental frame that elevate corals heads so the possibility to get to the colony is restricted.

*Ecosystem Functions*

## **Does Low Tide Behaviour of A Keystone Grazer Influence High Tide Foraging?**

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A fundamental problem in ecology is to link spatial arrangements of key biota and the scale at which these organisms affect ecosystems. Limpets are widely acknowledged to play an important role in the ecology of intertidal rocky shores and exert the strongest grazing effect of any marine grazer. As a consequence, to understand rocky shore dynamics we need to investigate what controls when and where foraging occurs. Whilst much is known about limpet behaviour and distribution whilst at rest, and foraging patterns, it is less understood how the behaviour and distribution of individuals within these two phases of activity may influence each other. Limpets exhibit population-level biases in orientation during low tide and if a limpet's orientation influences where and when it forages, this bias may lead to a directional bias in foraging direction during high tide and patchy grazing effort. Additionally, where a limpet has been foraging may also correlate with their subsequent orientation. We tested these ideas using an Australian limpet (*Cellana tramoserica*) and compared an individual's low tide orientation with foraging frequency, departure angle and foraging location. We found that though there was an overall bias in departure angle and foraging location, there was no relationship between an individual's low tide orientation and departure angle nor foraging location. There was also no link between the direction of travel of limpets returning from foraging and their final orientation. Limpets instead actively selected their orientation and departure direction by rotation on their resting site. Our findings suggest that there is no direct link between an individual's orientation and subsequent foraging, nor vice-versa. These results decouple the small scale distribution and orientation of grazers with their ecological functioning and suggest that noting where limpets are at low tide is not useful for predicting ecological consequences of their grazing.

*Marine Ecology*

## **Comparing Coral Reef Conditions Before and After Typhoon Haiyan in Concepcion, Iloilo, Philippines**

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This study assessed the impact of typhoon Haiyan (locally known as Yolanda) in five Marine Protected Areas (MPAs) in Concepcion, Iloilo, Philippines. Live hard coral cover was assessed employing the line-intercept transect (LIT) while reef fish was assessed with fish visual census (FVC). Results of the assessment were compared with surveys conducted before the typhoon. Coral lifeform and MPA locations were found to greatly influence the effect of typhoon, with areas dominated by branching and foliose corals being severely damaged as compared to sites with massive, sub-massive and encrusting lifeforms. Overall mean live hard coral cover decreased by 24%, from 47.1% in 2012 to 35.8% in 2014. Despite this decrease in coral cover, reef fish abundance, biomass and species richness seemed to improve after Haiyan. Thus, other factors may have contributed to the improved reef fish condition. The decrease in fishing effort due to unavailability of fishing boats after the typhoon could have led to the good reef fish condition, or it could be due to enhanced management and effectivity of MPAs, or could be the effect of banning the Danish seine operation in the area. Whichever situation is true is unclear, thus, further study is recommended to answer the above question.

*Marine Ecology*

## **Multispecies and Multi-Gear Fisheries in the Iloilo River, West Central Visayas, Philippines**

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Despite its importance in serving the transportation and food requirements of the highly urbanized area where it is located, the Iloilo River, a tidal seawater inlet, has received minimal research attention. Fisheries data recorded in 2007 through roving surveys and daily monitoring, showed the use of a total of 8 gear types, with fish corrals, motorized push nets, and hook and line providing 90% of the total catch. Total annual fisheries production in the river ranged from 45-62 mt yr<sup>-1</sup> which translates to a yield of 5.2-7.1 mt km<sup>-1</sup> of riverbank yr<sup>-1</sup>. These are much smaller compared to yield estimates (9.2-90.8 mt km<sup>-1</sup> of coastline yr<sup>-1</sup>) from various coastal fishing grounds in the country. Although the River provides easy access and income to the fishers who live in the vicinity, there is an urgent need to manage its fisheries, particularly the corrals and push net whose combined catches (82.7% of total catch in the river), are made up primarily of shrimp (59.4 and 45%, respectively), which are individuals of the Sulu Shrimp, *Metapenaeus suluensis* (Racek & Dall, 1965). There are only a few records of this species and it is reported to be endemic to the Sulu Sea. Since only juveniles have been observed so far, it is possible that the River is a critical habitat for the Sulu Shrimp.

*Marine Ecology*

## **Blood Parasite Biodiversity of Reef Associated Fishes of the Eastern Caribbean, with Comments on Their Ecology Relevance**

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Understanding the biodiversity and function of microorganisms lies at the frontier of research on coral reef biocomplexity. Many microorganisms are parasitic, living inside of other organisms and thus often ignored in biodiversity surveys. Examples of these include apicomplexan protozoans that may infect the blood of vertebrates. No extensive surveys of their occurrence, or the occurrence of any other potential blood parasite in coral reef fishes have been undertaken since the 1960's, and inferences from such studies are limited. Thus, an understanding of the biodiversity and ecology of protozoan and other blood parasites on coral reef fishes requires renewed biosurvey efforts involving multiple fish species at multiple localities. In the most comprehensive survey of blood parasites of coral reef fishes to date, 1298 blood samples were examined from wild-caught reef fishes from 6 islands in the eastern Caribbean, and representing 27 families, 57 genera and 103 species, including invasive Indo-Pacific lionfish. Some members of 14 species from 8 families were found to be infected, including damselfish (Pomacentridae), parrotfish (Scaridae), mullet (Mugilidae), jacks (Carangidae), blennies (Blenniidae and Labrisomidae), snappers (Lutjanidae), and angelfish (Pomacanthidae). None of the blood parasites found conformed to the description of any of the previously reported parasites from the Caribbean. Parasites found resembled in morphology typical *Haemogregarina*-like intraerythrocytic parasites as well as *Haemohormidium*-like parasites collected from fishes on the GBR, Australia. In total, eight distinct types of blood parasites were found. Gnathiid isopods, an apparent vector of some apicomplexan blood parasites in other systems were common at the collection sites. When gnathiids were allowed to feed on blennies infected with *Haemogregarina*-like parasites, the parasites were taken up by and remained viable in the gnathiids. However, no reproductive stages were found. By comparison, when gnathiids fed on *Stegastes* damselfish infected with a *Haemohormidium*-like parasite, no parasites were found.

*Marine Ecology*

**Phytoplankton from the Southern Coast in the Gulf of México:  
Biodiversity, Ecology and Biogeography (2005-2014)**

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For this study eight sampling periods in 36 sites (9 coastal lagoons, 7 river inlets and 4 coastal localities) were surveyed between November 2005 and December 2014. Surface water samples analyses by Utermöhl method revealed the presence of 279 species of the group Bacillariophyceae, 114 to Dinophyceae, 39 to Cyanophyceae, 35 to Chlorophyceae, 23 to phytoflagellates, 7 to Euglenophyceae, 7 to Cryptophyceae, 6 to Prymnesiophyceae, 2 to Prasinophyceae, 2 to Dictyochophyceae, 1 to Chrysophyceae and 1 to Raphidophyceae. Results of quantitative analyses show a wide variation from 1880 to 92.6 million of cells L<sup>-1</sup>. Of these, 54 species had algal blooms with 37 associated, 14 no massive, 2 massive and one hypermassive. *Cylindrotheca closterium* and *Thalassionema nitzschioides* were the most frequent species. Physiochemical and biotic variables (salinity, temperature, pH, total nitrogen: total phosphorus, chlorophyll-a, frequency, dominance, species richness, diversity and life-form) were obtained by traditional methods. Thus a value of moderate water quality was obtained. Statistical analyses (minimum variance) were used to classify the sampling sites, as well as with other localities in the country in order to stablish characteristic habitats in both cases. It is concluded that limnetic to beta-oligohaline species which are thrown into the sampling sites can change the water quality.

*Biodiversity Conservation*

## **Biodiversity and Conservation of Macao's Mangroves**

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Mangrove forests are one of the most ecologically valuable and biologically diverse coastal ecosystems in the world. Macao, a coastal city situated on the west shore of the Pearl River, is at present home to several species of mangroves with many other associated flora and fauna. Extensive land reclamation and massive urban developments in the area over the past decades have significantly reduced the mangroves area. In 2001, the Macao SAR government established a 50 ha ecological zone as a protected area in which around 40 ha are mangroves, around 33% decline compared to an estimate published in 1998. This ecological zone play a very important role in Macao's ecological balance and caters for around 300 species of plants, 42 species of mollusks, 300 species of insects, 13 species of crustaceans, 35 species of fishes among many others. It is also an important habitat for around 300 species of endemic and migratory birds. The remaining mangroves in Macao which are in the coastlines of Taipa and Coloane are vulnerable to threats due to pressures from developments in the area. The government has been doing conservation and restoration efforts in this area by planting samplings and introducing the structurally dominant and fast-growing species *Sonerattia apetala*. Other strategies such as environmental education and scientific research are being done by universities and other institutions to promote the protection of this important ecosystem.

*Biodiversity Conservation*

## **Phenology and Litterfall Dynamics Structuring Ecosystem productivity in a Tropical Mangrove Stand on South West Coast of India**

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The litterfall dynamics contributing to Net Primary Productivity (NPP) and phenology in three major mixed mangrove habitats in Cochin estuarine system, South -West coast of India. Eleven true mangrove species and three mangrove associates were formed the plant biomass where *Avicennia officinalis* was abundant in Site 1, *Excoecaria agallocha* in Site 2 and *Avicennia officinalis*, *Rhizophora mucronata* were abundant in Site 3. Total tree density varied from 11760 stems ha<sup>-1</sup> in Vypin Island (Site 2); 11440 stems ha<sup>-1</sup> in Mangalavanam Bird sanctuary (Site 3) and 7680 stems ha<sup>-1</sup>, Aroor (Site1). The average stands basal area of the three mangrove habitats were 75.54, 54.85 and 103.26 m<sup>2</sup>ha<sup>-1</sup>. The mean annual litterfall production in Cochin mangroves was 16.57± 6.58t ha<sup>-1</sup>y<sup>-1</sup> in which leaves (53.90 %) contributed more followed by flowers, propagules (28.66%) and twigs (17.44%). The spatial variability in litterfall recorded highest in lower latitudinal mangrove habitat, Site 1 followed by Site 2 and Site 3 (2413.36 ± 873.72, 1295.65 ± 401.09, 1263.28 ± 255.28 g DW m<sup>-2</sup>y<sup>-1</sup>). Site differences in litter production were statistically significant (one- way ANOVA p < 0.001 for total litterfall and p <0.05 for litter components) between the three mangrove habitats. Litter components and total litterfall showed significant seasonality (p < 0.001). Highest litterfall was recorded in pre-monsoon period followed by post-monsoon and least in monsoon period. The temporal trend of litterfall was explained through mean atmospheric temperature and rainfall and a positive correlation was there to atmospheric temperature during the period. The mean carbon content in the litterfall was estimated as 42.96% of the dry weight and the primary productivity through litterfall in the study area was estimated to be 7.12 ± 2.81 t C ha<sup>-1</sup>y<sup>-1</sup>. This will act as the major source of carbon input to the mangrove ecosystem and surrounding coastal ecosystems and in turn reflected in NPP.

*Biodiversity Conservation*

## **Links Between Benthic Invertebrate Community Structure and Abiotic Factors in Fragmented Mangrove Habitats**

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Mangroves, hotspots of diversity and productivity, play an essential role in the functioning of coastal zones and provide a multitude of crucial services to local populations. Nevertheless, these ecosystems are among the most threatened in the world: 35% of their global cover has already disappeared and the decline continues at a rate of 2% per year. The conservation of this fragile ecosystem is a national priority in many countries, among others Vietnam. In order to establish efficient conservation strategies and management plans we urgently need to improve our understanding on the responses of mangrove ecosystems to the global changes that menace these coastal wetlands. In Southeast Asia, mangrove ecosystems are particularly threatened by habitat fragmentation mainly due to land reclamation for urban development, aquaculture and agriculture activities. Habitat fragmentation inevitably leads to an increase in the amount of transition zones or habitat edges. Here organisms are exposed to a sharp change in light regimes, microclimatic conditions, food availability and predation pressure. The sharper the difference between natural habitat and altered habitat is, the stronger is the so-called "edge effect". We will present the results of an experimental study on the link between benthic invertebrate communities, biogeochemical properties of the substratum and micro-algal food sources, in the context of mangrove habitat fragmentation. This study was carried out in the Red River Biosphere Reserve in Northern Vietnam.

*Climate Change Impacts*

**Resilience to Climate Change Induced Coral Bleaching Events in the Andaman Sea**

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Several studies have conducted resilience assessment of coral reefs after natural and anthropogenic disturbances. Coral reefs across the world are under increasing pressure from climate change induced coral bleaching events. After mass coral mortality, coral recruitment is an important factor influencing coral recovery and plays a major role in population dynamics and maintains healthy coral populations. Elevated sea water temperatures in summer months of 2010 were associated with mass coral mortality in the Andaman Sea. A large number of corals at most reef sites in the Andaman Sea exhibited high mortality rates following the bleaching event. The present study aims to examine coral recovery patterns at Mu Ko Surin and Mu Ko Similan in the Andaman Sea following the 2010 coral bleaching event. The densities of coral recruits varied significantly among the study sites and were obviously observed at certain reef sites in the western side of the islands. The juvenile corals showed distinguishable colonization between several types of substrate but it was the highest on dead laminar corals. At least, thirty eight genera of juvenile corals were observed. The juvenile coral densities of *Fungia* and *Acropora* were relatively high. The taxonomic composition of coral recruits on settlement panel experiments revealed that Acroporidae, Pocilloporidae, Poritidae and some identified coral recruits were dominant. Recruitment rates on the settlement panel varied greatly among reef sites and study periods. Coral recruitment might not be a limiting factor for recovery of coral communities at these study sites. Some mitigation measures are needed to cope with additional anthropogenic stressors in order to enhance coral recovery after the climate change induced coral bleaching events. The present study provides insights into the degree to which coral reefs in the Andaman Sea are resilient to climate change based on empirical scientific evidence.

*Climate Change Impacts*

## **Climatological Mixed Layer Dynamics and Its Impact on Phytoplankton Biomass in an Altered River Estuary**

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The influence of the variation of mixed layer depths and critical depth on the distribution of phytoplankton biomass was investigated over an annual cycle in Youngsan river-estuary. Five stations along the axis of river-estuary were sampled monthly from January to December, 2011. Depth profiles of temperature, density and light were obtained to examine the climatological water column characteristics. Water samples were collected to estimate phytoplankton biomass using fluorometric determination of chlorophyll a concentration (Chl a, mg m<sup>-3</sup>). Findings showed that phytoplankton biomass depends on the photic, thermal and pycnal characteristic of the water column, which were found to vary temporally. Variation of Chl a within the euphotic and mixed layers was shown to have an opposite relationship to the interaction between MLD and critical depth. This suggests that Chl a decreases with increasing MLD relative to the critical depth. This was consistent on the observed variation in the average Chl a within these layers between pycnally characterized water columns, where the levels in the mixed water columns were lower than the levels in the stratified water columns. The findings suggest that vertical mixing distribute phytoplankton throughout the water column while stratification of water masses allows phytoplankton to maintain their vertical distribution. Also, variation of Chl a was also attributed to the average irradiance within the mixed layers. This study showed the impact of water column climate on phytoplankton biomass, indicating that climate induced changes could possibly affect phytoplankton by intensifying the environmental alterations (i.e. blocked estuarine circulation, water quality degradation and sedimentation which were documented since the construction of the dike in 1981).

*Ecosystem Functions***Structure and Dynamics of Nematode Assemblages on the Marginal Sea Sediments of the Northern Yellow Sea: Relationships with Seasonal Changes in Cold Water Mass**

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Quantitative samplings were conducted on nematode assemblages from the marginal sea sediments of the Northern Yellow Sea on a seasonal basis (from July 2006 to October 2007). Previous study suggested that meiofaunal abundance and biomass showed significant seasonal changes, with higher values in spring-summer than those in autumn-winter; spatially meiofauna tended to decrease in abundance and biomass from the edge towards the centre of the Yellow Sea Cold Water Mass (YSCWM), especially in summer. The present study further investigated structure and dynamics of the nematode assemblages in relationships with seasonal growth and decline of the YSCWM.

A total of 120 nematode morph species were identified, with a mean species richness of  $S=39\pm 11$  per station,  $E_s(100)=24.6\pm 0.6$ , Shannon-Wiener  $H'(\log_2)=3.9\pm 0.6$ , evenness  $J'=0.8\pm 0.1$ . Comparison of species and taxonomic diversity indices among the six stations along the C5 transect indicated lower species diversity, but higher taxonomic and phylogenetic diversity in the central stations of the YSCWM.

Two-Way Crossed ANOSIM (no replicates) test on the community structure of the nematode assemblages showed significant spatial difference ( $\rho=0.568$ ,  $P=0.007$ ) but insignificant seasonal dynamics ( $\rho=0.206$ ,  $P=0.115$ ). Test on the functional structure based on feeding types and biological traits, however, showed no significant spatial difference ( $\rho=0.139$ ,  $P=0.180$ ) while as seasonal change was significant ( $\rho=0.434$ ,  $P=0.024$ ).

BIOENV correlation analysis revealed that YSCWM had the greatest impact on the community and functional structures of nematode assemblages in summer, but the effect declined with the decline of YSCWM in autumn and winter when water depth and food supply in the sediments and from the overlying water column became more important environmental factors.

*Ecosystem Functions***Benthic and Epiphytic Toxic Algae (BETA): an Emerging Threat to Coral Ecosystems**

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*Gambierdiscus* is a genus of benthic and epiphytic toxic algae (BETA) which are of increasing interest as most of them can produce potent ciguatoxins (CTXs). They are confirmed to play a role in ciguatera fish poisoning in humans, which is one of the most common forms of phycotoxin-borne seafood illness across the globe, affecting 50,000 – 500,000 people annually. Recent studies indicated the presence of BETA in Asia-Pacific regions. A new *Gambierdiscus* species named *G. scabrosus* was described from Japan. CTXs have also been detected in coral reef fishes collected along the coast of south China and Taiwan. Recently, *Gambierdiscus* and *Ostreopsis*, together with numerous unidentified benthic dinoflagellates were isolated from rocky and coral habitats in Hong Kong waters. These snapshot studies indicated that BETA exist in the South China Sea, and some of them could well be new and toxic species.

Attention has been recently paid to the ecological impacts of BETA. A number of laboratory and field studies have proven that CTXs may not only lead to human health problems, but also induce mortalities of crustaceans, sea urchins, fishes and marine mammals. Predators of high trophic levels may generally be exposed to greater levels of phycotoxins via their diets and therefore are at higher risk associated with BETA. It is conceivable that predators in a BETA-affected coral ecosystem could be eliminated by phycotoxins, causing an elevated abundance of CTX-resistant grazers. The excessive grazing pressure could result in a top-down effect on primary production via over-grazing and cause a reduction in coral recruitment and larval growth rate, and even induce the external bioerosion of corals. Hence, BETA may not only lead to impacts at an individual or population level, but affect the coral ecosystem as a whole. The dislodgement and fragmentation of coral networks could also promote BETA proliferation, intensifying their adverse impacts on coral ecosystems. Over time, there could be a cascade effect on the structures, functions and food web dynamics of coral ecosystems.

*Ecosystem Functions*

**Benthic Microalgal Diversity and Primary Production in Korean Tidal Flats**

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A historical review on the studies of benthic microalgae (BMA) on Korean tidal flats has been made. The internationally recognized topics related to the tidal flat BMA were shown to be assemblages, dynamics, primary production, and food web etc. Accordingly the chronology of the BMA studies in Korea was presented in the given topics, evaluating pros and cons of individual scientific efforts and data. In particular the summary of the several representative works (e.g., highly cited papers) corresponding to each topic of interests was provided. The worldwide studies of tidal flat MPBs during and after the last century generally reflected the target balanced and logical development of varying subjects. While over half a century of scientific gap between Korea and European countries were evidenced both in number and quality of publications, a rapid scientific advancement in Korea during the recent 10 years is also noted. Scientific interest in the floral assemblages of MPBs was found to be steady in Korea with documentation of >400 diatom species from the Korean tidal flats. Recent progress in diatoms taxonomy is also noteworthy with description of ca. 10 diatom species news to science supporting the biodiversity of the Korean tidal flats. In addition the selected data from the previous and current MPBs works encompassing above 4 topics were reanalyzed as part of the present review, and our key ecological findings have been highlighted. Finally future research direction was discussed and suggested through comparisons between worldwide versus Korean studies in diverse perspectives e.g., logic, methodology, and also scientific recognition. In conclusion, the future MPBs studies in Korea would support high biodiversity and unique biogeography of MPBS in Asian tidal flats, yet certain limitations in scientific recognition and/or methodological weakness are to be overcome.

*Ecosystem Functions*

**More Than Just a Pretty Mantle: the Ecological Importance of Giant Clams (*Bivalvia: Cardiidae: Tridacninae*) on Coral Reefs**

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Giant clams are large and colourful bivalves that are ubiquitous across the present-day tropical Indo-Pacific. These bivalves have long been associated with coral reefs, where they are assumed to play various ecological roles. These roles, however, have never been fully elucidated. In this study, we show how giant clams are important providers of food and shelters, and function as reef builders and shapers. As a food source, giant clam tissues are attractive to predators and scavengers, while opportunistic feeders exploit their discharges of live zooxanthellae, faeces and gametes. Giant clam shells provide substrate for epibiont colonisation, while reef fishes, commensal and parasitic organisms live within their mantle cavities. Populations of giant clams can enhance the topographic relief of reefs, act as reservoirs of zooxanthellae, and also potentially counteract eutrophication via water filtering. Lastly, dense populations of giant clams can produce large quantities of calcium carbonate shell material that is eventually incorporated into the reef framework. Globally, giant clams are facing pressures of overfishing and habitat loss, resulting in extirpations that are likely to affect coral reefs negatively. Identifying the ecological roles of giant clams is an important step in strengthening the case for their conservation.

# Abstracts of Breakout Groups

*Environmental Education*

## **Sources of Environmental Knowledge on Shark Conservation Among Primary Students in Hong Kong – a Preliminary Study**

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One of the principal means in conserving biodiversity is to avoid the extinction of current existing organisms, especially on those endangered ones. Sharks, being the apex predators in marine ecosystem, face the risk of extinction due to the increasing anthropogenic threat. Although conservation of sharks has become a global concerning issue in the recent decades, recent studies have revealed that negative perceptions and misconceptions about sharks are widespread in young children in Hong Kong, one of the major shark-fin trading centres in the world. Such misunderstandings and negative attitudes developed among students in this trading centre with large consumption would be undesirable for the global conservation. Effective environmental education is an essential foundation for the sustainable success of shark conservation. Appropriate educational approach may promote the conceptual understanding and positive perception of children in this strategic place. While the acquisition of relevant environmental information is certainly not limited to formal education in school, it is noteworthy to investigate the source of environmental knowledge and information that the students acquire. This study, thus, aimed at examining the correlation between children's perception of shark, the conceptual understanding of sharks-related ecological knowledge and a variety of information sources in Hong Kong senior primary students, so as to pinpoint the most influential source of information in contributing students' perception and understanding about shark. On the bright side, we would identify the most effective platform in disseminating the information on shark conservation. The results showed the positive correlation between the conceptual understanding and the sources of TV documentary and readings. Types of reading materials and reading time are also correlated with their conceptual understanding of the issues on shark conservation.

*Environmental Education*

## **A Scenario-based Learning Strategy for Constructing the Concepts of Biological Classification and Marine Biodiversity in a Teacher Training Workshop**

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Misconceptions in biological classification are commonly found in both children and adults. Understanding the concepts of phylogeny may facilitate the learning of biological classification. A scenario-based learning strategy is immersed into a scientific inquiry activity developed for a teacher training workshop. This teacher training workshop is a tendering service aiming to provide professional development to primary school teachers responsible for teaching the subject General Studies. An interesting scenario motivates and probes the in-service teachers to learn actively in the workshop. Concepts of phylogeny or evolution and skills of biological classification are embedded in a series of interactive learning activities. Through a scientific inquiry and 'learning-by-doing' approaches, learners construct the concepts through trials and practices. The concepts and skills acquired from the interactive learning session will be further consolidated through a practical session on understanding the marine biodiversity and differentiating marine creatures. The strategy and the teaching flow will be elaborated and discussed in details in the seminar.

*Environmental Education*

## **The Use of Innovative Programmes in Marine Environmental Education**

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Hong Kong water nourished amazingly high marine biodiversity. However, marine environment have received far less attention compared to other habitats in Hong Kong from the public. In order to promote the marine biodiversity conservation in Hong Kong, it is essential to increase the awareness of the students so they can take actions on marine biodiversity conservation and act as messengers to spread the message to their family. This presentation will share the experience of using innovative programmes to equip students with knowledge of our unique marine environment and increase their awareness to marine biodiversity conservation. The change of their behaviour after joining the programme will also be shared in the presentation.

*Environmental Education*

## **Marine Conservation Education for Primary and Secondary Schools**

Wai Chin Li<sup>1</sup>, Wing Kuen Chow<sup>2</sup>, I Ha Eva Loi<sup>2</sup>, Chi Chiu Cheang<sup>1</sup>, Lincoln Fok<sup>1</sup>,  
Yiu Fai Tsang<sup>1</sup> and Kwok Ho Tsoi<sup>1</sup>

<sup>1</sup>Department of Science and Environmental Studies, the Hong Kong Institute of  
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China

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In the last two decades, a lot of effort has been put into protection of Hong Kong's marine environment. The environment, ecology and conservation strategies are all excellent teaching resources for executing environmental education in local schools. In 2013, Agriculture, Fisheries and Conservation Department (AFCD) has commissioned the Hong Kong Institute of Education (HKIED) to develop an educational programme to promote our marine environment, its ecological value and marine conservation work among Hong Kong local schools. The programme provided innovative and comprehensive education kits and web Apps for primary and secondary schools as well as school visits and field studies to effectively deliver marine ecological knowledge and messages of marine conservation to local students. The programme also involved a "train-the-trainer" project in which AFCD organized informative marine conservation seminars, field trips and poster competition for undergraduate students in HKIED who helped to provide interactive school talks for primary and secondary school students. All these activities target to educate the young generation our marine environment and raising their concerns and awareness on marine conservation issues and equip the potential teachers from HKIED with essential marine conservation knowledge and field experience in their future career.

*Climate Change Impacts*

## **The Challenges of Defining Winners and Losers: Understanding Global Climate Change Requires Global Scientific Responses**

Gray A. Williams

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Trying to understand the implications of global climate change is probably the greatest, and most important, challenge to ecologists. Numerous researchers have devised excellent approaches to achieve this, but often these are narrowly focused, or limited in scope and application. Trying to devise a more holistic framework to answer the question of which species will be winners and or losers requires a more collaborative, interdisciplinary and integrative approach. One such approach, as advocated by Somero, is to study genotypic and phenotypic relationships in closely related taxa to environmental stressors over wide geographic scales. Such a large geographic scale approach is not trivial, especially in SE Asia, and requires quality assured methodologies and great logistical determination. The importance of deriving standard testing procedures and their application will be highlighted using a case study of thermal stress in littorinids from Japan to Singapore. A further application of standard protocols to assess species' performance under changing environmental conditions will be discussed, looking at the application of Dynamic Energy Budget models (DEB) to predict life history variations in bivalve species. Ultimately, the integration of different approaches, using standardized protocols among a collaborative network of researchers, is advocated as a fundamental prerequisite to empower scientists to understand global climate change on the scale which is necessary to make informative predictions.

*Climate Change Impacts*

## **Unexpected Ecosystem Change: the Role of Multiple Stressors and Underlying Mechanisms**

Bayden D. Russell

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There is a rapidly increasing interest in both predicting and understanding the effects of climate change in marine ecosystems. Yet, this current flurry of research often ignores the effects of the combination of multiple stressors, in particular where local stressors (e.g. nutrient pollution) will combine with the increase in temperature and CO<sub>2</sub>. While these stressors in isolation can have relatively small effects on individual fitness and system function, when combined they can drive catastrophic system collapse. I will draw together recent work to identify the effects of multiple stressors in subtidal marine systems and discuss how they can drive ecosystem shifts. I will then discuss how recognition of the underlying physiological mechanisms and functional role of key species can be used to identify the potential for ecosystem shifts before they occur and management tools that can limit their impact.

*Climate Change Impacts*

## **Climate Change and Intertidal Ecosystems: the Ecological Relevance of Energy-related Biomarkers in Response to Environmental Stresses**

Yun-Wei Dong

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Sublethal stresses can affect organisms energy intake and are directly related to species' distribution and abundance. The maintenance of oxygen ventilation and circulation (i.e., energy-related metabolism) are essential for species to tolerate environmental stresses. Metabolic sensors are sensitive to low cellular energy states and can effectively regulate downstream cellular energy production. In low cellular energy states (i.e. high AMP/ATP ratio), AMP can initiate assembly of AXIN-AMPK-liver kinase B1 (LKB1) complex for AMPK activation, resulting in increased expression of AMP-activated protein kinase (AMPK). In low cellular energy states, upregulation occurs in histone/protein deacetylase sirtuin (SIRT). These metabolic sensors play crucial roles in regulating the networks that control energy homeostasis. Activation of AXIN, AMPK and SIRT switch on catabolic pathways to produce ATP, while simultaneously shutting down energy consuming anabolic processes. In low energy states, AMPK will enhance the expression of genes related to glucose transport and glycolysis. The expression of AXIN, AMPK and SIRT mRNA were positively correlated with genes involved in glycolysis in the limpet, *Cellana toreuma*, and genes were expressed at lower initial ( $T_{on}$ ) temperatures than heat shock protein mRNA. Genes involved in energy sensing, glycolysis and heat shock responses are, therefore, closely connected via energy supply and expenditure, and are likely important biomarkers indicating the different status of cellular energy and the intensities of environmental stresses. Such energy-related biomarkers can, therefore, provide new insights to understanding the physiological responses of intertidal species to environmental stress and, as a result, in predicting the ecological impacts of combined physical stresses.

*Climate Change Impacts*

## **Does a Synergy between Proteomics and Mechanics Benefit Climate Change Research?**

Vengatesen Thiagarajan

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Oysters are important commercial shellfish. They have a complex life cycle, during which the pelagic larvae select a suitable substrate, attach to it, and then metamorphose into adults. This remarkable transition from pelagic to benthic life in a very short span is executed by a specific "protein machinery". Interestingly, larvae switch their CaCO<sub>3</sub> shell biomineral from aragonite to calcite during this transition. Understanding how larvae can alter its proteome to cope with the climate changes can provide invaluable information for sustainable aquaculture and coastal management. Since metamorphosis is endogenously governed by proteome dynamics, biomineralization and larval physiology, expertise from ecology, biomedical science and mechanical engineering are jointly examining this process at HKU. Although oysters are able to adjust their proteome to cope with climate change, their metamorphosis and subsequent growth are severely compromised. Worryingly, oysters produced a structurally damaged and a mechanically weaker shell in a high CO<sub>2</sub> environment, which could ultimately wipe them off due to predation. This multi-disciplinary collaboration would rapidly advance our understanding of environmental, biomineral and organismal interactions, and boost our ability to predict the consequences of multiple climate change stressors, and thus assist us in the development of adaptive measures to mitigate impacts of climate change.

*Building Blue Networks*

**MarineGEO and Tennenbaum Marine Observatories Network**

David M. Baker

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The Smithsonian Institution's MarineGEO (Global Earth Observatories) and Tennenbaum Marine Observatories Network (TMON) were launched in 2012 as the first worldwide initiative to link field sites in the study of marine biodiversity. The aims of the project are to quantify marine biodiversity and determine the major drivers of change over time through a multi-disciplinary approach. Following the ongoing successes of the Smithsonian's ForestGEO, MarineGEO likewise seeks to engage partner sites through grassroots support and implementing standardized monitoring protocols and coordinated global experiments. This talk will highlight the framework and goals of MarineGEO-TMON and some of the exciting research that is already being generated, propelling us towards a better understanding of the global biodiversity of marine life.

*Biodiversity Data Sharing & Management*

**Biodiversity Data Sharing & Management**

Mark J Costello<sup>1</sup> and Kwang-Tao Shao<sup>2</sup>

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<sup>2</sup>Biodiversity Research Center, Academia Sinica, Taipei, Taiwan

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This session will first have three components: (1) a brief review of issues in biodiversity data management, from sharing to publication, and available standards; (2) an introduction to the major global biodiversity databases; and (3) summary of results from a questionnaire survey of issues delegates are interested in regarding marine biodiversity data management. This will be followed by an open discussion of questions, issues, experiences, opinions and recommendations of the people present.

**Current Status and Perspective of Digital Archives of Taiwan Fishes**

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The Fish Database of Taiwan (fishdb.sinica.edu.tw) was established in the early 1990s and has collected and integrated information such as classification, distribution, specimens, and references on 3,122 fishes of Taiwan. The contents include species descriptions (2,794 species), specimens (45,302 lots), images (3,871 ecological photos and 992 videos), skeletal X-rays (1,880 species), otoliths (1,392 species), COI gene sequences (1,731 pieces), and field collecting data; all are made accessible online and constantly updated. Besides providing academic services to promote academic exchanges and raise research quality, the database also has popular science materials, underwater real-time videos, and marine conservation information so that it can contribute to the research, education, and management of marine resources.

In 1994, we started a long-term partnership with the global FishBase and continue to actively collaborate with other international biodiversity databases and projects, including GBIF, COL, and EOL. We conduct cross-strait collaboration with China to exchange fish specimen data and establish a parallel list of traditional and simplified Chinese fish names. The repatriation of 228 type specimens of Taiwan fishes from more than ten institutions abroad is another achievement. Currently, the database has more than 500 thousands visits per month (including search engines), and is the only member of WDS that comes from Taiwan.

As to the value-added creations and applications, many educational materials, e.g. Taiwan Fish Multimedia Dictionary, Taiwan Fish Culture and Nature Knowledge Base, Intellectual Restaurant, Augmented Reality Knowledge Cards, e-books and e-magazines, Taiwan Seafood Guide, fish terms and definitions, governmental fisheries statistics, and allowed/prohibited aquatic checklists had also been compiled. Also, a cell phone version of The Fish Database of Taiwan had been developed to conform to the trend of querying real-time data.

The next steps will be providing some fish-related cultural information as well as integrating the molecular identification data of fish eggs and juveniles in Taiwan waters, so that the early life history of Taiwan fishes could be understood more and further used for limiting fisheries, MPA, and resources administration.

*Biodiversity Data Sharing & Management***Interprovincial Conservation on Marine Biodiversity - A Case in Dongshan-Nan'ao Area**

Wenhua Liu, Yinglin Wu, PingLi, Derun Lin and Mei Zhuang

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Dongshan-Nan'ao area is located at the border between Fujian and Guangdong provinces. The area is bounded to the south by Nan'ao Island and to the southeast by Dongshan Island. These richly endowed and biologically productive waters have historically supported some of China's most productive fishing grounds, particularly in areas of current convergence and upwelling such as occurs near these two islands. In addition, up to eleven distinct bay ecosystems can be identified within this roughly 500,000 ha marine area. Besides its important fisheries, this particular section of China's southern coast is known as a key transit center for important migratory species moving through China's coastal waters. Key migratory species found in the site area include five globally threatened species of marine turtles, three species of horseshoe crabs and the Chinese white dolphin (*Sousa chinensis*). Other migratory species recorded within the area include the finless porpoise (*Neophocaena phocaenoides*), bottlenose dolphin (*Tursiops truncatus*), *Pseudorca crassidens*, *Eschrichtius robustus* and *Grampus griseus*. While migratory species by definition depend on various locations and habitat types throughout their life cycles, and thus are found at a number of locations along China's South Sea coast, their numbers and concentrations are considered highly significant within these biologically rich coastal waters.

However, a number of threats have been identified as confronting the globally significant migratory species found within the site area. These include the followings:

*Overfishing* within the site area is depleting the fishery resources on which many migratory species depend, as well as leading to problems of by-catch.

*Aquaculture* within the area has taken place mainly in shallow coastal waters and in an overly concentrated manner. This has had several impacts, including localized pollution problems, as well as problems for migratory species that find their nearshore migration routes blocked by densely concentrated aquaculture pens and nets.

*Sand mining* at beaches within the site area is leading to loss of important spawning habitat for marine turtles and horseshoe crabs.

Therefore, in order to make, ratify, implement and assess the inter-provincial plans for cooperative conservation on Dongshan-Nan'ao marine biodiversity, and the plans cover policies, laws and regulations, and actions aiming to sustainable uses of marine resources, Global Environmental Facility (GEF) sponsored the project, which was executed by State Oceanic Administration, China. The project was finished in 2011, and the output is now recognized as the globally promoted experience. The actions and outcomes will be presented in the talk.

# Schedule of Poster Presentations

^ Student Presentation

Abstracts of presentations can be downloaded from the conference website:  
[www.biosch.hku.hk/become/abst\\_all.html](http://www.biosch.hku.hk/become/abst_all.html)

## **Biodiversity & Evolution**

- P-01    A New Method for Estimating the Area of the Seafloor from Oblique Images Taken by Deep-Sea Submersible Survey Platforms**  
R. Nakajima, T. Komuku, T. Yamakita, D.J. Lindsay, Y. Jintsu-Uchifune, H. Watanabe, K. Tanaka, Y. Shirayama, H. Yamamoto and K. Fujikura  
Department of Marine Biodiversity Research, Japan Agency for Marine-Earth Science and Technology, Yokosuka, Japan
- P-02    ^A Resource of Genomic Sequences and Genome-Wide Single Nucleotide Polymorphisms / Variants in Deep-Sea Mussels**  
T. Xu and J.W. Qiu  
Department of Biology, Hong Kong Baptist University, Hong Kong SAR, China
- P-03    ^DNA Mini-barcoding of Zoantharia (Cnidaria: Abthozoa) Museum Specimens**  
Jessica D. Gordon and James Davis Reimer  
Molecular Invertebrate Systematics and Ecology Laboratory, Graduate School of Engineering and Science, University of the Ryukyus, Senbaru 1, Nishihara, Okinawa 903-0213, Japan
- P-04    ^Mitochondrial Genome Rearrangements in *Brachipolynoe pettiboneae* (Annelida: Polynoidae)**  
Y. Zhang and J.W. Qiu  
Department of Biology, Hong Kong Baptist University, Hong Kong SAR, China
- P-05    On the Use of Cytochrome b Sequence for the Authentication of Dried Seahorse Samples Collected in Hong Kong**  
S.K. Lam and K.M. Chan  
Environmental Science Program, School of Life Sciences, The Chinese University of Hong Kong, Sha Tin, N.T., Hong Kong SAR, China

- P-06** ^Phylogenetic Investigation of *Palythoa* sp. "sakurajimensis" (Anthozoa: Zoantharia) Using Genetic and Morphological Analyses  
Courtney Timmons and James Davis Reimer  
Molecular Invertebrate Systematics and Ecology Laboratory, Graduate School of Engineering and Science, University of the Ryukyus, Senbaru 1, Nishihara, Okinawa 903-0213, Japan
- P-07** ^*Symbiodinium* Diversity and Host-Symbiont Ecological Physiology in Hong Kong Corals  
J.C.Y. Wong, P.D. Thompson and D.M. Baker  
The Swire Institute of Marine Science and School of Biological Sciences, The University of Hong Kong, Hong Kong SAR, China
- P-08** Symbiotic Diversity and Meta-Transcriptomics: The Case of the Hydrothermal-vent Shrimp *Rimicaris exoculata*  
J.S. Yang, X.L. Liu, H.W. Li, B. Lu, Y.P. Fan and W.J. Yang  
Key Laboratory of Conservation Biology for Endangered Wildlife of the Ministry of Education and College of Life Sciences, Zhejiang University, Hangzhou, China
- P-09** Three New and Two Known Free-living Marine Nematode Species of the Family Ironidae from the East China Sea  
Yuzhen Chen and Yuqing Guo  
Key Laboratory of Marine Fishery Resources and Ecological Environment of Fujian Province, Fisheries College, Jimei University, Xiamen, China
- P-10** ^Unexpected Diversity in Genus *Epizoanthus* (Anthozoa: Hexacorallia) Attached to Eunicid Worms from the Western Pacific  
Hiroki Kise and James Davis Reimer  
Molecular Invertebrate Systematics & Ecology Laboratory, Graduate School of Engineering and Science, University of the Ryukyus, Japan

### Biodiversity Patterns

- P-11** ^Analysis of Microbial Composition and Diversity of the Sediments of Arabian Sea by Paired-End Illumina Reads  
P.N. Harisree, M.P. Rinu, V. Helvin and G.B. Sarita  
Department of Biotechnology, Cochin University of Science and Technology, Kochi, Kerala, India

- P-12 Characterization of Plankton Communities in Kemena Estuary, Bintulu, Sarawak, Malaysia**  
I. Johan, M.H. Idris, M.K. Abu Hena, M.J. Musa and M.H.H. Komari  
 Department of Animal Science and Fisheries, Faculty of Agriculture and Food Sciences, University Putra Malaysia, Sarawak, Malaysia
- P-13 Community Structure of Meiobenthos in Arctic Kongsfjorden Ecosystem, Norway**  
S. Bijoy Nandan, P.P. Krishnapriya, M. Minu, Vijay Akhilesh and Hershey N. Regina  
 Dept. of Marine Biology, Microbiology & Biochemistry, School of Marine Sciences, Cochin University of Science & Technology, India
- P-14 DNA Barcoding of Marine Organisms from Trawl Fishery in Hong Kong**  
K.H. Chu, L.S. Mui, L.L. Ma and K.M.Y. Leung  
 Simon F. S. Li Marine Science Laboratory, School of Life Sciences, The Chinese University of Hong Kong, Hong Kong SAR, China
- P-15 ^Echinoderms Diversity at Gili Genting Beach, Lombok, Indonesia**  
 N.R.A.S. Amalia, S.C. Dimarti, Muzdhalifah, C.A. Aldiansyah, W. Merizka, A.E. Primasanti, G.A. Pratama, L.Z. Dewanti and Y.A. Tranggono  
 Marine Study Club, Faculty of Biology, Universitas Gadjah Mada, Yogyakarta, Indonesia
- P-16 Ecosystem Analysis of the Degrading Vembanad Wetland Ecosystem, the Largest Ramsar Site on South West Coast of India - Measures for Its Sustainable Management**  
S. Bijoy Nandan, C.V. Asha, C. Retina and P.S. Suson  
 Department of Marine Biology, Microbiology & Biochemistry, School of Marine Sciences, Cochin University of Science & Technology, India
- P-17 ^Macroinvertebrates Assemblage in Mangrove Associations of Hainan Island**  
S.S. Zvonareva and T.A. Britayev  
 A.N. Severtsov Institute of Ecology and Evolution, Russian Science Academy, Russia
- P-18 ^Scleractinian Corals in Hong Kong Are Dominated by Host-Generalist *Symbiodinium***  
J.C.Y. Wong, P.D. Thompson, J.W. Qiu, J.Y. Xie and D.M. Baker  
 The Swire Institute of Marine Science and School of Biological Sciences, The University of Hong Kong, Hong Kong SAR, China

- P-19 Seahorse Population Fluctuations in the Ria Formosa Lagoon, South Portugal**  
M. Correia, I.R. Caldwell, H.J. Koldewey, J.P. Andrade and J. Palma  
 CCMar, Universidade do Algarve, Campus de Gambelas, Portugal
- P-20 ^Species Composition, Abundance and Distribution of Barnacles and Bivalves Associated with the Massive Coral *Porites lutea* in Hong Kong**  
J.Y. Xie and J.W. Qiu  
 Department of Biology, Hong Kong Baptist University, Hong Kong SAR, China
- P-21 Temporal and Spatial Variations of Oligochaete Animals in Mangrove Wetlands in Fujian and Guangdong Coast, China**  
 Xin-Wei Chen, Li-Zhe Cai, Su-Jing Fu, Yi-Yong Rao, Xiang Li and Lu-Lu Yan  
 College of the Environment and Ecology, Xiamen University, Xiamen, China

#### Climate Change Impacts

- P-22 ^Bleaching Incidence in Cultured Giant Clams *Tridacna gigas* after Typhoon Megi**  
Elizaldy Maboloc, S. Suzanne Mingoa-Licuanan and Ronald Villanueva  
 The Marine Science Institute, College of Science, University of the Philippines, Velasquez Street, Diliman, Quezon City, Philippines
- P-23 ^Human Impacts, Climate Change and Marine Biodiversity in West Coast of India**  
 D. Sanna Durgappa and Nitish Venkateshwaralu  
 Centre for Sustainable Technologies, Indian Institute of Science, Bangalore, India
- P-24 ^Live or Die? The Future of the Green Lipped Mussel, *Perna viridis*, in a Warming World**  
C.F.M. Cheng, A. Rinaldi, G. Sarà and G. A. Williams  
 The Swire Institute of Marine Science and School of Biological Sciences, The University of Hong Kong, Hong Kong SAR, China
- P-25 ^Seasonal Dynamics of Kelp Species, *Ecklonia cava* Population Formed Following the Large-scale Disturbance**  
S. Kim, S.K. Choi, M.J. Kim, E.R. Baek, S.U. Hwang, Y.H. Kang, H.J. Lee and S.R. Park  
 Estuarine and Coastal Ecology Laboratory, Department of Marine Life Sciences, Jeju National University, Republic of Korea

- P-26**    **^The Temperature Effects on Sexual Reproduction in Two Zoanthids from Japan**  
Iori Kawamura and James Davis Reimer  
Graduate School of Engineering and Science, University of Ryukyus, Okinawa, Japan

### Conservation & Education

- P-27**    **Assessing Seahorse Abundance: A Comparison between Two Underwater Visual Census Techniques**  
M. Correia, J.P. Andrade and J. Palma  
CCMar, Universidade do Algarve, F.C.T., Edificio 7, Campus de Gambelas, 8005-139 Faro, Portugal
- P-28**    **^Can Local Community Members and International Volunteers Produce Reliable Coral Reef Survey Data?**  
J.M. Savage, P.E. Osborne and M.D. Hudson  
Centre for Environmental Sciences, Faculty of Engineering and the Environment, University of Southampton, United Kingdom
- P-29**    **Giving Them a Reason to Protect: Estimating Total Economic Valuation of Marine Turtles in Semporna Priority Conservation Area, Sabah, Malaysia**  
L.S.L. Teh, L.C.L. Teh and G. Jolis  
Fisheries Centre, University of British Columbia, Canada
- P-30**    **Professional Training on Environmental Pollution Investigation for In-Service Teachers / Technicians in Secondary Schools**  
Wai Chin Li, Kwok Ho Tsoi and Lincoln Fok  
Department of Science and Environmental Studies and Centre for Education in Environmental Sustainability, Hong Kong Institute of Education, Hong Kong SAR, China
- P-31**    **^What to Protect in the Seascape of Anthropogenic Pressure? Area Utilization of Indo-Pacific Humpback Dolphins *Sousa chinensis* in Hong Kong**  
C.K.M. Or and L. Karczmarski  
The Swire Institute of Marine Science and School of Biological Sciences, The University of Hong Kong, Hong Kong SAR, China

**Ecosystem Functions & Services**

- P-32**    **Analysis of Methylation Profile in Mitochondrial Genome of *Exopalaemon carinicauda* in Response to Starvation**  
Huan Gao, Binlun Yan, Lian Zhao, Bei Xue, Guohua Zhu, Xiaofang Lai, Jianhua Chen and Xin Shen  
Jiangsu Key Laboratory of Marine Biotechnology, Huaihai Institute of Technology, Lianyungang, China; Co-Innovation Center of Jiangsu Marine Bio-industry Technology, Lianyungang, China; The Jiangsu Provincial Platform for Conservation and Utilization of Agricultural Germplasm, Nanjing, China
- P-33**    **^Coral Recruits in Hong Kong Are Not Seriously Affected by *Drupella* Corallivory**  
R.H.L. Tsang and P.O. Ang  
Marine Science Laboratory, The Chinese University of Hong Kong, Hong Kong SAR, China
- P-34**    **^DNA-based Study of The Diet of The Marine Copepod *Calanus sinicus***  
T.W. Ho, C. Kim Wong, Jiang Shiou Hwang, Simon M.K. Cheung and Hoi Shan Kwan  
School of Life Sciences, The Chinese University of Hong Kong, Shatin, New Territories, Hong Kong SAR, China
- P-35**    **^Ecological Functions of Macrobenthic Community Are Compromised by Severe Pollution, but Enhanced by Afforestation: Evidence from Biological Trait Analysis**  
J.Y.S. Leung  
School of Biological Sciences, The University of Adelaide, Adelaide, Australia
- P-36**    **Ecology of Marine Amphipods in Hong Kong with Special Emphasis on the Use of Indigenous Marine Amphipod Species as Test Organism for Assessing the Toxicity of Marine Sediments**  
R.Y.H. Cheung and F.Y.K. Lee  
Department of Biology and Chemistry, City University of Hong Kong, Hong Kong SAR, China
- P-37**    **Effect of pH on Growth and Toxicity of Two Strains of *Gambierdiscus* spp.**  
Y.L. Mak, F. Zhang, J.J. Wu, T.C. Wai, P.K.S. Lam and L.L. Chan  
State Key Laboratory in Marine Pollution, City University of Hong Kong, Hong Kong SAR, China and Research Centre for the Oceans and Human Health, City University of Hong Kong Shenzhen Research Institute, Nanshan District, Shenzhen, China

- P-38** ^**The Philippine Marine Protected Area Support Network**  
Diovanie O. De Jesus, Hazel O. Arceo, Porfirio M. Aliño and MPA Support Network  
 Marine Science Institute, University of the Philippines Diliman, Philippines
- P-39** ^**Experience Matters: Context-dependent Central-Place Foraging Behaviour of the Sand-Bubbler Crab *Scopimera intermedia***  
T.Y. Hui, S. Cannicci, G. Santini and G.A. Williams  
 The Swire Institute of Marine Science and School of Biological Sciences, The University of Hong Kong, Hong Kong SAR, China
- P-40** ^**How to Allocate Energy When You Are Hungry? A Case of the Invasive Species, *Mytilopsis sallei***  
L.S. Tan, Gianluca Sara Alessandra Rinaldi and G.A. Williams  
 The Swire Institute of Marine Science and School of Biological Sciences, The University of Hong Kong, Hong Kong SAR, China
- P-41** **Physical-Biological Coupling Mechanism of Mesoscale Eddy in Central South China Sea: A Case Study Near the Zhongsha Islands**  
Huaxue Liu and Honghui Huang  
 Key Laboratory of South China Sea Fishery Resources Exploitation & Utilization, Ministry of Agriculture, China
- P-42** **Population Structure and Growth of *Euphausia pacifica* in the Yellow Sea**  
Zhencheng Tao, Chaolun Li and Song Sun  
 Key Laboratory of Marine Ecology and Environmental Sciences, Institute of Oceanology, Chinese Academy of Sciences, Qingdao, China
- P-43** ^**Study of Burrow Architecture of Fiddler Crab *Uca annullipes* (H. Millne Edwards, 1837) on Mudflats of Gulf of Khambhat, Gujarat, India**  
J.N. Trivedi, G.M. Soni, D.J. Trivedi, B.D. Purohit and K.D. Vachhrajani  
 Marine Biodiversity and Ecology Laboratory, Department of Zoology, Faculty of Science, The M. S. University of Baroda, India
- P-44** ^**Using Stable Isotope Bayesian Ellipses in R (SIBER) Analysis to Resolve the Complex Trophic Relationships of Corals**  
I.E. Conti-Jerpe, N.N. Duprey, C.W.M. Wong, C.M. Finelli, J.R. Pawlik and D.M. Baker  
 The Swire Institute of Marine Science and School of Biological Sciences, The University of Hong Kong, Hong Kong SAR, China

**Fisheries & Marine Resources Management**

**P-45    ^Age and Growth of Black Seabream (*Acanthopagrus schlegelii*) in Hong Kong and Adjacent Waters**

C.S.W. Law and Y. Sadovy de Mitcheson

The Swire Institute of Marine Science and School of Biological Sciences, The University of Hong Kong, Hong Kong SAR, China

**P-46    Development of the Environmental Monitoring System for Aquaculture**

J.J. Wu, Y.L. Mak, L.L. Chan and P.K.S. Lam

State Key Laboratory in Marine Pollution, City University of Hong Kong, Hong Kong SAR, China and Shenzhen Key Laboratory for the Sustainable Use of Marine Biodiversity, Research Centre for the Oceans and Human Health, City University of Hong Kong Shenzhen Research Institute, China

**P-47    ^Elucidating the Food Web Structure of Demersal Crustaceans in Hong Kong's Coastal Water using Stable Isotope Analysis**

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Reef Guardian Sdn., Sandakan, Sabah, Malaysia and Borneo Marine Research Institute, Universiti Malaysia Sabah, Jalan, Kota Kinabalu, Malaysia

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Fisheries College of Jimei University, Xiamen, China and State Key Laboratory for Marine Environmental Science, Xiamen University, Xiamen, China

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 Division of Ocean Science and Technology, Graduate School at Shenzhen, Tsinghua University, Shenzhen, China
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 The Swire Institute of Marine Science and School of Biological Sciences, The University of Hong Kong, Hong Kong SAR, China
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 Department of Marine Biology, Microbiology & Biochemistry, School of Marine Sciences, Cochin University of Science & Technology, India
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 M.K. Abu Hena, I. Johan, M.H. Idris and N. Anis  
 Department of Animal Science and Fisheries, Faculty of Agriculture and Food Sciences, Universiti Putra Malaysia Bintulu, Sarawak Campus, Sarawak, Malaysia
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C. Schweitzer and B. Stevens  
 Department of Natural Sciences, University of Maryland, Eastern Shore, United States of America

# Abstracts of Poster Presentations

## **A New Method for Estimating the Area of the Seafloor from Oblique Images Taken by Deep-sea Submersible Survey Platforms**

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In order to extract quantitative information on deep-sea benthic animals (no. individuals or biomass in an area) using oblique video/photo images taken by deep-sea submersible survey platforms, a new method was established to estimate the imaged area of the seafloor from the oblique images. The trapezoidal area appearing on the lower half of the screen was calculated using underwater horizontal and vertical aperture angles of the camera, the angle of incidence of the camera, and the camera-to-seafloor distance. The incidence angle of the camera was obtained using the angles of vehicle pitch and camera tilt, while the camera-to-seafloor distance was calculated from the lens-to-vehicle bottom distance, horizontal distance of lens-to-altimeter, and vehicle altitude. The areas estimated by the present method from images taken by some submersible survey platforms were comparable to those that were actually measured. With the above parameters, and by focusing on the lower half of an image, our method can be used for estimating the seafloor area from any oblique video/photo images taken by any submersible survey platform. Thus, this method is useful for the extraction of quantitative data on benthic animals from legacy oblique video/photographs acquired by submersible survey platforms.

## **A Resource of Genomic Sequences and Genome-wide Single Nucleotide Polymorphisms / Variants in Deep-sea Mussels**

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Studying genetic connectivity reveals population genetic diversity and provides information for the designation of marine protected areas. Previous studies using several genes elucidated no significant genetic differentiation between deep-sea vent and seep populations of *Bathymodiolus* mussels that are located thousands of kilometers away. However, conventional genetic markers might not be sensitive enough to detect genetic structure for marine species with a long pelagic larval developmental stage. Here, the 2b-RAD (type IIB endonuclease restriction-site-associated DNA) genotyping-by-sequencing approach was conducted to identify genome-wide single-nucleotide polymorphisms/variants (SNPs/SNVs) in twenty individuals of *B. platifrons*, and three other deep-sea bathymodioline mussels *B. japonicus*, *B. aduloides* and *Idas* sp. Shotgun sequencing and de novo assembling resulted in the *B. platifrons* survey genome of 781,720 sequences with a N50 of 2.3 kb and the longest scaffold of 46.9 kb. A total of 284,562 tags contained recognition sites of type IIB restriction enzyme BsaXI were detected from the survey genome and served as the reference for SNP/SNV identification. Among twenty *B. platifrons* individuals, 25,246 genomic loci and 34,547 associated SNPs were generated with a mean genetic diversity ( $\pi$ ) of  $0.00347 \pm 0.00295$ . Moreover, a total of 8,512 loci with 10,199 related SNVs, 5,081 loci with 6,429 SNVs and 3,026 loci with 3,811 SNVs were detected in *B. japonicus*, *B. aduloides* and *Idas* sp., respectively. The number of loci shared between each of the two species declined with increasing phylogenetic distance, and ranged from 1,652 to 333 with 24 fixed among all four species. Those genome-scale markers paved the way to further exploration of population connectivity of deep-sea mussel populations and understanding of their evolutionary and adaptation processes.

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## **DNA Mini-barcoding of Zoantharia (Cnidaria: Anthozoa) Museum Specimens**

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Due to complicated morphological identification methodology, vague species descriptions, and overall lack of genetic data, taxonomic identification within order Zoantharia has been problematic. Previously, species have been described using a combination of mesentery count, sphincter muscle anatomy, tentacle count, and polyp size. However, genetic studies have been shown to delineate species more accurately than the aforementioned methods. Species belonging to genus *Zoanthus* from the Indo-Pacific Ocean have been the subject of some recent genetic and morphological studies. Results from these investigations have supported the importance of DNA barcoding for species identification within this taxon. In this study, we emphasize the importance for mini-barcoding in Cnidaria and marine organisms belonging to museum collections by using sequences from the second Internal Transcribed Spacer region of ribosomal DNA (ITS2-rDNA) to create mini-barcodes (<350bp) for *Zoanthus* species. We examined specimens indigenous to Okinawa, Japan, collected for this study as well as formalin fixed samples obtained from Museum Volkenkunde, Leiden, Netherlands, in an attempt to determine species affinity. By amplifying small, highly variable regions of ITS2, it may be possible to use these mini-barcodes to determine the identity of museum samples that have been preserved in formalin for over 100 years. These markers have been successful in determining the identity of newly collected specimens. It is hoped that this study and future studies will help identify synonymy across the distribution of *Zoanthus* spp., as well as identify potentially undescribed species in Okinawa, Japan.

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**Mitochondrial Genome Rearrangements in *Branchipolynoe pettibonae*  
(Annelida: Polynoidae)**

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Mitochondrial genomes (mitogenomes) have been increasingly used to understand the phylogeny of metazoans. They provide rich information on gene sequences as well as gene orders. However, the application in Annelida has been limited partly due to their apparent conservation of gene order. Only 19 complete mitogenomes have been reported from Annelida, including the previously recognized phyla Echiurida and Sipunculida. Here we report that the mitochondrial genome of *Branchipolynoe pettibonae* (Polynoidae), a scale worm that lives in the mantle cavity of the deep-sea mussel *Bathymodiolus* spp., deviates greatly from the common gene order of currently recognized annelid mitogenomes. We sequenced several shallow water polynoids and the results showed that the gene order of *B. pettibonae* is uncommon in polynoidae. Phylogenetic tree analysis suggested that it was derived from the common gene order of other polynoids. We will compare gene order of *B. pettibonae* with several deep-sea polynoidae. It is necessary to better understand the uncommon gene order of *B. pettibonae* and the evolution of polynoidae.

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## **On the Use of Cytochrome b Sequence for the Authentication of Dried Seahorse Samples Collected in Hong Kong**

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Dried seahorses are mainly used for traditional Chinese medicine and such huge demand drives most of their species to different levels of endangerment. The confusing morphology and the fade of distinguishing features also impose difficulty on species survey at the retail levels. Reliable DNA fingerprinting methods are needed for authentication of dried seahorse samples for the needs of marine conservation locally and globally. We have studied 43 dried seahorse samples from local shops with DNA fingerprinting using cytochrome b gene sequences. *Hippocampus trimaculatus* are identified from local samples and samples from Mauritius. Relationship between samples and the actual origin could be inferred through comparison with gene back data and morphological study. Other DNA fingerprinting techniques were also studied and will be discussed in our presentation.

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## **Phylogenetic Investigation of *Palythoa* sp. "*sakurajimensis*" (Anthozoa: Zoantharia) Using Genetic and Morphological Analyses**

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Zoantharians (Cnidaria: Anthozoa) are an order of Hexacorallia known for their problematic taxonomy and high levels of phenotypic plasticity, and therefore recent studies have combined morphological and genetic data to make conclusions on specimen identities. In this study we examined the phylogenetic relationship between a potentially undescribed zooxanthellate species of *Palythoa* (Hexacorallia, Zoantharia, Sphenopidae) known from Okinawa and the Red Sea; referred to in the literature as *Palythoa* sp. "*sakurajimensis*". Sequences of mitochondrial 16S ribosomal DNA (16S) and cytochrome oxidase subunit I (COI), as well as of nuclear internal transcribed spacer region of ribosomal DNA (ITS-rDNA) were used for phylogenetic analyses and morphological characteristics such as tentacle count, polyp size, cnidae sizes and types, and external coloration were examined. Phylogenetic analyses have shown that *Palythoa* sp. "*sakurajimensis*" is closely related to *Palythoa mutuki* (Haddon & Shackleton, 1891) and is likely undescribed, but closer examination of original species descriptions and further genetic analyses are needed in order to make a definite conclusion. The morphological diagnostic characteristic that distinguishes *Palythoa* sp. "*sakurajimensis*" apart from other previously described *Palythoa* species is the presence of a solitary polyp, a strong, white dorsal directive with a corresponding single white tentacle. This research is one step toward the understanding of coral reef biodiversity in Okinawa and the Red Sea. Examining the species diversity of Zoantharia in coral reef environments is crucial because they have been known to be a phase shift indicator in local reefs.

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## ***Symbiodinium* Diversity and Host-Symbiont Ecological Physiology in Hong Kong Corals**

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*Symbiodinium* is a diverse genus of marine dinoflagellates which share a symbiosis with corals and other marine invertebrates. They provide photosynthesis-derived sugars to supplement metabolic needs in nutrient poor, tropical oceans. *Symbiodinium* species-level descriptions are currently being resolved as genotypic distinctions have not yet been fully established. Therefore they are organized into clade and subclade types such as A, B, C, and D. Using the second internal transcribed spacer region of the ribosomal DNA as a primer, DNA amplification and sequencing methods can be used to genotype *Symbiodinium* and identify dominant clade types within a host. It has been previously documented that the host-symbiont ecological physiology is affected by specific clade types in various water quality conditions. Clade D, for example, is associated with a greater tolerance to thermal and sedimentation stress. It has also been shown that *Symbiodinium* assimilates nutrients such as carbon and nitrogen at varying rates based on water quality parameters such as temperature. In this study we examined *Symbiodinium* diversity in coral communities in the oligotrophic, coastal waters of Hong Kong. We sampled *Symbiodinium* from coral fragments at the Swire Institute of Marine Science as well as various coral genera from field sites. *Symbiodinium* diversity was high relative to other geographic regions where similar studies have been carried out. Examination of our phylogeny of symbionts along with their respective hosts reveals an interesting pattern of distribution throughout the highly variable conditions of water quality in Hong Kong. This pattern suggests dominant clade types in Hong Kong have ecophysiological effects on their respective hosts.

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## **Symbiotic Diversity and Meta-Transcriptomics: The Case of the Hydrothermal-Vent Shrimp *Rimicaris exoculata***

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The hydrothermal vent is one of the most amazing marine environments on Earth. Although seemingly deadly to life, microbes and animals dramatically thrive at most hydrothermal vents. The shrimp *Rimicaris exoculata* is specific to Atlantic hydrothermal-vent sites, usually forming large dense swarms attached outside the "black chimney" (hydrothermal-vent center). *R. exoculata* has microbial ectosymbionts in its gill chamber, where a large number of setae on the mouthparts (scaphognathite and exopodite) raise these microbes. In this study, we isolated mouthparts of the shrimp, and analyzed the microbial diversity/richness and mRNA metatranscriptomes by Roche 454 and Illumina-Solexa sequencing, respectively. The symbiotic population comprises of mostly Proteobacteria, less Bacteroidetes and Firmicutes. In Proteobacteria,  $\gamma$ - and  $\epsilon$ -proteobacteria occupy majority of the phylum. Further, we obtained 64,929 mRNA-unigenes from the metatranscriptome from scaphognathite and exopodite of the shrimp, 8,478 of which are annotated from the host (metazoan) origin. The prokaryotic part of the metatranscriptome shows accordance with the population diversity/richness analysis. From the host transcriptome, we identified quite a few genes potentially concerned with symbiotic interactions as well as anti-adversity. All these results provide evidence elucidating the mechanism of the symbiosis between *R. exoculata* and microbes.

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## **Three New and Two Known Free-living Marine Nematode Species of the Family Ironidae from the East China Sea**

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Three new and two known species of free-living marine nematodes of the family Ironidae from the East China Sea are described and illustrated. *Conilia unispiculum* sp. nov. is identified by the relatively large body size (1883-2399  $\mu\text{m}$ ); the well developed lips; the number, shape and length of spicule (single and striated, length 87-100  $\mu\text{m}$  as arc); the shape of telamon; the number of supplement (1). *Pheronous donghaiensis* sp. nov. is characterized by its tail sharp point; caudal gland absent; buccal cavity armed with three big solid teeth and rows of minute denticles; spicules stout, with central septum at proximal end, male caudal region armed with two rows small conical subventral papillae. *Trissonchulus latispiculum* sp. nov. can be distinguished by its head not set off from remaining body, tail short and blunt, buccal cavity with minute denticles, spinneret opening slightly ventrally, spicule broad and alate with central septum and head on proximal end. *Trissonchulus benepapillosus* (Schulz, 1935) and *Trissonchulus oceanus* Cobb 1920 which are first reported in China, are redescribed in detail with emphasis on new or shortly described morphological features.

*Biodiversity & Evolution*

**Unexpected Diversity in Genus *Epizoanthus* (Anthozoa: Hexacorallia) Attached to Eunicid Worms from The Western Pacific**

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Zoantharians (Anthozoa: Hexacorallia) within genus *Epizoanthus* are generally known from deep water depths and are often found association with other marine invertebrates (e.g. hermit crabs, gastropods, eunicid worms). However, due to the difficulty of specimen collection at such great depths, there is limited information about the ecology and taxonomy of *Epizoanthus*. *Epizoanthus* species are often difficult to correctly identify due to a lack of external colony color; therefore taxonomy of *Epizoanthus* is chaotic. Although some *Epizoanthus* species can be found in shallow water, only a few molecular phylogenetic studies have been conducted and compared with other zoantharians. In this study, we focused on *Epizoanthus* spp. from shallow water as specimens are easily obtainable. Morphological and molecular phylogenetic analyses (mitochondrial cytochrome oxidase subunit 1 = COI, 16S ribosomal DNA = 16S, nuclear internal transcribed spacer region of ribosomal DNA = ITS-rDNA) were used to examine *Epizoanthus* specimens from localities in the western Pacific. The results of molecular phylogenetic analyses of all molecular marker suggests that the *Epizoanthus* specimens attached to eunicid worms are genetically different from other *Epizoanthus* species at the level of genus. The molecular markers used in this study clearly divided the *Epizoanthus* specimens attached to eunicid worms into two clades; the described species *Epizoanthus illoricatus* and another potentially undescribed species. Further phylogenetic and morphological investigations are needed for proper species description.

*Biodiversity Patterns***Analysis of Microbial Composition and Diversity of the Sediments of Arabian Sea by Paired-end Illumina Reads**

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Microbes are the most ubiquitous organisms on earth, present in all habitats, playing a key role in the biogeochemical cycles and representing a huge reservoir of novel biomolecules. Similarly marine habitat harbors a variety of microbes with vast potential. However it is estimated that most microbes in nature are rarely amenable to growth by standard microbiological methods, with the majority being unculturable. Metagenomic methods help to bypass and overcome the limitations of traditional culturing method; wherein total community DNA is isolated, cloned into suitable vector and host systems or can be directly used to analyze the phylogentic diversity. Similarly Next Generation Sequencing (NGS) methods enables a more accurate and comprehensive estimation of bacterial communities from environmental samples.

In this study microbial composition and diversity of sediments of Arabian Sea were analyzed. V3 region of the 16S rRNA gene was amplified and the resulting amplicons were sequenced on the IlluminaMiSeq sequencing platform using 151 bp x 2 paired end reads. The reads were clustered into operational taxonomic units (OTU) using Uclust program. The reads from filtered OTUs are processed using QIIME program to construct a representative sequence for each OTU. The representative sequence is aligned to the Greengenes core set reference databases using PyNAST program and taxonomy classification were performed using RDP classifier. The sequence analysis identified a total of 63,09 OTUs belonging to different bacterial phyla with a predominance of proteobacteria (51.7%). Minor representatives from phylum Actinobacteria, Bacteroidetes, Firmicutes, Chloroflexi, Acidobacteria, WS3, Gemmatimonadetes, Nitrospirae were also obtained. Deltaproteobacteria and Gammaproteobacteria was the dominant class in the phylum proteobacteria, representing 21.1% and 20.9% of the total OTUs. At the species level 9.6% of the OTUs did not fit into any taxonomic hierarchy, which suggests the possibility of novel yet to cultured bacteria present in marine sediments which awaits discovery.

*Biodiversity Patterns***Characterization of Plankton Communities in Kemena Estuary,  
Bintulu, Sarawak, Malaysia**

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The characteristics of plankton communities were observed in the Kemena Estuary, Sarawak, Malaysia. Samples of phytoplankton and zooplankton were collected from three stations located in Kemena river, Bintulu. The three stations representing river mouth, middle reach and upper reach of river were visited three times during spring tide and neap tide events. A total of 39 taxa of phytoplankton were recorded in the study. The phytoplankton community was dominated of diatoms (74.0%), dinophyceae (10.41%), chlorophyceae (10%) and cynophyceae (5.22%). A total of 24 taxa of zooplankton were recorded in the study. The zooplankton community was dominated by copepods (77.41%), amphipods (6.05%), lucifers (4.15%), crustacean larval groups (3.86%), mysids (2.53%) and others (6.00%). The most dominant taxa of plankton were determined based on important species index (ISI). Important taxa of phytoplankton were *Coscinodiscus* (10.33), *Pleurosigma* (8.38), *Navicula* (6.81) while zooplankton were *Paracalanus* (15.25), *Oithona* (14.28) and *Acartia* (12.75). The diversity index and species richness of both phytoplankton and zooplankton increased towards the river mouth. Daily tidal changes influenced the salinity profile where salinity decreased significantly at the three sampling stations from river mouth (>20 PSU), middle reach (>15 PSU) and upper reach (< 12 PSU). Correlation analysis between water quality parameters and plankton abundance data revealed that salinity has the most significant influence on the plankton distribution in the river. Findings indicated that the plankton community was highly influenced by marine affluence species.

*Biodiversity Patterns***Community Structure of Meiobenthos in Arctic Kongsfjorden Ecosystem, Norway**

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Kongsfjord (79°N, 12°E) is an open glacial fjord on the west coast of Svalbard, Norway influenced by both Atlantic and Arctic water masses and harbouring a mixture of Arctic flora and fauna. The meiobenthic samples collected as a part of Summer Phase III group 2 - Indian Arctic Expedition from 7 selected locations in the fjord (depth :76 to 303 meters) in August 2011 forms the basis of this contribution. The meiofauna was composed of Nematoda, Foraminifera, Bivalvia, Polychaeta, Harpacticoid copepoda, Gastrotricha and invertebrate eggs. Multivariate analysis showed an overall similarity of >80% of meiofauna between stations, where Shannon Wiener diversity index ( $H'$ ) was low in the inner fjord than the outer fjord. The nematodes (84%) formed the dominant phylum among the fauna and MDS (Multidimensional scaling) plots depicted 20% overall similarity in abundance of nematodes. Average biomass of nematodes in Kongsfjord was  $9.605 \pm 0.84$  mg/m<sup>2</sup> with forty five nematodes representing nineteen families belonging to the three orders, Chromadorida, Monhysterida and Enoplida. The outer fjord showed maximum numerical abundance of nematodes (452 ind./m<sup>2</sup>) than the inner fjord (266 ind./m<sup>2</sup>) and species *Dorylaimopsis* sp. (39.55%) showed the highest percentage abundance followed by *Terschellingia longicaudata* (12.53%). Forty species of foraminiferans belonging to 9 orders were identified where the species *Nonionella labradorica* was highly abundant followed by *Cassidulina teretis* and *Cibicides lobatulus*; *Oolina apipleura* with the least abundance.

*Biodiversity Patterns*

**DNA Barcoding of Marine Organisms from Trawl Fishery in  
Hong Kong**

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Effective conservation management can only be formulated and implemented with a thorough understanding on biodiversity in the region of interest. Yet the alpha diversity of many areas remains understudied. In the present study, DNA barcoding was employed to identify marine fish and crustacean species from trawl fishery in Hong Kong waters. A total of 140 fish specimens and 106 crustacean specimens were sampled from 12 collection sites in the eastern, southern and western waters of Hong Kong in 2012. Based on morphology, the fishes are identified into 76 species in 59 genera and 34 families, while the crustaceans belong to 54 species within 34 genera and 18 families. About 90% of the specimens produced satisfactory sequence data of the DNA barcoding gene, mitochondrial cytochrome oxidase c subunit I. The effectiveness of DNA barcoding in species identification, based on 5% sequence divergence as the cut-off value between intraspecific and interspecific variation, was found to be fair since only 67% of the sequences generated can be assigned to a species, using the GenBank and BOLD databases. With the completion of DNA barcoding analysis on about 80% of the specimens, we noted ambiguities in species assignment in about 16% of these specimens between molecular and morphological analyses, thus highlighting the importance of adopting complementary methods for precise species identification. Results from this study lay the foundation for constructing a DNA barcoding database of local marine organisms which would facilitate efficient taxonomic identification for various scientific and educational purposes.

*Biodiversity Patterns*

**Echinoderms Diversity at Gili Genting Beach, Lombok, Indonesia**

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Indonesia is a marine mega biodiversity country, passed by equatorial line. Located between two oceans and two continents, Indonesia owns various type of substrates in its shore. Gili Genting beach is located in the western side of Lombok Island, Nusa Tenggara Barat. It is known for its diverse Echinoderms. Echinoderm is indigenous marine animals which body is pentamerous radial symmetry and made of carbonate calcium. Its area is surrounded by a village and a cultivation area. The intertidal zone of the Gili Genting is composed of rocky substrate, death coral, mud, sand, and seagrass. Many marine animals live in this area because of this substrate diversity. Echinoderms are abundant in this area, however, research about Echinoderm diversity in Gili Genting beach is still scarce. The purpose of this study is to describe Echinodermata diversity in Gili Genting beach, to define important morphological features in order to identify Echinoderms species from 5 classes. Species was collected using purposive sampling method by snorkeling through the intertidal zone. Field sampling is conducted on September 2014. A total of 22 different species from four different classes were identified at the coast of Gili Genting, five from Echinoidea, five from Asteroidea, seven from Holothuroidea, and five from Ophiuroidea. Two genus from class Crinoidea also found in the coast of Gili Genting. The number of species is decreased compared to the data from 2012. The increased of tourism in Gili Genting affect the ecosystem in this beach.

*Biodiversity Patterns***Ecosystem Analysis of the Degrading Vembanad Wetland Ecosystem, the Largest Ramsar Site on South West Coast of India – Measures for its Sustainable Management**

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Vembanad wetland ecosystem- the largest Ramsar site on the south west coast of India, located in the most populous coastal segments of Kerala, serves as the rice bowl of the state and forms a major spot of biodiversity. Alteration of natural hydrologic regime of Vembanad wetland started with commissioning of Thaneermukkom barrage (TMB) across the backwater system in 1976, to prevent saline water intrusion, which adversely affected the eco-biology of the water body. The study was conducted during March 2011 to February 2012 on a monthly basis to evaluate the eco-hydrological status of this multifunctional ecosystem. Reclamation of estuarine areas for agriculture and other interventions has led to drastic decline in water holding capacity ( $2.4 \text{ km}^3 - 0.6 \text{ km}^3$ ) and depth (av. 4.02m) of the estuary over the years. Water quality reflects a neutral (7.11) and well oxygenated (7.4 mg/l) nature. Its salinity varies from 0.01 to 31.8 psu. TMB plays a crucial role in influencing the salinity pattern of Vembanad wetland; with an oligohaline (0.5-5 ppt) in southern whereas meso and polyhaline (5-18 ppt) condition in northern stations. The estuary is nutrient rich with nitrate-nitrogen and phosphate-phosphorus ranging between  $0.05 - 5.9 \mu\text{mol.l}^{-1}$  and  $0.13 - 6.49 \mu\text{mol.l}^{-1}$  respectively. Trophic index (TRIX value  $6.39 \pm 0.75$ ) indicated a decline in water quality leading to an accelerated eutrophication in the system. Bacillariophyceae (83.55%), Chlorophyceae (8.98%), Cyanophyceae (6.92%) and Zygnemophyceae (0.55%) were the major phytoplankton community with diversity index ( $H'$ ) ranging from 0.63 to 1.59. Zooplankton community was composed of calanoids (34%), cyclopoids (15%), rotifers (12%) and copepodites (10%) showing a declining trend in post barrage phase. Most of the benthic polychaete species were opportunistic bio-indicators of organic enrichment. Decline in fishery production (4387.31 t) and loss of fish biodiversity observed during the study, reflects considerable ecological impacts on lower trophic levels. Thus the present study gives an over view of the degrading estuarine ecosystem and signifies the need for better sustainable restoration programmes in the wetland ecosystem.

*Biodiversity Patterns*

## **Macroinvertebrates Assemblage in Mangrove Associations of Hainan Island**

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Diversity and structure of fauna in mangrove forests are under the influence of wide range of factors including geographic location, elevation above tide level and distance from the open sea in estuary, abiotic factors as salinity and soil structure, vegetation type, and anthropogenic impact. The aim of this research was to study the macroinvertebrate assemblage associated with mangrove stands in Hainan Island and to identify the major factors in formation of fauna of certain mangrove stand.

We have examined species diversity and composition of molluscs and crustaceans collected by hand, in three mangrove stands in different locations on Hainan Island. Abiotic characteristics of studied sites such as sediment's pH, granulometry and salinity were measured and anthropogenic impact was estimated.

Examined mangrove stand in Dongzhai national park was situated in the upstream of Yangfeng river and consisted of *Aegiceras corniculatum*, *Bruguiera* spp., *Kadelia candel* and *Ceriops tagal*. It had the lowest fauna diversity of three sites – 8 species, and since this territory is under protection, we suppose that the poorness of fauna is caused by its upstream position. The second examined mangrove site was located in shallow lagoon with low freshwater input near Xinying city, vegetation here consists mostly of *Rhizophora apiculata* and *Avicennia marina*, it was the most disturbed mangrove stand. This site had medium diversity - 15 species. The third site was located in the downstream of Wenchang/Wenjiao estuary. Vegetation is formed by *Avicennia marina*, *Sonneratia* spp., *Bruguiera* spp. and *Rhizophora apiculata*. This site had the highest diversity - 27 species. The second and the third sites had a lot of in common in their abiotic characteristics, but differed in faunal diversity, abundance and composition, as we suppose, due to strong anthropogenic impact that causes impoverishment and changes in species composition in mangrove stand near Xinying.

*Biodiversity Patterns***Scleractinian Corals in Hong Kong are Dominated by Host-generalist *Symbiodinium***J.C.Y. Wong<sup>1</sup>, P. Thompson<sup>1</sup>, J.W. Qiu<sup>2</sup>, J.Y. Xie<sup>2</sup> and D.M. Baker<sup>1</sup><sup>1</sup>The Swire Institute of Marine Science and School of Biological Sciences, The University of Hong Kong, Hong Kong SAR, China<sup>2</sup>Department of Biology, Hong Kong Baptist University, Hong Kong SAR, China

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Understanding the diversity of dinoflagellate endosymbionts (genus *Symbiodinium*) is critical for assessment of how corals respond to environmental changes. Symbiont assemblage in coral communities can be characterized by consisting host specialized types (specialists), and common types which associate with many hosts (generalists). We hypothesize that under variable environmental conditions, host-specific lineages are prone to competition and displacement by host generalists, which have a higher adaptive plasticity and are more resilient to disturbances. Hong Kong is located at a subtropical latitude with a highly variable seasonal fluctuation in temperature (14-31 °C) and salinity (24-32 psu). Thus, we identified *Symbiodinium* from 13 species of scleractinian corals of the region, representing 12 genera and 7 families by direct sequencing of the ITS2 sub-region of nuclear ribosomal DNA. Our results showed that clade C was the dominant *Symbiodinium*, with subclade C1 being a generalist type associated with most coral species, whereas C15 and C21a were specific to host coral species *Porites lobata* and *Montipora peltiformis*, respectively. *Symbiodinium* subclade D1a was found only in one species, *Oulastrea crispata*, which was also associated with subclade C1 in some individuals. The results indicate a low prevalence of host-specificity in Hong Kong hard corals, which support our hypothesis.

*Biodiversity Patterns*

**Seahorse Population Fluctuations in the Ria Formosa Lagoon, South Portugal**

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Identifying sources of marine population variability is a central goal in marine ecology and conservation. It requires long-term and repeated monitoring to assess whether there is cause for concern, particularly for species with vulnerable life-history traits. In the Ria Formosa lagoon (south Portugal), between 2001 and 2009 a substantial decline in the populations of two seahorse species, *Hippocampus guttulatus* and *Hippocampus hippocampus* (94% and 73%, respectively) was observed. During 2010-2013, the lagoon was re-surveyed 16 of the sites previously monitored. This new data set was then compared with the information obtained from those same locations in two earlier studies (2001-2002 and 2008-2009). *Hippocampus guttulatus* populations increased significantly between 2008-2009 and 2010-2013 but there were no significant differences between 2001-2002 and 2010-2013 surveys, suggesting that these populations are fluctuating rather than consistently decreasing. In contrast, there were no significant differences in *Hippocampus hippocampus* densities among the 16 sites surveyed throughout the three sampling periods, although the ability to detect any change was hampered by the overall low densities of this species in all time periods. Fluctuations in *Hippocampus guttulatus* densities were positively correlated with the percentage of holdfast coverage but not with any of the other environmental variables tested. These results highlight the importance of holdfast availability in maintaining stable seahorse populations. While the occurrence of population fluctuations is certainly more promising than a consistent downward decline, these extreme fluctuations observed for seahorses populations in the Ria Formosa lagoon could still leave these two species vulnerable to any additional stressors, particularly during low density periods.

*Biodiversity Patterns*

**Species Composition, Abundance and Distribution of Barnacles and Bivalves Associated with the Massive Coral *Porites lutea* in Hong Kong**

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Coral associated organisms may affect the health of corals, but little is known about the diversity and distribution of these organisms in Southern China. This study aimed to provide baseline information on the species composition, abundance and distribution of coral associated barnacles and bivalves along a gradient of water quality in Hong Kong. *Porites lutea* colonies were collected from 6 sites along a gradient of nitrogen concentrations. Sediment traps were deployed to determine sedimentation rate and nitrogen deposition rate. The barnacles and bivalves living on the surface and inside the colonies were extracted and identified using morphological and molecular techniques and quantified. Two species of barnacles and two species of bivalves were found inside the coral skeleton, and seven species of bivalves were found on the surface of the coral colonies. There was a positive correlation between the abundance of internal boring barnacles and bivalves and sedimental nitrogen concentration. However, there was no significant correlation between the abundance of epibenthic bivalves and sedimental nitrogen concentration.

*Biodiversity Patterns*

**Temporal and Spatial Variations of Oligochaete Animals in Mangrove Wetlands in Fujian and Guangdong Coast, China**

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Oligochaete animals are a common group of macrofauna and meiofauna which are commonly found in sediments in mangrove wetlands. They play an important role in cycling nutrients and energy in benthic food webs. But the biodiversity and distribution of oligochaete animals are relatively poorly known in China when compared to other groups of macrofauna and meiofauna. Hypothetically, the oligochaete density and biomass would likely have predictable spatial variations that they decrease from the lower latitude (tropical region) to the higher latitude (temperate region), and they vary among various mangrove habitats and among tidal levels. In order to verify these hypotheses, the oligochaete animals and some sediment parameters in four mangrove wetlands in Fujian and Guangdong Coast were determined in this study. The results showed that the annual average density and biomass of oligochaete animals decreased from the lower latitude to the higher latitude. The density and biomass of oligochaete animals were significantly influenced by habitats and seasons in Fujian Zhangjiang Estuary, but their density and biomass were not significantly influenced by habitats and seasons in Guangdong Gaoqiao mangrove wetland. Their density and biomass were not significantly influenced by tidal levels and seasons in Shenzhen Bay Futian intertidal zone. There were significant negative correlations between oligochaete density and biomass and silt content, whereas there were significant positive correlations between oligochaete density and biomass and clay content. The results also confirmed that the temporal and spatial variations of oligochaete density and biomass were mainly influenced by sediment grain size composition.

*Climate Change Impacts*

## **Bleaching Incidence in Cultured Giant Clams *Tridacna gigas* after Typhoon Megi**

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Assessment of cultured giant clams at the ocean nursery in Bolinao, northwestern Philippines after typhoon Megi in October 2010 showed bleaching of *Tridacna gigas*. Affected clams exhibit whitening of mantle margins. A total of 518 clams (1.04% of 49,716 clams monitored) showed whitening of the mantle margins. Five-year old *T. gigas* had the highest bleaching incidence with 28.13%. This was followed by twenty- and ten-year old clams with 7.81% and 6.10% bleaching incidence, respectively. Significantly recovery was observed after 5 weeks of improved weather condition, when only 89 clams or 17% of previously bleached clams remained bleached. Exposure of mantle margins to low-salinity seawater during the typhoon is believed to be the cause of the zooxanthellar expulsion/bleaching.

*Climate Change Impacts*

## **Human Impacts, Climate Change and Marine Biodiversity in West Coast of India**

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We conducted research on impact of climate change on marine biodiversity and result in altered community structure and diversity. We observed that marine ecosystems in west coast of India, rising atmospheric CO<sub>2</sub> and climate change are associated with concurrent shifts in temperature, nutrient input and oxygen content. Ecological resilience to climate change is a combination of resistance to increasingly frequent and severe disturbances, capacity for recovery and self-organization, and ability to adapt to new conditions. We discuss empirical evidence for how these ecological mechanisms contribute to the resilience of coastal marine ecosystems following climate change-related disturbances, and how resource managers can apply this information to sustain these systems and the ecosystem services they provide. Time series analysis of environmental quality parameters provides information on changes occurred in a region which provides us in determining the status of the region, impact of climate change and next course of action to be taken for abatement. This article reviews current and expected changes in marine biodiversity habitats in response to climate change in west coast of India. It then reviews how these changes may impact the marine biota of microbes, zooplankton, phytoplankton, dissolved oxygen, chlorophyll, fish diversity, total nitrogen, total phosphorous, and salinity. Increased water and atmosphere temperature was observed from 1997 - 2003 and significant trend was observed from time series data of above parameters in west coast of India. Nutrient composition of coastal waters showed variation in narrow range, for total nitrogen and total phosphorous respectively with exception in year 1997 and 2003.

*Climate Change Impacts*

**Live or Die? The Future of the Green Lipped Mussel, *Perna viridis*,  
in a Warming World**

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The amount of energy available to marine organisms obtained from food, and its potential allocation, will change under different environmental conditions. Environmental variation as a result of climate change will, consequently, impact species' life histories and has already resulted in shifts in species' distribution boundaries. Understanding how species may respond to climate change, therefore, is important when scientists try and predict which species will be successful and which may become locally extinct. The abundant, wide-spread, commercially and ecologically important mussel, *Perna viridis*, is such a key species as it is an important aquaculture species in Southeast Asian countries. Being a marine ectotherm, the mussel's body temperature varies with environmental temperatures, which ultimately will impact its energy utilization and subsequent life history traits such as maximum body size, longevity and reproductive potential. An effective way to predict the life history traits of *P. viridis* under future climate scenarios is by means of a Dynamic Energy Budget (DEB) model which uses changing environmental conditions to predict species' life history traits. To help build this model, surface area-specific ingestion and assimilation rates, and half saturation coefficients during feeding were determined. Changes in metabolic rate with environmental temperature showed that *P. viridis* has a higher temperature sensitivity, and thus has a faster increase in physiological rate as compared to temperate bivalve species, probably as a result of its adaptation to tropical conditions. By integrating these species-specific parameters of *P. viridis* with predicted environmental data, the DEB model can help predict the mussels' life history traits (whether the species will suffer from mortality or reproductive failure), which can be used to predict the future success and distribution range of *P. viridis* under projected climate change scenarios.

*Climate Change Impacts*

**Seasonal Dynamics of Kelp Species, *Ecklonia cava* Population Formed Following the Large-scale Disturbance**

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Jeju Island, Korea is the fastest warming region on the planet. Due to the global climatic warming, there has been an increasing trend in the number of intense typhoons in the past decade since 2000s. These changes can undoubtedly affect the coastal ecosystem in Jeju Island. However, few studies have been conducted on the dynamics and structure of marine benthic populations recovered after the disturbance. In this study, we investigated the seasonal dynamics of kelp forest-forming algae, *Ecklonia cava* population formed following the large-scale disturbance by Typhoon "Bolaven" in August 2012-event that seriously destroyed marine benthic communities in Jeju Island, Korea. *E. cava* were recruited in large numbers within 6 months of the physical disturbance and showed highest density in June 2013. However, no notable recruitment of *E. cava* was observed throughout the experimental period. This indicates that recruitment of *E. cava* is strongly affected by stochastic disturbances. By February 2014, 16 months after the disturbances, *E. cava* was almost recovered to the pre-disturbance population size structure. The mortality rate was size-specific and showed clear seasonal variation, being highest during summer-autumn and lowest during winter-spring due to high mortality rate of juvenile plant. Additionally, the cohort population of *E. cava* has survivorships that resemble type III curves, which represent high mortality rate early in life, followed by a period of much lower and relatively constant loss. These results should provide valuable insight into population dynamics of kelp species under global climatic warming.

*Climate Change Impacts*

## **The Temperature Effects on Sexual Reproduction in Two Zoanthids from Japan**

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The order Zoantharia (Anthozoa: Hexacorallia) are benthic cnidarians found worldwide from the deep sea to shallow coral reefs. They include the zooxanthellate family Zoanthidae that consists of three genera; *Zoanthus*, *Acrozoanthus*, and *Isaurus*. Despite the genera *Zoanthus* and *Isaurus* being widespread in Japanese waters, their reproductive biology is relatively unknown. It is possible that their reproductive period may not be homogeneous due to gradual changing environmental factors along with latitude: e.g. insolation, tides, temperature fluctuation. We conducted annual sampling and spawning observation to investigate sexual reproduction of *Zoanthus kuroshio* and *Isaurus tuberculatus* in Okinawa Island and Kochi, mainland Japan. Between 2011 and 2013, tagged colonies of *Z. kuroshio* and *I. tuberculatus* were sampled once a month, and observed by skin diving at night at the study location. Results indicated that the gametogenesis period of these two species is from May to July in Okinawa, and oogenesis sets in earlier than spermatogenesis, and both species are simultaneous hermaphrodites. In July, fertile colonies of *I. tuberculatus* included hermaphroditic polyps. However, fertile colonies of *Z. kuroshio* also included male and female polyps during reproductive seasons. We observed gamete release of *Z. kuroshio* in July 2012 and July to August 2013. The first spawning of the year occurred around the new moon, and *Z. kuroshio* colonies shed their bundles 4.5 h after sunset. It appears that the lunar phase and the time after sunset affect spawning timing in *Z. kuroshio*. In the case of *I. tuberculatus*, annual sea surface temperature suggests that temperature rising in spring is the cue to start gametogenesis. To clarify the influence the sea surface temperature on sexual reproduction, continuous sampling and data from other populations in different latitudes are needed.

*Conservation & Education*

## **Assessing Seahorse Abundance: A Comparison between Two Underwater Visual Census Techniques**

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Underwater visual census (UVC) has been used to document a wide variety of marine fish species. Two different UVCs (UVC1 and UVC2) were performed at three sites in the Ria Formosa and compared for differences in seahorse density and holdfast availability. The observed *Hippocampus guttulatus* density was significantly higher ( $P > 0.05$ ) using UVC2 for Site 1 and Site 2, but not in Site 3, compared to UVC1. No statistical differences were found in holdfast availability ( $P > 0.05$ ) between both UVC used. Thus, UVC2 method has proven to be more appropriate for long-term monitoring, particularly in low density population scenarios. This method is also likely to have wider applicability for surveying seahorses that tend to be found at low densities on a global scale.

*Conservation & Education*

## **Can Local Community Members and International Volunteers Produce Reliable Coral Reef Survey Data?**

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Monitoring biodiversity and resource use by professional scientists is often costly and hard to sustain, especially in developing countries where financial resources are limited. Coral reef and other marine monitoring programmes conducted by volunteer-based organisations or local communities have the potential to generate data sustainably and at a low cost. However, many scientists remain sceptical about its ability to appropriately detect changes in populations, habitats or patterns of resource use, compared with professional methods. A very limited number of studies have assessed the efficacy and validity of volunteer-based monitoring programmes, and even fewer have assessed community-based methods.

This study investigated the effectiveness of a simple survey methodology to assess reef health in coastal Cambodia and subsequently, the ability of surveyors of different levels of experience to use this methodology for coral reef surveys.

Surveyors were assigned to one of four experience categories: local community members with no experience, international volunteers with no experience, international volunteers with experience and trained scientists. Using five benthic indicator species, abundance was assessed (using snorkelling techniques) by each surveyor, over a series of six 20 m belt transects.

Results indicate a decrease in the amount of variation in marine community assessments with increasing experience. The least amount of within-group variation is seen in the experienced volunteers and scientists. However, while they were consistent within-group, each group was assessing communities in a different way. There was no difference between local community members and non-experienced volunteers, suggesting that it is experience, not cultural background which influences survey ability.

These results highlight the importance of training and assessment of any coral reef surveyors prior to surveys being conducted, whilst also suggesting that locally-based programmes could be capable of narrowing the gap in the need for monitoring data.

*Conservation & Education*

**Giving Them a Reason to Protect: Estimating Total Economic Valuation of Marine Turtles in Semporna Priority Conservation Area, Sabah, Malaysia**

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Marine turtles are threatened by multiple anthropogenic activities throughout Sabah, Malaysia, making improved protection of turtle populations an urgent priority. Successful implementation of conservation measures can be achieved by providing stakeholders with an economic incentive to invest in protecting marine turtles. To do this, we estimated the economic and social benefits marine turtles provide to fishing communities and the marine tourism sector in the Semporna Priority Conservation Area (PCA), located in southeast Sabah. We used a Total Economic Valuation (TEV) framework to estimate the consumptive and non-consumptive value of marine turtles. This was based on field interviews and questionnaires conducted with local community members, tourist operators, and tourists within the Semporna PCA in May 2014. The estimated total economic value of marine turtles was RM 73 million (USD 23 million), ranging from RM 66 million (USD 21 million) to RM 80 million (USD 25 million). This consisted of RM 86,000 in consumptive value, RM 68 million in non-consumptive value, and RM 5.4 million in passive value. Marine turtle based tourism could potentially provide RM 1.5 million (USD 468,750) annually in employment benefits to local communities, while marine turtle tourism value ranged from RM 61 to RM 75 million (USD 19-23 million) per year. Scenario analysis showed that discounted TEV of marine turtles could reach up to RM 2.5 billion (USD 784 million) over 30 years if full protection of turtles was implemented immediately. This was more than double the discounted TEV of marine turtles under status quo conditions (RM 920 million, or USD 287.5 million). Overall, this study highlights that marine turtles have a positive economic impact on fishers and the tourism sector, thus providing an economic incentive for two of the two largest turtle stakeholders in the Semporna PCA to invest in the conservation of these threatened species.

*Conservation & Education*

## **Professional Training on Environmental Pollution Investigation for In-Service Teachers / Technicians in Secondary Schools**

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The development of environmental conservation and education in Asia lags far behind the Western World. It appears to the team that education 'in' the environment in particular has been lacking, regardless of the fact that it represents one of the three important elements of environmental education (about, in, and for the environment). This is partly due to the fact that environmental studies is a multidisciplinary subject that many in-service teachers find difficulty in locating a set of appropriate teaching materials tailor-made for the local environment. The training workshop will help fill the gap. Instead of adopting materials produced in foreign countries, teachers can make use of the local information from the training to organize good quality educational activities for their students. The teaching materials are designed for in-service teachers/technicians of Liberal Studies, Geography, Science or Environmental Education in secondary schools. The content covered both scientific and technological knowledge, consisting of teaching materials and guides with suggested topics and references demonstrating the standard methods of environmental pollution investigation. It will not only supplement the existing monotonous academic textbooks, but also encourage students' a self-study outside classroom. From this training workshop, we aim to: (1) promote teaching effectiveness and quality of related courses by providing teaching resources for in-service teachers/technicians in secondary schools; (2) improve learning experience of secondary students; (3) enhance in-service teachers/technicians' knowledge and understanding of various environmental pollution in Hong Kong; (4) provide practical information of some of the pollution status in Hong Kong for the participants; and (5) provide consultancy and technical supports for in-service teachers/technicians in environmental pollution studies.

*Conservation & Education*

## **What to Protect in the Seascape of Anthropogenic Pressure? Area Utilization of Indo-Pacific Humpback Dolphins *Sousa chinensis* in Hong Kong**

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Given the vast coastal development and heavy marine traffic in Hong Kong (HK) and Pearl River Estuary (PRE), there is a need to map the area/habitat use pattern of Indo-Pacific humpback dolphins *Sousa chinensis* in this region to aid in the protection and conservation management of this threatened and locally endangered species. We investigated the spatio-behavioural dynamics and area utilization of humpback dolphins using kernel density estimates and Local nearest-neighbour Convex Hull (LoCoH) models constructed with 4-year (2011-2014) sightings records. Four spatially separated core areas were detected within shallow-water inshore habitats of south-western Lantau Island and northern Lung Kwu Chau. Foraging represents the key determinant of the dolphins' overall distribution pattern, while the small and patchy but predictable foraging sites lead to the formation of small groups with fluid membership. Spatial modelling depicts distance from shore and location as important variables in predicting foraging probability. Resting and socializing core areas were not evident but 85% records of socializing were within the foraging range. Considering that the dolphins seen in HK waters represent part of the PRE population, and that HK waters represent only a small portion of the PRE ecosystem, the use of HK waters throughout the year indicates that this region of PRE represents an important area for the dolphins' overall energetic and socio-behavioural needs. It is therefore concerning that < 17% of core areas and < 7% of core foraging grounds are within the HK marine protected areas. Furthermore, the HK-Macau fast-ferry shipping lane intercepts the dolphin foraging and travelling range between southern Lantau Island and Soko Islands. In general, our findings highlight the severe inadequacy of current protection measures in HK and, more broadly, the importance of the understanding animal behaviour and socio-spatial ecology in formulating effective conservation measures.

*Ecosystem Functions & Services*

## **Analysis of Methylation Profile in Mitochondrial Genome of *Exopalaemon carinicauda* in Response to Starvation**

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As the “energy factory”, the mitochondria play an important role in the metabolism of cells. However, it is little known whether or not the mitochondria in shrimps mediate the energy metabolism-related gene expressions by methylating the mitochondrial genome DNA sequences. In this study, in order to analyze the methylation profile of the mitochondria in response to starvation in the ridgetail white prawn *Exopalaemon carinicauda*, we designed 51 BSP (bisulfite sequencing PCR) primer pairs which PCR amplification zones covered the whole mitochondrial genome. Of the 51 primer pairs, 10 primer pairs could get the predicted PCR products, but only 5 primer pairs were selected for further studies because of their repeatable PCR amplification merits. The methylation profile of different individuals at 10 d, 20d and 30d after starvation stress were analyzed, using the above 5 primer pairs. Our results showed that the average death time of tolerating starvation for the *E. carinicauda* was 19.8 days, and the most tolerating time was 48 days. The DNA methylation in mitochondria genome were found at each starvation stress stages. But, to our surprise, the methylation ratio decreased following the elongation of starvation time. The individuals with DNA methylation were the most at 10<sup>th</sup> d, second is 20<sup>th</sup> d, and the last is 30<sup>th</sup> d. The DNA methylation were mainly found in the ND genes (NADH dehydrogenase gene) which expression production were responsible for maintaining the respiratory electron-transport chain in mitochondria. So, we speculated that the function of methylation is to control the energy transfer in mitochondria.

*Ecosystem Functions & Services*

## **Coral Recruits in Hong Kong Are Not Seriously Affected by *Drupella* Corallivory**

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Coral recruitments play a vital role in mediating adult coral population structure as well as promoting coral reef recovery after disturbances. As one of the most delicate life stages of coral, coral recruits were reported to be sensitive to a number of environmental, biological and physical stresses. This study aimed to examine the effect of one of the biological stresses, *Drupella* corallivory, on coral recruits in Hong Kong.

Coral recruits of *Platygyra acuta* and *Acropora valida* were respectively exposed to *Drupella* in different experiments. Three prey types (tile settled with coral recruits, tile without coral recruits and brand new tile) were provided in the prey-choice experiment which tested the attractiveness of coral recruits to *Drupella*. Among them, tile without coral recruits instead of tile containing coral recruits were most attractive to *Drupella*. However, the overall attractiveness of the tiles was low.

In the force-feeding experiment which aimed to evaluate the effect of corallivory, *Drupella* snails were placed in small aquaria with tiles that contained coral recruits. Alongside with *Drupella*, herbivorous gastropods *Tectus pyramis* and *Euplicia scripta* were also placed in aquaria to compare the effects of herbivory vs. corallivory. The impacts caused by both treatments were similar with only limited number of coral recruits removed.

All these results indicated that the effects of *Drupella* corallivory on coral recruits were low. Despite being one of the most aggressive corallivores, *Drupella* appeared to confine their impacts on adult corals only. The specific prey-preference on adult corals but not on recruits may suggest a possible role for the muricid to shape the coral community structure.

**DNA-based Study of the Diet of the Marine Copepod  
*Calanus sinicus***

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Illumina sequencing technology was used to study the dietary composition of *Calanus sinicus*, a dominant member of the marine zooplankton in continental shelf waters around China, Japan and Korea. Adults and copepodites (C5) were collected from coastal seas in southeastern Hong Kong (4 adults + 4 C5) and northern Taiwan (8 adults + 8 C5). Variable regions of the 18S and 16S rRNA genes were amplified using DNA extracted from pooled gut contents to determine the composition of eukaryotes and prokaryotes in the diet. For each sample, an average of 113,677 sequences were obtained for the 18S gene and 175,961 sequences were obtained for the 16S gene. The number of operational taxonomic units (OTUs) clustered at 97% similarity retrieved from the 18S and 16S gene libraries were 2,448 and 133,760, respectively. The diets of adults and C5 were quite similar. Hydrozoa and unclassified Ctenophora, accounting for 26–90% of the sequences, were common in the diet of *C. sinicus* from both Hong Kong and Taiwan. *C. sinicus* from Hong Kong contained Bacillariophyceae (3–38%) and Dinophyceae (3–23%). In northern Taiwan, where Chl-a concentration was < 0.7 µg L<sup>-1</sup>, *C. sinicus* tended to feed on Anthozoa (1–22%), Ascidiacea (6–22%) and Malacostraca (7–37%). Unclassified Stramenopiles (1–84%), unclassified Proteobacteria (1–92%) and unclassified bacteria (5–60%) were common in *C. sinicus* from both Hong Kong and Taiwan. Cyanobacteria, mainly *Synechococcus* (2–40%), were only found in *C. sinicus* from Taiwan. Our finding suggests that *C. sinicus*, which is widely considered to be herbivorous, can feed omnivorously on both phytoplankton and zooplankton. The work presented in this paper was supported by a grant from the Research Grants Council of the Hong Kong SAR, China (project no. CUHK475912) to C.K.W.

*Ecosystem Functions & Services*

**Ecological Functions of Macrobenthic Community Are Compromised by Severe Pollution, but Enhanced by Afforestation: Evidence from Biological Trait Analysis**

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Mangrove habitats in many developing countries are constantly impacted by sewage discharge which leads to serious pollution in mangrove sediment. Unlike mangrove plants, many macrobenthos are susceptible to pollutants and thus the ecological functions of macrobenthic community would be altered. However, macrobenthic community in estuarine ecosystems is suggested to have an inherently high resilience to environmental stress. As such, the present study attempted to investigate the functional diversity, functional redundancy and ecological functions of macrobenthic community in a severely polluted mangrove by studying biological traits of macrobenthos. The spatial and temporal variations of these parameters were examined. Results showed that typical traits of opportunistic species, such as '1 - 6 cm', 'Direct development', 'Low mobility', 'Long thin', 'Cylindrical', 'No attachment', 'Burrower' and 'Deposit feeding', prevailed throughout the studying period. The trait pattern of macrobenthic community was dictated by cadmium concentration and tidal level. The *Sonneratia* stand had a different trait pattern than the mudflat, highlighting the significance of habitat heterogeneity. More importantly, the former had a higher functional diversity, meaning that afforestation can diversify the ecological functions of macrobenthic community. Functional diversity was, however, lower in summer and negatively correlated with cadmium concentration. Given the dominance of opportunistic species, functional redundancy was generally high, indicating the high resilience of the macrobenthic community to species loss. Our findings demonstrated that the ecological functions of macrobenthic community were compromised by severe pollution and largely subject to seasonality. Afforestation of *Sonneratia* in the mudflat can be cautiously launched to enhance the functional diversity of macrobenthos community without engendering ecological consequences.

*Ecosystem Functions & Services*

**Ecology of Marine Amphipods in Hong Kong with Special  
Emphasis on the Use of Indigenous Marine Amphipod Species as  
Test Organism for Assessing the Toxicity of Marine Sediments**

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This paper present a study aimed to examine the feasibility of using indigenous benthic amphipods as test organisms for assessing toxicity of marine sediments. An intensive ecological survey on local amphipods in the coastal environment of Hong Kong was first conducted. An indigenous benthic amphipod species, *Melita koreana*, Stephensen was finally selected for further laboratory studies. A final sediment toxicity test using the local amphipods was conducted to assess the toxicity of representative sediment samples collected in the coastal waters of Hong Kong.

## **Effect of pH on Growth and Toxicity of Two Strains of *Gambierdiscus* spp.**

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pH is an important environmental factor that regulates abundance, distribution and physiology of microalgae through ways of changing the distribution of carbon dioxide species and carbon availability, altering the availability of trace metals and essential nutrients, affecting the efficiency of proton pumps and so on. To examine the effects of pH on growth and toxicity of marine benthic dinoflagellates, two strains of *Gambierdiscus* spp. (M2SWC12 and M1M03) were allowed to grow at various pH (7.4, 7.8, 8.2, 8.6 and 9.0) which was maintained by adding HCl or NaOH to the culture medium. Their growth rate and maximum cell density were monitored by counting cell numbers every four days during the course of experiment. A pH drift experiment was also performed to test ability of *Gambierdiscus* spp. to utilize inorganic carbon sources. At the end of the experiment, cells of *Gambierdiscus* spp. were collected to assess ciguatoxicity using in vitro mouse neuroblastoma assays (MNA).

The growth rates of M2SWC12 were significantly higher ( $p \leq 0.01$ ) when it was cultured at lower pH (pH 7.4, 7.8), while those of M1M03 showed no significant difference among the examined pH. Although no significant difference was found in the maximum cell density of M1M03 under all examined pH, the maximum cell density of M2SWC12 was significantly lower at pH 7.4 and 9.0. These results indicated that the effect of pH on growth of *Gambierdiscus* spp. was species-specific. Floating ability was observed in M1M03 at pH 9.0, reflecting that adaption could be developed for mitigating the adverse effects of extreme pH. In the pH drift experiment, maximum pH was measured to be  $> 9.0$  during the exponential phase. This indicated that both stains can utilize bicarbonate ( $\text{HCO}_3^-$ ) for cell proliferation although photosynthetic rate was lower when  $\text{pH} > 8.0$ . The patterns of nutrient utilization (ammonium, nitrate, nitrate and phosphate) by M2SWC12 and M1M03 were monitored during the course of experiment. No detectable ammonia was found in culture medium at Day 4, suggesting that ammonia could be one of the favorable nitrogen sources for the growth of *Gambierdiscus* spp. under the tested pH. Higher ciguatoxicity ( $>10$  fold) of *Gambierdiscus* spp. were measured when they were cultured at higher pH condition, demonstrating that higher pH could induce ciguatoxins production of *Gambierdiscus* spp.

*Ecosystem Functions & Services*

## **The Philippine Marine Protected Area Support Network**

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The Marine Protected Area (MPA) Support Network (MSN) is a network of government, non-government and academic institutions established to support MPA management in the Philippines. The MSN updates and maintains the Philippine MPA Database. The MSN has developed management assessment tools such as the MPA Management Effectiveness Assessment Tool (MEAT) and MPA Network Effectiveness Assessment Tool (NEAT). Through this performance systems, the MSN documents and recognizes best practices in MPA management and leverages support from public and private partnerships to provide incentives through the Parallel MAR (MPA Awards and Recognition). It facilitates institutional arrangements and information exchanges through MPA forums to help sustain coordination at various local and national management levels. The MSN partners also help provide inputs to the Philippines State of the Coast (SOC) Report. Also, the MSN provides inputs to international conservation initiatives such as the Sulu-Sulawesi Marine Ecoregion (SSME) and the Coral Triangle Initiative (CTI).

**Experience Matters: Context-dependent Central-place Foraging Behaviour of the Sand-bubbler Crab *Scopimera intermedia***T.Y. Hui<sup>1</sup>, S. Cannicci<sup>2</sup> and G. Santini<sup>2</sup> and G.A. Williams<sup>1</sup><sup>1</sup>The Swire Institute of Marine Science and School of Biological Sciences, The University of Hong Kong, Hong Kong SAR, China<sup>2</sup>Department of Biology, University of Florence, Italy

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Context-dependent foraging patterns are demonstrated by Bayesian foragers who are able to incorporate sampling information to make and adjust foraging decisions, e.g. foraging effort and movement. In general, forager with such a strategy performs better than an information-ignorant forager, whose behavioural patterns are fixed and unable to accommodate small scale changes in their local environment. The application of these different strategies was investigated in the sand-bubbler crab, *Scopimera intermedia*, which is a sandy shore deposit-feeder and so experiences a very heterogeneous foraging environment where food quality varies spatially. Observations on the shore, using first-passage time analyses of the crab's movement patterns, revealed that the crab spends a disproportionate amount of time foraging along its tracks, with foraging effort being concentrated at ~ 50% of the maximum foraging range. This strategy matches an area-restricted search movement pattern where foraging effort is restricted to potentially richer food patches. Experimental manipulations were used to create heterogeneous patches of different size and with sediments of different food values (i.e. microphytobenthos biomass as estimated by Chlorophyll a content). Under these experimental conditions, *S. intermedia* showed a strong context-dependent foraging pattern. While similar spatial-temporal patterns were observed in treatments with homogeneous food distribution, regardless of the overall food richness, more concentrated foraging on enriched patches occurred once they were detected by the crabs in the heterogeneous treatments. Sediments with normal food value, therefore, were either rejected or accepted depending on the immediate past experience of the crabs. Such a context-dependent strategy (i.e. positive/negative contrast effect) arises when the crabs experience a strong short-term contrast in environmental food richness, which the crabs incorporate into their decision-making process in order to maximize the rate of energy gain when foraging in spatially heterogeneous environments.

## **How to Allocate Energy When You Are hungry? A Case of the Invasive Species, *Mytilopsis sallei***

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Dynamic Energy Budget (DEB) models describe the dynamics of energy flow within organisms from their assimilation of food to the utilization of energy for maintenance, growth, development and reproduction. The DEB model, therefore, allows predictions of growth rates, maximal size and reproduction of species according to their environment and energy acquisition and can provide forecasts of the potential success of species, such as the spread of invasive species. According to DEB theory, during starvation, individuals are unable to amass any energy reserve and will devote all their energy to self-maintenance. A laboratory-based starvation experiment was used to test the use of energy reserves by the invasive mussel, *Mytilopsis sallei*. Dry weight (DW) and respiration rate were used as measures of maintenance costs of starved individuals, and these dropped by 55% and 61% respectively as compared with well-fed individuals. The organic content of starved individuals also reduced as indicated by ash free dry weight (AFDW). These decreases were caused by the utilization of the organic component of the mussel's energy reserve (e.g., fat and glycogen), leaving only structural tissue (flesh and internal organs) as the solo contributor to the final DW. The lower oxygen consumption indicated that at this stage the mussel is only expending energy for self-maintenance and not for feeding or growth. Differences in AFDW and oxygen consumption between well-fed and starved individuals enable the estimation of the relative amounts of energy allocated to growth and self-maintenance, and therefore contribute towards estimates of life history traits of *M. sallei* using the DEB model. In comparison with another aggressive invasive mussel, *Brachidontes pharaonis*, *M. sallei* appears to expend less energy on self-maintenance. Differences in energy allocation between these species allow the prediction of different invasion potentials, and therefore future range distributions under projected environmental changes.

*Ecosystem Functions & Services*

## **Physical-Biological Coupling Mechanism of Mesoscale Eddy in Central South China Sea: A Case Study Near the Zhongsha Islands**

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Eddies can be important in sustaining primary production in the tropical oceans, but their role for nutrient and material cycling is poorly understood in the central South China Sea (SCS). To assess the role of cyclonic eddies in enhancing primary production; both *in situ* observation and remote sensing method were carried in the central SCS during the spring 2014, around a cyclonic eddy close to 17.0 °N, 115 °E. Shallowing of the thermocline and halocline by 10 m was observed within the eddy compared to the surroundings; mixed layer depth was also reduced within the eddy. Both *in situ* observation and remote sensing results showed that notable cold and saline water was found near the Zhongsha islands, about 1-2°C lower than the surrounding area at 5m layer. Obviously increased phytoplankton biomass and primary production was observed via remote sensing analysis, with the mean of 309.25 mgC m<sup>-2</sup>.d<sup>-1</sup>. This study suggests the potential for assessing the biological response of eddies in central SCS.

## **Population Structure and Growth of *Euphausia pacifica* in the Yellow Sea**

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*Euphausia pacifica* is regarded as the key predominant euphausiid species in the Yellow Sea by virtue of its enormous abundance, large body size, and significant role in marine food chains. Spatial distribution, population structure and body length variation of *E. pacifica* in the Yellow Sea were studied from April 2006 to August 2007 during 8 cruises. We investigated their distribution of the developmental stages in relation to environmental factors (temperature, salinity, and chlorophyll a). We used principal components analysis and Pearson correlation to analyze the covariation and correlation between *E. pacifica* abundances and environmental factors. The spatial distribution of *E. pacifica* was controlled primarily by seawater temperature and the adults preferentially inhabited cold water. *Euphausia pacifica* occurred nearly throughout the entire study area in spring and winter. When surface seawater temperature was over 20 °C in summer and autumn, *E. pacifica* was mainly located in the Yellow Sea Bottom Cold Water (YSBCW) area where the temperature below the thermocline was 8-10 °C. The total length (TL) of adult *E. pacifica* ranged from 7.81 mm to 20.57 mm, which was positively correlated with body length (BL). The slopes of fitting formula between BL and TL illustrated the growth condition of *E. pacifica*. Size frequency of *E. pacifica* in June, August and September showed that the population was composed of new and older adults of different TL. The average TLs of *E. pacifica* in spring (March, April and May) were larger than other seasons. We conclude that *E. pacifica* can undergo its whole life history and maintain high abundance in the Yellow Sea. Population recruitment of *E. pacifica* mainly occurred in spring. YSBCW offers a refuge for *E. pacifica* in summer and autumn.

**Study of Burrow Architecture of Fiddler crab *Uca annullipes* (H. Millne Edwards, 1837) on Mudflats of Gulf of Khambhat, Gujarat, India**

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The fiddler crab *Uca annullipes* (H. Millne Edwards, 1837) is one of the most conspicuous burrowing organisms of mudflats of Gulf of Khambhat. In the present study, the burrow architecture of the species with relation to the crab size, age and environmental factors was studied. The study was carried out at Kamboi located on the northern part of Gulf of Khambhat. The unsaturated resin was poured into the randomly selected burrows and allowed to solidify. The crabs that emerged from the burrows were captured and size and sex were recorded. The burrow casts were excavated and various morphological characters were measured. The temperature variation in the burrow was measured at the interval of 5 cm up to the depth of 25 cm. Total 70 intact burrow cast were obtained and three different types of burrows like J, single tube and spiral shape were identified. The carapace width of the crab exhibited significant correlation with few morphological parameters of burrows which showed that burrow architecture is highly influenced by the crab size. Juveniles (CW= 2.3-2.6 mm) created simple tube burrow which had lowest opening diameter (6.3 - 7.00 mm), depth (17-21 mm) and volume (17-26 cm<sup>3</sup>) while adults (CW= 4-4.5 mm) created spiral and J shape burrows with larger opening diameter (> 10 mm), depth (20-25 cm) and volume (18-30 cm<sup>3</sup>). The burrows shelter the crabs from desiccation stress. The sediment surface temperature recorded was 37.5°C which dropped down to 24.5°C in the lowest part of the burrows. Juveniles created shallow and simple burrows because their gill areas are smaller and they need to come out frequently to renew their respiratory water while the larger crabs can tolerate longer period of time without renewing their respiratory water and therefore create deeper and larger burrows for mating and refuge.

*Ecosystem Functions & Services*

**Using Stable Isotope Bayesian Ellipses in R (SIBER) Analysis to Resolve The Complex Trophic Relationships of Corals**

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Corals have particularly complex trophic relationships; not only can they feed heterotrophically on a variety of particulate organic matter and dissolved organic nutrients, but many species also obtain carbon and nitrogen from their photosynthetic algal symbionts. Differences in how corals use nutrient sources are critical for understanding coral distribution and resilience in the face of anthropogenic stressors such as nutrient pollution and global climate change. The use of  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  is an established method for determining consumer diet. Mixing models, however, require sampling of all potential food sources, and sampling those sources is challenging in all but the most simple of systems. Stable Isotope Bayesian Ellipses in R (SIBER) analysis uses consumer isotope signatures alone to model an ellipse that represents the trophic niche of a population in isotopic space. Ellipses of two groups that share the same isotopic space indicate trophic niche overlap while distinct ellipses indicate niche partitioning. I will present SIBER analysis of two datasets that demonstrate how this analysis can elucidate the trophic relationships of different coral communities. First, I will show how SIBER analysis provides evidence for trophic niche partitioning among temperate Atlantic octocoral species that lack algal symbionts, and thus can only feed heterotrophically. Second, SIBER analysis of scleractinian corals and their symbionts from Hong Kong suggests that there is variation in the nature of this symbiosis across coral taxa.

*Fisheries & Marine Resources Management*

## **Age and Growth of Black Seabream (*Acanthopagrus schlegelii*) in Hong Kong and Adjacent Waters**

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Study of age and growth is important for understanding the life cycles of fish species and provides critical components for modelling fish population dynamics to understand the impacts of fishing, and for fishery management. Seabreams (family Sparidae) have long been commercially important in the capture fisheries in Hong Kong and adjacent waters yet biological information is limited on local population(s). Study of age and growth of a locally common sparid species, the black seabream (*Acanthopagrus schlegelii*), was conducted. Fish specimens were collected monthly during November 2011 – December 2012 from local fishermen or from Hong Kong government trawler surveys. Supplementary samples were collected till May 2014 to ensure wide size range coverage. Otoliths (i.e. ear bones) were extracted and grinded down to thin slices, and age of the fish determined by counting rings formed in the otolith. Validation of ring formation frequency was determined by using marginal increment analysis. The potential for using otolith weight as a proxy to determine age was also tested. Data were fit to a von Bertalanffy growth function (VBGF) to determine the relationship between fish length and age thereby to obtain life-history parameters, such as growth coefficient, age at sexual maturity and sex change for this protandric species. Results were analyzed with the findings from a reproductive biology study conducted on the same animals. This species is a fast growing and early maturing species with a maximum age of about 9 years. Otolith weight was found to be positively and generally correlated with age but may not be accurate enough to determine individual fish age. Implication in fishery management is also discussed.

## **Development of the Environmental Monitoring System for Aquaculture**

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The worldwide production of fishery products reached over 100 Billion US Dollars in 2012 with the Mainland China contributing over 60% of the entire world's supply. Aquaculture was already the fastest growing sector of food production over the last two decades and it will continue to be a crucial source of food for the world during the next century. However, with the development of economy and society, as well as aquaculture has not always been environmentally responsible, the ecological environment is deteriorating gradually and the irresponsible use of veterinary chemicals and drugs also cause food safety concerns. The water quality is one of the most important factors that affect the quality of the aquatic food. On the other hand, marine aquaculture is environmental dependence. Rapid changes in marine environment are creating an urgent need for real time environmental monitoring which is significant for the forecast of marine disasters and the prevention of economic loss.

With regards to research or professional services back up for aquaculture, a dynamic environmental monitoring system will be developed to monitor the changes of water qualities and biological communities at fish culture zones. The system will include on-site monitoring systems, data transmission systems and data processing systems. The state-of-the-art technologies of remote sensing platforms and sensors will be employed. Several key constituents related with water quality, including total nitrogen, total phosphorus, chlorophyll-a, harmful algal, zooplankton, trace metals, dissolved oxygen, turbidity, pH, salinity, and temperature, will be of major concern. The data will be transmitted to the data processing system by public telephone network, satellite communications, HF VHF communications, and data storage media, etc. The data processing system will analyze the raw data, establish databases, and provide information services. This proposed comprehensive monitoring system for the aquaculture environment will contribute to early warning of marine disasters, ensure the safety of aquaculture and provide a track record for the enquiries of supervision departments and customs, and thus help us to improve fishery resource management.

**Elucidating the Food Web Structure of Demersal Crustaceans in Hong Kong's Coastal Water using Stable Isotope Analysis**

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Bottom trawling has been demonstrated to be one of the most destructive fishing methods to marine benthic communities. Since the 1970s, marine fishery resources in Hong Kong, especially large predatory species, have been overexploited by non-selective fishing gears including bottom and pelagic trawlers. This fishing down the trophic level has resulted in a benthic ecosystem primarily dominated by small herbivorous and omnivorous fishes and crustaceans. To mitigate such impacts, the Government of the Hong Kong Special Administrative Region has implemented a territory-wide trawling ban in local waters since 31 December 2012. This study aims to investigate whether crustacean resources, in particular of the orders Decapoda and Stomatopoda, could recover after the implementation of the trawling ban in Hong Kong waters. During July to November 2012 (before trawl ban) and June 2013 to November 2014 (after trawl ban), 60 surveys were conducted at eastern, western and southern coastal water zones of Hong Kong using a commercial shrimp trawler (with scientific research permit). A total of 210 crustacean species from 36 families were recorded. Community structures of crustaceans significantly differed among the three zones with a salinity gradient being low at the western waters and high at eastern water. Species richness, evenness index and Shannon's diversity index were the lowest during both wet (July to September) and dry (October to November) seasons in the eastern zone, and a lower biomass was recorded in the eastern zone during the wet season. Differences of community structure were identified among years 2012 (before trawl-ban), 2013 and 2014 (after trawl-ban) based on the results of multivariate statistical analysis. During the wet season, overall abundance of crustaceans from all three zones in 2014 was higher than that in 2012, while biomass, species richness, species diversity and evenness indices, and Warwick statistic remained unchanged. The current study will be continued until May 2016. Trophic levels and population dynamics of selected crustaceans will also be studied in order to evaluate the effectiveness of the trawl-ban policy in facilitating ecosystem recoveries.

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**Hydrodynamic Conditions and Spawning Timing of Leopard  
Coralgrouper *Plectropomus leopardus* and Stony Coral *Acropora*  
spp. in Lankayan Island, Sabah Malaysia**

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Reef fishes and corals have evolved to spawn at specific times during new and full moons. The hydrodynamic conditions during spawning period are believed to influence the spawning timing besides providing a mechanism for transport of eggs and larvae to distant reefs. This study measured the current speed and directions during spawning periods of *Plectropomus leopardus* and *Acropora* spp. from April to July 2013 at Lankayan Island, Sabah, Malaysia. The hydrodynamic conditions were measured by Aquadopp Profiler (AquaPro 1Mhz). Current direction and speed varied according to depth. Surface currents were in the northwest direction and reached a maximum speed at 0.69 m/s. Water temperature at the bottom (19 - 20 m) reached 30 C° in June - July. During the full moon period of 25 - 27th April, *Acropora* spp. spawned an hour after the slack low tide, during flood tide when surface currents were rapid. Hydrodynamic modeling showed that surface current speed increased after the slack low tide and decreased during slack high tide and ebb tide. The current speed and direction during spawning hours determined the dispersal pattern of eggs and larvae. Hydrodynamic conditions also determined the population connectivity between reefs. Understanding the connection between source and sink habitats is important in management of marine resources.

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## **Long-Term Changes of Nutrient in the West Harbor of Xiamen Bay in relation to Aquaculture**

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To explore coastal water ecosystem response to sea aquaculture changes, we investigated inter-annual changes in the nutrient variables using data collected from the west harbor of Xiamen Bay during the 1989–2006. Concentrations of nutrients have changed much in the past years, with trends indicating an increase in nitrogen and phosphorus. The study also showed that, the value of nitrate, nitrite and ammonium apparently increased much but the value of reactive phosphorus slightly decreased after fishing net-cage removed. Statistical analysis has shown that the long-term variations of nutrients are not associated with sea aquaculture, but associated with other anthropogenic factors, such as industrial waste water and city sewage which can bring a lot of organic matter and inorganic matter flux into coastal sea.

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**Molecular Cloning, Tissue Expression of Long Chain Fatty Acyl-CoA Synthetase 1 (ACSL1) Gene and Effects of Dietary Lipid Levels on Its Expression in the Livers of Half-smooth Tongue Sole (*Cynoglossus semilaevis* Günther)**

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Long chain fatty acyl-CoA synthetase 1 (ACSL1) has important functions in fatty acid metabolism and cell membrane fluidity regulation. In this study, we obtained the full length cDNA of ACSL1 gene from *C. semilaevis* liver by performing reverse transcription PCR and rapid-amplification of cDNA ends (RACE). The results showed that the full-length cDNA of ACSL1 was 2462 bp long and had a 2402 bp open reading frame (ORF) encoding a 697 amino acid polypeptide with a calculated molecular weight of 78.0 kDa and an isoelectric point of 7.932. The polypeptide contained an ATP/AMP binding motif and a fatty acid binding motif, which had high homology with the corresponding sequences in other vertebrates. Gene expression analysis (real-time quantitative PCR) indicated that ACSL1 transcripts were widely distributed in various tissues, in which the highest relative expression level was observed in the heart (4.20) following by ovary (1.47), kidney (1.35) muscle (1.03), adipose tissue (0.99) and brain (0.98) and lowest expression level was detected in intestines (0.32). ACSL1 gene expression is regulated by a number of developmental, dietary, and environmental factors; thus, we determined the effects of ACSL1 mRNA expression in the livers after the fish were fed with diets added with 0% (control), 3.5%, 7%, or 10% fish oil for 12 weeks. The results revealed that all fish oil added diets resulted in strong inhibited effects on the amount of ACSL1 gene expression compared with control diet though no significant differences were observed among experimental diets.

**Ocean Floating Hapa Nursery System for Scaling-Up Juvenile Production of the Sea Cucumber *Holothuria scabra***

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Sea cucumbers or holothurians are high-value marine invertebrates collected, processed and sold as beche-de-mer or trepang. Due to increasing demand for sea cucumber products, a decrease in sea cucumber population worldwide has been observed. Release of hatchery-produced juvenile to rebuild wild stocks has been pursued. This study investigated the potential of the ocean floating hapa nursery system as an alternative for scaling-up juvenile production of cultured *Holothuria scabra* or sandfish. The ocean floating hapa nursery system was evaluated in a field trial to compare growth and survival of post-settled juvenile sandfish (4-10mm) with those in hapa nets in ponds and bottom-set cages. In addition, large-scale productions of juvenile sandfish from ocean floating hapas during five rearing periods were also compared. Average weight of juveniles reared in hapa nets in ponds ( $0.59\text{g}\pm 0.08$ ) was significantly higher (ANOVA,  $p=0.023940$ ) than in the two ocean nursery systems: a) floating hapas ( $0.38\text{g}\pm 0.14$ ) and b) bottom-set cages ( $0.38\text{g}\pm 0.08$ ). Survival was also significantly higher in the hapa nets in pond ( $57\%\pm 7$ ) and the ocean floating hapas ( $44\% \pm 13$ ) compared to the bottom-set cages ( $17\% \pm 17$ ). Significant differences were observed in the average weights of sandfish among the five rearing periods. Average weight of juveniles was significantly higher during April - May 2010 when seawater temperature was at  $31^\circ\text{C}$  compared to other rearing periods (ANOVA,  $p<0.001$ ). Meanwhile, survivorship was significantly higher during April - May 2010 and November - December 2011 (ANOVA,  $p<0.001$ ). Results of this study showed that the floating hapa nursery system may be an alternative nursery system to hatchery tanks and ponds for rearing post-settled juveniles (4-10mm) of *H. scabra*. Moreover, if programmed properly, production of release-sized juvenile sandfish in mass scale is viable through the ocean floating hapa nursery system.

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**Ovarian Maturation and Spawning Season of the White Spotted Rabbitfish, *Siganus canaliculatus* (Park, 1797) in Palompon, Leyte Eastern Visayas, Philippines**

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The white spotted rabbitfish is one of the most exploited marine resources in the Philippines. In places where they are abundant, they dominate catches covering 30 – 40% of the total catch. The study was conducted in Palompon, Leyte during a one year period from June 2011 – June 2012. Samples were collected monthly from catches of spearfishing and drive-in gillnets. A total of 295 fish samples ranging from 5.2 – 15.5 cm SL were randomly collected during the study period. Ovaries were taken and stained with hematoxylin and eosin. Six maturity stages were observed namely: immature, developing, mature, spawning, spent and re-developing. Gonadosomatic index (GSI) showed two distinct peaks from July/September and from February to May then decreased sharply by June 2012. An increase in GSI values was visible from immature to mature ovaries and reached a peak at spawning stage ( $10.63 + 4.13$ ). The minimum length at maturity was 7.1 cm. Oocyte diameters ranged from  $<20\mu\text{m}$  in immature ovaries to a maximum of  $440\ \mu\text{m}$  in spawning individuals. Based on the result, oocyte development of *S. canaliculatus* was group-synchronous, hence considered as batch spawners. Fecundity estimates of spawning individuals of 7.1 – 15.5 cm SL ranged from 18,350 – 306,850 eggs. Fecundity increased linearly with fish length, age and gonad weight. The results of this study will provide useful inputs in the management of *S. canaliculatus*.

**Population Dynamics of the Mantis Shrimp *Oratosquilla oratoria* Before and After the Trawling Ban in Hong Kong's Coastal Waters**

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Through studying population dynamics of marine benthic species, we can reveal the changes of their population size and structure in relation to environmental changes due to management intervention such as prohibition of trawling based fisheries. The results of population dynamics studies can also provide baseline information for stock assessment and sustainable management of the species. Due to the over-exploitation of fishery resources, a territory-wide trawling ban has been implemented in Hong Kong waters since 31 December 2012. This study, therefore, aimed to test a hypothesis that the abundance, biomass, asymptotic lengths, growth rate and reproductivity of the predatory mantis shrimp species *Oratosquilla oratoria* increases after the trawl-ban. We investigated the temporal and spatial variation of the population structure, growth, reproductive cycle and recruitment pattern of *Oratosquilla oratoria* in the eastern and western waters of Hong Kong before and after the trawl-ban. Our results showed that *O. oratoria* appeared to have a life span of less than one year in eastern and western waters as the cohort disappeared one year after recruitment. Time of recruitment of this species differed between eastern and western waters, although recruitments were consistently found at least once during wet and dry season, respectively. During the post trawl-ban period, asymptotic lengths ( $L_{\infty}$ ) of *O. oratoria* in eastern waters were similar to that of those in western waters (average  $L_{\infty} = 37.80$  mm). But this average value was considerably higher than that of those collected during 2003–2005 before the trawl-ban ( $L_{\infty} = 32.03$  mm). Such an increase of their asymptotic length may be due to the reduction of fishing mortality brought by the trawl-ban. Further analyses will be conducted in the other three Stomatopoda species: *Oratosquillina interrupta*, *Miyakea nepa* and *Harpisquilla harpax* to verify whether a similar trend could be observed.

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## **Spatial and Seasonal Variations in Trophic Dynamics of Benthic Communities of Marine Molluscs in Hong Kong's Coastal Waters before and after the Trawling Ban**

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To rectify the detrimental impact of overfishing and destruction of benthic ecosystems, a territory-wide trawling ban has been imposed in Hong Kong's coastal marine waters since 31 December 2012. It is anticipated that the local benthic marine ecosystem will gradually recover after the trawl-ban. Using stable isotope analysis (SIA), this study aims to compare trophic dynamics of benthic molluscan communities of eastern, southern and western waters of Hong Kong before and after the trawling ban. The results of this study will also serve as a baseline for studying long-term ecosystem recovery. Trawling surveys were conducted using a commercial shrimp trawler in each of the three zones during wet and dry season in 2012 (pre trawl-ban) and 2014 (post trawl-ban). In total, 17 species of molluscs were collected for the SIA. They included predators (e.g. the Japanese spineless cuttlefish *Sepiella japonica*), filter feeders (e.g. the undulate clam *Paphia undulata*) and scavengers (e.g. the burned nassa *Nassarius siquijorensis*). Mantle tissues of cephalopods, and the muscular foot of bivalves and gastropods were dissected and subjected to the SIA. The results consisted of nitrogen and carbon contents, as well as isotopic ratios of nitrogen ( $\delta^{15}\text{N}$ ) and carbon ( $\delta^{13}\text{C}$ ) for the tissue sample of each species. Bases on the samples collected in 2012, the results revealed clear spatial and seasonal variations in the isotopic signatures of the molluscan species. At present, we are still running the SIA for the samples of 2014, and the results shall be available soon. In our presentation, the overall results will be discussed with reference to a more holistic picture of the benthic ecosystem by considering observed changes in diversity and abundance of other coexisting taxonomic groups such as fishes and crustaceans.

## **Spatial Variation in Trophic Structure of Demersal Fish Communities in the Marine Environment of Hong Kong, South China**

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Hong Kong's western coastal waters (WW) situated at the Pearl River Estuary are heavily influenced by freshwater and sediment discharges from the Pearl River, while its eastern waters (EW) are mainly affected by oceanic and tidal currents. The southern waters (SW) are positioned along this estuarine-oceanic salinity gradient. Such variations in hydrography and salinity drive differences in trophic structure in local marine ecosystems. This study aimed to investigate the spatial variation in trophic structure of six demersal fish communities in WW (inner and outer estuary), EW (inner and outer Tolo Channel) and SW (waters in southeast and around Lamma). Stable isotopic ratios of  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  of all benthic fishes caught in trawl surveys during July-September and November 2012 were measured.  $\delta^{15}\text{N}$  range (NR),  $\delta^{13}\text{C}$  range (CR), total area (TA), mean distance to centroid (CD) and mean nearest neighbor distance (MNND) were calculated from  $\delta^{13}\text{C}$ - $\delta^{15}\text{N}$  bi-plots to reveal trophic diversity and trophic redundancy. Preliminary results showed that the outer estuary in WW had the highest trophic diversity by having the largest NR, TA and CD, and the greatest niche diversification at the food web base as revealed by the largest CR. While inner Tolo in EW had the lowest trophic diversity as shown by the smallest NR, CR, TA and CD. The two communities in SW had the highest trophic redundancy by having the smallest MNND, which implied that more fishes in SW had similar trophic roles. The stable isotope library built in this study can serve as a baseline for evaluating the prospective recovery of demersal fishery resources brought by the territorial-wide trawling ban that has been imposed in Hong Kong's marine waters on 31 December 2012.

## **The Fisheries Profile of Gigantes Islands, Carles, Philippines: A Review on the Scallop Fishery**

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This is the first report on the fisheries industry in Gigantes Islands, Carles, Philippines, with emphasis on the scallop fishery. Invertebrate populations around the world have been overexploited, generally because they are found in shallow water and mostly sessile, which make them easy to collect. Focused group discussions were done in North and South Gigantes islands on January 2014. Information on fishing gear types used, fishing seasonality, and estimated catches were gathered. The Gigantes Islands is exposed to fishing pressure of 8,811.9 trips/km<sup>2</sup>/yr, which is three times greater than that reported in nearby Concepcion, Iloilo (Campos et al., 2012). The total estimated annual catch of North Gigantes is 9,941.2 MT and 6,479.6 MT for South Gigantes. Compressor diving targeting scallops *Chlamys senatoria nobilis*, *C. maccasarensis*, *Bractechlamys vexillum*, etc. and the oysters, *Spondylus* sp. comprised about half of the total estimated annual catch, landing a total of 8,473.5 MT. The yield is equivalent to 103.3 MT/km<sup>2</sup>, which is comparable to that reported in the highly productive waters of Verde Island Passage (VIP). The productivity of VIP is known to be driven by hydrographic features resulting to increased production. Similarly, though Gigantes is highly fished, the production is still high. An attempt to answer the question of how this is maintained will be made. Issues and concerns of the local fishers on the depletion of scallop stocks were also discussed.

## **What Did the Fishers Think? Assessing the Socio-Economic Impact of Sugud Islands Marine Conservation Area (Sabah, Malaysia) on Fishing Communities after 10 Years of Establishment**

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This study aims to assess the socio-economic impact of a no-take marine protected area (MPA) on fishing communities where fishers were not consulted prior to the creation of the MPA. Non-compliance with MPA regulations, which jeopardises fisheries and conservation goals, is often a negative outcome when fishing communities are not consulted during the MPA creation process. The Sugud Islands Marine Conservation Area (SIMCA) is a no-take MPA in Sabah, Malaysia, that was created by a partnership between the private and state sectors without input from fishing communities. After 10 years of establishment, fishing within SIMCA still occurs despite regular enforcement patrols. To understand the drivers behind continued fishing activity within SIMCA, we targeted two groups of fishers to assess the impact of SIMCA on fishing activities: i) fishers living closest (~35km) to SIMCA; and ii) fishers encountered near or within the boundary of SIMCA. Interviews were conducted with fishers at two fishing villages, and at sea. Fishers living closest to SIMCA were minimally affected by the creation of SIMCA, as there was no or little overlap in their past and present fishing grounds with SIMCA. However, there were negative attitudes towards SIMCA due to perceived unfair distribution of MPA benefits. Thirty percent of at sea interviews were with fishers fishing within SIMCA boundary. The availability of targeted fish species for the live reef fish trade and suitable habitat for shrimp trawling appear to motivate fishers to risk fishing within SIMCA, although there were mixed opinions on whether more income and higher catches could be obtained from fishing near or inside SIMCA. This study highlights that MPAs have varying impact on different groups of fishers. Understanding the spatial use patterns of different resource users and ensuring equitable distribution of MPA benefits are important for effective MPA management.

*Human Impacts***Assessment of the Toxicities of Organic Ultraviolet Filters on Corals**

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Organic ultraviolet filters are active ingredients of personal care products which can protect skin from sunburn and cancers caused by UV radiation. These chemicals have been detected in surface waters, sediments, wastewater and organisms at concentrations ranging from ng/L to mg/L levels. A recent study reported that this group of chemicals could cause coral bleaching at low concentrations. Coral reefs are known to be one of the most productive and biologically rich ecosystems on Earth. Despite the potential negative effects of organic UV filters on the health of corals, information is still lacking about their toxicities. In our study, toxicities of four benzophenone UV filters [2,4-dihydroxybenzophenone (BP-1), benzophenone-3 (BP-3), benzophenone-4 (BP-4), and 2,2'-dihydroxy-4-methoxybenzophenone (BP-8)] to corals (*Pocillopora damicornis* and *Seriatopora caliendrum*) were tested. In coral larvae tests, parameters including settlement, bleaching and death were measured, while in adult nubbin tests, parameters such as death, visual bleaching and photosynthetic efficiency were measured. The level of BP-8 observed to cause larvae bleaching of *S. caliendrum* was 250 µg/L, which is lower than those of the other chemicals tested. The 50%-effect concentrations (EC50) of BP-1 and BP-8 for effects on the settlement of *S. caliendrum* larvae were estimated to be 670.2 µg/L and 716.8 µg/L, respectively. Among these chemicals, BP-3 and BP-4 have relatively low toxicities to *S. caliendrum* larvae. However, even in the 1000 µg/L treatments, effects of these compounds on *P. damicornis* larvae still could not be found. In the adult nubbin exposure, for all the tested parameters, significant effects were found in the 100 and 1000 µg/L BP-8 treatments with *S. caliendrum* nubbins, 1000 µg/L BP-8 treatments with *P. damicornis* nubbins and BP-1 treatments with *S. caliendrum* nubbins. Less toxic effects or no significant effects were found for all the tested parameters in the other nubbin tests.

*Human Impacts*

**Biomagnification of Mercury through a Tropical Marine Food Web in Van Phong Bay, Vietnam**

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Concentrations of total mercury (Hg) in sediment, sea grass, particle organic matter, 10 invertebrate species and 32 fish species from a tropical coastal food web in Van Phong Bay, Central Vietnam which influenced by shipyard activities were analyzed to evaluate differences in Hg accumulation pattern among species. Stable carbon and nitrogen isotope ratios ( $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$ ) also were measured to assess biomagnification profiles of Hg through the food web. The average concentrations of Hg in sediment, sea grass and particle organic matter were 5.11, 25.9 and 180 ng/g dry weight, respectively. Concentrations of Hg in invertebrate and fish species ranged from 46.9 to 194 and from 21.9 to 576 ng/g dry weight, respectively. Concentrations of Hg measured in these organisms were within safe levels for human consumption following criteria by the Ministry of Agriculture, Fisheries and Food in the UK. The simple linear relationship between log-transformed concentrations of Hg and  $\delta^{15}\text{N}$  values in specimens was used to measure the degree of biomagnification of Hg through the food web. The linear regression slope of log [Hg] against  $\delta^{15}\text{N}$  was 0.082. Compared to our previous studies from South Vietnam, the slope for Hg concentration in the present study was lower than that for the Mekong River food web, but higher than that for the integrated shrimp mangrove farm in the Ba Ria Vung Tau.

*Human Impacts*

**Biomass and Distribution of Green Tide-forming Macroalgae, *Ulva* Species in Jeju Island, Korea**

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Although massive green algal blooms (“green tides”) occur in Jeju Island every year, few studies have been conducted on distribution, extent and cause of green tides. We examined distribution, cause of occurrence, biomass and species composition of green tides in Jeju Island from July 2013 to March 2014 in relation to water column nutrients concentrations. Four *Ulva* species (*U. pertusa*, *U. conglobata*, *U. linza* and *U. ohnoi*.) were the main species causing green tides in Jeju Island, Korea. In particular, subtropical species *U. ohnoi* dominated at bloom sites all year round. Average biomass of *Ulva* mats was highest (2,850 g wet weight m<sup>-2</sup>) during the summer and lowest (850 g wet weight m<sup>-2</sup>) during the spring. Total area covered by *Ulva* mats was approximately 1,700,000 m<sup>2</sup> in Jeju Island. It was speculated that around 10,000 wet tonnes of the biomass of *Ulva* mats was produced in Jeju Island annually. Water column NH<sub>4</sub><sup>+</sup> and PO<sub>4</sub><sup>3-</sup> concentrations at blooms sites were usually less than 2 μM, respectively while NO<sub>3</sub><sup>-</sup> + NO<sub>2</sub><sup>-</sup> concentrations in the water column was more than 20 μM during the experimental period. This result implies that the growth of green algae is facilitated not by water column NH<sub>4</sub><sup>+</sup> concentrations but by water column NO<sub>3</sub><sup>-</sup> + NO<sub>2</sub><sup>-</sup> concentrations.

*Human Impacts***Comparison of Temperate and Topical Saltwater Species' Acute Sensitivities Distributions to Chemicals: Implication for Deriving Safe Extrapolation Factor**

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Due to a lack of saltwater toxicity data in tropical regions, toxicity data generated from temperate or cold water species endemic to North America and Europe are often adopted to derive water quality guidelines (WQG) for protecting tropical marine ecosystems. Given the differences in species composition and environmental attributes between tropical and temperate saltwater ecosystems, there are conceivable uncertainties in such 'temperate-to-tropic' extrapolations. This study aimed to compare temperate and tropical saltwater species' acute sensitivity to 11 chemicals through a comprehensive meta-analysis, by comparing species sensitivity distributions (SSDs) between the two groups. A 10 percentile hazardous concentration (HC10) is derived from each SSD, and then a temperate-to-tropic HC10 ratio is computed for each chemical. Our results demonstrate that temperate and tropical saltwater species display significantly different sensitivities towards all test chemicals except cadmium. Temperate species are more sensitive to un-ionised ammonia, chromium, lead, nickel and tributyltin, whereas tropical species are more sensitive to copper, mercury, zinc, phenol and pentachlorophenol. Through comparison of a limited number of taxon-specific SSDs, we observe that there is a general decline in chemical sensitivity from algae to crustaceans, molluscs and then fishes. Following a statistical analysis of the results, we recommend an extrapolation factor of two for deriving tropical WQG from temperate information.

Human Impacts

## **Conserving Intertidal Habitats: What is the Potential of Ecological Engineering to Mitigate Impacts of Coastal Structures?**

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Globally, coastal human population growth and urbanization continues in a fast pace, while climatic change leads to stormier seas and rising tides. Both driving forces jointly generate a strong and increasing demand for land reclamation and infrastructure protection in coastal areas which require engineered defence structures such as sea walls. This study aimed to review ecological impacts of coastal engineered structures on intertidal ecosystems, update the current status of ecological engineering to mitigate these impacts, and evaluate the effectiveness of such mitigations in relation to the conservation of intertidal habitats and biodiversity. Engineered structures alter important physical, chemical and biological processes of intertidal habitats, and strongly impact community structure, inter-habitat linkages and ecosystem services while they can also drive habitat loss. Such impacts occur diffusely across localised sites but scale to significant regional and global levels. Promisingly, developments in ecological engineering have identified a need to increase habitat complexity on artificial structures. Soft engineering options maximise habitat complexity and sustain natural process while they can simultaneously deliver engineering objectives such as coastal protection. Soft options additionally sustain multiple services, providing greater economic benefits for society, and resilience to climatic change. Under-inclusion and economic undervaluation of intertidal ecosystem services may, however, undermine best practice in coastline management. Evidently, mitigation and even restoration through ecological engineering often do not support intertidal communities or processes that are equivalent to pre-disturbance conditions. Crucially though, an absence of comprehensive baseline biodiversity data, or data comprising additional ecological parameters such as ecosystem functions and services, prohibits quantification of absolute and relative magnitudes of ecological impacts due to engineered structures or effectiveness of mitigation interventions. This knowledge deficit restricts evaluation of the potential of ecological engineering to contribute to conservation policies for intertidal habitats. To improve mitigation design and effectiveness, a greater focus on in-situ research is needed, requiring stronger and timely collaboration between government agencies, construction engineers and research scientists.

*Human Impacts****De novo* Transcriptome Analysis for Mechanistic Study of Organotin-mediated Endocrine Disruption in *Reishia clavigera***

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Many endocrine disrupting compounds are bioaccumulative and toxic to a wide range of marine organisms, leading to reproductive impairment, development of cancer and abnormal metabolism. For instance, organotin compounds (OTs) such as tributyltin and triphenyltin can induce the development of imposex (i.e., superimposition of male sexual organs) in females of over 200 gastropod species. OTs have been widely used as biocides in antifouling paints and industrial applications. Thus they have been released into the marine environment, posing risks to non-target marine organisms and human health. Although many studies have been conducted to examine the underlying mechanism of imposex development in marine gastropods over the past 40 years, the question has not yet been satisfactorily addressed. This study aims to elucidate the imposex mechanism by comparing the transcriptomic profiles among females of the intertidal whelk, *Reishia clavigera*, of different imposex stages. We first established a *de novo* transcriptome of *R. clavigera* using Illumina sequencing. A total of 453,422 assembled transcripts were obtained, with 51,316 transcripts annotated with at least a BLAST hit, 34,759 transcripts assigned with at least one well-defined Gene Ontology (GO) and 8,596 transcripts involved in 337 different Kyoto Encyclopedia of Genes and Genomes (KEGG) pathways. Currently, we are using RNA sequencing data to identify genes and pathways possibly related to imposex development in *R. clavigera* which were exposed to various treatments of OTs for four months under laboratory conditions. The extensive sequence data generated from this study will also provide valuable molecular resources for facilitating similar mechanistic studies of other chemical pollutants.

*Human Impacts*

**Determination of Antioxidant Enzyme Activities and Some Biochemical Changes in Fed Rainbow Trout (*Oncorhynchus mykiss*) Larvae**

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In this study, the activities of the antioxidant enzymes such as SOD, CAT, GSHpx, GR and GST as well as of MDA and of GSH levels were investigated in 7, 14, 21 and 28 days fed rainbow trout (*Oncorhynchus mykiss*) larvae.

Methods: Just after yolk-sac absorption, free-swimming larvae were fed manually on commercial diet over a period of 28 days. All samples of fed larvae were collected as 1 g of 3 repetitions at 7, 14, 21 and 28 days. Total lipid of the fed larvae was extracted by the 3:2 (v/v) hexane isopropanol mixtures. Fatty acid methyl esters were prepared from total lipid by acid-catalyzed transmethylation and they were analyzed in a GC-17A Shimadzu GC equipment. The level of A, E, D, K vitamins and cholesterol were analyzed by the HPLC equipment. Total protein level was spectrophotometrically measured at 750 nm and GSH at 412 nm and MDA at 532 nm. Total SOD (EC 1.15.1.1.) activity was assayed at the 480 nm by measuring the inhibition adenochrome, Catalase (EC 1.11.1.6) activity was measured at 240 nm, GSHpx, GST and GR activities were assayed 340 nm.

Results and Discussion: Considering the change in the amount of SOD, a decrease was detected in 21 and 28 day fed larvae compared to 7 and 14 fed larvae ( $p < 0.001$ ). While CAT activity increased significantly from 7 day to 14 day fed larvae ( $p < 0.01$ ), an important decrease was observed in 21 and 28 day fed larvae ( $p < 0.001$ ). The highest GR activity was observed in 14 day fed larvae those in 7 day fed larvae was the lowest ( $p < 0.001$ ). While there was no difference between 7 day fed larvae and 14 day fed larvae ( $p > 0.05$ ), GST activity was found to increase at a significant amount in 21 and 28 day fed larvae ( $p < 0.01$ ). Unlike the GST activity, GSHpx activity was found to decrease at a significant amount in 21 and 28 day fed larvae ( $p < 0.01$ ). Overall, the activities of enzymes of the antioxidation system expressed in this study showed that GST had the highest activity of all the enzymes assayed during 7, 14, 21 and 28 day fed larvae of *O. mykiss* and then CAT, GSHpx, GR and SOD respectively.

*Human Impacts*

## **Environmental Impacts of Ballast Water Discharge**

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The ocean constitutes over 90% of the habitable space on earth. An estimated 50-80% of all life on earth is found under the ocean surface. There occur several biogeographical barriers or factors such as temperature and salinity regimes and landmasses, that have prevented many species from dispersing into certain areas. But, man mediated, maritime activities, such as modern shipping have facilitated the process of species dispersal to such an extent that now, it has become a serious threat to marine ecosystem, posing ecological, economical and health related consequences to human and animal life. Shipping remains indispensable to the global economy transporting over 80% of the world's commodities (cargo). However, in doing so it also transfers approximately 3 to 5 billion tonnes of ballast water (water that is loaded inside the ship from surrounding ocean) internationally each year. Modern shipping cannot operate without ballast water, which provides balance, structural strength and stability to ships, both when ship is empty of cargo and when it is loaded. As this water contains living organisms (bacteria, viruses, protozoan and small metazoan), it poses threats to the marine ecosystem during ballasting (ocean water intake by ship) and de-ballasting (ocean water discharge) cycle, by introducing alien species to a completely new set of environmental conditions. If these conditions work in favour of a particular species, such introduction may lead to invasive extent resulting in ecological disturbances. This paper aims to provide a discussion and a detailed insight about ballast water discharge risks by reviewing various case studies and examples of aquatic bio-invasions in order to formulate better strategies with respect to its management.

*Human Impacts*

## **Giant Clams (*Bivalvia: Cardiidae*) as Potential Counteractors of Eutrophication and Associated Algal Blooms**

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Eutrophication is an increasing concern for tropical coasts, negatively impacting fisheries, tourism, as well as the economy. Coastal development is a major contributor of allochthonous nutrient input, which can lead to undesirable algal blooms. Biological control is one method to counteract algal proliferation. Giant clams can potentially counteract eutrophication in coral reef ecosystems due to their large size and the ability to filter microalgae from the water column. To date, however, no research has quantified this important role. Our study investigates the clearance efficiency of juvenile *Tridacna maxima* when exposed to two species of microalgae monocultures (*Isochrysis* sp. and *Tetraselmis suecica*) at three levels of algal densities: eutrophic density, feeding density and natural density. Test clams will be maintained in mini Vortex Resuspension Tanks (mVoRTs), that are designed to keep particulates suspended in the water column, for five hours. To calculate clearance rates, algal densities (initial and final) will be enumerated using flow cytometry. Preliminary results suggest that *T. maxima* filter feed readily and could exert significant top-down regulation on reef phytoplankton. Giant clam populations are facing decline from contemporary anthropogenic impacts and the extirpation of these potential biological controls could negatively affect coral reefs.

*Human Impacts*

**Impacts of Coastal Tourism on Indo-Pacific Humpback Dolphins  
*Sousa chinensis* in Hong Kong**

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The Indo-Pacific Humpback dolphins *Sousa chinensis* inhabiting Pearl River Delta are believed to represent the largest populations of this species in the world. Their affinity to shallow-water coastal habitats makes them highly susceptible to alterations of coastal environments, either natural or anthropogenic. In recent decades, the numerous infrastructure constructions and massive development projects, especially in the eastern part of the delta and Hong Kong waters, have greatly reduced the natural habitat available to these animals. The urbanization process has also opened a window for human activities such as coastal tourism and vessel traffic which inevitably affect the animals' daily life.

This study investigated the spatio-temporal utilization of an important feeding area, where movement patterns of humpback dolphins were observed and tracked with a surveyor's theodolite from a land-based platform. Dolphin watching boats and other vessels in a proximity of the animals were also tracked to investigate potential animal response. Case-specific interpolation, re-sampling and binning procedures were applied to reduce potential under/over sampling and pseudo-replication related bias. Uneven relative abundance and distribution pattern of dolphins in different spatial and temporal contexts indicated apparent habitat preferences of the animals. Movement characteristics of natural (not affected anthropogenically) behaviours were parameterized and compared to groups of dolphin with evident vessel impacts. Although the overall pattern of movement parameters was similar at each behavioural state, differences in movement parameters between natural (unaffected) and vessel-impacted groups of animals in certain behaviours indicated behavioural responses of dolphins. Impacts range from chronic low-level disturbance to acute, severe and re-occurring, albeit short-lasting. This study highlights the high habitat selectivity of this dolphin species and the considerable implications of seemingly benign human activities such as coastal tourism on the animals' daily lives. There is an urgent need for regulated management of coastal tourism and dolphin watching operations in Hong Kong.

*Human Impacts***Imposex Status and Tissue Organotin Concentration in the Whelk *Reishia clavigera* before and after Reciprocal Transplantation between Relatively Clean and Polluted Sites in Hong Kong**

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The endocrine disrupting organotin compounds (OTs), including tributyltins (TBT) and triphenyltin (TPT), are able to induce imposex (i.e., growth of penis and vas deferens) in female marine neogastropods. Since the 1990s, the intertidal whelk *Reishia clavigera* (= *Thais clavigera*) has been widely used as a biomonitor for evaluating OT contamination in coastal marine environments in Asia-Pacific regions including those in Hong Kong. Recent biomonitoring studies have showed that contaminations of TPT, relative to TBT, have become more serious in Hong Kong and other South China coasts. However, there is a lack of field-based evidence to demonstrate the casual relationship between TPT and imposex development in *R. clavigera* in this region. This study aimed to investigate the temporal changes of imposex development and tissue concentration of six OTs in tissues of *R. clavigera* after their reciprocal transplantation between relatively clean and polluted sites in Hong Kong for six-months. The results revealed a significant increase of tissue concentration of total OTs, in particular TPT, in the whelks transplanted from a clean site to a polluted site, while a decrease of tissue OT concentrations was observed in the whelks treated conversely. No significant changes in imposex level, however, were found in any transplantation treatment showing that imposex development is gradual and irreversible. In general, the whelks had lower tissue OTs concentration in winter than that in summer, though the exact mechanism is still unknown. This study has further confirmed that OT contamination is still prevalent in Hong Kong's coastal marine waters, which deserves tightened management controls on this group of chemicals especially on TPT compounds.

*Human Impacts*

**Influence of Plantation of the Exotic Mangrove Species  
*Sonneratia apetala* on Nematode Communities in the Zhanjiang  
Mangrove National Nature Reserve, China**

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The exotic mangrove species *Sonneratia apetala* from Bangladesh has been widely used for mangrove restoration purposes in southeastern China since 1985. As a potentially invasive mangrove species, *S. apetala* may interrupt the ecological functions of the native mangroves. It is, therefore, important to study their influence on native biodiversity. This study was designed to investigate the influence of *Sonneratia* plantation on meiofauna, in particular nematode communities. This study is specifically testing the hypothesis that spatial and temporal distributions of the nematode assemblage vary in sediment between the site with native mangroves (*Aegiceras corniculatum* and *Bruguiera gymnorrhiza*) and the site with exotic *S. apetala* inter-planted with *A. corniculatum* at a similar tidal elevation. The survey was carried at four different times between January 2010 and October 2010. Results showed that a total of 80 species belonging to 67 genera and 25 families of nematodes were recorded in the study areas. *Polysigma* sp. was commonly found throughout the study period and in all of the replicated plots in the native and exotic mangroves. Surprisingly, higher mean densities, number of species, diversity index and evenness index were found in the *S. apetala* habitat. There were significant differences of nematode assemblages among native mangroves and exotic mangrove, and among different sampling times. The infaunal nematode assemblages were similar between the two native mangroves. We concluded that the exotic *S. apetala* can enhance the biodiversity of nematodes and can alter the nematode community structure. This beneficial effect may be attributable to a higher habitat complexity and lower C/N ratios brought by this exotic mangrove plantation. Furthermore, we also found that salinity was an important factor shaping the nematode communities in Zhanjiang mangrove.

*Human Impacts*

## **Salinity-dependent Toxicities of Zinc Oxide Nanoparticles to the Marine Diatom *Thalassiosira pseudonana***

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This study comprehensively investigated the influences of salinity, exposure concentration and time on the aggregate size, surface charge and dissolution of zinc oxide nanoparticles (ZnO-NPs; 20 nm) in seawater, and examined the interacting effect of salinity and waterborne exposure of ZnO-NPs on the marine diatom *Thalassiosira pseudonana* for 96 h. We found that aggregate sizes of ZnO-NPs significantly increased with increasing salinity, but generally decreased with increasing exposure concentration. Ion release decreased with increasing salinity, whereas the surface charge of the particles was not affected by salinity. The increased aggregate size and decreased ion release with increasing salinity, and consequently lower concentration of bioavailable zinc ions, resulted in decreased toxicity of ZnO-NPs at higher salinity in general in terms of growth inhibition (IC<sub>50</sub>) and chlorophyll fluorescence (EC<sub>50</sub> -  $\Phi_{P_0}$  and EC<sub>50</sub> -  $\Phi_2$ ). However, IC<sub>50</sub>s and EC<sub>50</sub>s of ZnO-NPs were smaller than those of Zn<sup>2+</sup> (from ZnO-NPs ultrafiltrate and ZnCl<sub>2</sub>), indicating that dissolved Zn<sup>2+</sup> can only partially explain the toxicity of ZnO-NPs. SEM images showed that ZnO-NPs attached on the diatom frustule surface, suggesting that the interaction between the nanoparticles and the cell surface may exacerbate the toxicity of ZnO-NPs. Our results linked the physicochemical characteristics of ZnO-NPs in seawater with their toxicities to the marine diatom and highlighted the importance of salinity as an influential environmental factor governing the aggregation, dissolution and the toxicity of ZnO-NPs.

*Human Impacts***Influencing Effects of Size and Location on Baseline Metal Bioaccumulation in the Brown Mussel (*Perna perna*) from the Sub-tropical South East Coast of Africa**K.A. Brink<sup>1</sup>, J.H.J. van Vuren<sup>1</sup> and V. Wepener<sup>2</sup><sup>1</sup>University of Johannesburg, Department of Zoology, Johannesburg, South Africa<sup>2</sup>Water Research Group (Ecotoxicology), Research Unit for Environmental Science and Management, Potchefstroom, South Africa

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Despite the increasing industrial development along African coastlines, biomonitoring is seldom undertaken in these areas. In an effort to promote future biomonitoring in marine environments, this study provides a detailed description of baseline metal bioaccumulation data in the mussel *Perna perna*, specifying concentrations from various size compensatory techniques and from different locations on the sub-tropical east coast of Southern Africa. The spatial and size differences were found to be highly variable and as such it is essential that these influencing factors are well defined in baseline/ reference data. Mussels were sampled from three different sites and the shell length, total mass, wet tissue mass, dry tissue mass and metal concentrations were assessed. These data were then used to determine metal-size relationships. The resulting regression curves indicated that local conditions influenced the effect on size on metal concentrations. In mussels from rocky shorelines (Reference site - Sheffield Beach and Dawson's rocks) the smaller mussels contained higher Al, As, Cr, Fe, Mn and Ni than larger ones, whilst from Richards Bay Harbour no significant relationship was observed. This was attributed to the higher growth rates in the sheltered habitat. To limit the influence of size, three different approaches are described and documented. Overall, it was deduced that selecting smaller sized individuals was more advantageous than transforming the dataset of randomly selected sizes and that the total-mass metric should be used to select a group of 20 replicates in the field. Once the influence of size was taken into consideration, the baseline data showed that metal bioaccumulation in mussels along the shore areas was greater than in the harbour region.

*Human Impacts***Insight into the Anthropogenic Nitrogen Sources to the Coral Communities in an Urbanized Seascape**

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Hong Kong (HK) waters are eutrophic, owing to large inputs of nitrogen and phosphorus. Particularly, excessive dissolved inorganic nitrogen (DIN) is proven to be responsible for the decline of health and biodiversity of coastal marine ecosystems. In general, DIN comes from various sources such as agricultural, industrial, and sewage as well as upwelling and atmospheric deposition. This study aims to use stable isotope analysis to (1) trace the major DIN pollution source(s) that impact HK coral communities and (2) investigate the spatial and temporal variation of DIN pollution.

Hard coral samples collected in October 2013 (wet season) along the HK coastline showed unusually high  $\delta^{15}\text{N}$  signals on average (tissue  $\sim 9.2\text{‰}$ ; symbiont  $\sim 7.5\text{‰}$ ), which suggests that the anthropogenic DIN source, potentially human effluents ( $>10\text{‰}$ ), has altered the coastal nitrogen pool in HK. Spatially, the  $\delta^{15}\text{N}$  values of the sampled hard corals showed an increasing trend from Southern HK (tissue  $\sim 8\text{‰}$ ; symbiont  $\sim 6\text{‰}$ ) to the Northeast (tissue  $\sim 11\text{‰}$ ; symbiont  $\sim 9\text{‰}$ ). This spatial difference in the  $\delta^{15}\text{N}$  signals across the HK coastline could be attributed to the Pearl River, which may carry DIN from agricultural effluents (low  $\delta^{15}\text{N}$ ). This low  $\delta^{15}\text{N}$  signal from the river thus has a "dilution effect" on the omnipresent "local sewage signal", leading to a lower  $\delta^{15}\text{N}$  values in hard corals in Southern HK. Temporally, as the dry season carries only  $\sim 20\%$  of the Pearl River's annual total discharge, it is expect the corals collected in the dry season will display a more homogenized  $\delta^{15}\text{N}$  signal along the HK coastline and reflect stronger local sewage signals as the "dilution effect" from the river decreases. Ultimately, I will link the isotope data with coral biodiversity and coverage in HK, using  $\delta^{15}\text{N}$  signals as an indicator to the level of anthropogenic stresses on corals.

*Human Impacts*

**Marine Litter - The Global Problem and Our Local Actions in Coastal Watch Project**

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Marine litter is a serious global issue posing chronic threats to marine ecosystem as well as human health and our well-being. According to a recent study, a minimum of 5.25 trillion pieces of plastic particles weighing 268,940 tons are now floating in the world oceans. Scientists reported 663 species of animals have been impacted by marine litter in the world, in which all sea turtle species, half of all marine mammal species and one fifth of all sea bird species are reported to suffer from entanglement or ingestion of marine debris.

From our analysis on the International Coastal Cleanup data in 2013, it was estimated that on average 5.9 tonnes of litter was collected in each kilometer of Hong Kong shorelines, which ranked the third among all participating countries and locations. Although no systematic study on the ecological impact of marine litter was conducted in Hong Kong, evidence of marine species ingesting in or being entangled by different forms of debris were observed.

To tackle the severe marine litter problem in Hong Kong, "Coastal Watch" project was established in 2012 as a joint effort among green groups, citizens and government departments. This territory-wide citizen science project collects data on marine debris composition systematically in different coastal habitats in order to investigate the sources of marine litter. Besides, education and public engagement elements are incorporated in the project so as to raise public awareness on the issue and call for both collaborative and individual actions to alleviate the situation.

*Human Impacts***Metal Accumulation in the Tissues and Shells of the Rapanine Whelk *Indothais gradata* along an Acidified Estuarine Gradient**

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Acidification of estuaries results from microbial CO<sub>2</sub> generation, acid sulphate groundwater discharge, and anthropogenic activities, in the context of weak buffering potential of hyposaline waters. The resulting acidification introduces an additional yet poorly studied factor influencing the ecology and distributions of biological populations and species. Furthermore, it has a complex influence on estuarine chemistry, including altering the speciation of metals and potentially their availability to the biotic component. With the aim of providing baseline information for metal accumulation in the shells and tissues of organisms inhabiting acidified turbid tropical Asian estuaries, we studied the rapanine whelk *Indothais gradata* from the mineral-acidified Sungai Brunei estuary (Brunei Darussalam, Borneo). This snail inhabits hard (rock or wood) and soft (sediment) substrata further allowing the assessment of habitat type effects. We predicted (1) that Fe should predominantly accumulate (high Fe exposure from acid sulphate discharge), (2) that metal accumulation should decrease seawards (dilution and acid buffering effects), (3) that soft sediment habitats should present a greater burden (sinks for metals and increased contact with animals), and (4) that accumulation in shells and tissues should be similar (null hypothesis). Our findings based on seven localities and eight metals were largely consistent with these predictions. However, distribution patterns varied among metals, and shell metal accumulation vastly exceeded tissue accumulation per unit mass. Preliminary work suggests that shell metal accumulates mainly in the outer layer, rather than being an effect of sequestration. Shell analyses appear to be an effective approach to assessing sediment and water metal exposure, though the influence of acid dissolution in altering shell surface properties and their metal capturing capacity could introduce a bias.

*Human Impacts*

## **Monitoring Coral Reef Degradation through GIS and Remote Sensing Technologies**

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We examined the relative roles of human and natural impacts on coral biodiversity existing in the sub-tidal zone of Narara, Marine National park, Gulf of Kutch in west coast of India. We observed that corals in this region have declined as comparable to surveys made in previous years due to heavy sedimentation load, macroalgal bloom, nutrient influx, prolonged exposure of corals to direct solar radiations in subtidal zone and high sea surface temperature. In order to understand impacts of each of these factors on corals and coral reef ecosystem, we conducted coral reef biodiversity studies using line transect method for coral identification and biodiversity index. Seasonal water quality parameters analysis such as nutrients, salinity, dissolved oxygen and pH were carried out. Time series analysis for temperature was done using in situ data as well as NOAA-satellite SST data to check for anomalies in optimum reef temperature to provide context for our observations. We are using MODIS ocean colour images for analysis of spatial patterns of suspended sediment in SeaDAS package. Change in coral cover and other driver's analysis were carried out using GRASS-GIS image processing software. In our study area, we also observed macroalgal bloom on inshore reef areas where sediment loads are high and macroalgae grow on dead corals which serve as a substrate; one of the main factors for coral diseases and other related stresses such as reduced light availability. Therefore, our research aim is to evaluate and monitor drivers involved in coral reef degradation in West coast of India and to study dynamics and spatial extent of all these drivers over the time and predict the changes through GIS tool and Remote sensing technology for sustaining the livelihood of coral reef communities.

*Human Impacts***Population Structure and Recruitment Patterns of the Indigenous Mussel *Perna perna* and the Alien Mussel *Mytilus galloprovincialis* on the Central Coast of Namibia**

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Invasive species disrupt ecosystems and may consume resources and eventually replace indigenous species. This has been well documented for the Mediterranean mussel *Mytilus galloprovincialis* throughout the world. This study assessed the spatial and temporal variation of population structure, short-term recruitment patterns and abundance of the indigenous mussel *Perna perna* and alien mussel *M. galloprovincialis* at three different sites on the central Namibian coast. Sampling took place during spring tide, once during each season along Dolphin Beach, Long Beach, and a site 2 km outside Swakopmund during 2014. At regular intervals of 2 m one 10 x 10 cm quadrat was placed along a line transect from the spring low water level to the spring high water level. Everything was removed within the quadrat and stored at 20 °C. Thereafter, samples were sorted with two sets of sieves with mesh 2 mm and 0.5 mm into different size classes. Mussels were identified to species level. Multivariate tests showed no significant effect of season on the recruitment pattern of *M. galloprovincialis* ( $p = 0.102$ ), but indicated a significantly higher recruitment for *P. perna* during January and September 2014 ( $p = 0.006$ ). Spatial patterns were significantly different for the two species as *P. perna* recruits and adults dominated the low shore zone ( $p = 0.003$ ;  $p < 0.0001$ ) and *M. galloprovincialis* juveniles and adults dominated the mid shore zone ( $p = 0.025$ ;  $p = 0.001$ ). The high abundance of recruits observed at Dolphin Beach might be a sign of possible invasion which needs to be monitored.

*Human Impacts*

## **Prevalence of Antibiotic Resistance of *Escherichia coli* in Hong Kong Environment**

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Antibiotics are regarded as a group of emerging environmental pollutants. A key potential impact is to induce selective stress on bacteria, thus promoting antibiotic resistance in pathogenic bacteria and even threatening community health. In view of this, prevalence of antibiotic resistances in *Escherichia coli* (*E. coli*), a pathogenic indicator, was proactively screened in the Hong Kong environment.

A total of 64 *E. coli* isolates were sampled in 2014 from Kam Tin River and Kai Tak Nullah. Five antibiotics, namely, cefotaxime, ceftazidime, nalidixic acid, ciprofloxacin and tetracycline, were screened phenotypically. Two antibiotic resistance genes, including cefotaxime-hydrolysis beta-lactamase (*bla*CTX-M) and temoneira-hydrolysis beta-lactamase (*bla*TEM), were also examined for *E. coli* isolates producing extended spectrum of  $\beta$ -lactamase (ESBL).

Of 64 isolates, 50 showed phenotypic resistance to at least one examined antibiotics while 34 carried either one of the examined antibiotic resistance genes. Tetracycline was resisted by around 70% of *E. coli*, followed by nalidixic acid and ciprofloxacin being resisted by 41% and 19% of *E. coli*, respectively. Moreover, *bla*CTX-M and *bla*TEM were found in 8% and 45% of *E. coli* respectively. High prevalence of single antibiotic resistance among *E. coli* population reflected a large environmental reservoir carrying genetic materials of resistances and led to the horizontal transfer. Around 40% *E. coli* showed resistance to at least 2 kinds of antibiotics and 1 isolate even displayed its insusceptibility to all 5 tested antibiotics. Co-resistances to both nalidixic acid and tetracycline were the most common in 20 isolates. Multi-antibiotic resistances should be of primary concern for their stronger tolerability to different therapies and higher risk on human health.

*Human Impacts*

**Response of Coastal Ecosystem Structure and Function to Desalination and Eutrophication Caused by Regional Development in Seawater Reservoir Created by Dyke**

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The Saemangeum coastal area is enclosed brackish reservoir created by huge dyke construction. The Saemangeum reservoir receives eutrophicated freshwater inputs from two rivers, and simultaneously, seawater inputs from two sluice gates of dyke. Therefore dynamic temporal and spatial changes in ecosystem structure and function can be expected. Carbon and nitrogen stable isotope ratios are widely used to estimate the ecosystem structure and function. In this study, for the quantitative monitoring of ecosystem change according to government-run development project including acclimation and establishment of new city in Saemangeum region, we estimated food web structure of Saemangeum using carbon and nitrogen stable isotope ratios. POM including phytoplankton, zooplankton, benthos and fish samples were collected and their carbon and nitrogen stable isotope ratios were measured. To analyze the spatial and temporal dynamics of food web structure, samples were collected seasonally (2012 - 2014) from 9 sites covering input rivers, brackish area, and seawater sites where the seawater inflows through the sluice gates put was analyzed quantitatively. In addition to total food web structure, *Mugil haematocheilus* which distributes all sampling sites and can be tracked continuously was selected as target species representing a variety of food sources and its stable isotopes were analyzed to indicate habitat environment changes. Changes of food sources, trophic level and activity range of *Mugil haematocheilus* and related water quality parameters were analyzed. The responses of diversity of food sources and consequent food web structure of Saemangum against desalination and eutrophication due to regional development were estimated as indicator of ecosystem health assessment.

*Human Impacts*

**Seasonal Dynamics in Growth and Leaf Tissue Nutrients Contents of *Zostera marina* in an Eutrophic Lagoon**

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We examined the dynamics of growth and biochemical composition of *Zostera marina* in a nitrogen-enriched lagoon (Tongbatarl, Jeju Island, Korea). Water temperature ranged from 6.9 to 29.2°C. Average water column dissolved inorganic nitrogen (DIN) concentrations was more than 8 µM due to Wastewater Treatment Works and flatfish farm. Shoot height and sheath length showed distinct seasonal variations. Total shoot density and total biomass was highest during spring-early summer and lowest during autumn-winter. Leaf productivity also exhibited a distinct seasonality. The optimal temperature (approximately 15°C) of *Z. marina* growth at the study site was similar to that previously reported from other *Z. marina* meadows in Korea. The carbon, nitrogen and phosphorus of above- and below-ground tissues showed significant seasonal variations. In particular, the N contents of above- and below-ground tissues did not decrease to 2.0% throughout the experimental period. Leaf productivity and tissue nitrogen content did not exhibit any correlation. These results indicate that *Z. marina* growths at the study site were not limit by N availability during high growth seasons.

*Human Impacts*

**Sediments Quality and Benthic Biodiversity in Mangrove Habitats  
in the Extreme Environment of the Arabian Gulf, East Coast of  
Qatar**

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Qatar is a peninsula that is located within the Arabian Gulf. Coastal water of Qatar varies seasonally between about 12°C in winter to over 35 °C in summer. The average water depth in the surrounding Gulf is 35 m. The high evaporation and low precipitation result in high salinities (around 45 psu). In addition to the natural extreme conditions, the coastal water of Qatar has rapid industrial developments in the eastern coast where the natural mangrove reserve reside, making its biodiversity vulnerable to pollution from different sources. In order to assess the levels of contaminants in the sediments of the mangrove and to assess the associated biodiversity benthic macrofauna, three locations (Al Dakhira, Al Khor and the port) were selected with different proximities to sources of contaminants. The first location while the latter is near a harbor. Organic contaminants (PAHs, PCBs), trace metals (Hg, Pb, As and Cu) and benthic macrofaunal biodiversity were measured in the sediments in winter and spring of 2013. Sediments analysis showed that both trace metals and organic contaminants were impacted by proximity to the sources of pollution with higher levels of contaminants in Al Dakhira and the port. Species richness seemed to be impacted by the sediment quality where the highest number of species of benthic macrofaunal species (46 species) were reported from Al Khor. The number of species decreased by about 15% near the industrial city while it is reduced by over 60% near the harbor. Long term monitoring of these habitats is highly recommended for effective management and conservations.

*Human Impacts***Spatial and Temporal Variations of Zooplankton Community and Diversity in Saemangum Coastal Area, Seawater Reservoir Created by Dyke**S. Nakano<sup>1</sup>, M.Y. Jin<sup>1</sup>, D. I. Seo<sup>1</sup>, J.Y. Choi<sup>2</sup> and K.H. Chang<sup>1</sup><sup>1</sup>Department of Applied Environmental Science, Kyung Hee University, Korea<sup>2</sup>National Institute of Ecology, Republic of Korea

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Zooplankton community in brackish area often shows dramatic seasonal and spatial dynamics since it receives various effects both from ocean and freshwater. The Saemangeum dyke construction created huge brackish reservoir with unique ecosystem having strong eutrophication impacts from the catchment area as well as dilution impacts from open ocean water input through the sluice gates of the dyke. The Saemangeum plankton community consists of freshwater, brackish and oceanic species, and their composition and overall community structure respond to seasonal variation of environmental factors such as salinity and nutrients input from rivers, sensitively. In the present study, to investigate the spatial and temporal distribution pattern of coastal zooplankton community particularly in relation with eutrophication impact and sea water input, the field survey was carried out from 2013 to 2015. The sample collection and water quality monitoring were conducted in each season (July, October 2013, February, April, August, October 2014 and February 2015) at 17 sites in the reservoir including two river water input points. The zooplankton species compositions, diversities and their distribution patterns were analyzed. The zooplankton's community showed a distinctive trend of seasonal and temporal variation with changes of sea water input effects in the reservoir. Especially, the brackish copepods genus *Acartia*, which inhabited in the whole reservoir area except freshwater region, showed seasonally different dominant species. As effects of eutrophication, marine dinoflagellate, *Noctiluca scintillans* which was known to often occur in eutrophic sea was appeared abundantly in Saemangeum reservoir. The dynamics of zooplankton community with special emphasis on copepods, marine cladoceran species and *Noctiluca scintillans*, and the relationship with biotic and abiotic environmental factors were analyzed.

*Human Impacts*

**The Stable Nitrogen Isotope Fingerprint of Seawater, Rainwater and Wastewater Effluents in Hong Kong**

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Nitrogen pollution in marine waters is directly tied to human development. After a century of urbanization, Hong Kong faces a major challenge in mitigating marine pollution, particularly nitrogen. Indeed, nitrogen pollution is one of the primary causes of benthic ecosystem decline as evidenced by a contraction in the historical distribution of corals and seagrasses, which provide vital ecosystem services. While the Hong Kong Environmental Protection Department has established long-term monitoring of nitrogen concentrations in marine waters and wastewater effluents, the data obtained on the size of the nitrogen pool does not indicate the proportion of which is derived from human activities. Additionally, while the Hong Kong Observatory records daily total rainfall, it does not monitor rainwater quality. Stable isotope analysis of nitrogen ( $\delta^{15}\text{N}$ ) can provide accurate information on the sources of nitrogen not only in the receiving environment but also in the marine and benthic organisms present. This project aims to critically examine Hong Kong's nitrogen sources from seawater, rainwater and wastewater effluents using stable isotope analysis by investigating (1) the spatial and temporal variability of  $\delta^{15}\text{N}$  of sewage effluents sampled across Hong Kong, Kowloon, New Territories, Lantau and Outlying Islands (2) the  $\delta^{15}\text{N}$  variability across sewage treatment type (3) the  $\delta^{15}\text{N}$  of rainwater sampled between wet and dry seasons and (4) the  $\delta^{15}\text{N}$  of seawater sampled from marine parks. In the long-term, this project aims at developing an approach for detecting and mapping sewage impacts in Hong Kong and improving the effectiveness of the Harbor Area Treatment Scheme (HATS).

*Human Impacts*

**The Toxicity of Nano-TiO<sub>2</sub> on The Marine Microalgae  
*Phaeodactylum tricornutum***

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The rapid development of nanotechnology has raised concerns about the influence of nanomaterials to the ecosystem, including the marine ecosystem. To carefully address these concerns, cultured marine microalgae *Phaeodactylum tricornutum* was used to investigate the toxic effects of nano-TiO<sub>2</sub> through a five days (120 h) exposure. Our results demonstrated that the nano-TiO<sub>2</sub> exerted significant inhibition to the algae growth at the concentration of 10mg/L, and with inhibition rate of 39 % for the nano-TiO<sub>2</sub> concentration of 100mg/L. We observed that nano-TiO<sub>2</sub> could attach to the algae, which provide potential possibilities for the lesion of cell membrane caused by the nano-TiO<sub>2</sub>. Further test using Flow Cytometry confirmed the lesion of cell membrane. The impact of nano-TiO<sub>2</sub> to the photosynthetic yield (Fv/Fm) was accessed by the PHYTO-PAM. It is interesting that the Fv/Fm was inhibited by nano-TiO<sub>2</sub> at the first 48 h, but finally displayed no difference between the exposure group and the control. Our experiments provide direct evidences for the physiology impact of nano-TiO<sub>2</sub> on the marine microalgae.

*Human Impacts*

## **Tissue-Specific Accumulation of Triphenyltin Compounds in Selected Marine Demersal Fishes of Hong Kong**

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Applications of organotin-based antifouling paints in hulls of sea-going vessels have introduced large amount of these compounds, in particular tributyltin (TBT) and triphenyltin (TPT), into the ocean since the 1960s. These endocrine disrupting compounds have threatened a wide range of marine organisms, including fishes and marine mammals. In spite of the global prohibition of the use of organotins in antifouling paints by the International Maritime Organization in September 2008, there are no restrictions on their production and usage in Mainland China and Hong Kong and thus high concentrations of organotins, especially TPT, are still detected in marine fishes and molluscs from Hong Kong and South China. Previous studies have demonstrated that TPT can be bioaccumulated in marine organisms through diet or direct uptake from seawater; however, there is scant information regarding the tissue-specific accumulation of TPT with respect to its concentration in the whole organism, and how this accumulation profile would vary across organisms at different trophic levels. Therefore, this study aimed to obtain the tissue-specific accumulation profile of TPT in selected demersal fish species occupying different trophic positions in the marine benthic food web. Concentrations of TPT and its degradation products in ten tissues (including bone, brain, dorsal muscle, gills, gonad, heart, liver, skin, stomach and whole body) of two species of piscivorous fish sampled in western waters of Hong Kong were quantified using gas-chromatography mass-spectrometry. Our preliminary results showed that stomach and dorsal muscle had the highest concentrations of TPT compared to other tissues, whereas TPT concentrations in bone, skin and gills were relatively low. Multiple regression analyses will be conducted to investigate the relationships between TPT concentrations of the target tissues and the whole fish, and to identify the tissue(s) that has/have the most significant effect on TPT concentration of the whole fish. This would aid in predicting TPT concentration in the whole fish and investigating the biomagnification of TPT in the marine ecosystem.

*Human Impacts*

**Tough Life of Urban Dolphins: Skin Disorders and Traumatic Mutilations of Indo-Pacific Humpback Dolphins *Sousa chinensis* in Hong Kong**

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Indo-Pacific humpback dolphins *Sousa chinensis*, locally in China/Taiwan known as Chinese white dolphins, inhabit shallow-water inshore habitats which renders them susceptible to a wide range of the adverse effects of human activities. In western Hong Kong waters, Pearl River Estuary (PRE), one of the world's most developed estuarine systems, the health conditions of humpback dolphins are known to be compromised, directly and indirectly, by severe anthropogenic impacts. Skin disorders and traumatic mutilations can be used as proxy indicators of human-induced pressures on the animals. Since mid-2010, high-quality images were collected and used to visually assess cutaneous disorders and/or traumatic injuries. Among 381 photographically identified dolphins, skin disorders and incised wounds represented 29.1% and 4.2%, respectively. Secondary epidermal infection, likely bacterial or fungal, were seen and classified into 4 categories: 'pox-like' lesion, orange film, nodules, and others; and 3 levels of the extent of coverage. Sixteen individuals had traumatic deformation and incisive scars at dorsal fins and body parts, with most injuries nearly or completely healed. The presence of skin disorders likely indicates the deficiencies of immune system, which may be caused or exacerbated by anthropogenic factors. Habitat degradation, heavy maritime traffic and acoustic disturbance elevates the animals' stress levels; while pollutants might afflict natural skin barriers, thus aggravating the level of infection. The observed physical mutilations were caused by direct vessel strikes, propeller hits, or entanglement in fishing gear. In a recent incident of propeller-injured dolphin, continuous photographic monitoring of the animal's external health conditions provided a sad but valuable case study of a progressive deterioration of incisive wounds that lead to gross infection and severe secondary skin disorders. This unfortunate case highlights the importance of continuous photo-ID monitoring where individuals with known life histories and known etiology of observed abnormalities can serve as indicators of the population's ecological health.

*Human Impacts*

**Toxicity Effects of Copper on the Marine Diatom  
*Chaetoceros calcitrans***

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Copper forms an important contaminant of concern because of its high aquatic toxicity at environmentally relevant concentrations and its burgeoning use as replacement for tributyltin in antifouling paints. The toxicity of metals in turn varies according to the relative sensitivity of different species of microalgae. The growth response and the cellular defence mechanisms in diatom, *Chaetoceros calcitrans* to cope with the oxidative stress induced by copper were investigated. The 96 h IC 50 and 7 day no observable effect concentration (NOEC), low observable effect concentration (LOEC) and chronic value were 0.73 mg Cu/L, 0.30 mg Cu/L, 0.40 mg Cu/L and 0.35 mg Cu/L respectively. At all the concentrations above 0.67 mg/L, the pro-oxidant copper caused a significant decrease in growth rate, chlorophyll concentration and protein content. The most obvious change in cell morphology after copper exposure was increase in size particularly at 0.50 mg Cu/L, but the cell structure entirely gets damaged at 0.87 mg Cu/L. On exposure to sublethal concentration of 0.35 mg Cu/L, the copper uptake rate was found to be increased linearly up to 96 hr, but remain unchanged in rest of the 7 days. The marginal increase in the catalase (CAT) and superoxide dismutase (SOD) activity, particularly on exposure to 0.35 mg Cu/L and 0.67 mg/L indicated an oxidative stress and an efficient antioxidant system. On the other hand glutathione reductase (GR) activity showed an initial decrease, but showed highest activity at 48 h of exposure, indicating a mechanism to re-establish the cellular pool of glutathione. However, on exposure to 0.87 mg Cu/L, though a parallel increase in copper uptake rate, CAT and SOD activity is noticed up to 48 hr, but beyond that the system fails to cope up with the oxidative damage, which is further substantiated by a slight increase in malodialdehyde (MDA) activity. Ascorbate peroxidase (APX) activity was not significantly affected by copper exposure.

*Human Impacts*

**Trace Metal Accumulation by Mangrove Macro Algae in Miri River Estuary, Sarawak**

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The concentration of Fe, Mn, Cu and Zn were observed in soil, water, pneumatophores and mangrove macro algae. Samples were collected from three stations located in Miri river estuary, Sarawak. Out of 8 mangrove macro algal species observed, four species of macro algae named *Caloglossa leuprii*, *C. adherens*, *C. ogasawaraensis* and *C. stipitata* were found to be available in three stations. Macro algae *C. adherens* accumulated high concentration (1850.75 ppm) of Fe followed by Zn (39.71 ppm), Mn (20.1 ppm) and Cu (6.3 ppm). Mangrove pneumatophores accumulated maximum 2322.1 ppm of Fe followed by 44.89 pm for Mn, 43.53 ppm for Zn and 13.81 ppm for Cu. The concentration of Fe was higher in river water, while in pore water the concentrations of Mn, Zn and Cu were higher. Trace metals accumulation in pneumatophores was high compared to water and mangrove soil. Bio-concentration Factors (BCFs) for macro algae related to water were much higher than those bio-concentration factors related to soil. This study suggests that based on the accumulation, *C. adherens* could be a suitable biological species for trace metal monitoring in the estuarine environment.

*Human Impacts*

**Trap Fishing Impacts on Benthic Live-Bottom Habitat within the Black Sea Bass Fishery in the Mid-Atlantic Bight**

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The black sea bass (BSB, *Centropristis striata*) fishing industry has developed since the 1940's and fishing traps have been the dominant gear utilized since the 1970's. Impacts of traps on benthic habitats and emergent epifauna have become an increasing concern since the 1990's. Black sea bass are structure-oriented fish, living on live-bottom and reef habitats, and fish are targeted by dropping traps near or on these essential habitats. Currently, there are no published data on trap fishing impacts within the BSB fishery. In this study we attempted to assess the degree of impacts via video observations from commercial traps deployed at three popular BSB fishing sites 10-20 miles off the coast of Maryland, at depths of 20-30 m. GoPro® cameras were attached to a commercial trap within a line of five traps. Contacts with live bottom and trap drag time duration during retrieval were analyzed from 58 drops using both weighted and non-weighted traps in order to mimic empty and traps with catch. During the span of the study, our results show a single trap within a line has a 46% chance of coming into contact with live-bottom habitat. Analysis of bottom drag duration shows a significant difference between duration rates between weighted and non-weighted traps ( $P < 0.001$ ). Additionally, we show there is a significant positive correlation between drag duration and line position. During retrieval, loaded traps are dragged along the bottom; this time significantly increases the farther the trap is from the boat. The increase in drag time coupled with additional catch weight increases the likelihood of contact and subsequent disturbance of benthic habitats. Live-bottom habitats, essential to BSB, are highly fragmented and sparse off the coast of Maryland, so adverse impacts from disturbance probably affect a large portion of available habitat.

Schedule of Technical Workshop  
on Advanced Food Web and  
Trophodynamic Studies

Abstracts of the invited talks can be downloaded from the conference website:  
[www.biosch.hku.hk/become/abst\\_all.html](http://www.biosch.hku.hk/become/abst_all.html)

**Date: 4 June 2015, Time: 0915-1245, Venue: Rayson Huang Theatre**

**Invited Keynote Lecture**

**0915-1000 Stuart Bearhop**

University of Exeter, UK

*Stable isotopes as tracers of resource use: the models are much more robust than some of the literature might suggest*

**Invited Lectures**

**1000-1035 David M. Baker**

The University of Hong Kong, Hong Kong SAR, China

*Amplifying biology: stable isotope tracers and CSIA-AA shed new light on ecological interactions and eco-physiology*

**1035-1050 Coffee Break**

**1050-1125 Danny C. P. Lau**

Umeå University, Sweden

*Allochthonous and autochthonous support of consumers in boreal lakes – elucidation by using stable isotopes and fatty acids*

**1125-1200 Matthew Perkins**

The University of Hong Kong, Hong Kong SAR, China

*The use of stable isotope ratios to quantify community trophic structure*

**1200-1235 Tak-Cheung Wai**

City University of Hong Kong, Hong Kong SAR, China

*Food web studies in marine ecosystems: using stable isotope and fatty acid analyses to trace the ultimate carbon sources and trophic pathways*

**Date: 4 June 2015, Time: 1400-1730, Venue: K.K. Leung Building LG109**

**R workshop for SIAR and SIBER with Danny C. P. Lau and Mathew Perkins**

**1400-1530 SIBER - Stable Isotope Bayesian Ellipses in R (Introduction and Practice)**

**1530-1545 Coffee Break**

**1545-1715 SIAR – Stable Isotope Analysis in R (Introduction and Practice)**

Abstracts of Technical Workshop  
on Advanced Food Web and  
Trophodynamic Studies

## **Stable Isotopes as Tracers of Resource Use: the Models are Much More Robust than Some of the Literature Might Suggest**

**Stuart Bearhop**

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The development of Bayesian approaches has sparked a second revolution in the use of stable isotopes as measures of resource use. This has also resulted in a number of researchers pointing out the risks and caveats associated with many of the modelling approaches being employed. However, this risks throwing the baby out with the bathwater. Here I will draw an several of the most common criticisms and demonstrate that as long as you know the system you are working with well, and apply the technique appropriately the models can be extremely robust.

## **Amplifying Biology: Stable Isotope Tracers and CSIA-AA Shed New Light on Ecological Interactions and Eco-physiology**

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Stable isotope analysis has become a key part of an ecologist's toolkit, permitting the ability to resolve important linkages among organisms within foodwebs and biogeochemical cycling. For the last 30 years, bulk carbon and nitrogen isotope values have been used to quantify an organism's diet and its relative trophic position in the ecosystem. This breakthrough has advanced our understanding of ecological interactions even over evolutionary timescales for myriad terrestrial and aquatic species. However, for some organisms, the bulk isotope ratios are confounded by "vital effects". For example, species like reef-building corals form mutualistic symbioses with dinoflagellates. As a holobiont, such symbiotic associations create a novel metabolic palette. For corals the merger of auto- and heterotrophic nutritional pathways (that can be obligate or facultative), ultimately makes determinations of trophic position a "mixing muddle". In this talk, I will discuss the utility of isotope tracers ( $^{15}\text{N}$ ,  $^{13}\text{C}$ ,  $^2\text{H}$ ) for "amplifying" coral biochemistry to resolve the relative importance of autotrophic pathways under varied environmental conditions. Further, GC-C-IRMS methods permit the determination of amino-acid specific isotope values, which can be very powerful in resolving trophic position. When combined, tracers and CSIA can highlight important metabolic pathways and mechanisms that underpin the eco-physiology of symbiotic associations.

## **Allochthonous and Autochthonous Support of Consumers in Boreal Lakes - Elucidation by Using Stable Isotopes and Fatty Acids**

Danny C. P. Lau<sup>1</sup>, Ingvar Sundh<sup>2</sup>, Tobias Vrede<sup>3</sup>, Jana Pickova<sup>4</sup> and Willem Goedkoop<sup>3</sup>

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Allochthony and autochthony in aquatic food webs can be strongly influenced by ecological processes of adjacent terrestrial ecosystems and anthropogenic impacts. Dystrophic (i.e. nutrient-poor and brown-water) lakes are widespread in temperate regions and considered to be primarily subsidized by terrestrial inputs, because of the quantitative dominance of allochthonous organic matter (OM) and the limiting light and nutrient availability that hinders the production of photosynthetic autotrophs. Yet, autotrophs are higher in nutritional quality as they contain polyunsaturated fatty acids (PUFA) that are essential for consumer growth and reproduction. We quantified the relative support of allochthonous (coarse particulate and dissolved OM) and autochthonous resources (biofilms and seston) in five dystrophic lakes, where pelagic and littoral benthic consumers of multiple trophic levels were sampled and analyzed for carbon and nitrogen stable isotopes (SI) and fatty acids (FA). Results from SI show that allochthonous and autochthonous contributions to these consumers were 9–44% and 47–79%, respectively. Allochthonous OM are particularly important for the generalist isopod *Asellus aquaticus*, constituting 44% of its biomass. Tissue concentrations of eicosapentaenoic acid (EPA),  $\omega$ 3 FA and PUFA in consumers increased with autochthonous contribution. In a separate study we further found that, among 21 boreal lakes, ponds and streams, the EPA:total FA, EPA: $\omega$ 3 FA and  $\omega$ 3: $\omega$ 6 FA ratios of *Asellus* increased with increasing ambient nutrient concentrations and decreasing allochthonous dissolved OM (i.e. increasing water clarity). Taken together, our findings indicate that (1) autotrophs disproportionately support consumer production in dystrophic lakes despite allochthonous OM dominates the basal resource pool, (2) PUFA accumulation in aquatic food webs strongly depends on the relative autochthonous support, and (3) allochthonous subsidies can be important for consumers of lower trophic levels, yet ecological processes and/or anthropogenic activities that facilitate terrestrial OM export can consequently limit PUFA accumulation and consumer production in aquatic ecosystems.

## **The Use of Stable Isotope Ratios to Quantify Community Trophic Structure**

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Community trophic structure is of great importance as it underpins fundamental aspects of ecology including predator - prey interactions, coexistence - competition dynamics, and temporal and spatial community stability. Consequently, trophic structure strongly influences functions and services of ecosystems. Therefore, better understanding the mechanisms that influence community trophic structure is a vital pre-requisite for informing and catalysing progressive conservation that maintains naturally structured and functioning ecosystems.

In this presentation I draw upon two pieces of research that use stable isotope ratios of carbon and nitrogen to identify different aspects of community trophic structure in wild grassland habitats. In the first study, stable isotopes are used to identify the "isotopic niche" for all species in grasslands of differing biodiversity richness. Quantifying the spatial arrangement of isotopic niches amongst species at a community level allows characterisation of multiple measures of trophic structure (notably food chain length, resource breadth, trophic diversity and functional redundancy) allowing comparison of how niche partitioning amongst species changes as a function of biodiversity. The empirical insights from this study provide vital evidence to inform prevailing theory about the role of biodiversity in supporting ecosystem functions and services. In the second study, the degree of "generalism" in feeding behaviour within a guild of grassland predators is quantified as a function of relative prey abundances across a range of grasslands. Prey represent different energy pathways (herbivores vs detritivores) and thus the response of predators provides insights into the degree of linkage apex predators can provide across food web sub-components, again providing empirical evidence to support prevailing theory, in this instance, about the functional importance of predators to provide ecosystem stability.

## **Food Web Studies in Marine Ecosystems: Using Stable Isotope and Fatty Acid Analyses to Trace the Ultimate Carbon Sources and Trophic Pathways**

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In Pearl River Estuary (PRE) and Hong Kong waters, top predators namely white-spotted bamboo shark (*Chiloscyllium plagiosum*), spadenose shark (*Scoliodon laticaudus*), Indo-Pacific humpback dolphin (*Sousa chinensis*) and finless porpoise (*Neophocaena phocaenoides*) are present all year round. They co-exist and utilize resources in the PRE and southern Hong Kong waters.

Although the distribution of these species has been well-documented, intra- and inter-specific differences in energy sources are still not clearly known. Given the strong seasonality in the Hong Kong climate and their contrasting foraging behaviour, it is hypothesized that the energy flow and ultimate energy sources which support these top predators will vary with season and species, and the food webs in the PRE can be divided into pelagic and benthic components.

We have investigated the seasonal, inter-specific (species) and ontogenetic variation in food sources and energy (and detrital) pathways utilized by the sharks using both fatty acid profiling (FAP), stable isotope analyses (SIA) and also compound-specific SIA. With these established carbon ( $\delta^{13}\text{C}$ ) and nitrogen ( $\delta^{15}\text{N}$ ) database of food sources in the PRE, we recently investigate the food source utilization by the humpback dolphin and finless porpoise, and examine potential impact of trawling ban (since 2013) on the trophic niche segregation of these top predators.

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# General Information

## TRANSPORT

From Hong Kong Airport to Hong Kong University and hotels

**Airport Express and MTR** - *About 1h, HK\$ 105*

Take the Airport Express Train from the Airport to the Hong Kong Station (in Central), followed by **MTR** (Blue Line) to the University of Hong Kong (HKU station) or the closest exit to your hotel

For details, please visit

[http://www.mtr.com.hk/en/customer/tickets/more\\_airport\\_express.html](http://www.mtr.com.hk/en/customer/tickets/more_airport_express.html)

**Taxi** - *About 45 min, HK\$ 350*

Take a taxi for the whole trip from the Airport to HKU or your hotel

**Airport Bus** - *About 2h, HK\$ 48*

Take the bus from the airport to the Island Pacific Hotel, Courtyard by Marriott Hong Kong and Hotel Jen  
Cityflyer A10, A12

For details, please visit

<http://www.nwstbus.com.hk/routes/airport-bus/index.aspx?intLangID=1>

## BANKING SERVICES

Banks on Campus

**Hong Kong and Shanghai Banking Corporation (HSBC)**

G/F, Run Run Shaw Building, Main Campus

Opening Hours: Monday to Thursday 9:00 - 16:30

Friday 9:00 - 17:00

Saturday 9:00 - 13:00

**Bank of East Asia**

Shop P0030, G/F, Centennial Campus

Opening Hours: Monday to Friday 9:00 - 17:00

Closed on Saturday

ATMs on Campus

**Hong Kong and Shanghai Banking Corporation**

G/F, Run Run Shaw Building, Main Campus

**Bank of East Asia**

Shop P0030, G/F, Centennial Campus  
Run Run Shaw podium (Chong Yuet Ming Amenities Centre)

**Bank of China**

Podium of Haking Wong Building, Main Campus

## INTERNET CONNECTION

**HKU Open WiFi**

The HKU Open WiFi programme provides free WiFi service to members and visitors of the University so that users can surf the Internet freely for instructional, learning, research or administrative purposes whenever they are on campus. Connection to HKU Open WiFi is easy and no registration is required.

For details, please visit

<http://www.its.hku.hk/documentation/guide/network/wifi/openwifi>

## SUPERMARKETS

**PARKnSHOP Supermarket**

Room 204, Chong Yuet Ming Amenities Centre, Main Campus

Opening Hours: Monday to Friday	9:00 – 19:00
Saturday	9:00 – 17:00

**Centennial Campus Supermarket**

G/F, Cheng Yu Tung Tower (adjacent to Super Super Congee and Noodle)

Opening Hours: 8:00 – 20:00 (daily)

## SECURITY CONTROL CENTRE

Room 310, 3/F, Pao Siu Loong Building

Operation Hours: 0:00-24:00 (daily)

Tel: 3917 2882 (24-hour)

3917 2883 (lost and found)

3917 8280 (parking)

Fax: 2546 3950

## HEALTH SERVICE

For urgent medical attention, please go straight to the Accident & Emergency Department of any major hospitals of Hong Kong. All regional hospitals offer 24-hour emergency service for acute illnesses or injuries. The nearest hospital to the University with an Accident & Emergency Department is Queen Mary Hospital located at 102 Pok Fu Lam Road. For ambulance service, please dial 999 or 2735 3355.

## BOOKSHOPS

### **University Bookstore**

G/F, Chi Wah Learning Commons, Centennial Campus

Opening Hours: Monday to Friday      9:00 – 19:00

                                 Saturday                      9:30 – 14:00

### **Hong Kong University Press Bookshop**

G/F, Run Run Shaw Heritage House (adjacent to Run Run Shaw Tower),

Centennial Campus

Opening Hours: Monday to Friday      10:00 – 17:00

                                 Closes on public and University holidays

## SPECIAL ARRANGEMENTS DURING TYPHOON, RAINSTORMS OR OTHER ADVERSE WEATHER CONDITIONS

If a No. 8 typhoon warning signal or above, or a rainstorm black warning remains hoisted at or after 7:00am on a day during the conference period, all presentations scheduled for the morning sessions will be postponed to the next day. Presentations in the afternoon sessions will resume after 1:30pm if the signal is lowered.

If a No. 8 typhoon warning signal or above, or a rainstorm black warning remains hoisted at or after 12:00pm, all presentations scheduled for the afternoon sessions will be postponed to the next day.

In the event of adverse weather conditions, participants are advised to check out the latest arrangement on the conference webpage, <http://www.biosch.hku.hk/become>. A notice board at the reception desk will provide all details of any re-scheduled events.

## HKU CATERING OUTLETS

### Main Campus

<b>FRU: YO Factory</b>	G/F, Chong Yuet Ming Amenities Centre	9:30 a.m. - 7:00 p.m. (Daily)
<b>Café 330</b>	2/F, Chong Yuet Ming Amenities Centre	7:30 a.m. - 9:00 p.m. (Daily)
<b>Maxim's FOOD^2</b>	4/F, Chong Yuet Ming Amenities Centre	7:30 a.m. - 9:30 p.m. (Daily)
<b>Starbucks Coffee</b>	G/F, Composite Building, Main Campus	7:30 a.m. - 10:00 p.m. (Mon - Fri) 7:30 a.m. - 7:00 p.m. (Sat) 11:00 a.m. - 6:30 p.m. (Sun & Public holidays)
<b>U-Deli</b>	G/F, Composite Building, Main Campus	8:00a.m. - 18:00p.m. (Mon - Fri) Closed (Public holidays)
<b>Pacific Coffee</b>	G/F, Fong Shu Chuen Amenities Centre	8:30 a.m. - 9:30 p.m. (Mon - Fri) 9:00a.m. - 5:00 p.m. (Sat) Closed (Sun & Public holidays)
<b>Ebenezer's Kebabs &amp; Pizzeria (Halal Food)</b>	1/F, Fong Shu Chuen Amenities Centre	10:00 a.m. - 8:00 p.m. (Mon - Sat) Closed (Sun & Public holidays)
<b>Fong Shu Chuen Amenities Centre Restaurant</b>	2/F, Fong Shu Chuen Amenities Centre	7:30 a.m. - 8:00 p.m. (Mon - Fri) 11:00 a.m. - 2:00 p.m. (Sat) Closed (Sun & Public holidays)
<b>Union Restaurant</b>	4/F, Haking Wong Building	7:30 a.m. - 9:30 p.m. (Daily)
<b>Starbucks Coffee</b>	G/F, Main Library Building (Old Wing)	7:30 a.m. - 10:00 p.m. (Mon - Fri) 7:30 a.m. - 7:00 p.m. (Sat) 10:00 a.m. - 7:00 p.m. (Sun & Public holidays)
<b>Mangrove Tuck Shop</b>	Main Library Covered Podium (near Sun Yat-sen Place)	10:00 a.m. - 4:00 p.m. (Mon - Fri) Closed (Sat, Sun & Public holidays)

<b>SUBWAY</b>	Runme Shaw Podium	8:00 a.m. - 8:30 p.m. (Mon - Sat) 8:00 a.m. - 5:30 p.m. (Sun) Closed (Public holidays)
<b>iBakery</b>	Run Run Shaw Podium	8:30 a.m. - 7:00 p.m. (Mon - Fri) Closed (Sat, Sun & Public holidays)

**Centennial Campus**

<b>GROVE Café</b>	LG/F, The Jockey Club Tower, Centennial Campus	8:00 a.m. - 10:00 p.m. (Mon - Fri) 11:00 a.m. - 10:00 p.m. (Sat, Sun & Public holidays) 11:00 a.m. - 10:00 p.m. (Mon - Sun during non-term time)
<b>Delifrance</b>	G/F, The Jockey Club Tower, Central Podium, Centennial Campus	7:30 a.m. - 9:30 p.m. (Mon - Fri) 8:00 a.m. - 8:00 p.m. (Sat, Sun & Public holidays)
<b>Super Super Congee &amp; Noodle</b>	G/F, Run Run Shaw Tower, Central Podium, Centennial Campus	7:30 a.m. - 9:30 p.m. (Mon - Sat) Closed (Sun & Public holidays)
<b>BIJAS Vegetarian</b>	G/F, Run Run Shaw Tower, Central Podium, Centennial Campus	11:00 a.m. - 9:00 p.m. (Mon - Sat) Closed (Sun & Public holidays)

