
5th International Marine Conservation Congress
Kuching, Sarawak

PROGRAM

CONSERVATION X LABS

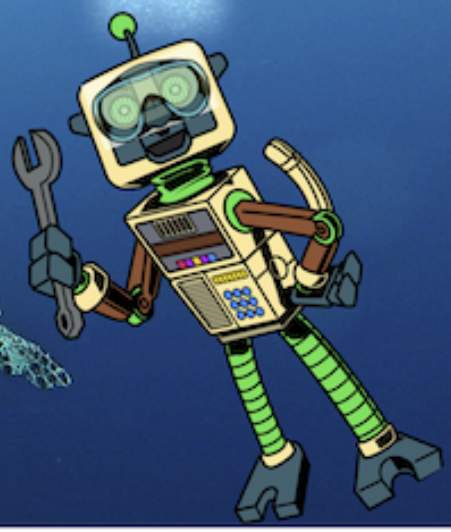
Make For The Planet Borneo

Come meet the M4TP teams:

S-191 M4TP Challenges: Ranyai Ballroom, Mon. June 25th 10:00-12:00 PM

Finalist Pitches: Ranyai Ballroom, Th. June 28th 1:30-6:15 PM

You can follow the competition at **#Make4ThePlanet** or visit the pop-up makerspace near **Café via Mare** on the main venue floor.



Conservation X Tech Prize

Conservation X Labs is launching a prize to support bright new ideas for the planet. Got a great idea to save the world? We're giving away....
$20,000 to one Grand Prize Winner
$3,500 to 20 winners each to create their first prototype.
Invite students and colleagues and join our online community of solvers on the **Digital Makerspace** to enter and win cash to bring your idea to life!

https://conservationx.com/prize

Gold Partners

Great Barrier Reef Foundation

GORDON AND BETTY MOORE FOUNDATION

6th International Marine Conservation Congress • Kuching, Sarawak •

Silver Partners

seeed

SCHMIDT MARINE TECHNOLOGY PARTNERS

MakerBay

SZOIL

M.A.R.E.A.

UiM

APEX

@conservationx #Make4ThePlanet conservationx.com


ICRI
IYOR 2018
INTERNATIONAL YEAR OF THE REEF
2018 has been designated the third International Year of the Reef by the International Coral Reef Initiative - a great opportunity to come together to strengthen awareness on the plight of coral reefs, to step up and initiate conservation efforts.
@IYOR2018
#IYOR2018
www.IYOR2018.org
Image credit:

About the Conference

After the first (1997) and second (2001) Symposia on Marine Conservation Biology confirmed the large number of marine conservation biologists interested in furthering marine science, research and public policy, a group of marine professionals organized a formal society for marine conservation biology. After much discussion, this group accepted an invitation from the Society for Conservation Biology (SCB) to become one of their 'sections'. The SCB Marine Section now provides a home for marine conservation biology in order to further marine conservation science, research and public policy. The Section's flagship meeting is the biennial International Marine Conservation Congress (IMCC).

Previous IMCCs have been held in Washington D.C - USA (2009), Victoria - Canada (2011), Glasgow, UK (2014), and St. John's - Canada (2016). IMCC5, to be held in Kuching - Malaysia (2018) will be the first iteration of the meeting to be held in a country defined by the World Bank as either "low income" or "middle income". The SCB Marine Section very much hope this move will open the meeting up to more delegates from such countries, who have historically found it harder to attend IMCCs due to high travel and subsistence costs. We believe marine conservation can only be successful at a global scale when a truly global community is working together on marine conservation issues.

Supporters and Sponsors

Supported By:

Leatherback Turtle Platinum Sponsor:

Saltwater Crocodile Gold Sponsor:

Silver Dugong Sponsors:

Bronze Staghorn Coral Sponsors:

Organizing Committee

Chair
Dr. Edward Hind-Ozan (SCB Marine Section President Elect)

Deputy Chairs
Holly Niner (SCB Marine Section Secretary)
Sophia Wassermann (SCB Marine Section Student Officer)

Steering Committee Members
Dr. Katie Matthews (SCB Marine Section President)
Dr. John Cigliano (SCB Marine Section Past President)
Professor Dr. Tonga Ak Noweg - Local Organizing Committee Chair
Dr. David Shiffman (SCB Marine Section Board Member at Large)

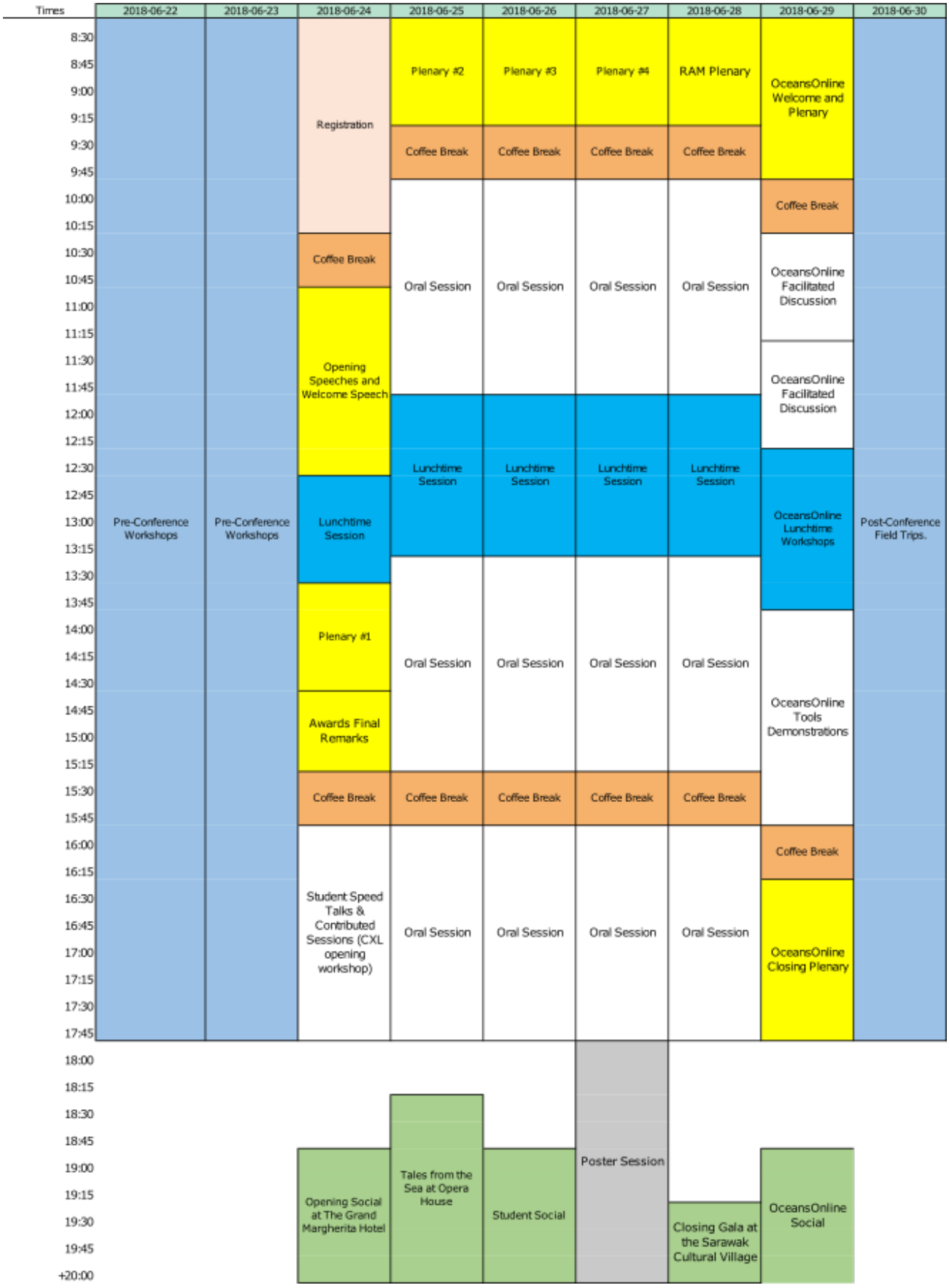
Committee Chairs
Dr. Joshua Drew - Program Committee Chair
Andrew Lewin - Sponsorship Committee Chair
Matt Tietbohl - Marketing Committee Chair
Heather Penny - Volunteer Committee Chair
Sophia Wassermann - Student Committee Chair
Dr. David Shiffman - OceansOnline Committee Chair

Local Organizing Committee
Professor Dr. Tonga Ak Noweg - Committee Chair
Dr. Jongkar Grinang - UNIMAS Board Member
Dr. Kon Yuk Fong - UNIMAS Board Member
Dr. Aazani Mujahid - UNIMAS Board Member
Miss Cindy Peter - UNIMAS Board Member
Mdm. Constance Vanessa Victor - Sarawak Biodiversity Centre Board Member
Mr. James Bali - Sarawak Forestry Corporation Board Member
Mr. Daud Awang - Sarawak Department of Fisheries Board Member
Mr. Chin Han Kiat - Sarawak Inland Fisheries Board Member
Mr. Phillcaine Pilla - FDS Board Member
Mdm. Belinda Lip - WWF Sarawak Board Member

Meeting Manager
Travis Nielsen

Contents

General Schedule



Pre-Conference Workshops

22 June

The Art of Knowledge Exchange, (8:30 - 17:30, Tubau 2)

Mr. Phil Karp[1]

[1]*World Bank*

This workshop will introduce participants to a practical, step-by-step approach to design and execution of results-focused knowledge exchange programs. Using a knowledge exchange case on MPA management developed by the World Bank and the Global Environment Facility, participants will take a hands-on approach to objective setting, identification of knowledge gaps, participant selection, identification of knowledge providers, selection of appropriate knowledge exchange modalities, and monitoring and measurement of results.

Tales from the Sea: developing and sharing your science and conservation story (8:30 - 17:30, Kabu)

Dr. Kirsten Gorud-Colvert[1], Dr. Stephanie Green[2], Ms. Heather Mannix[3]

[1]*Oregon State University,* [2]*Stanford University,* [3]*Compass*

We are excited to offer the third iteration of this popular workshop and add to the growing video library of stories told by IMCC participants. Marine conservation scientists are witnessing first-hand how the ocean is changing. Storytelling is a powerful tool to share these experiences in a way that reaches diverse audiences and opens the door to understanding and action. During this workshop, participants will learn key elements of storytelling and use these elements to craft powerful stories to share their conservation science experience with non-scientists. This 2-day workshop involves: 1) identifying a clear conservation science message, 2) developing an engaging story for public audiences, and 3) the option of telling the story in a public forum. Part 1 will help participants distill their work into a clear and succinct message. Part 2 will help participants share their messages in a complete and compelling story. Participants will take part in a combination of group exercises, live and video demonstrations, and one-on-one story development with organizers. By the end of the workshop, each participant will have developed an engaging telling of their conservation science story. Participants will then have the opportunity to tell their story to a public audience at a live event during the conference. The participants' conservation stories will be recorded and hosted online as part of a new legacy project co-hosted by the Society for Conservation Biology's Marine Section. This growing archive of stories is a living library of first-hand experiences from the frontlines of ocean conservation.

Indo-Pacific Seagrass Network (IPSN): Assessing the value of seagrass for supporting livelihoods and food supply across the Indo-Pacific: A focus on gleaning. (8:30 - 17:30, Tubau 1)

Mr. Benjamin Jones[1], Dr. Leanne Cullen-Unsworth[1], Dr. Richard Unsworth[2], Dr. Lina Mtwana Nordlund[3], Dr. Johan Eklöf[3]

[1]*Cardiff University,* [2]*Swansea University,* [3]*Stockholm University*

During this workshop we will launch the Indo-Pacific Seagrass Network (IPSN) a collaborative research network, with the overall aim to build capacity, foster learning exchange and conduct collaborative research on seagrass and their associated fisheries across the Indo-Pacific. We are inviting researchers, practitioners and resource users, interested in working with seagrass and associated fisheries in the Indo-Pacific, to this workshop and to become members of IPSN.

Seagrasses are important fishing grounds, used by men, women and children, targeting a wide range of species. The first year's theme within IPSN is "seagrass gleaning", in other words fishing/collecting invertebrates or fish with no or very basic gear in water where it is possible to stand.

This workshop will consist of two parts. Part 1 includes an introduction to IPSN, discussion on working within the network, and an introduction to the gleaning research protocol. Part 2 will focus on refining and practicing the research protocol for the first year's theme - gleaning, to enable replicated data gathering across sites. Year 1 fieldwork is expected to be conducted between July 2018 and June 2019.

The structure of the collaborative network (IPSN) is such that each contributing team will own their own data, but the data will also be shared within the network to allow for larger-scale analysis. Each site is encouraged (and will be supported though the IPSN mentor program) to publish its collected data and share it with local and national fisheries and environmental authorities.

Talking the talk - giving effective and engaging presentations to diverse audiences (8:30 - 12:30, Tubau 3)

Prof. Chris Parsons[1], Ms. Katie Walters[2]

[1]*George Mason University Fairfax,* [2]*The Society for Conservation Biology Marine Section*

This workshop, aimed at students and those who need public speaking experience, will give participants tips and advice on giving presentations to various audiences, including science conferences, corporate and gov- ernment agencies, and the general public. Advice will be given on tricks to calm the nerves, how to edit and organize your slides and talk, what aspects to focus on and tailoring presentations for different audiences. We will also go over helpful suggestions on public speaking and having a confident "stage" presence. Participants who are presenting at IMCC5 will get the chance to practice giving their presentations during the workshop, and will get feedback on visuals and the oral presentation from the organisers, peers and members of the SCB Communications and IMCC5 Organising Committees in a safe and supportive environment.

Using social media to make your marine science matter (13:30 - 17:30, Tubau 3)

Dr. David Shiffman[1], Ms. Ting-Chun Kuo[2], Ms. Katie Walters[3]

[1]Simon Fraser University, [2]University of British Columbia, [3]The Society for Conservation Biology Marine Section

If used effectively, social media can be rewarding and informative for scientists and conservation professionals. Social media is a significant means of communication for the general public, organisations and agencies. In fact, recent polls have shown that internet-savvy adults (and children) get a substantial portion of their news via social media and the web. Social media campaigns can take advantage of built-in audiences and the ease with which those people can share and promote your message, increasing the reach of your outreach. Social media and internet resources can also be used effectively for data collection and citizen science campaigns. We will discuss the importance of conservation communication and having an online and social media presence. We will also give how-tos and tips on successfully using various online tools and social media outlets. We will walk participants through setting up accounts with different social media outlets, the benefits of each and tips on successfully utilising each outlet. We will help each participant set up desired accounts for themselves or their organisations - including a variety of social media platforms - they can begin using during IMCC5.

---

23 June

Finding and Communicating the Human Dimensions of your Marine Conservation Research or Project (8:30 - 17:30, Tubau 1)

Dr. Kelly Biedenweg[1], Dr. Ana Spalding[1], Ms. Heather Mannix[2]

[1]Oregon State University, [2]COMPASS

The conservation of marine systems requires attention to the social component, often called the human dimension. The ubiquity of use of the term, however, usually hides what we really mean. We propose a one-day workshop that incorporates two successfully run workshops by the facilitators. The first portion of the workshop will help biophysical scientists, conservation professionals, and students identify and develop the "human dimensions" of their research or program. Building from a successful training for OSU graduate students, we categorize the human dimensions into three categories: Social Research, Arts & Humanities, and Application (communication, education and management). All participants will rotate through facilitated workgroups in each of the three categories, exploring best practices and innovative applications of the three types of human dimensions, and developing a prototype for integrating each type of human dimension into an existing project of their choice.

The second half of the workshop will facilitate the communication of human dimensions components to marine conservation. While all scientists need to practice effectively communicating their message, the marine social sciences and human component are particularly problematic for many professionals to frame in meaningful ways. Using COMPASS's proven tools and frameworks, workshop participants will learn how to identify their audience, frame, and deliver their human dimensions message. Through hands-on activities and small group feedback, participants in this workshop will leave with a better understanding of how to identify, incorporate, and communicate human dimensions in their research.

Tales from the Sea: developing and sharing your science and conservation story (8:30 - 17:30, Kabu)

Dr. Kirsten Gorud-Colvert[1], Dr. Stephanie Green[2], Ms. Heather Mannix[3]

[1]Oregon State University, [2]Stanford University, [3]Compass

We are excited to offer the third iteration of this popular workshop and add to the growing video library of stories told by IMCC participants. Marine conservation scientists are witnessing first-hand how the ocean is changing. Storytelling is a powerful tool to share these experiences in a way that reaches diverse audiences and opens the door to understanding and action. During this workshop, participants will learn key elements of storytelling and use these elements to craft powerful stories to share their conservation science experience with non-scientists. This 2-day workshop involves: 1) identifying a clear conservation science message, 2) developing an engaging story for public audiences, and 3) the option of telling the story in a public forum. Part 1 will help participants distill their work into a clear and succinct message. Part 2 will help participants share their messages in a complete and compelling story. Participants will take part in a combination of group exercises, live and video demonstrations, and one-on-one story development with organizers. By the end of the workshop, each participant will have developed an engaging telling of their conservation science story. Participants will then have the opportunity to tell their story to a public audience at a live event during the conference. The participants' conservation stories will be recorded and hosted online as part of a new legacy project co-hosted by the Society for Conservation Biology's Marine Section. This growing archive of stories is a living library of first-hand experiences from the frontlines of ocean conservation.

How does scientific research 'impact' on-the-ground decisions? Developing a typology, model, and common language for mainstream conservation science (13:30 - 17:30, Tubau 2)

Dr. Clare Fieseler[1], Dr. John Cigliano[2], Mr. Matt Tietbohl[3]

[1]UNC Chapel Hill, [2]Cedar Crest College, [3]King Abdullah University for Science and Technology

Conservation scientists have stated genuine interest in conducting impactful research that is useful to conservation interventions and decisions. This begs the question: what qualifies as 'impactful' research? In the conservation literature, there is little generalizable evidence or common vision. Implementing research with a clear pathway from knowledge production to knowledge use appears, at the moment, more about luck than method. This day-long focus group answers a call-to-action put forth by an IMCC4 symposia and related publication. The article challenged conservation scientists to refine a proposed 'typology' of knowledge impact, preliminarily developed from coral reef cases. The long-term objective is to develop a common way to talk about, describe, and assess the impact of research in ways that are useful to mainstream conservation science and practice. Initial work will occur in this session. First, we will review theories and concepts developed by social science fields that are relevant to understanding knowledge production, broadly. These include co-production, information usability models, usable science, and actionable knowledge.Second, we will synthesize marine conservation cases to refine the existing rough typology. Third, we will develop research questions that the field can use to validate or contest the typology. Lastly, participants will discuss adapting information usability models to more deeply envision how, why, and under what generalizable terms conservation knowledge is used by decision makers. The organizers expect a core group of invited scholars (~10) and openly welcomes interested practitioners (~10). All participants will contribute to a peer-reviewed manuscript that will report on the group's findings.

IMCC5 Day 1 (24/6)

Opening Ceremony (11:00 - 12:45, Ranyai Ballroom)

Plenary 1: Enriquetta Velarde, Ph.D.

13:45 - 14:45, Ranyai Ballroom

Seabirds of the Gulf of California, Mexico: what have they taught us?

Enriqueta Velarde was born and raised in Mexico City, and has worked since 1979 studying seabird ecology. She has visited Isla Rasa every spring for the past 39 years to measure, weigh, census, band, and observe the seabirds. She has also researched the interrelationship of bird population size to anchovy and sardine stocks in the Gulf of California. Velarde and her team have been successful in convincing fishermen to stop illegally ransacking birds' nests to sell the eggs, and they have totally eradicated invasive rats and mice that had a devastating effect on the seabird population. Additionally, Enriqueta has established a close collaboration with the indigenous Mexican Comcaac community and worked with them and biologist colleagues to train and empower the Comcaac to manage their own natural resources in the towns of Punta Chueca and El Desemboque in the state of Sonora along the west coast of the Gulf of California. She has done similar work with groups of local women in the town of Bahía de los Ángeles in the state of Baja California. At present, she is full time researcher at the Universidad Veracruzana in Mexico. Her main interests are seabird life history, genetics, and adaptations to present and past food availability, and nesting conditions for their long term survival. She is also interested how seabirds can be used to learn about the ocean conditions and as sentinels of the environment as well as indicators of forage fish populations, for management purposes. Also of interest to her are the sources of seabird mortality due to human activities and how to mitigate them. Velarde's book, Islas del Golfo de California, was also used as the base for the designation of the Gulf of California islands as a World Heritage site!

MPA Community Forum (16:00 - 18:00, Tubau 2-3)

Dr. Jane Lubchenko[1]

[1] *Oregon State University*

Society for Conservation Biology Marine Section Member's Meeting

16:00 - 18:00, Tubau 1

IMCC5 Bioblitz

16:00 - 18:00, Kuching Waterfront

Hacking for Conservation - Make for the Planet pre-conference workshop (16:00 - 18:00, Keranga)

Dr. Barbara Martinez[1]

[1] *Conservation X Labs*

We are in the middle of a period of extraordinary change on the planet, a sixth great mass extinction. This is happening, even as we have been successful in creating new enclaves to protect species at exponential rates. These challenges will increase as billions emerge into middle class placing new demands on the planet, exacerbated by climate change. While traditional conservation science can define the problems, it does not possess all the solutions. We need new solutions, disciplines, and solvers engaged in conservation as powerful new tools for conservation exist in adjacent fields. One way to achieve this is by harnessing the power of exponential technologies, open innovation, and entrepreneurship to transform the efficacy and scale of conservation efforts.

This workshop will offer participants a boot camp in design thinking and technology development for solving the grand challenges in conservation. It will also teach core skills for product development for conservation technology that can dramatically affect the speed, scale, and sustainability of such efforts. The workshop participants will include the registered Make for the Planet teams as well as IMCC5 delegates interested in designing scalable solutions for conservation. Following design thinking methods and activities, the teams will work through challenge statements to define a set of problems, brainstorm a set of solutions, consider design factors, iterate on ideas, and understand the most effective processes to move from idea to innovation, and innovation to social enterprise to scale for conservation impact.

IMCC5 Day 2 (25/6)

Plenary 2: Joshua Cinner, Ph.D.

8:30 - 9:30, Ranyai Ballroom

People and Reefs: emerging challenges and solution spaces in marine conservation.

Joshua Cinner began his work as an environmental social scientist while serving as a Peace Corps Volunteer in Jamaica in the mid 1990s. He has since completed a Master's degree from the University of Rhode Island and a PhD from James Cook University. Josh's research explores how social, economic, and cultural factors influence the ways in which people use, perceive, and govern natural resources. His background is in human geography and he often works closely with ecologists to uncover complex linkages between social and ecological systems. He has worked on human dimensions of marine conservation in Australia, Jamaica, Mexico, Papua New Guinea, Kenya, Madagascar, Tanzania, Seychelles, Indonesia, Mozambique, and the USA. He has published >115 peer-reviewed journal articles and a book published by Oxford University Press. Josh is now a Full Professor at James Cook University. He currently holds an ARC Future Fellowship, and is a recipient of the 2015 Pew Fellowship in Marine Conservation and the 2017 Elinor Ostrom Award on collective governance of the commons.

Focus Group: Determining Bycatch Susceptibility of Finfish and Invertebrates (10:00 - 12:00, Kabu)

Dr. Sara McDonald[1], Ms. Wendy Norden[1]

[1]*Monterey Bay Aquarium Seafood Watch*

Conservation scientists have stated genuine interest in conducting impactful research that is useful to conservation interventions and decisions. This begs the question: what qualifies as 'impactful' research? In the conservation literature, there is little generalizable evidence or common vision. Implementing research with a clear pathway from knowledge production to knowledge use appears, at the moment, more about luck than method. This day-long focus group answers a call-to-action put forth by an IMCC4 symposia and related publication. The article challenged conservation scientists to refine a proposed 'typology' of knowledge impact, preliminarily developed from coral reef cases. The long-term objective is to develop a common way to talk about, describe, and assess the impact of research in ways that are useful to mainstream conservation science and practice. Initial work will occur in this session. First, we will review theories and concepts developed by social science fields that are relevant to understanding knowledge production, broadly. These include co-production, information usability models, usable science, and actionable knowledge.Second, we will synthesize marine conservation cases to refine the existing rough typology. Third, we will develop research questions that the field can use to validate or contest the typology. Lastly, participants will discuss adapting information usability models to more deeply envision how, why, and under what generalizable terms conservation knowledge is used by decision makers. The organizers expect a core group of invited scholars (~10) and openly welcomes interested practitioners (~10). All participants will contribute to a peer-reviewed manuscript that will report on the group's findings.

OS-1A: Marine Tourism 1 (10:00 - 12:00, Tubau 1)

10:00 - Making Coral Reefs Matter to Tourism Under Threat in Guam

Ms. Mallory Morgan[1]

[1]*Guam Bureau of Statistics and Plans*

The tourism industry of Guam served a record number of tourists in 2017, and has ambitious goals to continue to grow these numbers. However, Guam faces intense geopolitical pressures threatening the vitality of the industry. Meanwhile, Guam's coral reefs also face heavy pressures threatening their survival. How do we make coral reefs matter in the context of such global pressures? While sustainable marine tourism management is not a nascent topic, one would argue it is for Guam. Given the multitude of stressors facing reefs today, reef managers have not yet had the capacity to address tourism impacts until now. My work seeks to reduce impacts of tourism and recreational use on Guam's coral reefs, while maximizing benefits to the tourism industry. A strategic communications process with tailored marine conservation messages is employed for each of four target audiences: marine tour operators, the hotel industry, tourists, and government agencies. Through relationship building, targeted outreach and education, and the development of various training modules, I am assimilating reef-safe practices into the industry through a process of buy-in as opposed to regulation. My talk will share how coral conservation may be institutionalized to collaboratively develop solutions for reefsafe tourism, from both a top-down and bottom-up approach. I will discuss the need for sustainable relationship-building across sectors, rather than those traditionally built on an individual level susceptible to turnover. Finally, we will explore communications frames making coral reefs matter to those motivated by its extractive use, in the context of global pressures.

10:15 - Evaluating the Sustainability of the Gray Whale-Watching Industry Along the Pacific Coast of North America

Ms. Alicia Amerson[1], Prof. Chris Parsons[2]

[1]Alimosphere, [2]George Mason University

This paper reports on the first study to critically examine the sustainability of whale-watching practices along the entire migratory range of a pelagic baleen whale species, the gray whale (Eschrichtius robustus). Commercial boat-based whale-watching operations along the west coast of North America were observed for sustainable practices. Data recorded aboard whale-watching vessels and collected via an online survey were integrated into the Lean Six Sigma quality improvement tool, in order to review business processes and identify where inefficiency or ineffectiveness exist in specific phases within a process. Whale-watching practices were analyzed using this method for 24 whale-watching companies operating in Canada, the United States and Mexico. The results show a high level of variation in management regimes, and operator non-compliance with guidelines, and highlight avenues to eliminate, revise, or reduce inefficiency and improve practices in the interests of high quality and sustainable operations. We recommend more specific and operational guidelines that allow operators to focus on high compliance with the most critical aspects of their business operation in order to build the sustainability of commercial tourist interactions with gray whales in their migratory range.

10:30 - Examination of tourists' willingness to pay under different conservation scenarios; Evidence from reef manta ray based snorkeling in Fiji.

Dr. Joshua Adam Drew[1], Ms. Shannon Murphy Parsons[2], Dr. Ian Campbell[2]

[1]Columbia University, [2]WWF Global Shark and Ray Programme

Wildlife-focused tourism is often considered as having the potential to play an integral part of threatened species conservation efforts, particularly through financial support. We focused on the direct financing of conservation by investigating tourists' willingness to pay to snorkel with reef manta rays (Mobula alfredi) in Fiji. Our results indicate that 82.4% of people surveyed would be willing to pay a mean value of ~USD $9.2 (SE 0.9) more than the current cost, a 28% increase. Also, 89% of people surveyed would be willing to pay a mean value of ~USD $10.2 (SE 0.9) more for a hypothetical scenario where they would snorkel with 50% fewer people, a 31% increase. We also investigated tourists' willingness to make voluntary donations to the local community above an existing payment of USD $10 that is built into the current snorkel payment of ~USD $32.5. On average, 91.3% of the tourists interviewed were willing to donate additional funds with an average additional donation of ~USD $8.6 (SE 0.5) to the community to pay for educational and environmental support, a 86% increase. There were few significant relationships between willingness to pay and demographic factors (including age, income, nationality, education, and others), suggesting that willingness to pay was widely held by tourists. Together, these results indicate that wildlife-based nature tourism could represent a potential, but not unlimited, income source to fund conservation in Fiji islands, and that conservation can arise from partnerships between local communities and the tourism sector.

10:45 - Towards an effective tourism management in Karimunjawa National Park

Mr. Azhar Muttaqin[1], Mrs. Shinta Pardede[1], Mr. Efin Muttaqin[1]

[1]Wildlife Conservation Society - Indonesia Program

Karimunjawa National Park is one of marine tourism destinations in Indonesia. Growing number of visitor on the last five years escalated up to 118,301 tourists and lead to mass tourism. It affected coral reef condition inside the park. Mean of hard coral cover within the park decreased from 57.86% to 49.89%, also in tourism zone, which decreased from 56.79% to 47.77%. Problem identification showed that weak management system within each tourism party lead to ineffective coordination. There are also other problems: lack of awareness on ecotourism, lack of tourism actor's skill and knowledge, high disparity in tourism development, low variety in tourist attractions, and lack of supporting facilities and infrastructure. In order to promote best practice tourism as well as protecting the reefs, this study was conducted to identify the impact of tourism to the coral reef and investigate the potential leverage to enhance the best practice conservation area management. A set of coral reef condition data has been collected from the area affected by tourism. Supporting data from stakeholders were also collected using Focus Group Discussion. We developed programs on strengthening the tourism guide association, capacity and knowledge enhancement for tourism guide, monitoring the implementation of regulations, and improving supporting facilities and infrastructure, achieved legalized agreement in sub-district level between the community, National Park authority, Tourism Agency, village government, private sectors, local NGO, and tourism guide association. These efforts resulted in an agreement for a periodic closure system in a dedicated area for tourism, with punishment prior to violation.

11:00 - Long-term change of herbivorous fish population after the 2010 coral bleaching event at tourism sites in the Gulf of Thailand

Mr. Sittiporn Pengsakun[1], Dr. Thamasak Yeemin[2], Dr. Makamas Sutthacheep[1], Mr. Charernmee Chamchoy[1]

[1]Marine Biodiversity Research Group, Department of Biology, Faculty of Science, Ramkhamhaeng University, Huamark, Bangkok, [2]Marine Science Association of Thailand

Coral reefs are the highest biodiversity ecosystems contributing lots of goods and services to human. The coral bleaching event in 2010 was a major cause of coral mortality and they are consequently covered by macroalgae. Herbivorous reef fish play an important role in controlling abundance of macroalgae on coral reefs and promote coral recruitment. This study aimed to monitor the long-term change of herbivorous reef fish population during 2014 - 2016 at seven study sites, which have high potential for ecotourism development, in Chumphon National Park, Chumphon Province, the Western Gulf of Thailand. The results showed that there were 10 species of coral reef fish including parrotfish and damselfish. The highest density of herbivorous reef fish was found in the year 2014 (143 individuals per 250 square meters) and the lowest one was recorded in the year 2016 (55 individuals per 250 square meters). Our result clearly showed that herbivorous reef fish made available substrates for coral recruitment which is very a very important factor for coral reef recovery. Measures for conservation of herbivorous reef fish are very importance to promote the sustainability of coral reef ecosystems and support ecotourism development. This study highlights the importance of reef fish monitoring data for both coral reef conservation and tourism management.

11:15 - Re-authoring of guides from capacity development processes,the key to the sustainable management of the whale shark in La Paz Bay

Mrs. Lizbeth Meza[1], Mrs. Gabriela Moreno[2], Dr. Dení Ramírez-Macías[3], Ms. Maritza Cruz Castillo[3], Mrs. Georgina Saad[4], Dr. Jorge Cáceres[1]

[1]Universidad del Medio Ambiente, [2]Secretaria de Medio Ambiente y Recursos Naturales, [4]World Wildlife Fund

The whale shark (Rhincodon typus) is a worldwide threatened species. La Paz Bay is a critical habitat for the species due to the juvenile that congregate in the area mainly for food and shelter. During 2016, studies recorded 62% of specimens injured and mutilated by boats. It is suggested to contact with boats as a result of a bad praxis in the performance of whale shark watching and swimming activity. In previous years, there has been an effort to train for good praxis and carrying out this activity. This paper analyses the role that the guides have played until now in the replication of bad praxis and establishes the hypothesis that a reauthoring process of the guides, will lead them to assume responsibility for the conservation of the species. Two workshops were designed; first aiming the service providers; second addressed to guides, focused on good praxis and mediation experience. The design of the workshop was based on the stream of environmental rationality, with a proposal of pedagogical approach of the subject from his own life. In 2017, 100 service providers and 120 guides were trained. Results: the creation of a professionalized guild; a guild that carries out good praxis during the exercise of its activity, a guild that is kept organized and has a constant communication through a learning community platform, a guild that has established a relationship of respect cooperation with the environmental authority in compliance with the rules and in the feedback of the reality in the field.

11:30 - What dive professionals know OR local ecological knowledge for the Millennial Generation

Dr. Edward Hind-Ozan[1], Dr. Andrea Sáenz-Arroyo[2]

[1]Cardiff University, [2]El Colego de la Frontera Sur

Since the 1970s, a growing number of marine scientists and conservationists have been making calls for the increased consideration of local ecological knowledge (LEK) in marine science and policy-making. Gradually, these calls have been heard and those that possess marine LEK have become more integrated in scientific and conservation processes. However, the integration seems to have extended little beyond fishing communities. Local fishing industries tend to have long histories, so it is no surprise that the LEK of fishing and seafood plant workers is that which has most commonly been considered. Yet, we now arrive at a point in history where marine tourism and commercial diving are also mature industries. With many workers in such industries having spent substantial portions of each day for the last couple of decades underwater, it is time to consider their experiential knowledge of changing marine environments in both our assessments of marine health and our marine conservation plans. In this presentation, the LEK of over 60 scuba diving instructors working along Mexico's Riviera Maya will be presented as a case study of why we should hear the LEK of those beyond the fishing industry. It will be shown that the Mexican divers' LEK, if considered by local environmental managers, could inform an early warning system of marine pollution events that would contribute to faster environmental clean-up than is possible under existing water quality monitoring programs. The presentation will conclude with guidelines for how you can record, analyse, and disseminate the LEK of dive professionals.

OS-1B: Fisheries and Aquaculture 1 (10:00 - 12:00, FJ Auditorium)

10:00 - A multidisciplinary approach to establishing a shifting baseline for the Japanese dogfish (Squalus suckleyi)

Ms. Markeike Dornhege[1], Prof. Anne Mcdonald[1]

[1]Sophia University Tokyo

Since Daniel Pauly coined the term "shifting baseline syndrome" in 1995, it has increasingly gained traction in the marine conservation community and is finally starting to be accepted by some policy makers as a more accurate benchmark to base total allowable catch on. The main obstacle for the establishment of a shifting baseline is data paucity. Detailed catch data has been recorded for a few decades at best in most cases. Therefore, establishing a shifting baseline relies on a multidisciplinary approach based on social sciences and marine environmental history, which is still often met with skepticism in the marine sciences, even though accepted in terrestrial science for years.

This paper presents a case study of an integrated approach to establish if a shifting of the baseline of the North Pacific dogfish (Squalus suckleyi) occurred and details the methods used: landing data, portside visits, interviews with fishermen and shark processors of three generations, museum visits, and study of old documents and photographs. The result shows that a massive shift occurred at the turns of the 19th to the 20th century that lead to what can probably be described as the ecological extinction of S. suckleyi on the Pacific Sanriku coast of Northern Japan. S. suckleyi remains unmanaged and unprotected, while other shark species, which are now the focus of commercial fisheries in Japan, are increasingly regulated based on visible trends in landing data which currently constitutes the only acceptable foundation for policy decisions.

10:15 - Regulating shark and ray mortality through effective policy

Mr. Daniel Fernando[1], Ms. Rosalind Brown[1], Mr. Akshay Tanna[1]

[1]Blue Resources Trust

Shark and ray populations across the world are under threat from fishing pressure resulting from global demand for shark fins and mobulid gill plates, and more recently, domestic consumption of meat. Many countries lack effective management measures to regulate these fisheries to curb population declines, aid species recovery, or shift toward sustainable methods. Increasingly, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Convention on the Conservation of Migratory Species (CMS) are playing a role to manage these species. Sri Lanka, although among the top-15 elasmobranch fishing nations, took a leading role in listing sharks at CITES and CMS. The recent national CITES Non-Detriment Finding (NDF) recommended additional species-specific data to be collected given the data-poor situation. Therefore, we have established a project to routinely collect data from landing sites across Sri Lanka. Since August 2017, 130 surveys were conducted identifying a total of 45 species (22 sharks and 23 rays) from 1,666 specimens. Such data improves knowledge of national species diversity, helps track changes over time, and updates distribution maps. However, to support informed and effective fisheries management plans, data collection must be standardised and expanded across the region to take into account shared stocks and knowledge on survival post-release and bycatch mitigation must be improved. Ultimately, for management policies to be effective they must be up-to-date, practical, and enforceable. A focus on the sustainable management of species via regulated trade should be prioritised over drastic last-minute measures such as total prohibition.

10:30 - Global Shark Trends

Prof. Nicholas Dulvy[1], Prof. Colin Simpfendorfer[2]

[1]Simon Fraser University / IUCN Shark Specialist Group, [2]James Cook University

Over the next three years the IUCN Shark Specialist Group is developing dashboard of global shark and ray indicators to track conservation outcomes at national, regional, and global scales. Specifically, we will produce a Living Planet Index summarizing trends all available population trend data and a Red List Index tracking change in extinction risk status in 1980, 2005, and 2020. To develop the Red List index, we will complete comprehensive IUCN Red List reassessments (and retrospective assessments) of the extinction risk status of all 1,250 chondrichthyans through 10 expert review workshops by end of 2020. While working toward the Living Planet Index, we summarise trends of 163 populations of 83 species, spanning 8 orders. We will use this knowledge to make the case for shark and ray conservation to the public and provide salient information to decision-makers to enable them to make appropriate conservation decisions. The team will develop a conservation priority model to combine Living Planet and Red List Indices with conservation likelihood indices and species distribution maps to identify those locations, and associated policy interventions, worthy of further conservation attention.

10:45 - Genomically-informed Fisheries Management of White Seabass (Atractoscion nobilis)

Dr. Matthew Iacchei[1],Dr. Jonathan Whitney[2], Dr. Kimberly Selkoe[3], Mr. Scott Aalbers[4], Dr. Chugey Sepulveda[4], Ms. Alfonsina Romo-Curiel[5], Dr. Sharon Herzka[5], Dr. Robert Toonen[6], Dr. Hunter Lenihan[7]

[1]Hawaii Pacific University, [2]University of Hawaii at Manoa, [3]National Center for Ecological Analysis and Synthesis, [4]Pfleger Institute for Environmental Research, [5]Centro de Investigación Cientifica y de Educación, [6] Hawaii Institute of Marine Biology, [7]University of California, Santa Barbara, Bren School of Environmental Science and Management

The white seabass (Atractoscion nobilis) is among the most valuable species targeted by commercial and recreational fisheries in California and Baja California, Mexico. Paramount to the effective management and conservation of this bi-national stock is knowledge of white seabass life history and ecology, and of the size and spacing of white seabass populations maintained by genetic connectivity. Here we present a genome-level survey of white seabass across much of their Pacific coast distribution to better understand the population structure of this species in the wild. Our method can be adapted for any non-model species and is a relatively affordable and scalable approach for resource managers to conduct an initial genome-scale, rangewide survey of a species of interest. We characterized eight unique sample locations plus multiple replicates using a pooled RAD-seq technique that produced a final dataset of 1561 SNPs on 261 contigs of 300-600bp length (mean = 420bp), distributed across the genome. Each SNP had at least 40x coverage and was scored across all pools. We found no indication of genetic structure across putatively neutral genomic regions, and few outlier loci across populations. These results are supported by preliminary electronic tagging data showing frequent long-distance movements of adult white seabass along the Pacific Coast, but contrast with previous genetic studies and otolith microchemistry data that indicate a distinct sub-population south of Punta Eugenia in Baja. We discuss the implications of these data for the management and conservation of wild populations across the United States-Mexico border.

11:00 - Trends of mobulids ray fishery: a case study of Indonesian megafauna hunters community

Mr. Mochamad Iqbal Herwata Putra[1], Ms. Sarah Lewis[2]

[1]Misool Foundation, [2]Marine Megafauna Research Group - Misool Foundation, Savu Sea Program; Manta Trust

The major threat to mobulids population is international wildlife trade, which has increased in the last decade. Meanwhile, this high demand is not in line with these species' biological characteristics, which tend to be slow in growth, late sexual maturation, long life spans, long gestation periods, low reproductive rates and low natural mortality. We recorded mobulids fishery landing in Lamakera along 2015-2017, where this village has famous as megafauna hunter community and one of the largest in the world. Generalized linier model (GLM) was used to describe the annual landing trends on each type of mobulids fishery. A total of 912 individuals were landed in the last three years, dominated by Mobula japanica (49%), Mobula birostris (37%), Mobula tarapacana (12%), and Mobula spp. (2%). Mobula birostrisis the highest targeted species (77%), while Mobula japanicais the highest mobulids of bycatch from drift gillnet fishery (79%). The GLM model demonstrates the management intervention through marine patrol and law enforcement have successfully push down the numbers of Mobula birostrishunting annually (R2 = 0.92, p-value <0.0001). However, the landing trends of Mobula japanicahas increased significantly up to 623% due to the increasing of the bycatch product from drift gillnet fishery (R2 = 0.97, p-value <0.0001). After all, the landing trends of all mobulids species from hunting were decreased, where the landing trends have changed and dominated by drift gillnet fishery bycatch. Meanwhile, the landing trends of Mobula birostris and Mobula tarapacanahas decreased significantly except Mobula japanica.

11:15 - Collaborative and innovative approaches to achieving sustainability in Indonesian small-scale tuna fisheries

Ms. Allison Stocks[1]

[1]MDPI

Indonesia is one of the largest seafood-producing countries in the world; it is the source of 16% of the world's tuna catch. Yet very limited data exists on the status of these fisheries, limiting management capacity and leading to unsustainable fishing practices. Indonesian marine resources are threatened by overfishing; illegal, unreported and unregistered (IUU) fishing; unregulated use of fish aggregating devices (FADs); and limited spatial management of vast and complex coastal ecosystems. The road to successful fisheries management involves many challenges, but MDPI, an Indonesian non-profit, has been tackling these challenges for the past five years. Working directly with the fishing industry and seafood supply chains, MDPI has built a program that is achieving measurable steps towards sustainable small-scale tuna fisheries in Indonesia. MDPI tackles several aspects of fisheries sustainability, working on fisheries improvement projects (with the goal of MSC certification), traceability and technology implementation, community development through Fair Trade certification, education and outreach, and more. The organization works in communities across Indonesia, engaging directly with small-scale fishermen (who comprise almost 70% of the roughly 3 million Indonesian fishermen). By partnering with seafood supply chains and associated industries, who have a commitment to engage in sustainability work, MDPI's work contributes to sustainable fisheries and the development of robust fisheries management. We address the persistent sustainability issues through improved data collection, the development of effective fisheries management, private sector engagement, and capacity development for government institutions and industry professionals.

11:30 - The scaling of area use in sharks and rays

Dr. Christopher Mull[1], Dr. Vinay Udyawer[2], Dr. Michelle Heupel[2], Prof. Colin Simpfendorfer[3], Prof. Nicholas Dulvy[1]

[1]Simon Fraser University, [2]Australian Institute of Marine Science, [3]James Cook University

Movement is a key aspect of marine vertebrate behavior and important information for the effective management of species. Over the past few decades movement in sharks and rays has received increasing attention as tracking technologies have evolved, from mark-recapture to acoustic telemetry and satellite tags. While we have increased our knowledge of the degree of movement in many species, and have gained more knowledge about key aspects of area use - such as home range size, dispersal distance, and migratory behavior - key next step is to develop a mechanistic understanding of what drives variation in an individual's patterns of area use. Patterns of area use, specifically home range size, are strongly determined by energy availability in relation to an individual's metabolic requirements. To develop a mechanistic understanding we will need to identify and investigate the strength of intrinsic biological characteristics (e.g. body size, breeding biology, metabolic rate) and ecological covariates (e.g. habitat type, ecological lifestyle, trophic ecology). Here we derive the scaling of shark and ray movements, including daily home range size and dispersal distances, and examine them in relation to morphology, ecology, and life history. We explain the variation in home range and movement attributes from 76 species from the IMOS Animal Tracking Facility database and from published studies.

11:45 - Sustainable management of grouper and snapper fisheries: the case of Saleh Bay, West Nusa Tenggara, Indonesia

Mr. Tezar Rafandi[1], Ms. Siska Agustina[1], Ms. Hernawati Hernawati[1], Ms. Sitti Hilyana[2], Mr. Tasrif Kartawijaya[1], Dr. Arisetiarso Soemodinoto[1]

[1]Wildlife Conservation Society - Indonesia Program, [2]Mataram University

West Nusa Tenggara Province (NTB) is a major source of commercially important demersal fishes such as grouper and snapper. Fisheries production of demersal and reef fishes alone reached approximately 18% of total production of NTB in 2014. As such, how NTB manage its grouper and snapper fisheries sustainably could be used as a good example to other regions.

This paper reports the development of management plan for sustainable fisheries of grouper and snapper in NTB. Employing fisheries reference points as basis for management decision-making, we use grouper and snapper fisheries in Saleh Bay as case study. The plan was prepared through several stages: (i) identifying biological characteristics of grouper and snapper populations; (ii) catch monitoring; (iii) determining fisheries reference points; (iv) preparing management plan document; (v) public consultation at national, provincial and local levels; and (vi) developing action plan for grouper and snapper fisheries. The sustainable fisheries management plan is built by two main components: input and output controls. Input control aims at limiting the allowable catch sizes; banning the use of destructive fishing methods and encourage the use of environmentally-friendly methods; increasing fishing gears selectivity; protecting core zone associated with fisheries; and prohibiting coral reef extraction to install fishing traps. Complementarily, the objectives of output control are to limit the number of fish catch; and to promote mutually beneficial agreements with fish traders to accept and sell snappers and groupers that comply with rules in input control. Challenges and opportunities faced during the process will also be discussed.

OS-1C: Culture and the Marine Environment 1 (10:00 - 12:00, FJ Event Hall)

10:00 - When Fishing Communities Meet Tourism: Fishers' and Tourists' Perceptions on Holbox Island.

Dr. Nadia Rubio[1], Dr. Marcia Moreno Báez[2], Dr. Jeffrey Glover[3], Dr. Dominique Rissolo[4], Ms. Chapin Dorsett[5], Mr. Erick Higuera[6], Dr. Igor Rubio[7], Dr. Andrea Sáenz Arroyo[8], Ms. Sara Morales[9], Dr. Silvia Salas[9], Dtr. Jorge Herrera Silveira[9]

[1]The Rufford Foundation Fellow, [2]University of New England, [3]Georgia State University, [4]University of California San Diego, [5]Whitman College, [6]Pelagic Life, [7]Permacultura Mexico, [8]El Colegio de la Frontera Sur (ECOSUR) San Cristoóbal de las Casas, Chiapas, [9]Centro de Investigación y de Estudios Avanzados (CINVESTAV), Unidad Mérida

We aim to understand the conservation needs of Holbox's natural capital by documenting and integrating fishers' traditional knowledge, tourists' perspectives, historical and archaeozoological data, and underwater landscape recordings.

Firstly, we documented Holbox's fishing history. We conducted 150 surveys of fishers' traditional knowledge on fisheries exploitation, fishing practices, and knowledge of historical fishing sites. Survey results were analyzed using geospatial tools which allowed the construction of coastal exploitation maps for 113 fishing sites. Fishers' traditional knowledge documented over 70 species in diverse families (e.g. Carcharhinidae) that were abundant and highly fished over the past 40 years. Data of 545 archaeozoological remains from the Mayan coastal site of Vista Alegre identified 33 families of exploited taxa, of which finfish and sharks, were the most abundant. Fishers and literature sources document Holbox's contemporary issues, including overfishing, illegal fishing, and accelerated tourism development.

Secondly, we are studying interactions between fishers, landscapes, and tourism to document how Holbox's socio-ecological environment has evolved. We collected 200 tourists' perceptions of: sustainability, environmental issues and seafood consumption. Preliminary results show that 54% percent of tourists agree tourism has negative environmental impacts, but only 5% of tourists actually research Holbox's environmental issues. This shows island conservation campaigns are needed beyond the local scale. Lastly, underwater video recordings of historical fishing sites that are currently popular tourist snorkeling sites allow us to qualitatively describe these undocumented landscapes. Combining the aforementioned data using historical ecology techniques, among others, can provide baseline information to develop policies tailored to preserve Holbox's natural capital.

10:15 - Global dugong conservation and cultural values

Dr. Donna Kwan[1]

[1]CMS Dugong MOU Secretariat

Dugongs are used in many traditional customs and practices throughout the world, from the Torres Strait in Australia, to Umm Al Quwain in the United Arab Emirates. The Dugong MOU, through the Conservation and Management Plan, encourages Range States to seek to understand the cultural importance of dugongs, and to ensure that management plans and policies consider traditional uses. The incorporation of traditional knowledge of dugongs and their habitats, as well traditional practices for conservation and management is important for successful dugong conservation and management, particularly where subsistence hunting is allowed. The Dugong MOU has a number of tools available to help dugong Range States to understand the cultural importance of dugongs to local communities, including

the CMS Dugong MOU Standardised Dugong Catch and Bycatch Questionnaire and the Dugong and Seagrass Research Toolkit.

The Torres Strait in Australia provides a useful case study for the inclusion of cultural values and community involvement in dugong and seagrass management. In this region hunting for dugongs is an important part of the traditional way of life and livelihood of Torres Strait Islanders. Community based Dugong Management Plans, developed by individual Torres Strait Islander communities, have been implemented on a voluntary basis throughout the Torres Strait. Each plan includes a range of culturally-based management arrangements that have been agreed to by each respective community. This demonstrates the successful implementation of the Dugong MOU's Conservation and Management Plan by ensuring that subsistence and customary use of dugong is sustainable in areas where it is permitted.

10:30 - The nexus of science, culture, and marine resources: stories from the outer islands of Micronesia and why they matter

Prof. Nicole Crane[1], Mr. John Rumal[2], Dr. Michelle Paddack[3], Dr. Peter Nelson[4], Dr. Giacomo Bernardi[5]

[1]Cabrillo College/One People One Reef, [2]Ulithi Falalop Community Action Program, [3]Santa Barbara City College/One People One Reef, [4]University of California, [5]University of California Santa Cruz

The Federated States of Micronesia contain a vast region of autonomously governed islands rich in marine biological and cultural diversity, both of which are under threat. With the erosion of traditional management, resources in decline, and pressure from outside entities vying for those resources, an approach that supports traditional management with scientific evidence is central to success. Local communities require a minimum level of autonomy for successful management, but also require scientific support. We discuss a unique approach that supports both marine resource management and traditional cultural practices in these remote outer islands. We present findings of a multi-year program that seeks to better understand the ecosystems, the fishing pressure, the reliance on seafood, and traditional management in order to tailor methods that work best for the people who live on these reefs. To strengthen understanding of the link between social and biological systems, we incorporate interviews, habitat surveys, genetic sampling, and fisheries landings data into a collaborative approach to supporting (not directing) management efforts. We present a model (and the data) of successful conservation with local people at the center, supported by western science, and implemented as a collaboration.

10:45 - Why save sharks?: A case for a relational values approach to studying shark conservation

Ms. Rachel Skubel[1], Mrs. Gina Maranto[1], Dr. Meryl Shriver-Rice[1]

[1]University of Miami

Sharks occupy unique roles in human society: objects of conservation campaigns, fishery and tourism resources, maligned predators inciting fear in beach-goers, and subjects of inquisitive scientists. There are more than 1250 species of sharks and their relatives, which have persisted on Earth in some evolutionary form for over 420 million years and now occupy countless environments - from arctic waters and tropical coral reefs, to deep seabeds and inland rivers. Sharks range in size from 20 centimeters (the dwarf lanternshark) to 20 meters (the whale shark), performing an array of functions in their natural habitats and in human society. For conservation purposes, sharks have generally been framed as having either intrinsic or instrumental value, that is value simply by merit of their existence or value for the sake of human use. This presentation will examine them in terms of relational values - that is, human values derived from a relationship with sharks, such as selfor community-identity, moral obligation to conserve non-human species, notions of well-being, and stewardship. We propose that efforts to rebuild or sustain shark populations through regulating human activities are more likely to succeed through assessing and considering relational values of all stakeholders, and mediating conflicting value frameworks (e.g., fishers versus environmentalists). We also discuss how relational values through sharks have manifested in the scientific community, fishers, indigenous groups, tourists, and the public, the unique roles held by each in 'valuing' sharks, and how policies targeteting these groups' behavior are well suited to include relational value assessments.

11:00 - Marine Planning, Management and Conservation depend on Social-Ecological Resilience Features

Dr. Fernanda Stori[1], Mr. Caiua Mani Peres[1], Prof. Alexander Turra[1], Prof. Robert Pressey[2]

[1]University of São Paulo, [2]Australian Research Council Centre of Excellence for Coral Reef Studies / James Cook University

Marine planning, management and conservation (MPMC) depend on Social-Ecological Resilience (SER). We investigated SER features in Araçá-Bay, (São Paulo State/Brazil), integrated with Biota-FAPESP/AraçáProject (BFAP). Currently, a governmental port expansion project may exterminate this environment. Combined methods were performed during 3 years of intense research-action (2014-2017): in-depth ethno-oceanographic interviews with 18 expert fishers (EF); participatory meetings of Local Plan for Sustainable Development (LPSD) organized by BFAP; monitoring of the meetings of Araçá-Working-Group of Marine Protected Area/NorthernCoast (AWG/MPA-NC); and, production of a film-documentary (Pulsating/25') encompassing 17 stakeholders' interviews (SI). All EF reported historical disturbances on ecosystems due to port and urban infrastructures that led to biodiversity and fisheries decline. We found local-practices and social-mechanisms that foster SER: Traditional Ecological Knowledge (TEK) on 57 fishing species, on ecosystem-services (food production, leisure, cultural heritage,etc.), and on measures to protect habitats and species (closed areas, closed seasons, interdict fishing techniques, protect endangered species, exclude outsiders and improve enforcement). We systematized TEK to LPSD meetings. Amongst 26 ecosystems-services, the top-three voted by the participants were those founded on TEK. The AWG/MPA-NC discussed the comprehensiveness of Araçá-Bay into MPA-NC design and TEK was determinant to the arrangement. SI demonstrated how society, pushed by community, scientists and prosecutors, won in court the revocation of the license previously given authorizing port expansion. The filmdocumentary revealed this scenario, spotlighted the conflict in media and strengthened the community. SER features depend on science-based MPMC strategies that: consider TEK, nurture collective learning, strengthen co-management and stakeholders' surveillance for the sustainability of ecosystem-services.

11:15 - Seabirds to Shipbuilding: A Novel Approach to Integrating Natural, Cultural & Historical Marine Heritage - Case Study of the UK's first Seascape-scale Conservation Initiative

Ms. Emily Cunningham[1]

[1]SeaScapes Partnership

In a post-industrial seascape in North-East England, once the most polluted in Europe, poor perceptions of the marine environment pervade; resulting in seabird persecution, high levels of beach litter and a lack of engagement with conservation initiatives and the environment itself. This has severely limited our understanding of the marine environment and impacted our ability to effectively manage the seascape. There is however much to be celebrated across this seascape, from rich maritime heritage to an internationally important seabird colony. Thus, by framing and managing the natural, cultural and historical heritage of the seascape as a whole, we can reach new audiences and catalyse multi-disciplinary collaboration that is greater than the sum of its parts. In the UK this approach is well established in terrestrial landscapes but had not yet been applied to seascapes. In 2016, local authorities, universities, NGOs and community groups working across natural-cultural-historical heritage came together to pool resources towards a collective vision for the seascape, its communities and its heritage. Together they developed "SeaScapes", the UK's first Seascape-scale conservation initiative. This will be delivered through a 4-year scheme of conservation projects, engagement activities and training opportunities designed to better understand and manage the seascape, instigate a culture of marine citizenship and inspire behavioural change. The scheme has secured funding and is currently in detailed development, bringing scientists, practitioners and citizens together to make marine science matter in conservation practice and leave a lasting legacy for the heritage, communities and wildlife of this seascape.

S-117: Justice and equity in marine conservation: theory, empirical analysis, and practice (10:00 - 12:00, Tubau 3)

10:00 - Fairness and marine resource management: exploring principles of distributional equity in Fiji

Dr. Georgina Gurney[1], Ms. Margaret Fox[2], Dr. Sangeeta Mangubhai[2]

[1]Australian Research Council Centre of Excellence in Coral Reef Studies, James Cook University, [2]Wildlife Conservation Society, Fiji Program

Marine resource management initiatives invariably result in costs and benefits to local stakeholders. Understanding local stakeholders' perspectives of what constitutes a fair distribution of management impacts is critical not only to ensuring that conservation contributes to human well-being but also because it is instrumental to achieving biodiversity gains. Indeed, given that disparities in how distributional equity is conceived are a key source of management-related conflict, identifying how such conceptions vary among social subgroups is imperative to achieving successful management outcomes. To this end, we explored coastal community members' preferences for alternative benefit sharing arrangements in relation to tourist revenue associated with a payments for ecosystem services project involving a marine protected area in Ra province, Fiji. Using semi-structured interviewers, we elicited 122 individuals' preferences for alternative benefit sharing arrangements that represent different principles of distributional equity: egalitarianism; utilitarianism; and proportionality (four forms based on need, opportunity cost, contributed effort to project management, and property rights). We also examined whether community members' preferences for alternative benefit sharing schemes varied according to their position in society. Our research highlights the need to take into account the pluralistic nature of distributive equity when developing marine resource management initiatives.

10:15 - Social justice, sustainability and conservation from a community perspective: A Case from Selayar, Indonesia

Dr. Dedi Supriadi Adhuri[1]

[1]Research Center for Society and Culture, Indonesian Institute of Sciences

The conventional approach to conservation is a top down initiative, driven by conservation NGOs that see serious threats to biodiversity or endangered species and sustainability of particular resources, and supported by governments. The government agencies in charge of conservation, with NGO encouragement - establish conservation areas by excluding local people from the territory concerned. This approach tends to fail or at least meets serious resistance from the community on the grounds of social justice and food security issues. The community considers the delineated space and the resources therein as their source of livelihood, and in many cases their right under customary law. Closing the area is considered unjust, so communities resist, negating the conservation objectives. This paper will present an unusual case from Selayar, South Sulawesi, Indonesia, where the very same reasons; social justice, sustainability and food security are used by communities to establish conservation areas and coastal management in their village waters. Interestingly, this initiative was triggered by a conflict between the communities and outsider fishers, and the failure of government to facilitate a resolution. The government incapability of resolving the conflict is due to both limited human resources and inconsistent regulations in coastal fisheries. Ironically, the latter also constrains the establishment of the community-based conservation and coastal fisheries management.

10:30 - What's fair and Why? Empirical equity and customary marine management in Papua New Guinea

Ms. Jacqueline Lau[1]

[1]Australian Research Council Centre of Excellence in Coral Reef Studies, James Cook University

Justice is both ethically mandatory and a key ingredient for conservation success.

Unfair conservation interventions and marine management can cause conflict, distrust and fail to produce biodiversity outcomes. Environmental justice provides a theoretical framework for investigating distributional, procedural, and recognitional justice in conservation. However, studies of empirical equity (i.e. what is considered fair on the ground) remain nascent, particularly in marine contexts. To fill this gap, I apply an environmental justice lens to two case studies of customary management of coral reefs in Papua New Guinea. Both cases have historical customary reef management systems and different ecological outcomes (one thriving, one struggling). Specifically, I examine what is considered fair in the distribution of benefits from and governance of coral reefs, and how governance manifests in practice. I then explore how marine conservation can identify and apply plural understandings of justice. I find that social values and relationships shape conceptions of justice around reef management. for instance, unequal distributions of benefits are not necessarily considered unfair, and are tied to beliefs and values about luck, need, and hard work. In addition, deliberative decision-making is a key practice for negotiating the terms of just management. I argue that marine conservation must recognise that what counts as justice in one place may not count in another. To achieve socially just conservation, marine conservation needs to go beyond dichotomies of costs and benefits, or winners and losers, to identify what is fair, why, and the gap between these ideals and practice.

10:45 - Building Stakeholder Support for Marine Protected Area: A case study in the Tun Mustapha Park, Sabah, Malaysia

Dr. Robecca Jumin[1]
[1]*WWF-Malaysia*

A Marine Protected Area (MPA) is a conservation tool used to conserve marine areas and resources. It has various meanings in different places, depending on the objectives and design it was established. The World Conservation Union (IUCN) defined an MPA as "any area of intertidal or subtidal terrain, together with its overlying water and associated flora and fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment". The IUCN also established 6 management categories of protected areas that also apply to MPAs. These management categories describe the management mechanism of each category and imply the level of involvement of stakeholders in its management. In recent years there are increasing calls for the participation of stakeholders, especially the local communities, in the establishment and management of MPAs. Participation of stakeholders varies from passive participation where stakeholders have no role in decision-making, to self-mobilization where the decision-making is fully in the hand of the stakeholders. Active participation of stakeholders is important in ensuring future compliance to any decisions made pertaining to the MPA, and subsequently influence the success of an MPA. Strategies to build stakeholder support for MPA include stakeholder consultation, demonstration of benefits, development of alternative livelihoods and continuous communication, education, and awareness activities. This paper describes how these were applied in the establishment of Tun Mustapha Park in the northern part of Sabah, Malaysia, which was gazetted in May 2016.

11:00 - Scales of human values, trade-offs, and justice in coastal fisheries

Dr. Tim McClanahan[1]
[1]*Wildlife Conservation Society*

Justice, fairness, and economic trade-offs are related concepts that are critical for considering and developing effective management in fisheries. Critical to how these divisions are evaluated is the social scale of value from the individual, family, community, to nation and the degree to which nature is valued for its intrinsic rights or value to people. Efforts to manage or conserve resources without understanding implicit assumptions and perceptions among stakeholders is expected to encounter compliance and sustainability problems that are often difficult to predict. The emerging polarization and trade-offs arise from implicit assumptions that are seldom explicitly stated in selective stakeholder forums and therefore difficult to plan around and resolve. Consequently, polarization of political identities is frequently at the core of management and conservation conflicts. Conservationist must therefore engage in research and dialogues on perceptions of fairness if they are to achieve their proposed goals. I discuss some of the major division in the political cognitive rifts that emerge in fisheries from fishers, leader, managers, and researchers in different social contexts. I show that the psychologies of these stakeholder positions are different enough that generic conservation proposals are unlikely to succeed outside homogenous or routine trade off social contexts. Developing diverse membership forums at the planning stage is a potential solution but are socially uncomfortable because of the underlying conflicts. Yet, agreed-on actions are expected to have high adoption and compliance rates and therefore a critical to management success.

Make for the Planet: what are the five marine Conservation Challenges?

Dr. Barbara Martinez[1]
[1]*Conservation X Labs*

What are the five marine conservation challenges inspiring today's multidisciplinary teams of solvers, hackers, and makers? This session kicks-off the Make for the Planet competition at IMCC5 after five conservation experts describe their challenges for the teams. Make for the Planet is an event where multidisciplinary teams are challenged to rethink conservation by brainstorming, iterating, and designing possible solutions to one of the five proposed conservation challenges. Teams will have access to a pop-up makerspace, as well as inexpensive electronics and 3D printers at IMCC5 to inspire physical representations or prototypes of ideas. Teams are encouraged to create solutions outside the box, along the leading edge of technological and scientific innovations.

Make for the Planet is an event to source new ideas to solve seemingly intractable conservation problems. We are in the middle of a period of extraordinary change on the planet, a sixth great mass extinction. Challenges will increase as billions emerge into middle class placing new demands on the planet, exacerbated by climate change.

While traditional conservation science can define the problems, it does not possess all the solutions. We need new solutions, disciplines, and solvers engaged in conservation as powerful new tools for conservation exist in adjacent fields. One way to achieve this is by harnessing the power of exponential technologies, open innovation, and entrepreneurship to transform the efficacy and scale of conservation efforts. This is an event at IMCC5 to create real solutions - join us, and interact with the teams during the conference!

S-44: Marine Plan Partnership Implementation story: four marine spatial plans, five outcome areas, and seventeen indigenous and western governments. (10:00 - 12:00, Tubau 2)

10:00 - Implementing Marine Protection and Conservation Measures in the Haida Gwaii Marine Plan

Mr. Russ Jones[1], Mr. Chris Mcdougall[2], Ms. Molly Clarkson[1], Dr. Lais Chaves[1]
[1]*Council of the Haida Nation,* [2]*Haida Oceans Technical Team*

The 2015 Haida Gwaii Marine Plan captures commitments by the Haida Nation and Province of British Columbia (the "partners") to managing marine and coastal uses and activities within Haida territory. This presentation describes progress on three priority initiatives: (1) establishing marine protected areas, (2) managing aquatic invasive species (AIS) and (3) enhancing compliance and enforcement.

- (1) The plan established a Protection Management Zone primarily for conservation purposes, comprised of 87 sites and 19.6% of the plan area. The plan partners participate in a joint process to review tenure applications according to zoning guidelines. Management plans that were already in place for about one-third of the sites are being updated and provide enhanced legal protection. Some sites are expected to be advanced as new protected areas through a Marine Protected Area network planning process with the federal government. As well, alternative protection measures such as Indigenous Protected Areas designations are being investigated.

- (2) Highly invasive tunicates (Botryllus spp.) have been detected at several locations in Haida Gwaii. Partners are monitoring spread and have assessed policy gaps and vectors such as small vessel movements. A preliminary risk assessment is underway for AIS and an interim management plan and public awareness campaign are expected to be in place by summer 2018.
- (3) The partners have bolstered their compliance and enforcement capacity through additional staff and training and are exploring opportunities to collaborate with the federal government. Linkages to existing Haida Watchmen and Guardian programs are being enhanced to improve surveillance and enforcement.

10:15 - Marine Plan Implementation on BC's North Pacific Coast

Mr. Steve Diggon[1]

[1] *Coastal First Nations - Great Bear Initiative*

With high levels of first Nation, provincial, federal and stakeholder participation, the Northern Shelf Bioregion (NSB) of British Columbia, Canada is a hotbed of marine planning and management initiatives. Marine planning in the region has ranged in jurisdiction, scale and scope for a variety of political and operational reasons. These processes include community-based marine planning by first Nations, biodiversity-focused protected area planning (NSB MPA Network), detailed sub-regional planning (Marine Plan Partnership-MaPP), and broad-scale, policy-oriented strategic planning (Pacific North Coast Integrated Management Area-PNCIMA). Related initiatives include a new multi-million dollar federal Ocean Protection Program, that seeks to enhance marine safety through 57 different projects. This will initiate fine scale community-based emergency response planning, as well as regional collaborative work on marine transport and shipping. First Nations have co-lead or participated significantly in all these processes and developed extensive marine planning capacity and expertise over the last decade. First Nations strive to integrate these disparate initiatives through progressive governance arrangements, rigorous research and analysis, collaborative policy development and ongoing community engagement in order to ensure that aboriginal rights and values are respected and protected through all marine planning initiatives. Through an approach that nests operational and governance structures, subregional alignment and regional coordination, first Nations are a key driver in marine planning and the harmonization of diverse processes for marine conservation and sustainable development.

10:30 - MaPP North Vancouver Island Marine Plan Implementation

Mr. Dallas Smith[1]

[1] *Nanwakolas Council*

The North Vancouver Island Marine Plan implementation strategy is increasingly influencing ocean management. The first Nation and provincial government Plan partners use annual work plans and budgets to implement priority strategies. An "incremental approach" promotes refinement of our efforts in successive implementation years. Two priority topics are improved cultural resource inventory and improved opportunities for sustainable aquaculture. for cultural resources, an initial desktop exercise to document to predict first Nations archaeological sites was followed by a field investigation that confirmed the model's accuracy and documented many new sites. In Year 3 we expanded field surveys to other areas to document more sites. Year 4 saw an assessment of cultural site vulnerability and sensitivity, first Nation guardian training on inventory and documentation, identification of several hundred new sites, and a pilot project proposal for collaborative management of sites. for shellfish aquaculture, initial 1 efforts were to complete a biophysical capability assessment of the entire sub-region. This led to a pilot grow-out and monitoring study for selected shellfish species. Positive grow-out results at pilot locations led to a Year 3 marketing study for any product coming from the area. Year 4 effort has been a business feasibility assessment, which could lead to a specific business plan and a new shellfish industry.

10:45 - Turning Plans into Action: the Marine Plan Partnership for the North Pacific Coast's Shift from Plan Development to Implementation

Ms. Kristin Worsley[1]

[1] *Province of British Columbia*

Integrated marine planning is emerging globally as a leading tool for achieving ecological, social, cultural, and economic objectives within shared ocean areas. To that end, the Marine Plan Partnership for the North Pacific Coast (MaPP) was formed as a collaborative, government-to-government initiative between the Province of British Columbia and 17 member first Nations. Together, the MaPP partners co-led the development of integrated marine use plans for 102,000 km2 of Canada's Pacific coast. Over the course of four years, the partners completed a set of comprehensive marine plans for four subregions and an accompanying Regional Action framework, which includes objectives and strategies related to governance, marine zoning and protection, stewardship and monitoring, and sustainable economic development. In anticipation of what was to come, the MaPP partners initiated a number of key actions towards the end of the planning phase to ensure a seamless transition to implementation. This included developing a longer term business plan, securing and allocating initial funding, identifying short- and long-term priorities for implementation, and identifying preliminary measures of plan performance. Now into year 4 of implementation, the MaPP partners have achieved some key milestones, including the signing of formal implementation agreements in 2016, and gathered early learnings to support implementation of marine plans in other regions.

11:00 - Innovative place based planning on Canada's Central Coast

Mr. Danielle Shaw[1]

[1] *Wuikinuxv Nation*

Place-based marine planning grounded in local and indigenous values can be effective in sustainably managing complex and dynamic marine environments. The Marine Planning Partnership (MaPP) on the Central Coast of British Columbia (BC), a collaboration of first Nations and the Province of British Columbia, integrated indigenous knowledge, western science, and stakeholder advice in innovative ways to develop marine plans that address local-scale marine management issues, such as food security and sustainable community-based economic opportunities. On the Central Coast of BC, MaPP Partners are continuing this place-based approach by developing and building on local youth and collaborative management programs to: develop a robust ecosystem-based management monitoring system, guide local economic development opportunities, monitor management effects on local ecosystems and communities; and adapt management and policy that better integrates indigenous knowledge and western science.

S-47: Synthesizing the extent and impacts of trawl fishing across the globe (10:00 - 12:00, Kerangas)

10:00 - Bottom trawl-fishing footprints on the world's continental shelves

Dr. Ricardo Amoroso[1], Dr. C.Roland Pitcher[2], Dr. Adriaan Rijnsdorp[3], Dr. Bob McConnaughey[4], Dr. Ana Parma[5], Dr. Petri Suuronen[6], Dr. Ole Eigaard[7], Dr. Francois Bastardie[7], Dr. Niels Hintzen[8], Dr. Franziska Althaus[9], Dr. Susan Baird[10], Dr. Jenny Black[12], Dr. Lene Bulh-Mortensen[13], Dr. Alexander Campbell[14], Dr. Rui Catarino[15], Dr. Jeremy Collie[16], Dr. James Cowan[17], Dr. Deon Durholtz[18], Dr. Nadia Engstrom[19], Dr. Tracey Fairweather[18], Dr. Heino Fock[20], Dr. Richard Ford[21], Dr. Patricio Galvez[22], Dr. Hanz Gerritsen[23], Dr. Jessica Gonzalez[22], Prof. Jan Geert Hiddink[24], Dr. Kathryn Hughes[25], Dr. Steve Intelmann[26], Dr. Chris Jenkins[27], Dr. Patrik Jonsson[28], Dr. Paulus Kainge[29], Dr. Mervi Kangas[30]

[1]University of Washington, [2]The Commonwealth Scientific and Industrial Research Organisation, [3]Institute for Marine Resources and Ecosystem Studies, [4]NOAA, [5]Cenpat, [6]LUKE, [7]National Institute of Aquatic Resources, [8]Wageningen IMARES, [9]CSIRO Oceans and Atmosphere, [10]National Institute of Water and Atmospheric Research, [11]GNS Science, [13]Institute of marine research, [14]Queensland University, [15]Marine Scotland Science, Marine Laboratory, [16]Graduate School of Oceanography, University of Rhode Island, [17]College of the Coast and Environment, [18]Department of Agriculture, Forestry and Fisheries of the Republic of South Africa, [19]Queensland Department of Agriculture, Fisheries and Forestry, [20]Thünen Institute, [21]Ministry for Primary Industries, [22]Instituto de Fomento Pesquero, [23]Marine Institute, [24]Bangor University, [25]School of Ocean Sciences, [26]National Marine Fisheries Service, [27]University of Colorado, [28]Department of Aquatic Resources, Swedish University of Agricultural Sciences, [29]Ministry of Fisheries and Marine Resources, [30]Western Australia Fisheries Department

Bottom trawl fisheries are an important source of seafood and employment, but the disturbance on seabed habitats and benthic communities occasioned by the gear is a major environmental concern. An ecosystem-based fisheries management thus requires a detailed assessment of the extent and spatial distribution of fishing activities. However, the intensity of trawling is often reported at a coarse spatial scale, which creates a distorted picture of the total area impacted by fishing. We quantified the bottom trawling footprint using high-resolution satellite Vessel Monitoring System (VMS) and logbook data on 24 continental shelves and slopes to 1000 m depth for the period 2008-2010 (with few exceptions). The trawling footprint was markedly different among regions ranging from less than 10% to more than 50% of the seabed area. In 18 regions, more than two thirds of the seabed was not trawled. The footprint area was very sensitive to the spatial scale of the analysis; in the most extreme case the footprint increased from less than 1% of the area on a 1 km2 cells grid to ~60% on a coarser grid of 100 km2 cells. Within the footprint fishing effort aggregated in areas intensively trawled. On average, 90% of the activity comprised 77% of the total footprint area. We found that the swept-area ratio (ratio of total swept-area trawled annually to the total area of a region) was a good predictor of the proportion of the seabed trawled, allowing estimation of regional trawling footprints when high-resolution spatial data are unavailable.

10:15 - Assessing bottom-trawling impacts based on the longevity of benthic invertebrates

Prof. Jan Geert Hiddink[1]

[1]Bangor University

Bottom trawling is the most widespread human activity affecting seabed habitats. Assessment and effective management of the effects of bottom trawling at the scale of fisheries requires an understanding of differences in sensitivity of biota to trawling. Responses to disturbance are expected to depend on the life-history, and in particular, the intrinsic rate of increase of populations, which is expected to be linearly related to the reciprocal of longevity. We examine the relationship between the longevity of benthic invertebrates and their response to trawling. We test whether longevity distributions of benthic communities can be used to predict their sensitivity to trawling impacts. for biota with a life-span >1yr, the depletion caused by a single experimental trawl pass was ~9%. The effect of bottom trawling in comparative studies increased with longevity of the organism, with a 2-3 times larger effect on biota living >10yr than on biota living 1-3yr. This is because recovery after trawling takes a few years for short-lived organisms but can take more than 10 years for long-lived organisms. The sensitivity of habitats to bottom trawling is, therefore, predicted to be higher in habitats harbouring higher proportions of long-lived organisms. Where the longevity distribution of a community can be inferred, the parameters of depletion and recovery rates estimated here can be combined with high resolution maps of trawling intensity to assess and manage trawling impacts. The conservation status of ecosystems can be improved by avoiding bottom trawling in areas with a high abundance of long-lived biota.

10:30 - Measuring change in a southern Benguela benthic ecosystem after cessation of trawling

Dr. Lara Atkinson[1], Dr. Colin Attwood[2], Dr. Charles Von Der Meden[1], Dr. Kerry Sink[3], Dr. Natasha Karenyi[2]

[1]South African Environmental Observation Network, [2]University of Cape Town, [3]South African National Biodiversity Institute

Offshore benthic biodiversity and ecosystem functioning are poorly understood in South Africa. Increasing anthropogenic and climate change pressures on deepsea ecosystems intensifies the urgency for research towards improved understanding of these habitats. Impacts of demersal trawling have been cited as one of the largest global anthropogenic sources of disturbance to the seabed and its biota. The implications of benthic disturbance resulting from South Africa's 100+ year-old hake trawl fishery, remains under debate. A previous study in the southern Benguela reported a greater impact on epifauna in heavily trawled areas than infauna however, representative untrawled areas were not available for comparison in this study. Trawling impacts are known to vary with habitat, gear type and trawling practice, necessitating a site specific experimental approach to quantify such impacts. A five-year 'press-and-release' experiment is currently underway that aims to measure changes in a southern Benguela outer shelf ecosystem, after portions of a 6 x 15 nm area were closed to trawl fishing. The baseline survey in 2014 showed that the habitat in the experimental area is largely homogenous, although depth appears to inĭňĆuence biota composition, validating the experimental design implemented. Changes in fish and epifauna are assessed visually using a towed camera, whilst infauna and sediment properties are quantified from grab samples. This experiment showcases an opportunity for long-term, co-operative research through collaborations between industry and scientists.

10:45 - Assessing the status of seabed habitats in trawled regions of the world.

Dr. C.Roland Pitcher[1], Prof. Jan Geert Hiddink[2], Dr. Tessa Mazor[1], Dr. Richard Amoroso[3], Dr. Simon Jennings[4], Dr. Adriaan Rijnsdorp, [5], Dr. Bob McConnaughey[6], Dr. Ana Parma[7], Dr. Marija Sciberras[2], Dr. Chris Jenkins[8], Prof. Michel Kaiser[2], Dr. Petri Suuronen[9], Dr. Jeremy Collie[10], Prof. Ray Hilborn[11]

[1]CSIRO Oceans and Atmosphere, [2]Bangor University, [3]School of Aquatic and Fishery Sciences, University of Washington, [4]ICES, [5]Institute for Marine

Resources and Ecosystem Studies, [6]NOAA, [7]Centro Nacional Patagónico, [8]University of Colorado, [9]Fisheries and Aquaculture Department, Food and Agriculture Organisation of the United Nations, [10]Graduate School of Oceanography, University of Rhode Island, [11]University of Washington

The impacts of bottom trawling on seabed habitats often are considered to pose serious environmental threats. Risk assessment can be used to evaluate these threats and to guide management regarding interventions needed to help meet sustainability objectives. We apply a simple quantitative method, applicable in data-limited situations, to assess seabed sedimentary habitats in 24 regions worldwide where bottom-trawl fishing occurs. The method estimates the relative benthic status (RBS) of the seabed: the amount of biota present, in equilibrium with bottom-trawling depletion, as a proportion of biota present without trawling. Estimating RBS for grid cells spanning a region requires few parameters: rates of recovery and trawl impact, and maps of fishing intensity and habitats. The overall status of regions is represented by the distribution of grid-cell RBS values and their mean, which are sensitive to trawling exposure and impact and recovery rates. Our assessment is currently a work-in-progress. Preliminary estimates indicate that most regional RBS values are greater than 90% (i.e. trawling has depleted regional biota by <10%) whereas few regions had RBS <70%. This assessment places trawling impacts in regional landscape perspective and provides world-wide comparisons for guiding management of environmental risks from trawling. A range of management interventions are possible to reduce these risks but may require trade-offs against food security priorities. Decisions about such trade-offs will vary among countries depending on the relative balance of environmental, social and economic priorities and costs of alternative interventions. RBS can assist by quantifying the environmental benefits of any alternative management strategies.

11:00 - Trawl exposure and protection of seabed fauna at large spatial scales

Dr. Tessa Mazor[1], Dr. C.Roland Pitcher[2], Dr. Wayne Rochester[3], Dr. Simon Jennings[4], Prof. Jan Geert Hiddink[5], Dr. Bob McConnaughey[6], Prof. Michel Kaiser[5], Dr. Ana Parma[7], Dr. Petri Suuronen[8], Dr. Mervi Kangas[9], Prof. Ray Hilborn[10]

[1]Commonwealth, [2]The Commonwealth Scientific and Industrial Research Organisation, [3]CSIRO, [4]ICES, [5]Bangor University, [6]NOAA, [7]Centro Nacional Patagónico, [8]LUKE, [9]Western Australia Fisheries Department, [10]University of Washington

Sustaining seabed fauna is critically important for marine ecosystem processes. We provide the most extensive assessment of the current trawl fishing exposure of benthic invertebrates across Australia's waters. This work responds to the global need to quantify and address the broad scale impacts of trawling on the seabed. We aimed to quantify trawl exposure and protection of benthic invertebrates at large-scales, including developing a method that integrates data from disparate seabed surveys to spatially expand predicted distributions. We incorporate data from 18 seabed surveys to map the abundance distribution of benthic invertebrates in 9 regions within Australia's Exclusive Economic Zone. Our approach combines disparate benthic surveys and uses Random forests to predict taxa group distributions from environmental variables. Exposure and protection are quantified by overlapping predicted abundance distributions of benthic invertebrate groups with maps of trawl-footprint, marine reserves and fishery closures. We found that more of Australia's EEZ is currently protected from trawling (58%) than exposed (<5%). Across all regions, 96% of benthic invertebrate groups had greater abundance protected than exposed to trawling. The mean exposure of benthic invertebrate abundance to trawling was 7%, compared to mean protection of 38% - further, 55% was neither exposed nor protected. This study is widely applicable elsewhere and for a range of other taxa, helping decision makers: identify taxa and regions that are at higher risk of disturbance, determine the effectiveness of current protection measures, and guide the placement of future protection measures. Such analyses can help managers achieve more sustainable marine ecosystems.

11:15 - Quantifying benthic impacts and recovery from trawling; developing a risk assessment tool for the Marine Stewardship Council

Dr. Jenny Shepperson[1], Prof. Jan Geert Hiddink[1], Dr. Michel Kaiser[1]

[1]Bangor University

Trawling can be a damaging fishing practice, but considering its importance for global food security we need to balance environmental conservation with food provision. We are developing a tool to quantify and assess the benthic impacts of trawling against a defined conservation objective. The Marine Stewardship Council recognises and rewards sustainable fishing practices, through its global certification and eco-labelling program; this tool is being developed primarily to help assess fisheries against the MSC Standards for eco-certification. The tool applies a simple risk assessment method to estimate the status of seabed habitats. The relative benthic status (RBS) of seabed habitats is calculated using a grid cell approach; the resulting distribution of RBS scores across the area indicates the overall status of a habitat or region. The predicted time to recover to a threshold RBS score indicates the sustainability of the fishery. To calculate RBS with the tool, users input maps of fishing intensity and habitat type. Depletion and recovery parameters can be derived from a global meta-analysis of trawling studies, or related to the penetration depth of a fishing gear. The tool requires relatively few parameters and thus may be applicable in data-limited fisheries. A data degradation exercise has illustrated how the perceived benthic impacts of a fishery can be sensitive to the data inputs (e.g. habitat data resolution). We also need to understand the sometimes-counterintuitive incentives that may be unintentionally created with such a tool. These represent important considerations when developing tools to assess fisheries against a common standard.

11:30 - Path to sustainable trawl fishery in Southeast Asia

Dr. Petri Suuronen[1]

[1]LUKE

Trawl fishing constitutes an important part of the marine fisheries sector in SE Asia. It provides livelihoods and food for millions of people in coastal communities as well as feed for the region's growing aquaculture sector. Trawl fisheries, as all nearshore fisheries in the region, are poorly managed and reported in terms of effort and catch, and are characterized by overcapacity and low profitability. The decreasing average size of landed fish, increasing share of low-value species in catches, declining cpue, and serious user conflicts reflect the excessive fishing effort and poor resource utilization patterns. The high diversity of fisheries and species composition, and the poor enforcement capacity, makes management extremely challenging. Addressing the management problems of these fisheries needs to take into account the poverty and food security context as well as the complex cultural and institutional features in the region. Key characteristics of SE Asian trawl fisheries are described and the fundamental barriers are addressed to improve trawl fisheries management in the region. The best management practices are identified and recommendations are provided to achieve more sustainable fisheries. Policy and institutional changes are inherently time-consuming in the SE Asian context. A participatory approach is recommended noting that simple, robust and easily enforced measures are likely to work best in such

a complex environment. finally, its is stressed that all key fisheries must be managed; management of trawl fishing only will not enable a sustainable nearshore fishery in the region.

Focus Group: Mapping Priority Areas for Marine Conservation Part (12:00 - 13:50, Kabu

Dr. John Cigliano[1], Prof. David Johns[2], Prof. Chris Parsons[3]

[1]Cedar Crest College, [2]Portland State University, [3]George Mason University Fairfax

Research has shown that Marine Protected Areas (MPAs), and especially no-take and adequately staffed and funded MPAs, work to safeguard and recover marine species and ecosystems. Many marine scientists have argued that at least 30 per cent of the global ocean needs to be in such reserves, including both high seas and national waters. To be effective, however, it must be the right 30 percent, representing all ecosystems in all biogeographic regions, and taking into account special elements and foreseeable anthropogenic impacts. Identifying that 30 per cent or more is an important initial step in putting MPAs in place. Conservation resources are limited and the forces diminishing ocean life and health are great. This focus group will bring together experts at the conference, and others by electronic means as possible, to create and begin to carry out a strategy for identifying MPA locations and connectivity. Prior to the focus group the organizers will bring together existing data on, e.g. EBSA's (ecologically or biologically significant marine areas), and provide this information to prospective attendees as well as an agenda for the focus group. The focus group will be open to conference attendees, as well as invited experts from every marine region.

Communication Workshop Part 1: Communicating Your Science (12:00 - 13:30, Tubau 1

Ms. Heather Mannix[1]

[1]COMPASS

Conservation scientists have a tremendous amount to contribute to solving today's most pressing problems. As both the need and the opportunities to communicate scientific information to different audiences increase, it can be difficult for scientists to know exactly how and where to engage most effectively. Grounded in the latest research on science communication, this two-part, hands-on workshop is designed to help scientists build their communication skills, understand paths to engagement and make their science matter to the audiences they most want to reach. Participants may take either Part I, Part II or both. In Part I, "Communicating your Science," participants will learn to share what they do, what they know - and most importantly, why it matters - in clear, lively terms, using a tool called the Message Box. Participants will be introduced tools and strategies to help you communicate and distill what you know and why it matters for different audiences. This workshop will involve hands-on practice, feedback and an interactive exercise practicing your "elevator pitch." In Part II "Becoming an Agent of Change," participants will learn the components of successful science engagement, and explore their own avenues to engagement. They will receive an introduction to, and practice with, tools and frameworks for developing a personal plan for bringing about change through their work. Previous experience with the Message Box is recommended for this workshop.

Workshop: Conservation communication: building effective and productive relationships with science communicators and the media.

Ms. Katie Walters[1], Mr. Matt Tietbohl[2]

[1]The Society for Conservation Biology Marine Section, [2]King Abdullah University for Science and Technology

The importance of science communication has been known for decades, but communication needs to be effective to be successful. Some scientists don't have the time, skill or inclination to be "science communicators" as well. This workshop will ask the professional "intermediaries" -journalists or professional science-communicators - what their role entails, and how scientists can work with them to spread the right messages in the right place, to achieve marine conservation goals.

Science communication professionals, journalists, editors, and communication-savvy scientists will speak on the importance of understanding and selecting the right outlet for your marine conservation message. Long-form, short-form, interviews, podcasts, narrative and illustrative storytelling - what works, where does it work, and why?

The workshop will also address framing a message, building relationships with media and publications, and give tips for working with the media (antagonistic and friendly).

The workshop will end with a question-and-answer session.

OS-2A: Participatory Marine Conservation 1 (13:30 - 15:30, Tubau 1)

13:30 - Evidence of citizen science contributions to coastal and marine conservation outcomes: A synthesis across projects

Prof. Heidi Ballard[1], Dr. John Cigliano[2]

[1]Heidi Ballard, [2]Cedar Crest College

Amidst the wicked problems the marine conservation field is facing, we are also equipped with an old but newly powerful tool that may yet help track and address these problems, in the form of citizen science. from crowdsourcing apps that allow beach visitors to track marine litter in Chile, to intensively trained volunteers identifying beached birds, to community science projects co-created by fishers in Micronesia, coastal and marine citizen science as a field is burgeoning in scope, scale, and diversity of projects around the world. In this presentation, we examine multiple cases of the wide range of marine and coastal citizen science programs, documenting the ways each project contributes scientific information used for conservation research and natural resource management, as well as educational, community development, and policy outcomes. We synthesize the experiences and lessons across cases to identify, 1) the circumstances under which citizen science is effective for marine and coastal conservation (e.g, which ecosystems, human communities, conservation needs, kinds of research questions), 2) the key considerations in designing marine and coastal citizen science programs, and what strategies and approaches have been effective in addressing them?, and 3) lessons for the future of marine and coastal conservation, and the role of citizen science? An overarching lesson from these cases is that citizen science can be a unique and effective approach to addressing conservation science questions, but should be thoughtfully designed and applied to carefully evaluated situations; citizen science is not a silver bullet, nor is it a one-size-fits-all endeavor.

13:45 - Empowering communities in conservation: A participatory mapping apprach for coastal contexts

Ms. Pia Harkness[1]
[1]*Charles Darwin University*

Research shows that in low-income settings, the likelihood of marine protected areas (MPAs) to deliver either social or ecological benefits depends on effective participation of local communities from the very outset. The spatial nature of protected areas means that participatory mapping is an ideal tool for participation processes. Used equitably, it can empower communities, elevate local knowledge and needs in the design phase, and open dialogue between practitioners and communities when discussing potential boundaries and their impacts. However, technological and skills requirements have prevented local practitioners from using this powerful tool, resulting in a situation when mapping is controlled by outside experts, and communities often lose control of their local knowledge. In this paper I outline an accessible participatory mapping method for visualising and understanding community use and value of marine resources. The relatively low-tech approach, which can be done using standard computers, free software and basic GIS skills, helps to overcome some of the more common barriers to participatory mapping for local facilitators. When combined with livelihood information, these maps provide a powerful insight into the importance and diverse value and benefits of marine areas for coastal livelihoods. In fishing communities where this approach was implemented it was reported that the maps made people feel empowered to negotiate with government about decisions which affect their fishing activities. Bringing communities into the conservation conversation from the beginning improves the likelihood that they will be supportive, which in turn improves the likelihood of positive ecological and social outcomes from MPAs.

14:00 - A tangled net: Counterproductive conservation pathways in the case of vaquita (Phocoena sinus) conservation

Dr. Tara Sayuri Whitty[1], Prof. Samantha Young[2], Ms. Areli Hernandez[3], Ms. Veronica Y. Vargas[3]
[1]*International Union for Conservation of Nature,* [2]*San Diego Zoo Global,* [3]*Independent Consultant*

The plight of the vaquita (Phocoena sinus) in the Upper Gulf of California is one of the highest profile cases of marine mammal bycatch. The main threat to this Critically Endangered species has been bycatch in gillnets for shrimp fisheries (a vital livelihood for local communities) and the illegal totoaba fishery. However, conservation actions, including a gillnet ban with a compensation scheme for fishers, set pathways into motion that likely impeded conservation. Using scenario analysis, we interviewed diverse stakeholders - fishers, community members, government agencies, conservation groups, researchers - about the process, impacts, and possible future outcomes of vaquita conservation. In particular, we elicited perceptions on two proposed future scenarios, one where the gillnet ban continues, and one where it ends. Applying a logic model approach, we evaluated pathways from conservation actions to outcomes reported by respondents. We identified possible intervention points where these pathways could be transformed for more desirable outcomes for conservation and communities. Conservation actions have not matched the situation's complexity, leaving underlying problems unmitigated while exacerbating stakeholder conflict. Key gaps include lack of: oversight in the compensation program; support for communities transitioning from gillnet-based livelihoods; and meaningful inclusion of communities. Potential productive pathways, where vaquita conservation could have been an opportunity for positive social-ecological outcomes, include collaborative efforts to end the totoaba fishery and address social-ecological needs through participatory research, partnerships across sectors, and investment in social and ecological issues beyond the vaquita. This holds important lessons for the worldwide threat of bycatch in small-scale fisheries.

14:15 - Using local knowledge to inform community-led marine protected area development and management in Cambodia

Mr. Phallin Chea[1], Ms. Rylida Vong[1], Ms. Marianne Teoh[1]
[1]*Fauna & Flora International*

Understanding local users' views is crucial for effective design and management of marine protected areas (MPAs), especially during the development of zoning and management plans. Koh Sdach Archipelago is being considered as a site for the establishment of a MPA in Cambodia, building on the nationâĂŹs recent momentum for MPA establishment. Currently, the archipelago is locally managed marine area managed named as Koh Sdach Community Fisheries (CFi). Most of CFi members are small-scale (family-scale) fishers who depend heavily on fisheries resources for their daily consumption. The study investigated the potential areas within the CFi boundary for potential conservation zones, fisheries refugia, recreational zones and fishing zones and identified areas threatened by human activities. Structured interviews conducted with 30% of the population indicated that the main fishing areas used by the local people are located inside Koh Sdach CFi, nearby the islands. There were some conflicting areas between fishing area (small and medium scale fishers), conservation and potential recreational areas and among potential areas for different kinds of protection and management purpose. Drawing from these results, it is important that zoning is carefully designed based on priority areas for fishing, conservation and recreation to meet the needs of the local population. In addition, ongoing and inclusive consultation with all relevant local resource users must continue to minimize conflict. This data will be combined with existing biological survey data to design a practical and adaptable management plan for the site that is based on both scientific and local knowledge.

14:30 - Institutional Arrangements and Governance in Coastal Indigenous Communities in the Philippines

Dr. Maria Rebecca Campos[1]
[1]*University of the Philippines Open University*

This study evaluated the capability of the local institutional mechanisms in the implementation of various fisheries policies in the Philippines in indigenous coastal communities using the Structure, Systems, Style, Staff, Skills, Strategy, Superordinate Goal (7S) McKenzie framework; and Strengths, Weaknesses, Opportunities, Threats approaches. These organizations are mandated to perform developmental and/or regulatory functions on fisheries. The developmental function consists of carrying out fisheries related projects to improve the lot of the fishermen. Except for one, they are all involved in the implementation of projects for the fisher folk. The regulatory function consists of monitoring the conduct of fishing activities and apprehension of those caught committing fishing violations. While most institutions are involved in monitoring fisheries activities, only one has police power to apprehend violators. Despite the mandate, all mechanisms are constrained by limited physical, financial and manpower resources. While membership to institutions is highly representative of the fishing sector, members are not really prepared to perform functions expected of them. One institution is able to keep its manpower complement because it is a regular department of the local government unit. Operations of one institution ceased after a few months of activity. This study recommends that the institutional

mechanisms should perform for the welfare of the fishermen through the development of an M & E system to monitor compliance to fisheries policies anchored at the village level. It also proposes the provision of proper education and training to members of institutions.

14:45 - Citizen Science: Involving local communities and citizens into marine mammal research and conservation using mobile App in Cameroon.

Mr. Ngafack Rodrigue[1], Mr. Kamla Aristide[1]
[1]*African Marine Mammal Conservation Organization (AMMCO)*

There are very limited available data on marine mammals in Cameroon as aquatic research requires enormous resources and skills which are absent in most low income countries. Without an effective monitoring system the populations might go under a stealthy extinction. In our first attempt to cost effectively address the data scarcity, we established in 2012 the Siren network of about 30 fishermen along the Cameroon coast that has been successfully reporting on marine mammal sightings and carcasses using datasheets and phone calls. However this report system was time consuming and bore less accuracy and details as it did not provide ways for reporting on GPS locations, time, dates and eventual pictures for identification purposes. The objective of Siren App is to empower fishermen to easily and quickly collect more accurate data including Date, time, GPS location, species photo, species name, number seen, habitat, behavior, animal life status, weather status and effort and remotely send them over a server to be automatically analyzed and shared for view with public and decision makers on our interactive web map (http://www.ammco.org/index.php/template/add_sighting) as soon as the user's phone is connected to internet. Smartphones with integrated Siren App were distributed to 20 fishermen. To date, more than 300 sightings including several species of whales, dolphins, marine turtles and sharks and ray has been clearly reported in Cameroon using SIREN App. Confirmed collected data will provide reliable information on the distribution and trends of the populations. furthermore, identified hotspots will be used for ecotourism and education purposes.

15:00 - Sea Turtle as marine conservation efforts in Bangladesh

Mr. Mohammad Islam[1], Mr. Abdul Wahab Akonda[1]
[1]*Marinelife Alliance*

In Bangladesh Marinelife Alliance is conducting monitoring and conservation of marine megafauna including sea turtle, cetacean, sharks and coral habitat restoration. Under the sea turtle program this is an integrated efforts to save other marine megafauna species within the effort through community people including offshore fishermen. The program has been supported by internationals organization and Bangladesh government. The sea turtle program activities are nesting turtle monitoring, threat reduction and mitigation, community awareness, education, beach protection, nesting beach restoration, advocacy, bycatch reduction, fishermen training for offshore bycatch monitoring, and safe release at sea. Migration, movement and foraging habitat study are being conducted by satellite tracking and also by VHF radio tracking. Beach temperature being monitored by dataloggers that helping us tracking climate change activities. The efforts are spread over the last 20 years along the whole Bangladesh coast including 400kms of sandy beach where sea turtle are come to nest. 50-70 community people are engaged for nightly observation on the nesting turtle and for their safety while nesting on beach. this huge manpower also help monitoring and conservation of other key marine and coastal species viz., cetacean, sea birds and shorebirds and whale sharks.

15:15 - How does the diversity of divers affect the designing of citizen science projects?

Ms. María Isabel Hermoso Beltrán[1], Dr. Stefan Gelcich[2], Dr. Wolfgang Stotz[1], Dr. Martin Thiel[1]
[1]*Universidad Catolica del Norte,* [2]*Pontificia Universidad Católica, Center of Applied Ecology and Sustainability*

In Chile a large number of divers from all over the country are actively diving for multiple purposes (fisheries, recreation, instruction, installations, research). Understanding differences among these diverse types of divers is crucial to design more inclusive citizen science projects. Recreational specialization theory has been used to explain changes in the perceptions, preferences, and behaviours of different types of divers according to their level of expertise in diving (LED). This variability among divers might also result in differences in their potential (ability and willingness) to participate in citizen science projects. The LED and potential for participating in citizen science projects were evaluated through a survey of 228 divers between Arica and Chiloe (Chile). An elevated level of interest in participating in citizen science projects was detected among all types of divers who share same motivations to participate. However, significant differences were detected between divers in terms of their level of expertise in diving, with recreational divers being less specialized. Divers also preferred different methods of participation: artisanal divers and spearfishers prefer not to involve extra activities during the dive, while recreational divers and instructors show greater interest in performing underwater sampling, dedicating part of the diving time to these new activities. Results of this study suggest that differences between types of divers (at the level of its LED) may determine their preferences to participate in citizen science projects. This finding should be taken into account when designing citizen science projects.

OS-2B: Marine Conservation Planning 1 (13:30 - 15:30, Tubau 2)

13:30 - Global marine protected area establishment largely avoids abatable threats to biodiversity

Ms. Caitlin Kuempel[1], Mr. Kendall Jones[1], Prof. James Watson[1], Prof. Hugh Possingham[2]
[1]*The University of Queensland,* [2]*The Nature Conservancy*

The world is rapidly expanding its system of marine protected areas, with a 513% increase in marine protection since 1990. In many cases, the benefits we receive from protected areas are still unclear because we do not know the counterfactual, or what would have happened in the absence of protection. While some contend that we should be protecting the most threatened areas (reactive approach), others maintain that we need to protect the last of the remaining large, intact landscapes (proactive approach). In the marine realm, the dichotomy between reactive and proactive protection has received considerably less attention. There has been criticism of the continued designation of large, isolated protected areas; however, the degree to which marine protected areas are targeting or avoiding threats that marine protected areas can abate in the sea has yet to be quantified. We assess this question by investigating the relationship between marine protected area establishment and 'stoppable' threat level in recent years. In doing so, we identify the dominant marine conservation priority

approach, unveil general patterns in marine threats and protection, and discuss what this could mean in terms of adequacy and biodiversity conservation in the world's oceans.

13:45 - Planning for the future: A broad-scale risk assessment of multiple anthropogenic threats to flatback turtles.

Dr. Sabrina Fossette-Halot[1], Mr. Graham Loewenthal[1], Dr. Tony Tucker[1], Mr. Florian Mayer[1], Dr. Scott Whiting[1]

[1]Department of Biodiversity, Conservation and Attractions

Long-term conservation planning of threatened, long-lived migrating marine species such as marine turtles is challenging. The North West Shelf Flatback Turtle Conservation Program (NWSFTCP) is one of the largest biodiversity offset programs in Australia and aims to increase the conservation of flatback turtles through research and monitoring, intervention, education and communication over 30 years. An eight-day aerial survey revealed that flatback turtles nest on more than 150 islands on the North West Shelf of Western Australia and on large extents (i.e. 100s km) of the mainland coastline making the management of this stock even more challenging. Although parts of their nesting range remain pristine, there are substantial overlaps with multiple human activities such as large ports, oil and gas exploration, extraction and processing and other urban development. For long term strategic planning that ensures effective species management and accountable use of government funds it is essential to prioritise management actions within a transparent framework. Fundamental to this is to understand and evaluate pressures acting on key areas of the life history of a species within a risk assessment framework to highlight vulnerabilities within current and future scenarios. We used the InVest Species Risk Assessment model to quantify the cumulative impacts of human-use stressors on flatback turtle rookeries in Western Australia. Key components of the model included turtle nesting density, level of impact on eggs, hatchlings and nesting turtles and assessment of multiple and cumulative pressures through space and time.

14:00 - Key-attributes in improving Gili Matra MRP management

Mr. Sukmaraharja Aulia Tarigan[1], Ms. peni lestari[2], Mr. Sebastian Aviandhika[1], Ms. Aldhila Yulistianti[1], Mr. Bobby Adirianto[3], Mrs. Hotmariyah Merry[3]

[1]Wildlife Conservation Society - Indonesia Program, [2]wi, [3]West Nusa Tenggara Marine and Fisheries Agency

Gili Matra Marine Recreational Park (MRP) is a marine protected area in West Nusa Tenggara Province, Indonesia with 2.954 ha and established in 2009 by the Ministry of Marine and Fisheries Affairs Decree Number 67/MEN/2009. To evaluate the effectiveness of Gili Matra MRP, we examined the coral reef ecosystem and socio-economic attributes from 2012, 2016 and 2017. In general, fish biomass and hard coral cover decreased by more than 10% in 2016 compared with 2012. In contrast, based on the asset ownership, there was an improvement in lifestyle score in 2017 and 2012. The average score of wellbeing in 2017 was higher when compared to 2012. The level of respondents' knowledge associated with management rules was quite high. Fisher respondents are aware of fishing rules that prohibited non-selective/destructive fishing gear. Meanwhile the visitor respondents were unfamiliar with zoning system. These results indicate that anthropogenic factors and natural factors by global warming was the most likely causing ecosystem degradation in Gili Matra. This study conducted to improve the management of Gili Matra MRP, including managing the existence of herbivore fish, building coordination with local governments to reduce waste disposal, limiting number of visitors, applying entry fee and promoting conservation awareness to the visitors.

14:15 - Life History, Growth, and Reproductive Biology of Four Mobulid Species in the Bohol Sea, Philippines.

Mr. Joshua Rambahiniarison[1], Ms. Mary Jane Lamoste[1], Dr. Christoph Rohner[2], Mr. Ryan Murray[1], Ms. Sally Snow[1], Ms. Jessica Labaja[1], Mr. Gonzalo Araujo[1], Dr. Alessandro Ponzo[1]

[1]Large Marine Vertebrates Research Institute Philippines, [2]Marine Megafauna Foundation

In light of the global decline of mobulid populations and the necessity for non-detriment findings, baseline data for population dynamics were collected from a targeted fishery in the Bohol Sea, Philippines. This study focused on life-history parameters and reproductive cycles of four mobulid rays (Mobula thurstoni, Mo. japanica, Mo. tarapacana, and Manta birostris), and re-estimated their intrinsic population growth rates. Size and reproductive data were collected from 1,509 specimens (30% of catch) landed in two seasons in 2015 and 2016. Size-at-birth was reviewed, and analysis of the embryos and follicles did not suggest a clear reproduction cycle, but supported an interbreeding interval. Females of all species matured at a larger size than males, and exhibited a larger size-at-pregnancy than -at-maturity. This delay in reproduction resulted in population growth rates lower than the actual rmax when based on size-at-pregnancy (rmat rmax=0.016-0.055 year-1 and rpreg=0.008-0.044 year-1), and a population doubling time of 15.8-86.6 years (44.6$\pm$10.5, mean$\pm$s.e). This study suggests that population growth rates previously reported were overestimated. In light of the CITES and CMS assessments, while fisheries management should reflect the delayed maturation of these species and the slower population growth potential, at the current status of these population, the sustainability of any exploitation level seems unrealistic and strongly discouraged.

14:30 - An assessment of sea turtle hatchery management practices in India

Prof. Andrea Phillott[1], Ms. Abhidnya Unhale[2], Ms. Nupur Kale[3]

[1]FLAME University, [2]Pune, Maharashtra, [3]Dakshin Foundation

In situ incubation of sea turtle nests is preferred but threats, including poaching, predation, and habitat loss, can require eggs to be transferred to a hatchery as an ex situ conservation strategy. However, hatchery management practices that do not result in high hatchling productivity will negate the potential benefits of incubating eggs in a secure environment. Using a mixed-methods approach (review of published literature about hatcheries and interviews with hatchery personnel) to describe hatchery productivity in terms of number of eggs or nests protected and hatching success, we present detailed descriptions of hatchery infrastructure and practices for handling, transporting and incubating eggs, and holding, rearing and releasing hatchlings from hatcheries in India. Factors most likely to contribute to conservation of sea turtles in India, and those with a potentially negative impact upon hatching success and hatchling survival, are identified. Strategies to improve hatchery management practices and mitigate the potential impacts of climate change are reviewed and targets for hatcheries are proposed so as to ensure high productivity and hatchling sex ratios that will contribute to the effective conservation of leatherback, green, hawksbill and olive ridley sea turtles in the region. The strategies and targets discussed will be applicable to sea turtle hatcheries worldwide.

14:45 - A multidisciplinary approach to detect and improve management of potential Vulnerable Marine Ecosystems in South Africa

Ms. Mari-Lise Franken[1], Dr. Kerry Sink[2], Dr. Lara Atkinson[3], Dr. Jock Currie[1]

[1]Nelson Mandela University, [2]South African National Biodiversity Institute, [3]South African Environmental Observation Network

South Africa's marine territory spans the Atlantic, Indian and Southern Ocean, with the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) advancing mapping of Vulnerable Marine Ecosystems (VMEs) in the sub-Antarctic territories since 2007. Efforts to designate VMEs in the mainland ocean territory have lagged due to inadequate data, taxonomic expertise and experience. It has been widely recognised that a major limitation to the effective management and protection of these fragile ecosystems to date, is the uncertainty in their distribution. This study followed a multidisciplinary approach to identify potential VMEs in South Africa. We applied the 2009 Food and Agriculture Organization of the United Nations (FAO) scientific guidelines for identifying VMEs, drawing from available national datasets including bathymetric, geological, sediment, fisheries and biodiversity data. Ten potential VME habitat types were identified within our Exclusive Economic Zone including features likely to host VMEs and potential VMEs identified from indicator taxa. Twenty-four potential indicator taxa were identified. Museum records and 8 years of invertebrate trawl bycatch data were analysed for this latter component. In addition, more than 350 visual surveys from 8 research projects, spanning the 50-600m depth range, along the South African coast were analysed to identify potential VMEs. These approaches show how limited data can readily be applied to advance identification of potential VMEs. This work has been applied in the advancement of South Africa's National Habitat Map; the identification of EBSAs, Marine Protected Area Planning and other work to support the meeting of fisheries eco-certification conditions.

15:00 - An Insurance Policy for Marine Biodiversity based on MPA Effectiveness Science: The Global Ocean Refuge System (GLORES)

Dr. Sarah Hameed[1], Dr. Lance Morgan[1], Prof. David Johns[2]

[1]Marine Conservation Institute, [2]Portland State University

Marine protected areas (MPAs) are effective conservation tools that can rebuild populations from exploitation, recover habitats from damage, and increase ecosystem resilience when designed well and managed effectively. However, the rich scientific literature on MPA effectiveness does not typically guide MPA design and implementation, leading to variable MPA effectiveness and poor ecosystem representation in MPAs globally.Over 15,000 designations currently meet the International Union for the Conservation of Nature (IUCN) definition of marine protected area, yet only 2% of the ocean is strongly protected. This coverage reflects two challenges - we need to improve the quality of MPAs and accelerate the implementation of effective MPAs to meet the Aichi 11 target of the Convention on Biological Diversity and goal 14.5 of the Sustainable Development Goals that aim for 10% MPA coverage by 2020. The Global Ocean Refuge System (GLORES) is a strategic initiative of Marine Conservation Institute to build a connected representative network of MPAs that effectively safeguard marine biodiversity. MPAs that meet science-based standards and contribute to the representivity and connectivity of GLORES are awarded Global Ocean Refuge status. GLORES will ensure that the ocean protections countries claim to have are truly making a difference for marine wildlife. Global Ocean Refuges are well-designed, employ effective management that engages the local community, strictly regulate destructive activities, and garner high rates of compliance. GLORES provides a comprehensive strategy to scale up existing marine conservation efforts and assemble a network of Global Ocean Refuges that protect biodiversity throughout the global ocean.

15:15 - Low seabird and marine mammal occurrences densities in the Bay of Bengal, despite intense marine productivity and longline fishing activity

Mr. Ravichandra Mondreti[1], Dr. Priya Davidar[1], Prof. Peter Ryan[2], Dr. Jean-Baptiste Thiebot[3], Dr. David Gremillét[4]

[1]Pondicherry university, [2]University of Cape Town, [3]National Institute of Polar Research, [4]CEFE-CNRS

At-sea observations of seabirds and marine mammals provide essential baseline information with respect to their biogeography and behaviour, facilitating marine spatial planning and management. Most of the world's oceans have been charted, yet some regions remain particularly data-poor. This is the case for, including the Bengal of Bengal, despite being a highly productive upwelling area potentially harbouring a guild of marine birds and mammals. We performed 39 days of vessel-based observations across the Bay of Bengal in 2012-2014. We recorded 17 species of seabirds, and at least seven eight species of marine mammals. Among the sea birds, were Sooty Terns (Onychoprion fuscatus, 87% of all birds) and Wedge-Tailed Shearwaters (Ardenna pacifica, 9%) predominated, and whereas most marine mammals were Spinner Dolphins (Stenella longirostris, 59%) and Indo-Pacific Bottlenose Dolphins (Tursiops aduncus, 34%). The diversity of both birds and mammals was low compared to other tropical areas, despite this area being one of the most productive marine regions. We speculate that low top predator abundances result from long-lasting disturbance and the virtual absence of suitable reproductive breeding habitats for seabirds, coupled with overfishing of key seabird and marine mammal prey, in particular small pelagic fish.

OS-2C: Fisheries and Aquaculture 2 (13:30 - 15:30, FJ Auditorium)

13:30 - Commercially exploiting deep sea sharks for oil in Sri Lanka - a new threat on the horizon for sharks?

Ms. Rosalind Bown[1], Mr. Gobiraj Ramajeyam[1], Mr. Akshay Tanna[1], Mr. Daniel Fernando[1]

[1]Blue Resources Trust

The bathymetry of Trincomalee Harbour in eastern Sri Lanka, containing submarine canyons, has enabled a seasonal artisanal bathydemersal elasmobranch fishery, supplying the international shark liver oil trade. The oil is utilised in shark liver oil tablets, poultry feed and aquaculture feed. Following extraction from livers via melting, the oil is transported to a production facility for purification where three oil quality grades of distinct density ranges are produced, each from livers of specific shark species. Preliminary morphometric data, identification photographs, sex ratio, maturity data, and tissue samples are being collected on the species landed in this fishery. Species sampled in Mutur (n=58) over 6 days include Centrophorus atromarginatus, Echinorhinus brucus and Neoharriotta pinnata, listed as Data Deficient on the IUCN Red List; Centroscymnus coelolepis and Hexanchus griseus, listed as Near Threatened on the IUCN Red List; sharks from the genera Iago, Mustelus and Planonasus; and skates from the genus Dipturus. Additionally, deep sea specimens sampled 100 kilometres south in Valaichchenai (n=51) over 87 days include Pseudocarcharias kamoharai, sharks from the genus Iago and skates

from the genus Dipturus. Genetic samples are being sequenced to confirm species. The relatively short holding time of landed specimens will facilitate detailed studies of their feeding habits through stomach content analysis. Shark breeding grounds potentially exist on Sri Lanka's east coast given observations of pregnant female sharks and from fishers' anecdotal evidence. The data collected will facilitate the evaluation of their population status and help ascertain the sustainability of this fishery.

13:45 - The influence of multiple stressors on the spatial distribution of corals

Dr. Jennifer Selgrath[1], Dr. Amanda Vincent[2], Dr. Sarah Gergel[3]

[1]Project Seahorse, University of British Columbia/ Stanford University, [2]Project Seahorse, University of British Columbia, [3]University of British Columbia

Coral reef ecosystems are widely threatened, but the influences of many stressors have proven difficult to quantify particularly when the intensity of stressors varies over space and time. Here, we evaluate how long-term fishing effort, human population density, and marine reserves interact with biophysical and seascape variables to influence the spatial distribution of corals in a biodiverse, but heavily impacted ecosystem. We focus on corals because coral cover is a widely used metric of reef health. By integrating high spatial resolution satellite imagery, participatory mapping, and hierarchical modelling we show that historical fishing effort and population density had a negative, synergistic effect on the probability that an area supported living corals. However, the effects of fishing exhibited a ten year lag suggesting long-lasting, indirect effects of fishing pressure on corals. The probability that an area supported living corals increased with depth, patch size, and protection, but the effect of protection was highly variable. Overall, the strongest influence on coral distribution was the spatial arrangement of habitats. By successfully integrating local environmental knowledge and satellite-based mapping, we demonstrate an opportunity for monitoring the effects of stressors on coral reefs at the scale of ecosystems. These relationships offer guidance for conservation including managing ecosystems to optimize beneficial seascape characteristics, reducing the spatial overlap of synergistic stressors, and ensuring that conservation programs address stressors that accumulate slowly.

14:00 - Deliberate transformation of fishery social-ecological systems: The Bahamas spiny lobster fishery improvement project experience

Mrs. Kendra Thomas Travaille[1], Dr. Jade Lindley[2], Dr. Larry Crowder[3], Dr. Julian Clifton[4]

[1]UWA Oceans Instutite, The University of Western Australia, [2]School of Law, The University of Western Australia, [3]Hopkins Marine Station, Stanford University, [4]School of Agriculture and Environment, University of Western Australia

Many fisheries have become trapped in patterns of unsustainable use and require significant change to be reset on new a trajectory towards sustainability. Here, we explore how certification programs, using fishery improvement projects (FIPs), can drive transformative change in fishery social-ecological systems using a case study of The Bahamas spiny lobster fishery. Specifically, we evaluate how the FIP process aligned with the four phases of social-ecological transformation and, using outcomes from The Bahamas, assess the poential for this model to create lasting change. To understand The Bahamas lobster FIP process, we undertook a detailed literature review of FIP activities and conducted semi-structured interviews with 40+ stakeholders across The Bahamas. We qualitatively analysed all documentation and interview notes, structuring our analysis around the social-ecological transformation framework (Moore et al. 2014). We found that market incentives for certification played a key role in creating transformative change in the fishery. Specifically, market demand for certified lobster necessitated improvements in fishery performance and created a window of opportunity for industry members to initiate change. The FIP model facilitated improvements by establishing a structure for implementing and monitoring change and creating a forum for collaboration. Despite the adoption of new practices and ideas, at the project's completion the fishery had yet to institutionalise its new trajectory. In order to build resilience, the fishery requires additional work, e.g. expanding activities to other islands (scaling-up the changes) and formalising the new governance arrangements (routinizing new practices).

14:15 - Paradoxical advantages and disadvantages of dive fishing for achieving holistic sustainability

Ms. Hannah Bassett[1], Dr. Edward Allison[1]

[1]University of Washington

Diving using compressed air technologies, such as SCUBA or hookah, allows for selective and efficient harvest of high value benthic species. These characteristics make dive fishing a strong candidate for achieving economic, ecological, and social sustainability. Despite several examples of sustainable dive fisheries, others have experienced negative effects including over exploitation of benthic resources and labor, and high levels of diver morbidity and mortality. Through a qualitative review of dive fisheries in the peer-reviewed and grey literature I compare the benefits and drawbacks of dive fishing for achieving sustainability as compared to alternative methods for harvesting benthic resources, namely breath-hold diving and boat-based gear, such as dredging, tonging, and trawling. While all fishing types operate at varying levels of sustainability in different contexts, I posit that inherent qualities of dive fishing predispose it to occupy extreme ends of the sustainability spectrum. The results of my study suggest that dive fisheries have potential for great risk, but also great reward. The paradoxical social, ecological, and economic effects of dive fisheries highlights the need for increased attention to this type of fishery.The advantages and disadvantages of dive fishing for system sustainability vary depending on the alternative harvest type to which it is compared. Yet, dive fishing presents greater physical risk to fishers and allows for more effective harvest of rare and endangered species. Here I present the benefits and drawbacks of dive fishing for holistic sustainability of benthic resource harvest and discuss implications for management considerations and research objectives moving forward.

14:30 - Predatory fish population dynamics and diet in a traditional Hawaiian fishpond

Ms. Anela Akiona[1]

[1]University of Hawai'i at Mãnoa

Overfishing and anthropogenic stressors have decimated Hawai'i's coastal fisheries. Traditional Hawaiian fishponds, or loko i'a, are a low-impact and culturally significant food source in the face of climate change and increased concerns over food security. He'eia Fishpond, on the windward side of O'ahu, is currently trying to raise herbivorous fish as a local and sustainable food source. It is therefore crucial to understand the population dynamics and diet of predatory fish to assess their potential impact on the food production species. A mark-recapture experiment (the Lincoln-Petersen closed population estimator with Chapman correction) was conducted to estimate the population of predatory fish in the pond, and visual, genetic barcoding, and stable isotope analyses were used to assess their diet. Catch-per-unit-effort data from community fishing days were also utilized to examine trends in the relative abundance of predator fishes.

Sphyraena barracuda had the largest population in He'eia fishpond at 189 individuals, follwed by Caranx ignobilis (89) and C. melampygus (19), which reflects trends in the CPUE from September 2016 - September 2017. Diets of the three species consisted mainly of nearshore, estuarine fishes and crustaceans. We did not find evidence that the predators consumed the herbivorous fishes typically raised as food, suggesting that they are either not specifically targeted by the dominant predators in the fisphond or are such low population sizes that they are not part of the predator's diet. Based on these findings, we recommend maintaining current strategies for management of He'eia Fishpond's top predatory species.

14:45 - Monitoring the Impact of Offshore Aquaculture on Ambient Water Quality in the Red Sea

Ms. Aislinn Dunne[1], Dr. Susana Carvalho[1], Dr. Dale Kiefer[2], Prof. Burton Jones[1]

[1]King Abdullah University for Science and Technology, [2]University of Southern California

The Saudi Arabian government has announced an economic development plan (Vision 2030) to invest in a range of industries across the Kingdom, one of which is aquaculture. In the face of a likely increase in Red Sea fish farming, we investigated the impacts of offshore aquaculture on the coastal water quality of the Red Sea by monitoring the water column surrounding a Saudi Arabian offshore fish farm on the southcentral coast of the Red Sea. Water quality parameters around the fish farm as well as organic loading on a nearby coral reef were measured seasonally to determine the impacts of fish farm effluent on the surrounding environment. Water column properties differed upcurrent and down-current from the fish farm, with bacteria and dissolved inorganic phosphorous and nitrogen concentrations showing patterns of enrichment, and dissolved oxygen concentrations being lowered, close to and down-current of the fish farm. These signals of enrichment were mainly observed close to the farm (within several hundred meters), and decreased with distance from the farm. We are in the process of using the data from our sampling efforts as input parameters for an aquaculture modeling software to model the fate and transport of fish farm effluent. Through this field study, we assess the spatial extent and magnitude of organic enrichment caused by a Red Sea fish farm, with the goal of understanding and predicting the potential impacts of future offshore aquaculture development in Saudi Arabia on the water quality of this tropical, oligotrophic environment.

OS-2D: Estuary and Coastal Restoration 1 (13:30 - 15:30, FJ Event Hall)

13:30 - Shelving the Coast with Vertipools: Retrofitting Artificial Rock Pools on Coastal Structures as Mitigation for Coastal Squeeze

Dr. Alice Hall[1], Dr. Roger Hebert[1], Prof. Robert Britton[1], Mr. Ian Boyd[2], Mr. Nigel George[2]

[1]Bournemouth University, [2]Artecology

Coastal squeeze threatens the size and quality of intertidal habitats. Along coastlines protected by hard defences, there is a risk that natural rocky shore habitat will be lost, with remaining assemblages characteristic of hard substrata confined to sea walls and breakwaters. These assemblages are likely to be less diverse and different to those found on natural shores as these structures lack features that provide moist refugia required by many organisms at low tide, such as pools and crevices. Yet engineering solutions can help mitigate the impacts of sea level rise by creating habitats that retain water on existing structures. A feasibility study worked with artists and local school children to design and retrofit five concrete-cast artificial rock pools ('Vertipools TM') on to a vertical seawall on the south coast of England. After 5 years, the artificial pools increased the species diversity of the sea wall and attracted mobile fauna previously absent, including fish and crabs. The Vertipools had assemblages which differed significantly from the existing seawall and supported different functional groups including predators and grazers. Collaboration between policy makers, ecologists, children and artists produced an ecologically sensitive design that delivered substantial benefits for biodiversity which could be adapted and scaled-up to both mitigate habitat loss and enhance coastal recreational amenity.

13:45 - Transplantation of a habitat-forming species as a conservation/restoration measure: the case of the Mediterranean pen shell Pinna nobilis

time

Dr. Silvija Kipson[1], Mr. Donat Petricioli[2] , Dr. Tatjana Bakran-Petricioli[1]

[1]University of Zagreb, Faculty of Science, Department of Biology, [2]D.I.I.V Ltd. for marine, freshwater and subterranean ecology

Coastal development, resulting in habitat loss or degradation, threatens many sessile marine species. The pen shell Pinna nobilis is an endemic, long-lived Mediterranean species and one of the largest bivalves in the world, reaching up to 120 cm in shell length. As a suspension-feeding habitat-former it provides important biogeochemical functions of water clarification and biodeposition and enhances local biodiversity. To avoid smothering of this strictly protected species during construction of a new nautical centre in the Pula Harbour (North Adriatic Sea), we transplanted a total of 184 pen shells to the nearby Brijuni MPA and tested the effect of location, habitat type, depth and density on their survival and growth during 1 year. The pen shell transplantation was confirmed as an effective restoration method, resulting in generally high though habitat-dependent transplant survival and increased function and services of the host habitat. Building upon our and previous transplantation actions, we summarize reasons for restoration success/failure and estimate related costs. Besides being the first official case in Croatia to implement transplantation of a sessile marine species as a measure prescribed by the environmental impact assessment, this action additionally offered a compelling case for the citizen-science. In the light of recently reported pen shell mass mortality events due to a rapidly spreading disease, every effort should be made to minimize more manageable impact in situ (e.g. of costal construction, anchoring, trawling, illegal extraction) in order to ensure maintenance of its populations relaying on survival of adults.

14:00 - Increasing seagrass restoration success by promoting positive feedbacks between ecosystem engineers

Dr. Karine Gagnon[1], Dr. Christoffer Boström[1]

[1]Åbo Akademi University

As seagrass meadows disappear around the world, along with their associated biodiversity and numerous ecosystem services, efforts have been made to restore these critical ecosystems. However, restoration success rates are low (37%), due to habitat degradation and the disappearance of critical feedbacks regulating seagrass ecosystems, which are often not addressed in restoration projects. Using a combined approach including meta-analysis, aquarium experiments, and field studies, we studied interactions and feedbacks

between seagrasses and bivalves to understand the factors and mechanisms involved, and to determine how they could be applied in a restoration context. In the meta-analysis, interactions between seagrasses and bivalves were mostly positive, except between infaunal bivalves and intertidal seagrasses. We then used a series of field and aquarium experiments across Europe (using local species) to test whether adding infaunal and epifaunal bivalves in different environmental conditions increased restoration success, i.e. the survival, growth, and reproduction of planted seagrass. In the lab, epifaunal bivalves increased seagrass growth through sediment fertilization and seed retention in high hydrodynamic conditions, while seagrass presence supported bivalve growth. However, results were less consistent in the field, as in some sites degraded environmental conditions (e.g. algal blooms, sedimentation, erosion, invasive species) reduced seagrass survival. The most critical aspect of seagrass restoration and conservation must thus be to first reduce anthropogenic impacts and ensure suitable environmental conditions. However, once these are in place, our results support the idea that promoting positive feedbacks by planting seagrass along with other ecosystem engineers together can indeed increase restoration success.

14:15 - Increase in mangrove forest area in the Auckland Region, New Zealand, is mainly driven by land use change in the catchments

Mr. Suyadi Suyadi[1], Prof. Jay Gao[2], Dr. Carolyn Lundquist[3], Dr. Luitgard Schwende[2]

[1]University of Auckland and Indonesian Institute of Sceinces (LIPI), [2]University of Auckland, [3]National Institute of Water and Atmospheric Research

In some regions an increase of mangrove forest area has been observed. However, the factors influencing changes in mangrove area are not well investigated. The objectives of this study were (1) to quantify to change in mangrove area from 1940-2014, and (2) to identify the factors driving mangrove cover change across 38 estuaries in the Auckland Region, New Zealand, using remote sensing and field based surveys. The study showed that mangrove forest area in the Auckland Region, New Zealand, increased from 2,313 ha in 1940 to 10,483 ha in 2014 (on average 3.2% yr-1). Separating tall and dwarf mangroves revealed that the proportion of tall mangroves decreased from 89% to 55% whereas the area covered by dwarf mangroves increased. In contrast to other studies we found that the increase in mangrove area was mainly through gap filling. Boosted regression tree analysis revealed that sea level and mean annual air temperature explained 36% of the variation mangrove cover change in the Auckland Region. However, the loss of forest cover in the catchment and associated sediment loads was the strongest predictor explaining up to 62% of the variation in mangrove area. Our findings highlight that catchment management to reduce sediment loads is an important aspect of mangrove management.

14:30 - Collaborative coastal marine habitat restoration within an indigenous co-management context in Gwaii Haanas, Haida Gwaii, western Canada

Ms. Lynn Lee[1], Ms. Vanessa Bellis[2]

[1]Gwaii Haanas Parks Canada, [2]Haida Fisheries Program

Relationships between indigenous Haida, sea otters, and ecosystems of Haida Gwaii, British Columbia, Canada, adapted and persisted for millennia until cultural disruption and sea otter extirpation by the maritime fur trade during the 1700s and 1800s. For nearly 200 years now, ocean ecosystems of Gwaii Haanas National Marine Conservation Area Reserve and Haida Heritage Site have been out of balance. With loss of sea otters-voracious predators of shellfish like sea urchins, crabs, clams and abalone-macroinvertebrates became larger and much more abundant. As a result, contemporary kelp forests are greatly diminished in abundance, depth and area due to voracious grazing by hyperabundant sea urchins. Degraded kelp forests negatively impact marine ecosystems, species at risk, and culturally important species, including northern abalone and rockfishes, by reducing habitat that provides food and protection, reducing primary productivity, and decreasing protection from coastal erosion forces. We will restore kelp forests at a 3-km long pilot site by working with the commercial sea urchin fishery to mimic sea otter predation, removing and culling ~75% of the urchins. Marketable urchins will be fished for commercial processing and provision of traditional foods, guuding.ngaay (red urchin) and styuu (green urchin), to Haida and other islands communities. Academia is engaged to advance knowledge about marine ecosystem processes. Through this restoration project, Chiixuu Tll iinasdll, Gwaii Haanas' cooperative management partners - Council of the Haida Nation, Parks Canada Agency, and Fisheries and Oceans Canada - are showcasing how co-management and collaboration can advance shared conservation goals and objectives.

14:45 - Do artificial reefs have a role in the restoration of biodiversity and ecosystem services in the NE Atlantic?

Dr. Roger Herbert[1], Dr. Joan Franco[2], Dr. Elena Blanco Fernandez[3], Dr. Nassim Sebaibi[4], Dr. Alice Hall[5], Prof. Isabel Sousa Pinto[2], Dr. Mohamed Boutouil[4], Prof. Rick Stafford[1], Prof. Miriam Guerra[6], Prof. Daniel Castro[3]

[1]Bournemouth University, [2]University of Porto, [3]University of Cantabria, [4]ESITC, [5]Bourn, [6]IMPA

In some regions, Artificial Reefs have been widely used to help restore degraded marine habitats, biodiversity and ecosystem services such as fisheries and tourism. In the North-east Atlantic they have been deployed for a variety of purposes, yet they remain uncommon. Here we firstly examine the existing role of artificial reefs and structures that have been deployed over past decades in the North-east Atlantic. We consider whether Artificial Reefs in the region have significantly increased biodiversity indicators, such as species diversity, productivity and ecosystem services, or have largely displaced/attracted existing fauna and flora. We consider whether the function of new reefs in the region needs to be redefined in view of emerging challenges related to habitat loss, increased storminess and sea level rise as a result of climatic changes. Secondly, we discuss whether innovative materials and construction technologies can introduce sufficient authentic complexity to optimise the design and development of new reefs in this region to enhance biodiversity. This will include the potential mitigation of negative impacts, such as the colonisation of invasive non-native species that can commonly establish on newly exposed surfaces and which then become stepping stones for species dispersal. We report on new international multidisciplinary collaborations in the NE Atlantic that seek to trial innovative 3D printed designs and structures of different materials to inform the deployment of new, larger scale, 'Reefs' in different coastal regions. Through an 'Eco-structures' network, these collaborations encourage the participation and engagement of multiple stakeholders, including scientists, engineers, policy makers and NGOs.

15:00 - A global synthesis reveals gaps in coastal habitat restoration research

Ms. Stacy Zhang[1], Mr. William Cioffi[2], Ms. Rebecca Cope[1], Dr. Pedro Daleo[3], Ms. Eleanor Heywood[1], Ms. Carmen Hoyt[1], Ms. Carter Smith[4], Prof. Brian Silliman[1]

[1]Division of Marine Science and Conservation, Duke University, [2]University Program in Ecology, Duke University, [3]Instituto de Investigaciones Marinas y Costeras (IIMyC), CONICET âĂŞ UNMDP, [4]Institute of Marine Sciences, University of North Carolina at Chapel Hill

Coastal ecosystems have drastically declined in coverage and condition across the globe. To combat these losses, marine conservation has recently employed habitat restoration as a strategy to enhance depleted coastal ecosystems. For restoration to be a successful enterprise, however, it is necessary to identify and address potential knowledge gaps and review whether the field has tracked scientific advances regarding best practices. In doing so, managers, researchers, and practitioners alike may more readily establish restoration priorities and goals. We synthesized peer-reviewed, published literature on habitat restoration research in salt marshes, oyster reefs, and seagrasses to address three questions related to restoration efforts: i) how frequent is cross-sector authorship (i.e. University, NGO, or GO) in coastal restoration research; ii) what is the geographic distribution of coastal restoration research; and, iii) are abiotic and biotic factors equally emphasized in the literature and how does this vary with time? Our vote-count survey indicated that one-third of the journal-published studies listed authors from at least two sectors. Across all habitat types, there was a dearth of studies from Africa, Asia and South America. Finally, despite many experimental studies demonstrating that species interactions can greatly affect the recovery and persistence of coastal foundation species, only one-fourth of the studies we examined discussed their effects on restoration. Combined, our results reveal gaps and discrepancies in research and emphasis that should be addressed in order to further propel coastal restoration science.

S-133: Cutting Edge Advances in Environmental Social Science for Marine Conservation (13:30 - 15:30, Tubau 3)

13:30 - Addressing poaching in marine protected areas through voluntary surveillance and enforcement

Mr. Brock Bergseth[1], Dr. Adrian Arias[1], Dr. Michele Barnes[2], Dr. Georgina Gurney[1], Prof. Josh Cinner[1]

[1]Australian Research Council Centre of Excellence in Coral Reef Studies, James Cook University, [3]University of Hawaii at Manoa

Poaching renders many of the world's marine protected areas (MPAs) ineffective. Because enforcement capacity is often limited, managers are attempting to bolster compliance by engaging the latent surveillance potential of fishers. Yet, little is known about how fishers respond when they witness poaching. Here, we surveyed 2111 fishers living adjacent to 55 MPAs in seven countries and found that 48% had previously observed poaching. However, the most common response was inaction, with the primary reasons being: 1) conflict avoidance; 2) a sense that it was not their responsibility or jurisdiction; and 3) the perception that poaching was a survival strategy. We also quantified how institutional design elements related to fishers' responses to poaching, and highlight avenues to engage fishers while mitigating risks. These include emphasising how poaching personally affects each fisher, promoting stewardship and personal responsibility norms, and poverty alleviation to reduce the need for fishers to poach for survival.

13:45 - Marine social science and conservation: exploring the policy potential of citizen behaviour change

Ms. Holly Griffin[1], Ms. Josie Wastell[1], Dr. Laura Friedrich[1]

[1]UN Environment World Conservation Monitoring Centre (UNEP-WCMC)

At the United Nations Ocean Conference in 2017, the UN Environment World Conservation Monitoring Centre (UNEP-WCMC) made a voluntary commitment to actively explore how ocean literacy can be catalysed to generate behaviour changes that increase conservation of the marine environment in support of UN Sustainable Development Goal 14 (Life Below Water). This commitment is part of UNEP-WCMC's strategy to advance the transition to a healthy ocean by increasing uptake of social science in marine conservation on global, regional and national scales. To this end, UNEP-WCMC is convening multi-disciplinary expertise on new social science strategies such as ocean literacy and citizen behaviour change, and is designing guidelines to facilitate use of these strategies as tools to achieve global ocean policy goals and targets. This will support the delivery of national policy goals and international commitments under the UN 2030 Sustainable Development Agenda. In this context, UNEP-WCMC, in collaboration with international coral reef scientists and behaviour change experts, has developed new guidance to identify and target human behaviours that are harmful to coral reef ecosystems. Coral reefs are highly vulnerable to human activities and targeted behaviour change can relieve some of the human pressures on these ecosystems. Using behaviour-impact-pathways to identify relevant behaviours, effective and targeted messages were developed to promote context-specific behavioural changes, such as reducing diver contact with coral reefs. This presentation for IMCC5 will expand on the coral reef behaviour change work and outline how UNEP-WCMC's marine social sciences strategy will contribute to effective marine biodiversity conservation.

14:00 - Adaptation, Knowledge, and Leadership in Managed Fisheries

Dr. Joshua Stoll[1]

[1]University of Maine

The dynamic nature of marine systems requires that fishers constantly navigate change. To do this, fishers deploy a range of strategies, changing where, when, and how they fish as well as what species they target. However, increasingly, fisheries are being managed in ways that constrain fishers' access to marine resources, whereby reducing their ability to adapt to socioeconomic and environmental shifts. One of the consequences of this process is that fishers tend to become more specialized and are therefore exposed to higher levels of financial risk. Here, I use a multigraph network approach to describe the social-ecological relationships between fishers and fisheries in a highly fisheries-dependent region of the United States (Maine) and investigate how differences in access among individual fishers also alter the production of local ecological knowledge and leadership - both key concepts in marine conservation. The results of this research suggest a need for greater attentiveness to the role fisheries management strategies play in theorizing about knowledge production, leadership, adaptive capacity among fishers.

14:15 - Social licence and marine citizen science: Potential and progress

Ms. Rachel Kelly[1]

[1] *Centre for Marine Socioecology, University of Tasmania*

Social licence is an emergent concept in the marine sector and has become an important theme for development in marine industry and resource use, particularly in the context of exploring communication and stakeholder engagement. At the same time, meaningful public and societal engagement with science and research is increasingly recognised as necessary to advance public knowledge about the marine environment and to promote stewardship of ocean spaces. Citizen science is a diversified phenomenon that is expanding rapidly in marine spaces and may create pathways for support between social groups and promote networks for collaborative decision making that can enhance outcomes for science and management. This paper is among the first attempts to link social licence theory with citizen science, aiming to produce actual practical outcomes that can be applied in ocean management to make marine science matter. Here, I examine the role marine citizen science can play in promoting social licence in the marine realm. Firstly, through an exploration of European citizen science projects and their potential to enhance social licence for marine conservation. Secondly, I describe an Australian case-study highlighting whether diverse participant groups (i.e. divers, fishers) construct and exchange opinions via marine citizen science and whether social licence is promoted or withheld through such exchange. I outline the potential role of social licence as a tool to foster positive engagement between marine user groups, and identify how citizen science may influence perceptions and promote social licence in the marine realm.

14:30 - Demographic characteristics and scales of agreement and disagreement over resource management restrictions

Dr. Tim McClanahan[1]

[1] *Wildlife Conservation Society*

Conflicts over restrictions in common-pool resources management (CPRM) institutions are expected to arise from variations in human values, perceptions of justice, and the disparate demographic scales of benefits and costs. We hypothesized and tested a series of propositions about how the demographic scale and context of proposed restrictions would influence African coral reef fisheries. We surveyed the preferences and perceived benefits of 1849 people in 89 fish landing sites for six common restrictions of increasing severity. Variability in perceived benefits within and between neighboring communities was evaluated to determine how perceptions changed with the severity of the proposed benefit/costs restriction scale, perceived benefits, disparities between beneficiaries, and national context. Within community variability declined strongly with perceived benefit but was either weak or not significantly associated with the neighboring community's variation. Within community variation was less than between-community variation and increased with human population density, economic, and the governance influences of the nations. There was generally broader scale agreement on the benefits of weaker restriction strength options of minimum sizes of fish and allowable fishing gears and more disagreement on stronger restrictions of species, time, and space restrictions. restriction strength and perceived fairness of benefits. Reduced variability was strongly associated with less disparity in benefits between local and government beneficiaries. These findings indicate potential conflicts between neighboring communities for most but particularly the strongest restrictions. This can lead to defection and communities complying with only the weakest restrictions and behaviors of the least-compliant neighbors.

14:45 - The effectiveness of 'nudges' on compliance behaviour in recreational fisheries

Ms. Mary Mackay[1], Dr. Satoshi Yamazaki[2], Dr. Sarah Jenkins[2], Dr. Ingrid Van Putten[3], Dr. Hugh Sibly[2]

[1] *Centre for Marine Socioecology, University of Tasmania,* [2] *University of Tasmania,* [3] *CSIRO*

Non-compliance is a tenacious problem in recreational fisheries management and poses a risk to marine conservation and socio-ecological systems. In fisheries management, deterrence-based approaches have traditionally been used to tackle non-compliance. However, enforcement is often limited in recreational fisheries and an alternative approach is needed. In this paper we explore the lessons from behavioural economics and apply nudge theory as the basis of alternative management approaches to boost compliance. Nudge theory argues that through positive reinforcement or indirect suggestion non-forced compliance can be achieved. There is an opportunity to test the effectiveness of nudges on compliance behaviour in recreational fisheries, which as of yet, has not been explored. We test the influence of a nudge based on a social norm through an economic laboratory experiment. Our results show that a nudge can increase compliance behaviour by 10% and 30% of people reduced their catch. We find that a nudge was more effective when deterrence is low, but its effects become weaker when deterrence is high. We find that there is heterogeneity in individuals responses to nudges and that risk preferences and gender are significantly correlated with compliance behaviour. This study suggests that nudges are applicable to recreational fisheries since the scale of the compliance decision is on the individual level, in which behavioural incentives, such as social norms play a large role. We anticipate that nudges may have the potential to complement traditional management and this approach could prove successful as a cost effective compliance tool in the marine environment.

S-179: Novel approaches to the conservation and management of coral reefs under climate change (13:30 - 15:30, Kerangas)

13:30 - Coral Reefs at a Crossroad - The need for new tools for management and conservation.

Mr. Tom Moore[1]

[1] *National Oceanic and Atmospheric Administration*

Saving the world's coral reefs requires a multi-pronged approach. Immediate and aggressive action on climate change is paramount for the long-term survival of reefs; however, carbon already released into the atmosphere will continue to warm ocean waters to a level inhospitable to corals for decades to come. Coral reef restoration can help span the predicted gap between the present when existing coral populations are threatened with extinction, and a future ocean that is hospitable again to corals. Globally work is showing that local restoration of reefs is possible, and the spatial scale of success is steadily increasing. However to matter at an ecosystem level, major upscaling and a shift from simple gardening to industrial processes will be needed. Tools from other industries need to be adapted and new processes developed. Working to close the gap between success at the local level and impact at the ecosystem level will not be easy or quick, but in the face of a rapidly declining population is necessary to maintain the ecosystem services that coral reefs provide.

13:45 - Easing bottlenecks in the early life history of coral

Dr. Margaret Miller[1]

[1]*SECORE*

As a practical matter, the implementation of many proposed 'novel interventions' would involve active breeding/propagation of improved corals and establishing them in reef populations at large scales. Corals must navigate many complex life history steps to successfully recruit on a reef and any of these stages may represent a bottleneck in certain circumstances. With years of experience and development, procedures have been developed to successfully assist many of these stages including prediction of spawning time, capturing and fertilizing gametes, larval culture, and settlement in most regions and with many species. The big remaining challenge is survivorship of settlers after placement on the reef. Both K- and r- type strategies may be hypothesized to address this restoration challenge, either investing in costly post-settlement care for grow-out to a more survivable size, or attempting to overcome high mortality with massive, low-investment propagule inputs. However, it seems that neither of these strategies lends itself to the tremendous upscaling of coral restoration goals now being contemplated. Another approach is to design specialized settlement substrates ('seeding units') that can provide acceptable settlement habitat along with features (e.g. materials, coatings, or shapes) that enhance survivorship for small settlers on the reef. This challenge is at the forefront of current restoration research, leveraging both ecological and engineering expertise.

14:00 - Sorting the wheat from the chaff - evaluating the potential benefits and risks of novel interventions on coral reefs

Dr. Line Bay[1]

[1]*Australian*

Coral reefs are at a cross road in terms of their ecological health and management. Declines in coral cover and health, in particular from mass bleaching, have spurred a flurry of discussion around the role of restoration in the management of reefs. This discussion has moved from more traditional approaches, such as coral gardening and replenishment to include a range of novel approaches, many of which have never before been implemented in wild ecosystems or at large spatial scales. How will we know which approaches are good ideas and which ones are are not? This presentation will outline the approach taken in Australia's Reef Recovery and Adaptation Program to answer this question. I will use case studies to highlight the potential benefits and risks of prospective biological approaches to support the recovery of reef habitats and enhance adaptation of reef corals. I will also explore the research and development required to demonstrate safety and efficacy, and how interventions may be bundled for greater impact. I will argue that while an exploration of novel reef restoration tools must not detract from a focus on addressing the root causes of reef declines, principally climate change, it is a conversation we must have. Rigorous, systematic and objective analyses of both existing and novel restoration approaches will ensure that coral reef managers and decision makers will have the best tools available to face the challenging task of conserving coral reefs in an uncertain and warming future.

14:15 - The role of evolutionary adaptation in coral reef management and conservation

Dr. Mikhail Matz[1], Dr. Eric Treml[2], Dr. Benjamin Haller[3]

[1]*University of Texas at Austin,* [1]*University of Melbourne,* [3]*Cornell University*

Contrary to the common belief, evolution is not necessarily slow. Numerous studies have now demonstrated very rapid evolutionary change in natural populations, including increase of a population's stress tolerance as a result of a single exposure to stress. This rapid evolution is enabled by adaptive alleles that are already present in natural populations. Such alleles can be reshuffled to generate adapted phenotypes and rapidly enriched by natural selection to maintain the population's fitness despite environmental change.

Reef-building corals exhibit genetic adaptation to local thermal conditions while maintaining genetic connectivity across broad thermal gradients. These two features are expected to facilitate both generation of adaptive genetic variation and its redistribution among populations when conditions change.

We have developed a multigene evolutionary model encapsulating these ideas, capable of producing a map of future bleaching and extinction risks across the Indo-West Pacific. We find that coral populations should be able to maintain their fitness for at least 100 years solely by redistributing existing adaptive alleles between populations. Still, bleaching risks will increase throughout the region with the exception of a few locations, most notably the mid- and southern Great Barrier Reef (GBR). These areas of the GBR emerge as the most important refuge from global warming for coral across the whole Indo-West Pacific.

Our model can be used to examine the impacts of various management strategies under different climate change scenarios. One particularly promising management intervention is assisted gene flow, or "genetic rescue", which would promote the redistribution of adaptive alleles among populations.

14:30 - Managing and manipulating coral microbes for coral health under climate change

Dr. Raquel Peixoto[1]

[1]*Federal University of Rio de Janeiro*

Despite the early coral reef bleaching warning system (NOAA/USA), there is no feasible treatment option that can minimize temperature bleaching and/or disease impacts on corals in the field at reef scale. I here present the first attempts to extrapolate the widespread and well established use of bacterial consortia to protect or improve health in other organisms (e.g., humans and plants) to corals. The results from a controlled and replicated aquarium experiment demonstrated the ability of a selected putative beneficial microorganisms for corals (pBMC) consortium to delay coral bleaching induced through both temperature and pathogen challenge. The improvements in coral bleaching metrics were observed in pBMC inoculated corals, even when also challenged with V. coralliilyticus, at 30C, in contrast to controls without pBMC addition, which displayed strong bleaching signs as indicated by significantly lower photopigments and Fv/Fm ratios. Differences in the coral microbiome community structures were also observed between treatments with and without pBMC addition with specific bacterial groups correlated with bleached and non-bleached corals. Delaying the effects of bleaching might buy time for the corals allowing for dissipation of the stress, thereby reducing levels of mortality across the duration of a bleaching event. Strategies currently used for the remediation of oil spills could be adapted for the delivery of coral "probiotics". In addition, the development of protective management or treatments to boost the resilience of native and diverse populations of corals in the field can also represent a useful and complementary strategy to be applied in restoration efforts.

14:45 - Designing for climate resilience - an urgent conservation challenge

Dr. Kenneth Anthony[1]
[1]*Australian Institute of Marine Science*

Tropical coral reefs are home to a quarter of the world's marine species. That richness is underpinned by the complex habitats built by corals that are sensitive to climate change. Projected ocean change under an unmitigated carbon emission scenario could see reefs lose their most prominent habitat builders already by 2050, and with them the biodiversity, ecosystem services, and livelihoods they support. Importantly, climate change is already affecting sensitive reef corals and is set to compromise reef function even under strong carbon mitigation.New interventions are now needed to sustain reef resilience under climate change. However, I here show that for such interventions to be effective, they must address three questions: (1) can the target species be sustained in the long-term?; (2) could hardier but less preferred species be effective alternatives for ecosystem services in the long-term?; and (3) when should a conservation program decide to switch from supporting sensitive/preferred to instead investing in hardy/less preferred species? Using modelled examples I argue that reef conservation is now set to become a design challenge under time pressure. Hard choices of what species are to receive resilience support will become necessary to sustain ecosystem functions and services. An understanding of how alternative reef designs will perform (functions, productivity, values) under different climate scenarios need to inform the conservation strategy. Further, the timing of such a switch from Plan A to Plan B species should be informed by projected rewards vs risks, and the likelihoods of different climate trajectories.

Speed Talks (13:30 - 15:30, Kabu)

13:30 - Significance of mangrove biodiversity in fishery production and living conditions of coastal communities in Sri Lanka

Ms. Chaya Sarathchandra[1], Dr. Sriyani Wickramasinghe[1]
[1]*Rajarata University*

Sri Lanka is an island nation where ∼59% of population lives in coastal regions. The main income source of them are fishery and related activities which contributes to ∼44% of national GDP. Fishery resources depend on the mangrove diversity associated with them especially in estuaries and lagoons as mangroves provides the best nursery grounds for both brackish and marine species who are significant in island's fishery industry. But it's an inevitable fact that growing pressures from increasing population and development activities are posing irreversible damages to mangroves. We analyzed how and whether variation of mangrove diversity along a lagoon system affects aquatic food production and livelihood diversity. We found the sites with the highest diversity also had the highest fish catches. Our results confirms that the higher mangrove diversity supports higher variation of income generation methods which signals for a development which prioritize biodiversity conservation in coastal regions.

13:35 - Patch dynamics of the gastropod Strombus luhuanus provides insights on alternative population states of heavily exploited species from the Philippines

Dr. Katherine Sanchez-Escalona[1]
[1]*Mindoro State College of Agriculture and Technology*

Strombus luhuanus is a gastropod species widely distributed in the Indo-West Pacific commonly exploited for food by coastal community. The species is gregarious with size of aggregations largely determined by habitat factors and season. The aggregating behavior facilitates exploitation of the species with a computed rate of 86.2% which is higher than the rate computed from other exploited species within Southeast Asia. Population modeling using PRESENCE where aggregations were considered patches, however, showed a persistence value of 1.01 to 1.25. While the value may be due to a low detection probability (0.087 to 0.599) as well as low detection probability (0.05 to 0.5) mainly from crypsis and burrowing, aggregations were found to have lower density relative to unexploited ones. Low density aggregations may be an alternative state to high density aggregations of exploited species occurring as patches in a landscape. High density aggregations are maintained by biological attributes such as seasonal dispersion, high colonization rate and high occupancy probability. The change from high density state to low density state is facilitated by high harvesting pressure while low detection probability and low extinction rate serve as the sill for change in state.

13:40 - WHALETIME - a citizen science approach to conservation of humpback whales

Ms. Rachel Kramer[1]
[1]*WILDOCEANS*

The WhaleTime Project's goal is to bring science, conservation, tourism and community together around the key phenomenon of the annual migration of humpback whales (Megaptera novaeangliae) along the eastcoast of South Africa.The project has four main elements. firstly, to conduct and support research about the population status of the eastcoast C1-stock humpback whales; to gain an understanding of population trends and any threats to the population. The project has populated a catalogue of whale images, photographed in their breeding grounds in Mozambique and in South Africa en route to and from these grounds, and continues to expand the catalogue with collaboration from the Department of Environmental Affairs. Secondly, the promotion of a citizen science approach allows the public to contribute fluke images to the catalogue. The project has established an online platform that allows "citizen scientists" to upload their photos, identified by experts. The third element of the project aims to build awareness about whales, the opportunities they present and the threats they face, using social and conventional media and a dedicated website. The final element promotes ethical and sustainable community-based tourism. Community guides have been trained and currently offer whale tours at the Port Natal Maritime Museum in Durban, where they contribute to the larger Whale Route, in the south of Durban. The WhaleTime project's objectives are to be a lead provider in quality public awareness information around whales and related marine conservation topics and facilitate Durban in meeting criteria to become a World Whale Heritage site.

13:45 - The drivers of green turtle, Chelonia mydas, abundance around Mussau Island, Papua New Guinea

Ms. Azalea Anota[1], Prof. David Mowbray[2], Mr. Nathan Whitmore[3]
[1]*University of Papua New Guinea,* [2]*The University of Papua New Guinea,* [3]*The Wildlife Conservation Society - Papua New Guinea Program*

Green turtles (Chelonia mydas: Endangered) are found in high numbers around Mussau Island, Papua New Guinea because the island community is made up of Seventh Day Adventists who have a religious prohibition against eating them. Some locals believe turtle herbivory is detrimentally affecting seagrass and seaweed abundance and therefore affecting the viability of both an inshore fishery (Siganidae) and the abundance of edible seaweed. As a consequence some locals were proposing a turtle cull. While we are currently awaiting sufficient data to assess the causative relationship between turtle numbers, seagrass and seaweed we are examining the drivers behind daily changers in turtle abundance. We used distance sampling to determine turtle density and the drivers of daily density changes between reef crest and inshore sites at two locations: Nae and Lolieng. Observers made a total of 381 1 km long transects. To determine turtle density 46 candidate models were considered within a model selection framework. Inshore turtle density was at a maximum during high tide: ∼0.5 turtles per ha at Nae and ∼5 turtles per ha at Lolieng. Turtle density at the reef crest was at a maximum during low tide: ∼1.5 turtles per ha at Nae and ∼8 turtles per ha at Lolieng. This represents the first robust estimate of turtle density in Papua New Guinea, and demonstrates the strong effect of tide. Our monitoring also suggests there is circumstantial evidence that turtles may be being prosecuted at Nae.

13:50 - Management and benthic characteristics influence the distribution of the Bumphead Parrotfish (Bolbometopon muricatum) in the Andaman and Nicobar archipelago, India.

Dr. Vardhan Patankar[1], Mr. Tanmay Wagh[1], Mr. Aniruddha Marathe[2]

[1]Centre for Wildlife Studies and National Centre for Biological Sciences, [2]Ashoka Trust for Research in Ecology and the Environment, Bangalore

The charismatic bumphead parrotfish (Bolbometopon muricatum), a highly prized fishery resource worldwide, has experienced population declines throughout its geographical range. Currently, there is limited knowledge on distribution, abundance and threats to these fish from Indian waters, particularly from the Andaman and Nicobar Islands. To assess their distribution and conservation status, we conducted systematic underwater surveys across 51 islands (n=75 sites) and semi-structured interviews with fishers (n=99) across the Andaman and Nicobar archipelago. We recorded a total 59 individuals of B. muricatum across nine sites from the northernmost island in the Andamans (Landfall Island) to the southernmost island in the Nicobars (Great Nicobar Island). Interviews revealed that the most fishers (100% in Central Nicobar, 94% in Middle Andaman, and 62% in South Andaman) have seen the bumphead parrotfish, and knowledge about the bumphead parrotfish is highest amongst the spear fishers. A Zero Inflated Poisson, Generalised Linear Models indicated that presence of marine protected areas and high live coral cover influenced the abundance and distribution of B. muricatum. Along with this, the species densities seem to be naturally low in the study area. The results are discussed in the light of protecting rare and endangered species with the recommendation of strengthening the existing marine protected areas in these islands.

13:55 - The community structure of macrofauna on seagrass bed in Lagoi Maritime, Bintime Island, Riau Archipelago

Ms. Maghfira Luthfiya[1]

[1]Department of Biology, Faculty of Mathematics and Natural Science, Riau University

Macrofauna is one of the animals that can be associated with seagrass beds, it can be used as an indicator to determine the quality of the waters. The purpose of this study was to determine seagrass importance index and know macrofauna community structures (density, diversity, uniformity, and dominance). The research was conducted in January 2018. The method used is purposive sampling with two observation stations, where each station is divided into five sub-stations, each sub-station is divided into five plots measuring observation 0.5 x 0.5^2 . It also carried out measurements of physical and chemical environmental parameters (temperature, pH, salinity, and substrate type). The results of study showed 73 species of macrofauna. While seagrass species found in this study consisted of 5 species. Thalassia hemprinchii is seagrass species with the highest importance value index of 156.8. Density and frequency value of highest macrofauna attendance was dominated by genus Cetirhium. Diversity index value (H ') macrofauna ranged from 3.11 to 3.19, uniformity index value (E) is 0.78, while the index of dominance was 1. In general, the base substrate of sand and sandy gravel, ranging 0-0,7m depth, water temperature ranged from 31.5 to 32.3°C, water pH ranges from 7.7 to 8.2, and water salinity ranges from 24-25o/oo. Based on the category level of environmental pollution, water in Lagoi has not been contaminated with a high macrofauna diversity, stable communities, and there is no dominant species of the community. In general, physical and chemical conditions of the water environment can support life macrofauna organisms.

14:00 - Wedges: A new way to think about the plastic litter challenge

Dr. Lucy Woodall[1], Mrs. Jo Royle[2], Dr. Jenna Jambeck[3]

[1]University of Oxford/ Nekton, [2]Common Seas, [3] University of Georgia

Plastic litter is a complex issue due to many disparate sources, the diverse pathways and a plethora of interacting factors. There is no one solution that will solve this rapidly escalating problem, rather a portfolio of interventions is required across regions. We need to determine which intervention might be most successful and which combination of strategies could overlap and interact. This could be achieved by considering the potential physical reduction in the amount of marine litter and/or the risk of it, as well as the political/ social will and resource availability to conduct the intervention for each strategy. Mapping these together in a framework will provide an actionable set of interventions and strategies, as well as suggesting how litter accumulations/outputs could change, thus providing a target against which success can be measured. In this presentation we provide the skeleton of the framework and highlight the advantages of this joined-up approach.

14:05 - Launch of a New Local Monitoring Program to Manage a Crown-of-Thorns Starfish Population

Dr. Catherine Jadot[1], Mr. Jeethvendra Kirishnamoorthie[2], Mr. Sonny Culkin[2]

[1]ES Caribbean, [2]TRACC

In recent years, outbreaks of the starfish crown-of-thorns (COT), Acanthaster planci, have become a major concern in the Indo-Pacific region. Targeted removal of COT is the strategy the most often used to manage outbreaks. However, to be effective, this strategy should rely on an understanding of the demographics and dynamics of local populations. In order to gain such knowledge, a new local monitoring program, named TRACCOT, has been launched in February 2018 around the island of PomPom, just 30 km east off the coast of Semporna, Borneo, Malaysia. Underwater belt transects (2 m x 50 m), photoquadrats (50 cm x 50 cm), and depth are recorded monthly at five locations around the island (Lobster Wall, Eastern Plateau,

Big PomPom, North Tip and North Tip buoy 1) to estimate population density and coral cover. Five additional sites in nearby islands (Kalapuan, Timba timba, and Mataking) are also part of the monitoring program to investigate population dynamics. Since inception, the program has been able to ascertain active outbreaks at 5 locations with more than 45 mature COT per hectare of reef (n=51). Interestingly, the site the most infested (Eastern Plateau, 182 COT.ha^{-1}) is not located directly downstream of Kapikan island, considered the source of COT larvae for PomPom Island. The data collected with TRACCOT will enable the development of a strategic management program and the efficient allocation of resources to reduce the population of A. planci along the coast of PomPom Island. It will also provide valuable management information for neighboring islands.

14:10 - The Mangrove Rehabilitation and Conservation Initiative of ZSL in the Philippines

Mr. Godofredo Jr Villapando[1], Dr. Jurgenne Primavera[1], Mrs. Rona Joy Loma[1], Mr. Jofel Coching[1]
[1]*Zoological Society of London*

Mangroves is an important part our coastal marine ecosystems. It serves as habitat of the different mangrove dependent species. For humans, mangroves serve as construction materials for our homes, livelihood, recreation areas, protection from storm surges, and a good carbon sink. In the Philippines, the mangrove has already shrunk from more than 500,000 hectares in 1920 to 120,000 hectares in 1994. The major reason for this was the conversion of our mangrove areas to fishponds, settlement areas, recreational areas, and road network. In 2011, the Philippine Government started to implement the National Greening program that aims to increase the forest cover of the country. However, there are concerns on the program as it does not follow the sciencebase protocol. The ZSL-Philippines is implementing the Mangrove and Beach Forest Conservation Programme with the following components:

- Capacity Building we train conservation workers from government, non-government organizations, private sector, and academic institutions involved in mangrove and beach forest protection and conservation.
- Documentation. It covers data gathering in mangrove and beach forest trees in selected key biodiversity areas and to come-up with a protocol on how the seeds will be propagated, established in nursery, planted and maintained based on their specific environment.
- Knowledge Management. From the three manuals on mangroves, the abridged versions will be developed and written in a vernacular so that it will be easier to be understood by the community members.
- Policy Advocacy. The approval of a national policy will be advocated as part of a climate change adaptation strategy.

14:15 - People, Dolphins and Fishes of the Kinabatangan River, Sabah

Dr. Lindsay Porter[1], Ms. Ling Swee Nian[1]
[1]*The University of St. Andrews*

The Kinabatangan is one of the worlds richest and most diverse riverine systems. A complex array of river outlets that meander to the sea are home to a myriad of wildlife, including Irrawaddy dolphins (Orcaella brevirostris) and some 1000 indigenous community members. The overall aim of this study is to ensure the long-term viability of the dolphin population, the sustainability of fish resources and the development of the livelihoods of those people that live along the rivers shores. To establish the underlying socio-economic status of the communities, a series of interviews were conducted with fishermen in the villages of Abai, Momiang, Pitas Laut, Tondon Bonghangan and Seri Ganda. There was a good response to the interviews with a total of 80 fishermen providing data. Most fishermen reported encountering dolphins 2-3 days every week and provided details of seasonal fisheries. In addition, members of the community were trained and employed to participate in systematic surveys for dolphins in both riverine and coastal habitats. Data from line transect and photo-id surveys indicate that small groups inhabit discrete areas of this complex system and mixing between groups appears to be limited.

14:30 - Partnering to advance conservation action in the Coral Triangle

Dr. Erin Meyer[1], Mr. Jim Wharton[1]
[1]*Seattle Aquarium*

The landscape of marine conservation encompasses a broad suite of organizations and community leaders, including academic institutions, governments, Native Nations, fishing groups, and NGOs. Each actor plays an important role in advancing conservation, from generating and sharing knowledge to connecting science to decision-making. Aquariums occupy a unique and underutilized niche in this complex landscape - they are trusted, have huge audiences, and have scientific and educational credibility. The Seattle Aquarium is a prime example which renewed its commitment to inspiring marine conservation across four focal areas: science, policy, engagement, and sustainability. We are ushering in a new era of conservation programs, guided by an ocean ethic embodied by building connections and finding shared values that inspire conservation actions. As part of this vision, we are expanding our geographic scope to include the Coral Triangle. To-date, we have focused on the Salish Sea - our backyard - but many threats it faces are global in scale, such as climate change, plastic pollution, ocean acidification. Increasing our scope allows us to understand and tell the story of ocean health in a global context. We completed an initial fact-finding trip in April 2018, and hope to continue learning from and connecting with regional experts. We are seeking opportunities to bring our expertise (e.g., ecological monitoring, human dimensions, marine policy) together with local leadership to launch partnerships that will strengthen and grow for decades to come. Are you interested in advancing conservation action and active stewardship in the Coral Triangle and across the Pacific? We stand at the ready.

14:35 - Coastal-Marine Planning Policies Should Consider Social-Ecological Resilience for Sustainability of Ecosystem-Services

Dr. Fernanda Stori[1], Prof. Alexander Turra[1]
[1]*University of SÃčo Paulo*

Coastal-Marine policies are recommended to promote sustainability in coastal-marine ecosystems. In Northern Coast of São Paulo State (Brazil), an Ecological-Economic Marine Zoning (ECEMZ), an instrument of Coastal Zone Management Policy (CZMP) is active since 2004 and had its revised version published in November/2017. There is a concern that the zoning criteria do not stem from scientific and Traditional Ecological Knowledge (TEK), but are influenced by political-economic interests. We analyzed qualitatively the ECEMZ zoning criteria (2004-2016) and a comparative table of zones' social-environmental characteristics, guidelines for management and uses and activities permitted was produced. Twenty-eight hours of committee meetings were recorded to register agreements and conflicts. Maps, reports, and literature were analyzed. CZMP states that the

zoning criteria were based on abiotic and biotic structures and functions and, according to uses and activities. However, amongst 20 physical-biotic and socioeconomic criteria listed, only two can be applied to ECEMZ (topography and protected areas). Also, indicates the criteria adopted exclusively to ECEMZ were the breeding areas, the fishing and aquaculture grounds, nautical development, and port infrastructure. It is suitable to affirm that only the first criterion does not follow an economic thought. TEK is not evident in the policy, except by some traditional territories mapped. ScientiiňĄc knowledge was verified in zoning methodology and diagnostic, however, these criteria were superseded in plenary by economic interests due to asymmetry among stakeholders in a tripartite committee model. Approaching science to ethnoscience is necessary to develop coastal-marine policies based on social-ecological resilience for sustainability of ecosystem-services.

14:40 - Population structure of shallow water coral Madracis auretenra (Pocilloporidae: Anthozoa) in the Colombian Caribbean-Preliminary results.

Ms. Diana Ballesteros[1], Dr. Lina Barrios[1], Prof. Richard Preziosi[1]
[1]*Manchester Metropolitan University*

Current coral reef ecosystems show a massive decrease in their populations due mainly to overexploitation and climate change. As a consequence of this deterioration, several Marine Protected Areas (MPA) have been created to preserve the connectivity dynamics between organisms and reefs. In order to design these reserves of biodiversity (MPAs) it is necessary to have information about the genetic exchange among coral populations to allow estimating the consequences of anthropogenic and natural effects (essential to understand the reef resilience against stochastic events). For this reason, to improve conservation strategies for these ecosystems, we need to understand; (1) What is the genetic structure of the coral M. auretenra in the Colombian Caribbean;(2) What is the connectivity level of this shallow coral in Colombian reefs; and (3) How is the genetic structure of M. auretenra between Colombia and other Caribbean reefs? We developed 36 new molecular markers (microsatellites) for Madracis auretenra (Pocilloporidae: Anthozoa), using the bioinformatics tool Pal Finder from the Galaxy Centaurus Server, developed by the Preziosi's Lab at Manchester Metropolitan University. We already tested the primers and obtained ampliiňĄcation for all the 36 primers. We are now testing the primers in 147 samples from seven localities, distributed across the Colombian Caribbean. We expect to identify several populations in Colombia and compare the results with samples from the Caribbean. These results will support effectiveness assessments of MPAs design and will promote the understanding of the connectivity dynamics and the effects of anthropogenic stochastic events against coral reef ecosystems.

14:45 - Elasmobranchs through the Looking Glass

Ms. Alissa Barnes[1], Dr. Rima W. Jabado[2], Dr. Naveen Namboothri[3]
[1]*Dakshin Foundation, Bengaluru, Karnataka* [2]*Gulf Elasmo Project, Dakshin Foundation*

Claspers: male sharks; No claspers: female shark. Is this character enough to determine gender in elasmobranchs? While hermaphroditism has long been observed, recognized, and studied in many teleost fish species, this reproductive condition in elasmobranchs - sharks and rays, is typically unusual. Here, we discuss the occurrence of intersexuality, the presence of both male and female sex characters, in the Bigeye Houndshark Iago omanensis and its potential implications on data used to inform fisheries management strategies. During landing site surveys along the northeastern coast of India, seven I. omanensis specimens (immature males) ranging in size between 40 and 60 cm total length, were collected and dissected. Externally, these specimens appeared to be immature males that were gravid (visible stomach bulge). Six out of seven males were gravid with pups present at different stages of development. Initial observations suggest these specimens exhibit basic intersexuality (a combination of both male and female reproductive characters) with the presence of fully developed female sexual organs. Over the past few decades, there have been increasing occurrences of intersexuality recorded in elasmobranchs. fisheries monitoring data are often based on the external identification of species and the determination of sex ratios based on the presence or absence of claspers. With the increase in reports of intersexuals in a number of elasmobranch genera and species, there is a growing need to understand this phenomenon and its underlying causes. Without such an understanding, we risk under/ over-estimating sex ratios in routine fisheries sampling aimed at population modelling.

15:00 - Common sawfish, Pristis pristis, makes its appearance after 14 years in Peru

Ms. Alejandra Mendoza[1], Dr. Shaleyla Kelez[1], Ms. Rossana Maguiõ[1]
[1]*ecOceanica*

The common sawfish (Pristis pristis) is critically endangered because its populations have suffered large reductions according to the International Union for Conservation (IUCN). Currently, the international scientific community, specializing in the group of sawfish, believes that the common sawfish could have been extirpated from Peru. The latest evidence for this species in Peru comes from the 1990s and is a legally captured and commercialized species. Recent field evaluations and commercial fishing activities in the Tumbes area resulted in the reporting of two individuals of sawfish caught in Peruvian waters. The individuals were registered in 2014 and 2015, were of an adult size and both were reported in the austral summer. Both individuals were caught by gill nets and one was released while the other was commercialized. These reports are the first evidence of its presence in the north of Peru after 14 years, showing that the species has not been extirpated and that Peruvian waters are still the southern limit of its distribution in the Eastern Pacific. In addition, it is hypothesized that its presence in Peru may be seasonal. These encounters show that the incidental catch by gill nets is a threat to the species. This report highlights the importance and need for more research and awareness-raising efforts, as well as providing legal protection for this species.

15:05 - Indonesian perception of Marine Protected Areas: Karimunjawa National Park

Ms. Thao Nguyen[1]
[1]*University of Wyoming*

The Indonesian government has committed to increasing their marine protected areas to 20 million hectares by 2020. Management of some marine protected areas in Indonesia follow a cooperative management (comanagement) model. In the co-management model, government agencies, non-governmental organizations, and local community members are all involved in the management of the marine protected area (MPA). Process tracing method was used to illustrate the relationship between co-management, participation, and compliance. Subsequently, the congruence method assessed the congruity between co-management and compliance. The purpose is to refine the co-management theory and test if participation in co-management has produced the promises of compliance. This research uses Karimunjawa's local community's perception to assess compliance and enforcement in Karimunjawa National Park (KNP). Using perception as an evidence based research tool, the research aim is to assess

Karimunjawa's local community's support and potential success of Karimunjawa National Park's long term marine protected area goals. Archival research revealed only 112 out of a potential 9000 community members were involved in the KNP rezoning process. Majority of the respondents did not know anyone directly involved in the management rezoning in 2012. Also, many believe that education and awareness of MPA goals were the reason why non-compliance occurs. The significance of the findings indicates a lack of participation from the community in this co-managed MPA. By using a mixed method and interdisciplinary approach, this research will produce a more holistic perspective of co-management in KNP.

15:10 - Overlap of offshore fossil fuel extraction with important marine biodiversity at a global scale

Mr. Ruben Venegas Li[1], Prof. Hugh Possingham[2], Prof. Noam Levin[1], Prof. Salit Kark[1]

[1] *University of Queensland,* [2] *The Nature Conservancy*

Human global demand for energy has pushed the energy industry to intensify its offshore activities, especially oil and gas extraction. The expansion of these activities in the ocean poses potential threats to biodiversity, such as an increase in noise pollution, chemical contamination from drilling and transportation (e.g. spills and drill cuttings), physical changes to the seaïňĆoor (dredging, drilling and pipe laying), and an increased contribution to greenhouse gasses. The aim of this research is to quantify the overlap between marine biodiversity with offshore oil and gas activities. We have compiled a database on offshore oil and gas activities globally, and characterized their spatial and temporal distribution. In a 0.5 X 0.5 degree grid, we quantified the overlap of these activities with the ranges of over 24,000 marine species, with areas of high species richness and endemism, as well as other areas important for marine biodiversity such as MPAs, IBAs and EBSAS. Results indicate thatalthough offshore oil and gas platforms are present in less than 1% of the ocean area, they overlap with at least 90% of the species in our dataset in part of their range. furthermore, 40% and 30% of the areas where oil and gas activities occur are within the top 10% of areas with higher species richness and range restricted species, respectively, in Exclusive Economic Zones. We consider this analysis to be an important first step for prioritizing actions that allow avoiding or mitigating potential negative impacts from offshore fossil fuel extraction on biodiversity.

OS-3A: Participatory Marine Conservation 2 (16:00 - 18:00, Tubau 1)

16:00 - Community-based Sustainable Financing System in Gita Nada Marine Recreational Park West Nusa Tenggara - Indonesia

Mr. Sebastian Aviandhika[1], Mr. I Dewa Warmadewa[2], Mrs. Hernawati Hernawati[1], Mr. Tezar Rafandi[1], Mr. Abdul Muis[1], Mr. Azwar Anas[1], Mr. Sukmaraharja Aulia Tarigan[1], Mr. Fajar Ardiansyah[3]

[1] *Wildlife Conservation Society - Indonesia Program,* [2] *Gianyar Marine and Fisheries Agency,* [3] *West Nusa Tenggara Marine and Fisheries Agency*

Gita Nada Marine Recreational Park (MRP) is a marine protected area in West Nusa Tenggara with 21.556 ha, established in 2016 by the West Nusa Tenggara Governor Decree Number 523-505. Prior to the establishment of the MPA, stakeholder mapping was conducted in 2015 to increase the MPA effectiveness. We identified several stakeholders that could contribute significantly to improve management effectiveness of Gita Nada MRP. They are private sectors from tourism entrepreneur, provincial government, and community surveillance groups. To create a collaborative management, management board of Gita Nada MRP established a local organization named Deep Blue Sea Foundation in May 2016. The committee members consist of community surveillance groups, coastal communities, and fishermen who lived around the MPA. Socialization and supporting request from the private sector was conducted from October to November 2017. An agreement between provincial government, tourism actors, and Deep Blues Sea Foundation was developed in December 2017. This agreement accommodates contributions from tourism entrepreneurs to support monitoring surveillance activities inside the MPA by providing budget and gasoline. Deep Blue-sea foundation is also given a sub-grant to establish Eco Blue Resto Apung (floating restaurant) as a business unit of the organization. The agreement of collaboration is a decent milestone as a model of sustainable financing system in managing Gita Nada MRP.

16:15 - The Long-Term Conservation of Marine Resources in the Southern Great Barrier Reef: Archaeological Marine Science and Traditional Ecological Knowledge Baselines in Resource Management

Ms. Samantha Aird[1], Prof. Michael Rowland[1] , Prof. Katherine Szabo[2] , Dr. Harry Van Issum[3] , Mrs. Christine Hansen-doherty[4]

[1] *James Cook University,* [2] *University of Wollongong,* [3] *Griffith University,* [4] *Woppaburra Land Trust*

Contemporary fisheries management plans typically rely on modern catch records to develop resource use management and conservation outcomes. However, they fail to incorporate past socio-ecological baselines, especially those of Indigenous cultures, which are imperative for understanding both cultural and environmental complexities when planning for future marine resource resilience. Archaeological archives are ideal repositories to extract historic palaeocultural and palaeoenvironmental baseline data for recording shifts in resource use, identifying trophic cascades and assisting in resource management and conservation initiatives.

We use the North Keppel Island, Great Barrier Reef, archaeological oyster fishery record to identify periods of expansion and contraction in Saccostrea cucullata (rock oyster) populations over 5000 years of human occupation. Results confirm rock oyster populations responded to human harvesting and environmental changes. The Woppaburra people sustained their oyster fishery throughout the Holocene and continue to use rock oysters as a traditional food and ceremonial resource.

Today, Woppaburra people are actively involved in the conservation of marine resources at the Keppel Islands with contemporary small-scale oyster farmers and the Great Barrier Reef Marine Park Authority. Archaeological sites and use of marine resources by the Woppaburra and their ancestors, makes a significant educational component in the demonstration and implementation of common marine resource conservation goals to the local community and younger generations. Our scientific archaeological dataset and Woppaburra Traditional Ecological Knowledge has contributed to longer-term understandings of resource use which can be compared to historic and modern datasets, useful for environmental impact statements and recording socio-cultural complexities.

16:30 - Seagrass-Watch: two decades of capacity building in participatory seagrass assessment and awareness raising provides insight into dugong habitat knowledge

Mr. Len McKenzie[1], Mr. Rudi Yoshida[1], Dr. Richard Unsworth[2], Dr. Leanne Cullen-Unsworth[3], Mr. Benjamin Jones[3]

[1]*Seagrass-Watch HQ,* [2]*Swansea University and Project Seagrass,* [3]*Cardiff University and Project Seagrass*

Enhancing the conservation of the dugong (Dugong dugon) and the seagrass ecosystems on which it depends, requires improved scientific literacy and understanding of seagrass importance, filling critical knowledge gaps and strengthening evidence-based policy and regulatory frameworks. The participatory science program Seagrass-Watch, established in 1998, is globally recognised as an example of successfully engaging and building the scientific literacy and capacity of local stakeholders (citizen and indigenous) to contribute to environmental science. Seagrass-Watch investigates and documents the status of seagrass resources and the threats to this important and imperilled marine ecosystem. We will demonstrate/ present how Seagrass-Watch has brought together scientists and local coastal communities to protect seagrass ecosystems; how Seagrass-Watch has integrated the scientific approach with the traditional knowledge; and how the adoption of the program has contributed to protecting cultural values of seagrasses and dependent biodiversity, including the dugong.

16:45 - Fishing for answers: Understanding obstacles to sustained autonomous local coral monitoring in community co-managed MPAs in the Central Visayas, Philippines.

Mrs. Rina Hauptfeld[1]

[1]*Colorado State University*

Data is required to manage and respond to global and local changes in marine systems. Unfortunately, capacity for monitoring is often lacking in regions where biodiversity is greatest and local populations are disproportionately dependent upon dwindling resources. Local monitoring (i.e. citizen science) is increasingly hailed as a as a boon for stewardship, adaptive co-management, and sustainability, particularly in the developing context, where financial and human resources are limited and local people have significant interest in natural resource use. Local monitoring is thought to provide increased opportunity to address community-driven questions, placing resource decisions more fully into the hands of the people affected by the outcomes, in turn empowering local communities to better manage their resources, and shorten the adaptive management cycle. In the Philippines, where authority for coastal resource management and marine protected areas has been devolved to local governments for two decades, and MPAs are co-managed between local governments and fisher-folk, local coral monitoring programs have been widely implemented. However, despite two decades of efforts to train locals in coral monitoring, sustained autonomous monitoring in the Central Visayas is largely illusive following the withdrawal of the training organizations. I will present results from semi-structured interviews and focus group discussions with fishers, local government officials, and training organizations to shed light on the question 'Why are fishers and municipal officials failing to adopt and sustain coral monitoring practices?' Results suggest misalignments in resource priorities, perceptions of the value of data, and theories of change among the three groups of actors.

17:00 - Philippines: using citizen science and dedicated research to understand a global hotspot for the world's largest fish

Mr. Gonzalo Araujo[1], Ms. Jessica Labaja[1], Mr. Ryan Murray[1], Ms. Emer Mccoy[1], Mr. Raul Burce[2], Ms. Sally Snow[1], Dr. Alessandro Ponzo[1]

[1]*Large Marine Vertebrates Research Institute Philippines,* [2]*WWF-Philippines*

The whale shark Rhincodon typus is the world's largest fish inhabiting tropical and warm temperate waters. The species is Endangered due to continued exploitation primarily in the Indo-Pacific region for their meat, oil and fins. The Philippines was once home to one of the largest targeted fisheries for the species, with ~100 whale sharks landed seasonally in the Bohol Sea alone. Following a national ban in 1998, tourism with the species developed in the town of Donsol in Luzon, which still supports local livelihoods. Tourism further developed in Pintuyan, Southern Leyte, where whale sharks aggregate seasonally between November-June. An unregulated tourism industry also developed in Oslob, Cebu, where whale sharks are provisioned daily, year-round. A smaller operation also operates out of Puerto Princesa in Palawan, and encounters with whale sharks are substantial at Tubbataha Reefs Natural Park in the Sulu Sea during the tourist season between March-July. By photographing their unique spot pattern, whale sharks can be individually identified through photo-ID. Using this technique, and by harnessing the widespread boom of tourism in the Philippines, we have now identified 1251 individuals across multiple provinces. We receive year-round reports from citizen scientists from across the Philippines, highlighting whale sharks' highly mobile nature and widespread distribution. This also highlights that although aggregation hotspots are management priorities, migratory corridors and other areas of importance are widespread and difficult to manage. Citizen science is an invaluable tool for whale shark conservation and can provide cost-effective monitoring of the species and its habitats.

17:15 - Using fisheries and biological information to inform co-management in Northern Mozambique - participatory approaches

Mr. Jamen Mussa[1], Dr. Melita Samoilys[2], Mr. Kennedy Osuka[2]

[1]*Associação do meio Ambiente,* [2]*CORDIO EA*

The coastal communities of Cabo Delgado, Northern Mozambique are highly dependent on marine resources for food security and income, making them highly vulnerable to changes in the marine environment. This region also suffers from rapid degradation of marine habitats due to a multitude of threats, including unsustainable resource use. However, the establishment of community-managed marine areas (CMMAs) is relatively new to Mozambique. We sought to use fisheries and biological information to establish best-practice CMMAs at six sites between the Rovuma River and Mocimboa da Praia, Cabo Delgado, with the inclusion of appropriate access and benefit sharing in order to sustainable manage a range of coastal habitats. CMMAs operate through a participatory co-management process including formulation of Conselho Comunitario de Pesca (CCPs - formally recognised community fisheries councils). These co-management plans include designation of no-take replenishment zones and temporal reserves to ensure fisheries enhancement is complemented by protection of biodiversity. A structured assessment of the fisheries and local ecology was used to inform the co-management process. Participatory and ground-truthed maps of fishing zones were overlaid with habitat health assessments using participatory data collection methods involving the CCPs and incorporating Local Ecological Knowledge. Three replenishment zones, as well as four temporal reserves. Here we report on the stages of this process, including octopus landings assessments from the first two cycles of the temporal

reserve of Quiwia, community perceptions from intervention sites as well as perceptions of neighboring villages. Additionally we outline plans for expanding this model to other sites.

17:30 - Community Participation in Marine Protected Area Management in Karimunjawa, Indonesia

Ms. Rusianti Amat Sugio[1], Dr. Natasha Pauli[1], Dr. Julian Clifton[1]
[1]*University of Western Australia*

Marine protected areas (MPAs) have been popular as a tool to protect marine biodiversity, provide areas for fish breeding that can increase fish catch from spillover into adjoining areas, and potentially increase the income of local communities while maintaining cultural values. Management of MPAs can be improved when a range of stakeholders are involved in the planing and decision-making process. Karimunjawa National Park (KNP) is a MPA that is located in Karimunjuawa Island, Jepara Regency, Central Java, Indonesia. KNP is significant due to its rich biodiversity, potential for economic activity, and important social values; it has recently been subject to rezoning to allow a range of activities. The objective of this research was to identify community participation in MPA management in KNP. Semi-structured interviews was conducted with key informants, including community represntatives, tourism entrepreneurs, religious leaders, village heads, NGO staff, and KNP Authority staff to determine the extent of community participation in MPA management. Community members participated in a range of MPA management programmes. These included: participation in rezoning programmes, involvement in sea patrol organisations involved with socialisation of regulations and reporting the violations of zoning and village rules; informing tourists about village rules; supporting the regulation of fishing activities, participation in mangrove and turtle conservation.

OS-3B: Land-Sea Interface 1 (16:00 - 18:00, Tubau 3)

16:00 - The role of ocean nutrient subsidies for beach and dune ecosystem services

Ms. Vanessa Constant[1], Dr. Sally Hacker[1]
[1]*Oregon State University*

Recent extreme coastal storms and tsunamis have caused erosion and flood damage in coastal communities around the globe. As vulnerability increases, there is growing interest in how to best protect coastal areas without compromising other ecosystem services such as recreation, carbon sequestration, and species conservation. Coastal sandy beaches and dunes are of particular interest as sustainable, natural barriers with their shape, and thus their level of protection, dependent on the interaction of sediment and vegetation. Little is known, however, about how these systems are linked to coastal processes, particularly nutrient subsidies from the ocean, and their effect on vegetation. We examined the relationship between ocean productivity and beach grass production to coastal protection in the U.S. Pacific Northwest. Here, coastal communities are exposed to one of the most extreme wave climates in the world, and nearly half of the coast is backed by sand beaches and densely vegetated coastal dunes. We found that seaweeds and seagrasses washing onshore improve the available nutrient pool and that dune plants use these marine nutrients, addressing a deficiency that might otherwise constrain production in dune-building coastal vegetation. Understanding this land-sea relationship is key for evaluating the protection afforded to coastal communities by dunes and how alterations induced by climate change or human activity could shift this relationship.

16:15 - Modeling coastal vulnerability for insight into mangrove and coral reef conservation efforts in Cuba

Ms. Teresa Gomez[1], Dr. Steve Schill[1], Ms. Ximena Escovar-Fadul[1], Dr. Steven Petersen[2]
[1]*The Nature Conservancy,* [2]*Brigham Young University*

Cuba, a tropical ecosystem located in the Caribbean region, supports a remarkable diversity of plant and animal species, and is home to one of the largest coral reef environments. Cuba maintains the ninth largest mangrove forest in the world, providing shoreline stability and wildlife habitat. Its coral reefs and mangrove forests provide vital protection to the islandâĂŹs coastal population by reducing erosion and flooding that result from storms. These ecosystems are some of the most preserved in the world, however, they are under threat from the impacts of climate change, increased tourism, and urban development. While conservation leaders are aware of these impacts, they recognize the need for increased conservation planning and protection. Using an ecosystem-services conservation approach, we are assisting Cuban leaders to better understand the direct and indirect impacts of coastal habitat loss, and to identify the consequences of coastal development in exposing shorelines to erosion and inundation. Using the ecosystem services management software InVEST we developed a coastal vulnerability model and qualitatively estimate coastal exposure in terms of a Vulnerability index that differentiates areas with relatively high or low exposure to erosion and inundation during storm. By combining these results with population information, the model identifies areas along specified coastlines where communities are most vulnerable to storm waves and surges. With a more tangible understanding of the services provided by marine ecosystems conservation efforts can be maximized. This information will allow decision makers to concentrate restoration and protection efforts in providing resources where people need it most.

16:30 - Which are the best methods of mangrove cover change detection and anthropogenic drivers of cover loss?

Dr. Nickson Otieno[1]
[1]*Stellenbosch University*

Despite their crucial role in marine biodiversity conservation, ecological services provisioning and protection of downstream coastal habitats and species, mangrove cover continues to decline worldwide. Yet selection of assessment method for mangrove cover change, and natural or anthropogenic factors driving it, remains a challenge for researchers and managers. To determine important anthropogenic mangrove cover change drivers within Kenya's four coastal Counties, I used 3 cover change detection methods and 6 socio-economic predictors, for 2005-2016 period. The detection methods were: remote-sensed satellite imagery; modelling-based on known annual change-rate; mapping instantaneous cover for 2016. Socio-economic predictors were population density; poverty rates; total protected-areas cover; tourist-facility density; agricultural opportunities; fishing opportunities. I used generalized linear modelling to test influence of the predictors on cover estimates from each detection method, and identify cross-cutting change predictors. From instantaneous estimates, mangrove cover was negatively influenced by poverty rate (t=-22.27, p=0.029), tourist-facility density (t=-13.81, p=0.046), agricultural intensity (t=-41.80, p=0.015) and total protected area size (t=-36.26, p=0.018) but positively by fishing opportunities (t=45.83, p=0.014). When modelled as annual change-rate, negative influence was by tourist-facility density (t=-12.43, p=0.048) but positive

by fishing opportunities (t=21.42, p=0.023). Remote-sensed cover estimation showed negative effect of population density (t=-14.22, p=0.046). Instantaneous cover assessment was best for capturing a comprehensive range of anthropogenic predictors of cover change while fishing opportunities and tourist-facility density the most resilient and suitable predictors for change monitoring. Management action for reducing mangrove loss should involve expanding community benefits from tourism, and facilitating fisheries opportunities through improved infrastructure and equipment.

16:45 - State and rates of mangrove fragmentation

Mr. Dale Bryan-Brown[1], Dr. Chris Brown[1], Prof. Rod Connolly[1]
[1]Griffith University

Mangroves deliver important ecosystem services; including the provision of critical habitat for many coastal organisms, long-term Carbon storage, shoreline stabilization and improving coastal water-quality. Effective provision of habitat to organisms (including economically important fished species) may be linked to the spatial arrangement of mangroves around coastlines. Habitat fragmentation is the process of changing the spatial arrangement of patches through breaking up large, contiguous patches into smaller, isolated patches. The spatial arrangement of mangrove patches influences the bird and fish assemblages which utilize these forests. Mangroves are threatened in many areas of the world, with some areas experiencing losses of 1% per year. As such, considering fragmentation in mangrove habitats is a critical area of research.We utilized high resolution, annually replicated Landsat derived estimates of mangrove density to assess rates of mangrove fragmentation globally for 12 years. Results indicate that areas with high rates of mangrove loss have experienced substantial shifts in mangrove habitat arrangement. However, the spatial arrangement of patches has remained relatively stable in some areas with high loss rates. The effect of loss is related to the specific habitat degradation that has occurred (entire patch/local deforestation or patch fragmentation). Regions dominated by mangroves are buffered against shifts in patch arrangement. Indicating that areas with fewer mangroves are more likely to suffer the ecological consequences of mangrove fragmentation, and need to be managed with greater care. This study is an important step in recognizing the threat that habitat fragmentation poses to coastal systems.

17:00 - Eye on Seagrass Management; are seagrasses protected in high cumulative impact areas?

Mrs. Laura Griffiths[1]
[1]Griffith University

Seagrasses represent one of the richest and most important coastal habitats in the ocean however their accelerated rates of decline have made them among the most threatened ecosystems on earth. Seagrasses are threatened by coastal urbanisation, development, destructive fishing and climate change, so they provide a useful case-study to explore how vulnerable habitats are protected in areas subject to multiple threats. Here I reviewed the different management approaches used to protect seagrass habitats in global hotspots of cumulative impacts. Seagrass protection was enacted inconsistently through a range of legislative, policy and planning processes that typically only addressed some aspects of threat mitigation. Water quality was the only threat addressed in all regions. High level strategies that recognise the importance of preserving biodiversity and ecosystem services have been developed in the majority of regions analysed; however actionable plans to specifically address multiple threats are lacking. Further, the lack of integration between different management approaches meant that cumulative impacts were typically not addressed. Coastal management of the German Wadden Sea provided one of the most comprehensive forms of protection for seagrass habitats. Management of cumulative impacts are best achieved through: the integration of terrestrial and marine policies that incorporate a holistic mandate; actionable plans that extend over biologically relevant spatial scales; international agreements/policies that provide support platforms and motivation to act; and having an active community participation program. Consideration of multiple threats into coastal management requires significant progress if vulnerable coastal habitats are to be adequately protected given global coastal urbanisation projections.

17:15 - Recognition of mangrove ecosystem services by the community and policy makers in the Gulf of Guayaquil, Ecuador

Mrs. Jodie Darquea[1], Dr. Raul Carvajal[2]
[1]Universidad Estatal Peninsula de Santa Elena, [2]Conservation International

In 2000, Ecuador created the "Agreements of Sustainable Use and Custody of Mangroves" management for the local communities, helping to stop deforestation of mangroves caused by shrimp farming. With this program, the Ecuadorian government offers economic incentives to support community-based management without taking into consideration the essential role of ecosystem services. This project aims to understand stakeholder's perceptions of the services that mangroves could deliver to them and determine understanding of changes in services and the causes to enhance participation in sustainable management mangroves in the region. An assessment of ecosystem services has not been conducted in the area prior this project. A total of 96 surveys of stakeholders were performed in three mangrove concessions in the Gulf of Guayaquil located in Cerrito de los Morrenos, Balao, and 6 de Julio. 96% of the stakeholders agreed that mangroves could deliver services or benefits, such as fisheries, nursery grounds for fishers, and climate regulation, which are the services that holders wanted to maintain most. Additionally, 48% of the stakeholders believed that fishery services have declined in recent years. Holders from 6 de Julio expressed significantly more value for a sense of place than those from the other two concessions. However, fishers in all three locations strongly valued maintaining mangroves for future generations. These two cultural services were most valued by fishing associations that have strong leadership, motivated members, and a high level of involvement. Members of fishing associations which have a high participation level have internalized lessons from these activities.

OS-3C: Fisheries and Aquaculture 3 (16:00 - 18:00, FJ Auditorium)

16:00 - Are communities better off? Leveraging perceptions data in an impact evaluation of small-scale fisheries interventions in Brazil, Indonesia, and Philippines

Mr. Gavin McDonald[1], Dr. Steve Box[2], Dr. Stuart Campbell[3], Mrs. Michaela Clemence[1], Dr. Christopher Costello[1], Dr. Courtney Cox[2], Mr. Micah Effron[2], Dr. Steve Gaines[1], Mr. Raymond Jakub[3], Mr. Roquelito Mancao[4], Mrs. Becky Twohey[1], Dr. Diogo Verissimo[5], Dr. Gabriel Vianna[6], Ms. Molly Wilson[1]
[1]University of California, Santa Barbara; Bren School of Environmental Science & Management, [2]Rare, [3]Rare Indonesia, [4]Rare Philippines, [5]Oxford University, [6]Rare Brazil

Using both objective and perceived measures of success across diverse stakeholder objectives, we evaluate the performance of a global rollout of small-scale fisheries management interventions. Effective impact evaluation is critical to understanding how well interventions work so that interventions can be improved and scaled over time. Traditionally, such evaluations often focus on objective measures of ecological impact but exclude perceived measures of socioeconomic impact. However, ecological responses may not always be significant over short time scales, while community perceptions may respond more quickly and will ultimately drive long-term conservation behavior. Over the past several years, an initiative called Fish Forever has implemented behavior change campaigns in 41 sites across Brazil, Indonesia, and the Philippines in order to establish TURF-Reserves (community-based territorial use rights for fishing areas coupled with no-take marine reserves). The goal of the program is to improve ecological, economic, and social conditions for these small-scale fishing communities. To evaluate the program, a set of common ecological, economic, and social indicators was collected before and after the campaigns across Fish Forever treatment and matched control sites. These indicators include objective ecological indicators collected through underwater visual surveys as well as subjective indicators of behavior change and perceived socioeconomic well-being. We will present preliminary results of this program's success in meeting diverse management objectives, as well as lessons learned in monitoring and evaluation design and implementation. We will also argue that perceptions data should play an important role in the impact evaluation of marine conservation and small-scale fisheries interventions.

16:15 - Dependency of Local Community on Mangrove Ecosystem in Mahi and Dadhar River Estuaries - Western India

Dr. Bhavik Patel[1], Dr. Manan Shukla[2], Dr. Kauresh Vachrajani[3], Dr. Deepak Apte[1]

[1]Bombay Natural History Scoiety, [2]Gujarat Maritime Board, [3]Maharaja Sayaji Rao University of Baroda

The global annihilation of mangroves ecosystem is of concern as they provide diverse and high valued ecosystems services to human communities, both direct and indirect. The mangrove forests have been shown to sustain more than 70 human activities, ranging from fuelwood collection to fisheries. Present study was carried out to know various usage of mangrove, economic benefits and perceptions about mangrove cover in two adjoining estuaries, Mahi and Dhadhar River, in Gulf of Khambhat, Western Coast of India. A Questionnaire based survey was carried out in 18 villages with sample size of 25 individuals per village. The result showed high dependency pressure and overall mangrove users are more in Mahi river estuary. Use of mangrove as a fishing resources was the main use apart from use as a fodder and use of mangrove, Avicennia marina, seeds as food by local villagers. Conservation knowledge about mangrove ecosystem was good and people noticed increased in mangrove covers probably because of recent mangrove plantation projects by various organizations in the study area.

16:30 - Tracking the Footprint of Global Fisheries: New Opportunities for Fisheries Science & Marine Conservation

Mr. Juan Mayorga[1]

[1]National Geographic Society's Pristine Seas project & University of California, Santa Barbara, Bren School of Environmental Science and Management

Although fishing is one of the most widespread activities by which humans harvest atural resources, its global footprint is poorly understood and has never been directly quantified. We processed 22 billion automatic identification system messages and tracked ~70,000 industrial fishing vessels from 2012 to 2016, creating a global dynamic footprint of fishing effort with spatial and temporal resolution two to three orders of magnitude higher than for previous data sets. Our data show that industrial fishing occurs in ~55% of ocean area and has a spatial extent more than four times that of agriculture. We find that global patterns of fishing have surprisingly low sensitivity to short-term economic and environmental variation and a strong response to cultural and political events such as holidays and closures. We illustrate the vast potential of this dataset to 1) inform the creation of new marine protected areas (MPAs) by allowing us to quantify trade-offs between fisheries and conservation, 2) evaluate the effectiveness of fisheries and conservation measures such as Indonesia's IUU policy, and 3) estimate the net fishing profits and the role of government subsidies in high seas fisheries.

16:45 - Where you are and what you eat: stable isotope analysis for marine conservation

Mr. Matt Tietbohl[1]

[1]King Abdullah University for Science and Technology

Understanding how animals move through and use their environment underpins much of the information marine managers need to best manage marine ecosystems. Having well-connected habitats and high biodiversity is known to allow marine habitats to have increased flexibility in their ability to adapt to climate change and other human stressors. Stable isotope analysis is a useful tool for better understanding how different marine organisms interact to produce productive, healthy ecosystems. While conventional bulk stable isotope analysis has yielded key information about animal movement and food web structure, new advances in compound-specific stable isotope analysis (CSIA) are opening doors to vastly improve our understanding of how marine ecosystems function. Using CSIA of δ13C and δ15N values from essential/non-essential and source/trophic amino acids, researchers are gaining an unprecedented view into how marine organisms historically and currently use their environments. Recent studies have documented shifts in the foraging ecology of seabirds to diets dominated by lower trophic level squid, quantified the contributions of different habitats and food sources to economically important fishes' juvenile populations, and developed new understanding of the different roles herbivorous fishes play on coral reefs, among other key findings. This talk aims to expound on key results from recent CSIA research efforts, with a goal of highlighting their relevance for marine managers. When incorporated with current management plans, CSIA has great potential to positively influence ecosystem-based management initiatives.

17:00 - Developing and testing a collaborative data collection method to characterize the deep-slope demersal fishery in Indonesia

Ms. Elle Wibisono[1], Prof. Peter Mous[2], Prof. Jos Pet[3], Prof. Austin Humphries[1]

[1]University of Rhode Island, [2]The Nature Conservancy Indonesia, [3]People and Nature Consulting International

Indonesia is the center of marine biodiversity and the second largest global seafood producer. Here, many fisheries go unmanaged. This results in either overexploitation or their status remains uncertain because there are no data. The deep-slope (50-500 m) multispecies demersal fishery remains as one of the few lucrative commercial fisheries in Indonesia and is characterized by dropline and longline gears

that capture over 100 species of grouper, snapper, and emperor. Our research aims to ensure the sustainability of this fishery with a theory of change built around a collaborative data collection system. Thus, we have developed a Captain Operated Data Recording System (CODRS), which collects detailed catch and effort data for the past 3 years. Our results indicate that 52% of catch composition is dominated by six species. In addition, we have identified fifteen species that have never been considered a part of this fishery. We found significant differences in catch composition between dropline, longline, and mix gear, however, Pristipmoides multidens is the top species in all gear types. We calculated percentage of catch below length at first maturity (Lmat) and found that the most dominant species, P. multidens, was dominated by immature individuals. Fishing effort was correlated with vessel size and was not dispersed equally among fishing grounds. In fact, many fishing grounds were located across two different Fishery Management Areas (FMAs). Our findings show that characterizing a fishery through collaborative methods can serve as an effective way to collect data that informs sustainable fisheries management.

17:15 - Net-Works - delivering more fish, less plastic

Dr. Nicholas Hill[1], Mr. Amado Blanco[2], Ms. Surshti Patel[1], Mr. Gildas Andriamalala[1], Ms. Rosemarie Apurado[2], Ms. Frenz Garcia[2], Ms. Hazel Panes[2], Mr. Godofredo Jr Villapando[2], Ms. Miriam Turner[1], Prof. Heather Koldewey[1]

[1]Zoological Society of London, [2]ZSL-Philippines

On the current trajectory of plastic pollution and overfishing there will be one tonne of plastic for every three tonnes of fish in the ocean by 2025. The people most affected are those in marginalised rural communities within biodiversity hotspots of the developing world, especially in Southeast Asia which contributes ~60% of the world's marine debris, is the centre of marine biodiversity, contains 55% of the global population of artisanal reef fishers and suffers the highest level of fishing pressure.

Community-based Marine Protected Areas (MPAs) with No-Take Zones (NTZs) and mangrove rehabilitation areas are key tools for restoring coastal ecosystems and enhancing socio-ecological resilience. There are ~1,500 MPAs in the Philippines (NTZs average 12ha) that are often too small to be effective due to high dependence of communities on fishing. They typically focus on coral reefs and do not capture critical seagrasses or mangroves, and are too dependent on donor funding cycles.

In this presentation we describe a simple, scalable and holistic model that delivers less plastic, more fish and improves the lives of marginalised coastal communities across Southeast Asia. By creating efficient community-based supply chains around aquaculture and recycling of fishing nets and linking them to conservation actions, we are able to increase the average size of NTZs to over 200ha, whilst also breaking the cycle of boom and bust that comes from an over-dependence on donor funding. We will discuss our learnings from implementing this model, results to date, and areas for future development.

17:30 - Development of a dynamic management tool to aid in the bycatch reduction and recovery of the critically endangered Eastern Pacific leatherback turtle

Ms. Aimee Hoover[1], Prof. Helen Bailey[2], Prof. Dong Liang[3], Ms. Hannah Degenford[4], Dr. George Shillinger[5]

[1]Upwell, University of Maryland Center for Environmental Science, [2]University of Maryland Center for Environmental Science, [3]Upwell and University of Maryland Center for Environmental Science, [4]University of Maryland, [5]Upwell

The critically endangered Eastern Pacific leatherback turtle has declined by over 97% since the 1980s and is at risk of regional extinction. Leatherback turtles historically nested along Mexican and Central American nesting beaches. Impacts from fisheries bycatch and egg poaching are among the major reasons for their decline. Management of leatherback turtles and other highly migratory marine organisms requires an understanding of their year-round distributions to reduce fisheries bycatch both nearshore and offshore. In this study, we combined satellite telemetry data and fisheries observations of leatherback turtles to develop a habitat-based model of their distribution. In order to account for the complexities of the data set, a novel modeling approach was applied in this analysis. We used a Poisson generalized linear model in a continuous-time Markov chain (CTMC) model framework for the telemetry data to predict individual, post-nesting leatherback movement throughout the South Pacific based on environmental drivers, such as sea surface temperature. Population-level estimates of leatherback movement were obtained with a Bayesian approach. Fisheries observations were incorporated using a point process model to estimate density under varying environmental conditions for these predominantly juvenile leatherbacks. Monthly, near-real time predictions of leatherback movement throughout the South Pacific are then estimated with these parameters and the most recent satellite-derived environmental information. This tool will help to inform managers, fishers and other stakeholders how to anticipate and prevent fisheries interactions, which is vital for ensuring the viability of this leatherback turtle population.

S-168: Optical Technology and Computer Vision for Marine Conservation and Sustainable Management (16:00 - 18:00, Tubau 2

16:00 - Advances in optical technologies to improve scientific information for the conservation and management of living marine resources.

Mr. William Michaels[1], Dr. Matthew Campbell[1]

[1]NOAA Fisheries

Recent advances in the development and utilization of optical technologies has enhanced the quantity, quality and timeliness of scientific information for the sustainability living marine resources. These advances are particularly helpful for supporting data-limited stock assessments in habitats that are difficult to sample, such as coral reefs. Transitioning optical technologies into enhanced survey operations include improved stereo camera/video systems for more accurate identification and measures, autonomous platforms to cost-effectively increase survey coverage, and improved software with machine learning to streamline the labor intensive processing of underwater imagery data. To transition technologies beyond the research and development phase, an evaluation of the technology's performance and cost-benefits is critical for developing the business case to transition technology into survey operations. This decision must be directed by management priorities and operational objectives, appropriate calibrations for standardized measures, and reliability of sustained measures for time series data used in assessments and forecasting. Rapidly evolving technology presents challenges for survey operations, data management, and maintaining a high level of accuracy and precision in environmental monitoring and survey operations that rely on standardized measures to support our long-term time series. As we strive to augment or enhance survey operations with innovative technologies, we should also minimize disruptions to

our business practice for supporting stakeholders with the best scientific information available for effective policy decisions.

16:15 - VIAME: Video and Image Analytics in Marine Environments

Mr. Matthew Dawkins[1], Dr. Jon Crall[1], Dr. David Zhang[2], Mr. Linus Sherrill[1], Dr. Lakshman Prasad[3], Dr. Kresimir Williams[4], Dr. Michael Piacentino[2], Dr. Anthony Hoogs[1], Dr. Benjamin Richards[4]
[1]Kitware Inc., [2]SRI, [3]Los Alamos National Laboratory, [4]NOAA Fisheries

Seafood sustainability is predicated on healthy fish and shellfish populations. Recent developments in the collection of large-volume optical survey data by autonomous underwater vehicles (AUVs), stationary camera arrays, and towed vehicles has made it possible for fishery scientists to generate species-specific, size-structured abundance estimates for different species of marine organisms via imagery. The immense volume of data collected by such survey methods quickly exceeds manual processing capacity and creates a strong need for automatic image analysis. To address these challenges, we have created the Video and Image Analytics for Marine Environments (VIAME) toolkit, at viametoolkit.org. VIAME is an open-source computer vision software platform designed to integrate common image and video analytics, such as stereo calibration, object detection and object classification, into a sequential data processing pipeline that is easy to program, multi-threaded, and generic. The system provides a cross-language common interface for each of these components, multiple implementations of each, as well as unified methods for evaluating and visualizing the results of different methods for accomplishing the same task. Most recently, the ability to measure fish, to run detector ensembles, and to rapidly train models for novel detection tasks has been integrated into the platform. Sponsored by the Automated Imagery Analysis Strategic Initiative of the United States National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS), VIAME will be deployed at multiple NOAA Fisheries Science Centers to continue improving scientific data that support stock assessments. VIAME will also be freely available to the global community of marine researchers.

16:30 - Automatic recognition, counting and measurement of fish from underwater stereo-video

Prof. Euan Harvey[1], Prof. Mark Shortis[2], Dr. Ajmal Mian[3], Dr. Faisal Shafait[4], Dr. James Seager[5], Dr. Phil Culverhouse[6], Dr. Duane Edgington[7], Dr. Danelle Cline[7]
[1]Curtin University, [2]School of Science, RMIT University, [3]School of Computer Science and Software Engineering, The University of Western Australia, [4]National University of Sciences and Technology, [5]SeaGIS, [6]Centre for Robotics and Neural Systems, University of Plymouth, [7]Monterey Bay Aquarium Research Institute

Underwater stereo-video systems are used for counting and measuring fish in aquaculture, fisheries and conservation management. Decreases in the costs and size of video cameras and increases in image resolution have made this technology more accessible. There has also been a rapid uptake of video based sampling in the marine environment over the last 2 decades. The manual identification, counting and measuring of fish in video images by human operators is labour intensive, costly and is a major disincentive against the uptake of this technology. Automating species identification, counts and length measurement using computer vision and machine learning techniques will have a huge impact on marine science and conservation and fisheries management. We present results for both identification and measurement and discuss future directions.

16:45 - Challenges and recommendations related to the storage and accessibility of voluminous optical data collected for monitoring living marine resources

Ms. Sarah Margolis[1], Mr. Chris Beaverson[2], Mr. Mashkoor Malik[2], Dr. Benjamin Richards[3], Mr. William Michaels[1]
[1]NOAA Fisheries, [2]NOAA Office of Oceanic and Atmospheric Research, [3]NOAA Pacific Islands Fisheries Science Center

There is an unprecedented growth of digital imagery information from many of NOAA's science based operations, services, and products. For the purposes of this presentation, optical data refer to digital video and still images collected from the marine environment. When optical data are archived efficiently and properly, a decrease in the cost and human effort will be realized in processing these large image datasets with benefits in more timely results, and increased utilization that may extend beyond the original operational purpose for the data. NOAA programs have made progress with the collection, storage, and processing of various imagery data, yet efforts are underway to improve the accessibility of these data to streamline processing, and enhance capabilities in analysis and visualization. Standardized metadata, reliable storage, and easily accessible archives are a priority for NOAA's data enterprise to advance the use of optical data for the NOAA mission and the wider scientific community. This presentation will highlight the current state of optical data collection, storage, and accessibility by NOAA Fisheries, and highlight associated challenges and recommendations. Our goal is to provide guidance as we adapt to the next generation of optical technologies that will streamline the processing and accessibility of large data sources.

S-181: Coral reef conservation in a rapidly changing world: traditional strategies and new paradigms (16:00 - 18:00, Kerangas)

16:00 - Changes in coral cover and coral size distribution in Mexican reef restoration sites.

Mrs. Gabriela Nava[1], Mr. Miguel Garcia[1], Mr. Edgar Samos[1], Mrs. Claudia Le Clercq[2]
[1]Oceanus, A.C., [2]Oceanus

Four years ago Oceanus and its partners started a Reef Restoration Program focused on strengthening resilience and the adaptation potential of coral reefs in the Gulf of Mexico and the Mexican Caribbean. The Program involves the transplant of thousands of colonies every year and identification of genetic material to increase diversity in restoration sites, thereby promoting natural resilience and resistance to climate change and local stressors. After four years sites are starting to show visible changes of recovery. Monitoring of trasplants has indicated success in survival (80%) and growth, which will mean sexual maturity in a short time and subsequent sexual reproduction. Due to the continuous input of new colonies (small sizes), cover of living tissue in each colony ranges from 1.5 cm2 to 86 cm2 with an average of 17cm2. According to field results to date, at least 10% of the total of colonies already trasplanted, at least in 2 sites, are in this stage. After achieving that size, every additional year of growth, the proportion of the colony that spawns will increase according to maturity. Sexual reproduction of transplanted colonies is the ultimate goal, as it will start the multiplier effect of restoration, sending hundreds or thousands of genetically diverse larvae and recruits to new sites on the reef.

16:15 - Managing for systemic resilience in coral reef systems and marine reserves

Dr. Karlo Hock[1], Dr. Nicholas Wolff[2] , Dr. Juan Ortiz[1] , Dr. Scott Condie[3] , Dr. Kenneth Anthony[4] , Dr. Paul Blackwell[5] , Prof. Peter Mumby[1]

[1]The University of Queensland, [2]The Nature, [3]CSIRO, [4]Australian Institute of Marine Science, [5]University of Sheffield

Individual reefs in coral reef systems are exposed to different levels of disturbance impacts. This spatial heterogeneity of exposure patterns will result in, sometimes temporary, refugia that can support the recovery of coral populations on affected reefs through connectivity. Combining individual source-sink relationships into a system-level connectivity network highlights reefs with the highest potential to support regional recovery processes. Ideally, such reefs will have not only high replenishment potential but also preserved adult stocks due to low exposure. The presence of such reefs will make the whole system resilient, as the potential for recovery could persist even after large portions of the system have been affected. Here we use Australia's Great Barrier Reef as an example to show how such an analysis can be performed. We also address the challenges inherent in such prioritisation, chiefly the need to account for spatiotemporal changes in disturbance patterns, especially as the disturbance impacts become more intense and unpredictable with climate change. Moreover, variability in connectivity patterns can leave critical sources vulnerable to not only increasing exposure, but also to recovery setbacks due to loss of upstream connectivity. Ecosystem and connectivity models therefore need to capture these dynamic processes in order to inform management decisions that aim to prioritise reefs for their role in maintaining systemic resilience. These principles can also be applied to not only conservation and planning marine reserves under climate change, but also to guide restoration efforts, manage spatially explicit fisheries, and detect potential regime shifts.

16:30 - Linking coral reef conservation interventions to social and ecological impacts

Dr. Gabby Ahmadia[1], Dr. Dominic Andradi-Brown[2], Ms. Louise Glew[3], Mr. Awaludinnoer Ahmad[4], Dr. Helen Fox[5], Mr. Nur Ismu Hidayat[6], Dr. Michael Mascia[6], Mr. Defy Pada[6], Dr. Fitry Pakiding[7], Mr. Purwanto Purwanto[7]

[1]World Wildlife Fund-US, [2]World Wildlife Fund, [3]WWF-US, [4]The Nature Conservancy, [5]National Geographic, [6]Conservation International, [7]University of Papua (UNIPA)

Corals reefs are increasingly under pressure, with the rapidly changing environment and increase in human populations leading to more intensive use of marine resources. To reduce local threats on coral reefs, marine protected areas (MPAs) are the most commonly used conservation intervention. MPAs come in many forms ranging in how that are established and designed to reach those conservation objectives. While MPAs have been show to have positive social and ecological outcomes, this is not always the case; key to their future success is understanding underlying conditions that lead to different outcomes. Recent global studies have documented characteristics of MPAs that have led to positive ecological outcomes, however, the resolution and conclusions of these studies remains coarse. Here, we present a study in the Bird's Head Seascape (BHS) in Indonesia, the epicenter of coral reef diversity, that uses a rigorous quasi-impact evaluation design to examine both social and ecological impacts in an MPA network. We find variation in results within and among both indicators and MPAs. While we begin to disentagle characteristics leading to this variation, there are general trends in the region that we hypthosize are driving these changes. The MPA has reduced fishing pressure in certain areas and been successful at removing large fishing vessels from entering waters within the MPAs boundaries. In addition, while the BHS has been spared of wide-scale climate change impacts, this is a region that is experiencing increases in population, infrastructure, and due the MPAs success - a large increase in tourism.

16:45 - Strategic conservation and management of coral reefs in the Anthropocene

Dr. Emily Darling[1], Indo-Pacific Coral Collaboration

[1]Wildlife Conservation Society

With the future of tropical coral reefs in jeopardy, solutions are urgently needed that can address both local and global anthropogenic stressors. Here, we evaluate the influence of 21 climate, social, and environmental drivers on the abundance of four reef coral functional 'types' using an unprecedented ecological dataset of 2,584 Indo-Pacific coral communities. Higher abundances of important framework-building corals were associated with: weaker past thermal disturbances and longer recovery intervals; slower human population growth; less access by human settlements and markets; and less nearby agricultural use. We further identify a small subset of reefs (n = 449, or 17.4%) that were exposed to limited thermal stress during the third global coral bleaching event in 2014-2017. Under the stewardship of 22 countries, these reefs are immediate policy priorities to manage and mitigate stressors to sustain the last, functioning reefs of the Indo-Pacific.

17:00 - Cross-sector collaboration enables the achievement of development, health, and coral reef conservation goals

Dr. Amelia Wenger[1], Dr. Stacy Jupiter[2], Dr. Simon Albert[3], Dr. Daniel Harris[4], Dr. Talitha Santini[4], Mr. Nicholas Hutley[3], Prof. James Watson[4], Dr. Carissa Klein[4], Prof. Peter Mumby[1]

[1]University of Queensland, [2]Wildlife, [3]School of Civil Engineering, The University of Queensland, [4]The University of Queensland

Increasing development in tropical regions provides new economic opportunities that can improve livelihoods, but it threatens the functional integrity and ecosystem services provided by terrestrial and aquatic ecosystems when conducted unsustainably. The UN Sustainable Development Goals aim to balance these potentially competing interests through emphasizing the co-benefits that can arise when development planning and management incorporate both human and environmental health. Yet, determining ways to manage development in order to maximize co-benefits and minimize trade-offs is still not fully understood. This study quantifies the impacts of logging activities on sustainable soil erosion rates, downstream drinking water quality, and coral reef health. Further, we examine the ability of common erosion reduction strategies, stipulated in logging codes-of-practice, to reduce these impacts as clearing extent increases. We found that increasing land clearing - even with best management strategies in place - led to unsustainable levels of soil erosion and significant impacts to downstream water quality, compromising the integrity of the land for future agricultural uses, consistent access to clean drinking water, and important downstream ecosystems. The spatially-explicit examination of the impact of land-clearing on multiple sectors allows for an examination of locations where development activities could occur that minimizes impacts to key ecosystem services, thus providing opportunities to achieve development, health, and coral reef conservation goals. Our results demonstrate that in order to achieve multiple Sustainable Development Goals in one location, the approach taken here to understand cross-sector interactions must be applied more broadly.

17:15 - Drivers of coastal communities' adaptive capacity in the Western Indian Ocean

Dr. Stephanie D'agata[1], Dr. Georgina Gurney[2] , Dr. Joseph Maina[1] , Ms. Caroline Abunge[3] , Dr. Tim McClanahan[3] , Dr. Emily Darling[4]

[1]Macquarie University, [2]Australian Research Council Centre of Excellence in Coral Reef Studies, James Cook University, [3]Wildlife Conservation Society, [4]WIld

In Madagascar and Kenya, coral reefs have decreased dramatically in recent years due to human activities and climate change. Evidence of recent declines of fishery resources, especially species of high value, such as shrimp, sharks, and sea cucumbers, has been documented, and most of the small-scale coastal fisheries in Madagascar and Kenya are considered unsustainable, largely due to overharvesting and destructive fishing practices.

We looked at drivers of adaptive capacity at the local and regional scale and resilience of communities across a gradient of dependence on fisheries resources in three seascapes in Madagascar, in the southwest, northwest and northeast in 26 villages and in 16 villages in Kenya. Households socio-economic surveys as well as ecological and catch surveys were performed in all areas. Preliminary results demonstrated significant differences in the level of dependence on coastal and marine resources across seascapes in Madagascar and Kenya, the southwest seascape presenting higher dependence and potential vulnerability while the northeast presenting the lowest vulnerability due to other sources of resources. We also observed significant differences among seascape that could be explained by coping strategy by certain households to increase adaptive capacity in a particular seascape. Overall, local and regional drivers of adaptive capacity had both significant influences on adaptive capacity. Counter intuitively, despite the significant differences between seascape and countries, the proportion of fish catch sold was constant across all seascape (about 80%), which might be explained by external factors such as the influence of a market as a key driver of adaptive capacity.

17:30 - Lessons and experiences of co-management of coastal small-scale fisheries from the western Indian Ocean

Dr. Nyawira Muthiga[1], Mr. Maxwell Kodia[1]

[1]Wildlife Conservation Society

In the Western Indian Ocean (WIO), challenges of managing small-scale fisheries (SSF) resources and perceived failures of top-down approaches have inspired a shift towards collaborative governance arrangements or co-management. However, despite the popularity of co-management, the institutionalization and effectiveness of the approach are not well understood. We undertook an expert opinion study with the objective of: (1) evaluating the process and incorporation of institutional design elements into co-management and (2) identifying and ranking the barriers and the solutions for effective co-management of SSF in the WIO. The evaluation was undertaken during a regional workshop using questionnaires and working group discussions. Participants included individuals using or trading SSF resources, implementing management, developing policy or in some other ways influencing co-management. The thirty-eight experts from 6 countries reported a diversity of challenges and ranked financing, benefit sharing and access, management, compliance and enforcement, political influence and poor leadership as the top challenges. In terms of national institutionalization of co-management, most countries had supportive laws, but few had guidelines for monitoring and implementation resulting in ad-hoc arrangements that often lacked the design elements that enhance success. This limited effectiveness and sustainability of co-management. The importance of taking into consderation the social and political context, the governance context, the nature of the resource, potential social disruption, problematic expectations and the presence of many other role-players were also ranked amongst the aspects that influenced the success of co-management.

Speed Talks (16:00 - 18:00, Kabu)

16:00 - Catch structure of Lobsters in Southeastern Madagascar

Dr. Daniel Raberinary[1], Dr. Paubert Mahatante Tsimanaoraty[2]

[1]Marine Institute Anosy For-Dauphin, [2]Marine Institute Tulear

Majority of domestic catch of lobsters in Madagascar is found in Southeast coast. In this Island, 5 species of lobsters are present (Panulirus homarus, P. longipes, P. ornatus, P. penicillatus, P, versicolor) and the P. longipesand P. homarusdominate the catch. The fishing technics are totally small-scale (traditional) - by trap, snorkeling and net. Data from regional fisheries authority reports catches have declined, likely due to over-exploitation.Data from 2000 to 2017 show that catch trend has decreased but not very strong (r2 =0,3) and the annual catch is around 200 tonnes. Surplus model analysis of this data show also that lobster stock in this region is fully exploited. Data from socio-economic survey and catch survey show that CPUE per canoe per day is still benefit for fisherman during the last 3 years (CPUE = 1,22 per canoe per day). Seasonality Test of the catch confirms as well that the maximum of the production happens in January and in April to May. The test shows that 70.91% of production are dependant on the season. Those results are very important and used to regularly verify the duration and the season of national closure, in additional to the reproduction data. Key words: Lobsters, Southeast coast Madagascar, catch, seasonality.

16:05 - Fixed ideas in fluid contexts: research and management of olive ridley turtles in Odisha, India

Dr. Madhuri Ramesh[1]

[1]Dakshin Foundation

In the domain of wildlife conservation, and as the main theme of this conference also suggests, it is believed that science has important insights to offer those involved in the management of coastal/marine areas and species. However, scientists often lament the lack of science-driven policy and management measures. This gap between rigorous understanding and the ability to drive actual changes in practice (i.e. knowledge and power) is often attributed to a 'communication gap'. This is particularly the case in developing countries where scientists and managers are located in different institutions and the former are usually more highly educated than the latter. However, in this paper, I suggest that this dissonance between scientists and managers is the result of a fundamental clash between different types of rationality: one that accepts fluidity as a natural feature and another that seeks to impose fixity. I trace the ways in which this has affected the conservation of olive ridley turtles in two globally important breeding habitats (Gahirmatha and Rushikulya located in Odisha, eastern India) and discuss ongoing attempts to address these debates around what constitutes 'rational' conservation.

16:10 - Modelling the connectivity of the black cod (Epinephelus daemelii): is there overlap with the current MPA network?

Mr. Steven Hawes[1], Dr. Will Figueira[1]

[1]*University of Dar es Salaam*

The black cod Epinephelus daemeliiis a large, long-lived reef fish of the family Serranidae, found mostly along the New South Wales (NSW) coastline. Listed as a threatened species since 1983, due to population declines from fishing pressure throughout the 20th century. NSW (and Commonwealth waters) has a network of marine protected areas (MPA) that have effectively been in place since 2007, albeit the size of no take zones within each MPA varies. Despite most known E. daemelii populations occurring within MPAs, the populations do not appear to be recovering. One explanation is that the current MPA network does not meet its objectives for E. daemelii. The aims of this study was to investigate the connectivity of E. daemelii along its known distribution, identifying potential strong spawning regions and regions of strong settlement. Using a biophysical dispersal model, larvae were released during April-May (2004-2011) from 19 known regions across its distribution and tracked until settlement (both reefs and intertidal rocky shores). Using the modelled connectivity, we can predict areas where E. daemelii could benefit from additional protection. We identified four strongly connected communities across the distribution. While each community contained marine protected areas (and no take areas), we identified areas in the northern and central communities with strong settlement success, high local retention and strong stable settlement, where additional protection might be beneficial. This study provides insights into the connectivity of E. daemelii in the NSW region, which can be utilised by conservation managers to aid in its recovery.

16:15 - Estimations of the tourist carrying capacity of whale sharks (Rhincodon typus) in the Bay of La Paz, B.C.S. Mexico

Ms. Maritza Cruz Castillo[1], Mrs. Gabriela Moreno[2], Mrs. Lizbeth Meza[3], Mrs. Georgina Saad[4], Dr. Jorge Cáceres[5], Dr. Dení Ramírez-Macías[1]

[1]*Tiburón Ballena México de Conciencia México,* [2]*Delegación Federal de la Secretaría de Medio Ambiente y Recursos Naturales en Baja California Sur, México,* [3]*Universidad del Medio Ambiente,* [4]*World Wildlife Fund,* [5]*Secretaría de Medio Ambiente y Recursos Naturales*

A high number of juvenile whale sharks (Rhincodon typus) gather to feed in a predictable manner at the Bay of La Paz, Mexico. The analysis of fresh injuries carried out from 2009 to 2016 shows that each year between 35% and 64% of sharks are harmed by boats. This problem originated by an increase on demand for tourist activities has generated the need to take specific management measures. A numerical model was implemented for the calculation of Tourist Carrying Capacity (TCC). 73 field work trips were made between 2015 and 2016, in order to record the number of boats making the whale shark activity and the good practices of the rules. for this study, the average number of photo-identified sharks per month was taken as abundance, using historical data from 2007 to 2016. The calculation of TCC was carried out monthly because shark numbers vary throughout the season, presenting a high in December with a range of 8 to 53 photo-identified sharks and an average of 31 sharks. Data shows a range from 6 to 17 boats at the same time. However, based on this study, modifications were made to the management plan and the precautionary principle was followed, starting with 14 boats at the same time. A tourist season that covers the months of October to April is suggested. It will be discussed how the management of this species must take into account the seasonality and abundance of sharks and the challenges to conservation that they entail.

16:20 - Our Sea Our Life: Empowering coastal communities in artisanal fisheries management in Mozambique

Mr. Raki Nikahetiya[1]

[1]*Zoological Society of London*

The 'Our Sea Our Life' (OSOL) project is addressing overfishing and threats to marine biodiversity and local livelihoods, aiming to create Community fisher Councils (CCPs) for the management of Locally-Managed Marine Areas (LMMAs) in northern Mozambique. OSOL is working with six vulnerable communities (~8000 people) and to date over 4200ha (over 400ha of no-take zones and over 3800ha of temporary reserves) of LMMAs have been established and enforced, improving the resilience of coastal ecosystems and community well-being by creating CCPs for the management of marine areas. Village Savings and Loan Associations (VSLAs) are a successful element of the project, with over 466 households enrolled in 23 VSLAs, allowing communities to diversify their income and ensuring women's financial autonomy. OSOL is a project coordinated by the Zoological Society of London, in collaboration with the Mozambican Associacao do Meio Ambiente (AMA) and Universidade Lurio, the Kenyan CORDIO East Africa, and the Portuguese Universidade de Aveiro, and Universidade de Lisboa.

16:25 - Assessing the reliability and utility of citizen science data for monitoring and managing sharks and rays

Mr. Andrew Harvey[1], Mr. Tri Nur Sujatmiko[1], Ms. Vidlia Rosady[1], Prof. Ron Johnstone[2]

[1]*MantaWatch,* [2]*University of Queensland*

Sharks and rays are the most threatened vertebrate group. At greatest risk are large-bodied, shallow-water species, many of which are flagship species for marine wildlife tourism. The value of global shark and ray tourism is estimated to exceed USD 500 million annually, with potential for further growth. Realizing this potential will require robust data on population distribution and status with which to inform and evaluate management interventions that address the threats to wild populations. However, obtaining accurate and timely data across Indonesia's expansive marine ecosystems is costly and time consuming. We present preliminary findings from a study to evaluate the accuracy and precision of population data obtained from citizen scientists. In-situ repeated measures were used to evaluate reported encounter rate estimation bias by non-specialists (recreational divers), specialists (dive professionals and guides) and experts (researchers). Crowdsourcing, machine learning and image recognition software were used to evaluate the potential of photographs, including those derived from social media platforms, to inform population assessments. We applied our findings to a 10-year data set obtained from recreational divers and tourism operators to assess long-term population trends for focal shark and ray species in Komodo National Park, Indonesia. Our findings suggest that data obtained from non-specialists and specialists can provide an accurate and precise estimate of species encounter rates, and a population status proxy to inform management planning and aid efficient targeting of research and monitoring resources.

16:30 - Plastic upcycling innovation technology in remote fishing villages as an alternative sustainable income

Mr. Sonny Culkin[1], Mrs. Murashimah Maluto[2], Mr. Jeeth Vendra[1], Dr. Catherine Jadot[3]

[1]TRACC, [2]University Putra Malaysia, [3]ES Caribbean

In the Semporna region, SW Malaysian Borneo, many of the Bajau ethnic group, a stateless oceanic tribe, live below Malaysia's national poverty line whilst living amongst coral reefs, some of the most productive and valued ecosystems worldwide. Despite the Semporna district economy relying heavily upon healthy reefs; waste management is inadequate. Plastic pollution is ubiquitous and has far-reaching consequences on the marine environment. Simultaneously, the Bajau, who also depend on the ocean, generally do not benefit from the tourism industry. Limited alternative livelihoods means there is constant pressure for food production, with destructive fishing methods (blast fishing) often heard in times of hardship (notably before celebrations). To tackle these issues, the Tropical Research and Conservation Center (TRACC) has started a community development project with funding from foreign financial donors. Plastic waste, such as straws, bottles, and bags, will be collected onshore, shredded, then , using injection and compression moulding, be upcycled into several environmentally friendly souvenir products. To assess project viability, TRACC conducted market research, quantitative waste production analysis as well as calculating future socioeconomic benefits for the local community. Local tourist vendors were found to be extremely receptive and, at the time of writing, four resorts dedicated space to sell the products. In order to maximize sales and facilitate education, TRACC created awareness booths informing visitors about environmental issues in the area and how they can reduce their impact in their daily lives.

16:35 - Understanding the barriers and supports for managing invasive lionfish with human consumption

Dr. Jennifer Solomon[1], Ms. Jennifer Chapman[2], Ms. Julie Sabattis[1], Mr. Phil Krening[1], Mr. Marc Fruitema[2], Mr. Tyrell Reyes[2]

[1]Colorado State University, [2]Blue Ventures

Venomous Pacific red lionfish (Pterois volitans) have invaded reefs across the Caribbean. In Belize, the invasion has raised concerns about deleterious impacts on the barrier reef, as well as on the fishing and tourism industries that form the core of the nation's economy. Although a growing body of research exists on the ecological impacts of the lionfish invasion, little is known about the human dimensions of lionfish management. The development of a lionfish market has been proposed as the most promising way to control the invasion. We present findings from standardized surveys of the Belizean public (n=400) and international tourists (n=386) designed to understand the potential of human consumption as a management strategy. Using the diffusion of innovation theory, we found that Belize almost possesses a critical mass of Belizean lionfish consumers (~11%) who can aid in increasing lionfish consumption locally. However, obstacles exist to reliable Belizean lionfish consumption, including market competition and misinformation concerning safeness of consumption. Tourists and Belizeans expressed willingness to consume lionfish, indicating that access to fish may be the critical barrier to address. Through participatory methods and semi-structured interviews (n=46), we found that fishers possessed substantial knowledge about lionfish but the lack of a consistent market is a major barrier to hunting. We suggest interventions aimed at increasing lionfish consumption, including segmentation for social marketing campaigns, and outreach to tackle consumer misinformation. Similar human dimensions research is needed across the geographic range of the invasive lionfish to increase potential for controlling impacts on biodiversity.

16:40 - Effect of abiotic factors on culture of Hypnea cornuta (Rhodophyta) in Fiji under a climate change perspective

Ms. Ashmeeta Shalvina[1], Dr. Nicholas Paul[2], Dr. Jimaima Lako[3], Dr. Susanna Piovano[1]

[1]The University of the South Pacific, [2]University of Sunshine Coast, [3]Fiji National University

The impacts of global climate change and anthropogenic activities have resulted in warmer oceans, sea level rise and changes in oceanic chemistry. These changes in the marine environment is affecting the sustainability of marine species for instance aquatic plants and animals and conserving these species is becoming a major concern. One of such species is Hypnea cornuta which is native to Fiji. H. cornuta is widely used by coastal communities as a source of food and for income generation but abundance and availability of it is becoming an issue. Hence, this study investigates the effects of temperature, salinity and nutrient concentration on the growth of H. cornuta. In this study an orthogonal experimental design was used for the aquaculture of H. cornuta at different temperatures (24C and 30C), salinity (25 ppt and 40 ppt) and nutrient concentrations (0.1 mg/l and 0.5 mg/l nitrogen). It was found that H. cornutashowed negative specific growth rate across all the culture treatments. The highest biomass loss was observed in high temperature than low temperature treatments and high salinity than low salinity treatments. Nutrient concentrations showed limited effects. Therefore, an increase in ocean temperature and salinity (the consequences of climate change) will further affect the abundance and availability of H. cornuta in Fiji as it was not able to grow well in culture conditions. The coastal communities will face the issue of food insecurity and income generating problem hence it is really important to conserve this species from an inevitable impacts of climate change.

16:45 - Bedouin clam fisherwomen of South Sinai, Egypt - a culturally significant fishery in decline

Mr. Chris Poonian[1]

[1]University of Nottingham

Although overfishing in tropical finfish fisheries has been studied in some depth, invertebrate fisheries are rarely monitored and often unregulated. Invertebrates have been gathered on foot in the intertidal zone throughout the tropics since prehistoric times, primarily by women. In South Sinai, Mzeina Bedouin women traditionally harvest Tridacna spp. at low tide on shallow reef flats using metal spears. I evaluated Tridacnadensity and size at eight intertidal fishing sites in South Sinai and discussed details of fishery with Bedouin women. It was apparent that the fishery had significantly declined in recent years, and was also subjected to negative impacts from unrestricted coastal development. There was a noticeable gradient of improved habitat and larger clam density and size with increasing distance from the main Bedouin settlement. In areas where the Bedu gained alternative income from tourism, clams were also larger and more abundant. The decline in these resources may have the dual effect of altering women's roles and importance within the household and the community on the one hand and causing a decline in household levels of food security and income on the other. Currently, the Bedu are exempt from fishing regulations within MPAs in the area. However, enforcement of fishing restrictions, particularly at remote fishing sites as those fished by the Bedu would be complicated. As such, the most realistic option could be to develop a locally-supported, self-imposed

management regime among Bedouin women, building awareness of the biology of the target species and links between resource management and sustainability.

16:50 - Fishing for Compliance - Including fishers in the Policy-making Process

Ms. Mareike Dornhege[1], Prof. Anne Mcdonald[1]
[1]*Sophia University Tokyo*

Marine policy-making is generally still a top-down process in most parts of the world. This might lead to reduced compliance with imposed rules by fishers for a number of reasons: policies might be perceived as limiting and impractical, and further, psychological factors like pride also plays a role in the adoption of new frameworks. These factors have been explored in interviews from 2014-2016 with Japanese offshore longline fishermen in the port of Kesennuma, the biggest landing port for the Japanese shark fishery and a hub for Pacific tuna and billfish species. Outcomes include that compliance was generally high amongst Japanese fishers, yet some of them reported modifying tools and measures they received from government officials to match their needs better. The majority expressed desire to be included in the decision-making process and presented their own ideas regarding increasing the sustainability of their fishery, including seasonal closures, MPAs, size limits and other measures that are currently not implemented by the Japanese government. It can be concluded that including fishers in the process can not only increase compliance, but also practicability of policies in the field and promote further measures that are currently not being considered.

16:55 - Rapid test to detect the infection load of the parasite, Anguillicola crassus, in the European eel Anguilla anguilla

Mr. Michele De Noia[1], Dr. Joshka Kaufmann[2], Dr. Russell Poole[3], Dr. Philip McGinnity[2], Dr. Martin Llewellyn[1]
[1]*University of Glasgow,* [2]*University College Cork,* [3]*Marine Institute*

Anguillicola crassus is a nematode parasite of the swim bladder originally endemic to Japanese eels, Anguilla japonica. A. crassus was introduced into Europe in the 80's since when it has spread widely and is thought to contribute to the rapide decline in the European eel. Currently, the only way to detect the parasite is to dissect the eel. We are developing a non-lethal rapid test based on presence/absence of eggs and L2 larvae in the faecal material. A faecal wash had been performed on c.60 European eels in the Burrishoole catchment in Ireland. qPCR primers were designed based on CO1, 18s specific genes and transcriptome available in the literature. Primers were tested using pure A. crassus DNA and and related nematodes to establish the specificity. To validate the test 24 eels were fecal sampled, euthanized, dissected, and the number of worms counted in the swim bladder. The rapid test is in an optimisation phase and we hope will be a valulable tool for fisheries managers hopeing to interrupt transmission of the parasite.

17:00 - Sea turtle conservation and livelihoods in marine protected areas of Terengganu in Malaysia

Mr. Seh Ling Long[1], Dr. Jarina Mohd Jani[1]
[1]*Universiti Malaysia Terengganu*

The local communities often rely on the natural resources but at the same time their livelihood activities can potentially pose a threat to sea turtles. There is therefore a need to understand the human dimensions in relation to their interactions with sea turtles, particularly in places where these two have an impact on each other. This study uses the Sustainable Livelihoods Approach to understand the human-sea turtle interactions in marine protected areas of Terengganu in Malaysia by exploring how, in different contexts, people draw on different types of livelihood assets which are influenced by structures and processes to develop livelihood strategies in order to achieve desired livelihood outcomes. Between October 2016 and July 2017, informal and in-depth interviews with the local communities were carried out at Perhentian and Redang Islands to understand how their livelihoods are linked to sea turtles, and how this influences their perception on human-sea turtle interactions and conservation management efforts. The local communities benefit from sea turtles through three livelihood strategies: collecting turtle eggs (consumptive use), working as a conservation ranger and in turtlerelated tourism activities (non-consumptive use). However, there are certain things they need to have (i.e. assets) and certain people they need to know to gain access to these livelihood activities. Nonetheless, whether or not their livelihoods depend on sea turtles, most of them think that conserving sea turtles is important especially for the future generations. Such understanding can provide valuable insights to ensure the sustainability of local community livelihoods and sea turtle populations.

17:05 - Seasonal distribution and diversity of seaweeds at two stations, Rameshwaram, southeast coast of India

Ms. Suparna Roy[1], Dr. Anantharaman Perumal[1]
[1]*CAS in Marine Biology, Faculty of Marine Sciences, Annamalai University, Parangipettai-608502, Tamilnadu, India*

In this present study, the two unexplored coastal areas such as Olaikuda and Vadakkadu, Rameshwaram, southeast coast of India have been explored for its seaweeds diversity to know the diversity status of these two areas. The two stations were well diversified with three groups of seaweeds such as Chlorophyceae, Phaeophyceae and Rhodophyceae. Totally, 74 species of seaweed were found in two stations among which 28 species belong to Chlorophyceae, 18 species belong to Phaeophyceae and 28 species belong to Rhodophyceae. This survey recorded 37.83% Chlorophyceae and Rhodophyceae, followed by 24.32 % Phaeophyceae. In Olaikuda, total 59 seaweeds were found. Of which, 26 species belong to Chlorophyceae, followed by 22 Rhodophyceae and 11 Phaeophyceae. The seasonal diversity of Olaikuda revealed that species diversity was equal during post monsoon and summer. A total number of 49 seaweeds including 9 Chlorophyceae, 15 Phaeophyceae and 25 Rhodophyceae were recorded at Vadakkadu. The seasonal survey at Vadakkadu showed that post monsoon and summer had the higher seaweed diversity than premonsoon and monsoon. The K-dominance plot, cluster analysis and biodiversity indices were analysed with software PRIMER package and software R statistic version 3.1.4. Package (vegan). It can be concluded that these two stations were well diversified with seaweeds.

Tales from the Sea Live Storytelling: Free to the Public

16:30 - 20:00, FJ Auditorium

Dugongs and Sea Dragons! A Conservation D&D adventure!

20:00 - 23:00, Cafe Via Mare Lounge

Dugongs and Sea Dragons - A conservation RPG adventure

IMCC5 Day 3 (26/6)

Plenary 3: John Aini and Paige West, Ph.D.

8:30 - 9:30, Ranyai Ballroom

Communities Matter: Decolonizing conservation management

John Aini is the founder and director of Ailan Awareness, an indigenous NGO in New Ireland, Papua New Guinea. He is also a Mai Mai, a traditional cultural leader, in New Ireland. Trained in Fisheries Science at the National Maritime College, Aini is one of the foremost experts on indigenous knowledge of marine environments and conservation practice in the Melanesian Pacific. He is the recipient of the Seacology award for international conservation and has served as a partner to The Nature Conservancy, The Wildlife Conservation Society, and Global Witness during their work in his country. Mr. Aini has held awards from the Asian Development Bank, The United Nations, The United States Ambassadors Fund for Cultural Preservation, The Christensen Foundation, and Columbia University. He is an advisor to the National Fisheries College, The National Fisheries Authority, and has worked with the IUCN to teach conservation workers about the importance of indigenous management practices.

Paige West holds an endowed chair and is the Claire Tow Professor of Anthropology at Barnard College and Columbia University. For the past twenty-one years she has conducted research on conservation in the Melanesian Pacific. West is the author of three books, the editor of five more, and the founder and editor of the journal Environment and Society. She is the recipient of numerous awards and fellowships including the American Anthropological Association's Anthropology and Environment Junior Scholar award (2002), the American Association of University Women Junior Faculty Fellowship (2004), and the American Council of Learned Societies Faculty Fellowship (2004), the Rockefeller Foundation's Bellagio Fellowship (2006), The Mack Lipkin Man and Nature Fellowship at the American Museum of Natural History (2013), and the Tow Family Foundation Professorship (2016). She has served as a distinguished lecturer for Phi Beta Kappa (2017/2018), the United States National Social Environmental Synthesis Center (2016), and the Leonard Hasting Schoff Memorial Lectures (2013). In 2003, she founded the Seminar on Politics, Society, Environment and Development at Columbia University, and in 2012, she became the chair of the Ecology and Culture University Seminar at Columbia. West currently serves on the board of directors for the Center for the Study of Social Difference, The University Seminars of Columbia University, the Barnard College Center for Research on Women, and as co-chair for the Pacific Climate Circuits project. She is the past chair of the Association of Social Anthropology in Oceania and the past president of the American Anthropological Association Environment and Society section. In 2017 her most recent book, "Dispossession and the Environment" won the Columbia University Press Distinguished Book Award. In addition to her academic work, Dr. West is the co-founder, and a board member, of the PNG Institute of Biological Research, a small NGO dedicated to building academic opportunities for research in Papua New Guinea by Papua New Guineans.

Since 1997, John Aini and Paige West have been working together to help understand the links between biological diversity and cultural practice and to help the people of New Ireland Province work to conserve both their natural resources and their valued cultural traditions. In 2010, they co-founded the Roviana Solwara Skul, a school in Papua New Guinea dedicated to teaching at the nexus of indigenous knowledge and western scientific knowledge.

Focus Group: Assessing and Using Guidelines for Interacting with Faith-Based Leaders and Communities

Dr. Jame Shaefer[1], Dr. David Johns[2]

[1]*Marquette University,* [2]*Portland State University*

Because 84% of people in the world identify with religions and spiritualities, profess ultimate reasons for acting ethically, and can be mobilized to act, they may be helpful to marine conservationists in their research and practice projects. The Best Practices Project was initiated in March 2016 by the Religion and Conservation Biology Working Group of the SCB to solicit successful practices members have used when interacting with faith leaders and communities and to encourage all members to consider implementing these practices in their conservation projects. After an iterative process that included a Society-wide survey, various sessions at international and regional congresses, contextualized affirmations of specific guidelines by individual members based on their projects, and comments by faith leaders, the proposed Guidelines for Interacting with faith-based Leaders and Communities when planning, initiating, implementing, closing, and following-up conservation projects was finalized in February 2018 and will be the focus of this session. Participants will (1) examine the proposed guidelines, (2) volunteer to share their experiences when implementing similar practices, (3) collaborate in developing a basic outline for case studies using the guidelines for presentation in a symposium to be proposed for the 2019 International Congress for Conservation Biology, and (4) recommend promising possibilities for disseminating the guidelines.

OS-4A: Fisheries and Aquaculture 4 (10:00 - 12:00, FJ Auditorium)

10:00 - Response of benthic fauna to experimental bottom fishing: a global meta-analysis

Dr. Marija Sciberras[1], Prof. Jan Geert Hiddink[1], Dr. Simon Jennings[2], Dr. Nick Ellis[3], Dr. Adriaan Rijnsdorp[4], Dr. Bob McConnaughey[5], Prof. Ray Hilborn[6], Dr. Jeremy Collie[7], Dr. C.Roland Pitcher[8], Dr. Ricardo Amoroso[9]

[1]Bangor University, [2]ICES, [3]EcoSciences Precinct 41, Commonwealth Scientific and Industrial Research Organization Oceans & Atmosphere, [4]Institute for Marine Resources and Ecosystem Studies, [5]NOAA, [6]University of Washington, [7]Graduate School of Oceanography, University of Rhode Island, [8]The Commonwealth Scientific and Industrial Research Organisation, [9]School of Aquatic and Fishery Sciences, University of Washington

Bottom-contact fishing gears are globally the most wide-spread anthropogenic sources of direct disturbance to the seabed and associated biota. Managing these fishing disturbances requires quantification of gear impacts on biota and the rate of recovery following disturbance. We undertook a systematic review and meta-analysis of 122 experiments on the effects-of-bottom fishing to quantify the removal of benthos in the path of the fishing gear and to estimate rates of recovery following disturbance. A gear pass reduced benthic invertebrate abundance by 26% and species richness by 19%. The effect was strongly gear-specific, with gears that penetrate deeper into the sediment having a significantly larger impact than those that penetrate less. Sediment composition (% mud and presence of biogenic habitat) and the history of fishing disturbance prior to an experimental fishing event were also important predictors of depletion, with communities in areas that were not previously fished, predominantly muddy or biogenic habitats being more strongly affected by fishing. Sessile and low mobility biota with longer life-spans such as sponges, soft corals and bivalves took much longer to recover after fishing (~3 yr) than mobile biota with shorter life-spans such as polychaetes and malacostracans (~yr). This meta-analysis provides estimates of depletion and estimates of recovery rates, which along with large-scale, high-resolution maps of fishing frequency and habitat will support more rigorous assessment of the environmental impacts of bottom-contact gears that can underpin better informed choices in trade-offs between environmental impacts and fish production.

---

not found

10:15 - Monitoring and enforcement of large Marine Protected Areas within EEZs and on the High Seas

time

Dr. Gwilym Rowlands[1], Mr. Brad Soule[2], Ms. Natallie Tellwright[2], Mr. Pablo Trueba[2], Dr. Judith Brown[3], Prof. Alex Rogers[1]

[1]University of Oxford, [2]OceanMind, [3]South Atlantic Environmental Research Institute (SAERI) Progress towards international targets for marine protection has gained momentum, largely a result of Marine Protected Areas (MPAs) encompassing large swaths of Exclusive Economic Zones (EEZs). Yet, the realization of benefits envisaged for biodiversity and stock conservation requires development of vessel monitoring and enforcement capacity at equally ambitious scales. Demonstrating such capacity is critical to High Seas protection, a pathway to which is envisaged through ongoing negotiations for a new Implementing Agreement for UNCLOS. Using OceanMind, a technology program for monitoring fishing vessel activity, we draw together over three years of data on large commercial fishing fleet movements in the Atlantic and East Pacific; data sources include satellite AIS (sat-AIS), Vessel Monitoring System (VMS), SAR satellite imagery, fishing vessel databases, oceanographic data, and coordinated at sea patrols. We draw out trends in vessel behaviour and compliance in response to both EEZ and on High Seas spatial protections. Use of SAR, in addition to sat-AIS, permitted assessment of 'dark' vessels, the scope of whose activities are generally unknown.The high level of compliance to protection suggests remote MPAs should not be dismissed as impractical. Areas with elevated risk are however implicated, particularly where vessel activity aggregates along borders. Satellite surveillance provides a viable foundation to remote vessel monitoring, extendable to both protected and fished areas. Yet, its utility is geographically variable and dependent on the quality of attendant vessel data. In developing viable monitoring and enforcement solutions we emphasize where capacity must also be built into management infrastructure, governance and policy.

10:30 - Climate-induced shifts in marine fish larval assemblages and communities of harvested species in the Southwestern Atlantic Ocean

time

Dr. Micheli Duarte de Paula Costa[1], Prof. Kerrie Wilson[1], Mr. Philip Dyer[1], Prof. José Henrique Muelbert[2], Prof. Anthony Richardson[1]

[1]The University of Queensland, [2]Universidade Federal do Rio Grande Shelf regions in the Southwestern Atlantic Ocean support one of the six richest hot spots of marine biodiversity in the Southern Hemisphere. In contrast, this region is within the warming hotspots in the ocean. Climate change will modify ocean circulation in the Southwestern Atlantic Ocean, and consequently affect species distribution patterns. Since early life stages of fish and adult population are related through the life cycle, we investigated the climate-induced changes in the distribution of fish larval assemblages and communities of harvested species in the Southwestern Atlantic Ocean through a community-based modelling approach. For that, we used gradient forest models to predict the influence of two climate change scenarios (RCP 4.5 and 8.5) to answer our two main questions: could climate change affect the distribution, abundance and composition of fish larval assemblages, and will communities of harvested species follow the same trends? Community-based approaches, such as gradient forest, have the advantage of using information from all species together, rather than species distribution approaches that treat each species independently. We found that fish larval assemblages and harvested communities are likely to move southwards and show a coastal-offshore gradient towards the coast. Also, higher expected changes are projected for the RCP 8.5 and in the southern portion of the study area for both fish larval assemblages and harvested species. These results are a first-step in predicting climate change impacts in biological communities in the Southwestern Atlantic Ocean and can bring substantial contributions to conservation and fisheries management.

10:45 - Conserving artisanal fisheries through territorial use rights in co-managed marine protected areas in Sierra Leone

Mr Sheku Sei[1]

[1]Natural Resource Management Consortium (NaReMaC), 32 Kortright, Fourah Bay College Campus

The Sierra Leone fisheries currently contribute around 10% to the country's gross domestic product (GDP) and serves as an affordable source of animal protein for over 90% of the country's population. However, as the number of fishing boats in the artisanal fisheries increased by about 55% over the past fifty years, the catch per unit of effort (CPUE) continues to decline. The use of illegal fishing gears and methods in sensitive coastal areas are among important causal factors for catch declines. In order to remedy this situation, territorial use rights in fisheries (TURFs) is being introduced using co-managed marine protected areas (MPAs) as a conduit. This paper presents the detailed process of the evolution of MPAs into TURFs, using scientific and local community knowledge

within a co-management framework. Community participatory management skills has been strengthened through the legal establishment of 32 clustered co-management associations (CMAs), with constituted roles to enable their assumption of stewardship responsibilities for MPAs that are now evolving into TURFs. A multi-criteria decision making analysis has revealed a number of successes and challenges with the key lesson that the MPA establishment process was rushed without fully addressing the community requirements for alternative livelihoods. Hence the high dependence on fishing as a sole economic source in most communities has hindered the adherence of resource users to MPA regulatory rules. Access right enforcement decision making ranks highest amongst the various management criteria impeding the introduction of territorial use rights in the artisanal fisheries of Sierra Leone.

11:00 - Bycatch and discard of longline fisheries in the Atlantic Ocean: its implication on marine ecosystem conservation and management

Prof. Julia Hsiagwen Huang[1]
[1]*National Taiwan Ocean University*

Taking ICCAT (International Convention for the Conservation of Atlantic Tuna) as an example, the management and conservation measures of regional fisheries management organization were mainly focus on major tuna, billfish and sharks. However, the bycatch/discard of other species were less attention. For understanding the impact on marine ecosystem, onboard observer data of Taiwanese large scale tuna longline fleets from 2009-2017 were used to analyze the spatial-temporal distribution of all species caught. Not like that seven species were accounted 97% of total catch from logbook, the results showed the recorded species were ranged from 43 for temporal operating albacore-targeting vessels to 46 species for tropical operating bigeye tuna-targeting vessels. The species diversity was higher in the tropical area. The discard rates significantly different by fleet, species, and area. Long snouted lancetfish, Crocodile shark, cookie cutter shark, and pomfrets were the major discard species. Among commercial species, blue shark and swordfish discard rates were over 40%. For swordfish, the discard rates were higher in the last quarter and when the catch rates were higher. These were due to quota limitation. It is suggested to consider full utilization on those discard species and take those number into the consideration for stock assessment.

11:15 - The Old Man and the Sea: Reconstructing the History of the Ocean Life around Ascension Island

Ms. Polly Burns[1], Dr. Julie Hawkins[1], Prof. Callum Roberts[1]
[1]*University of York*

In 2016, the UK government announced plans for a large-scale Marine Protected Area (MPA) around Ascension Island, a UK Overseas Territory in the South Atlantic. Legal designation is expected in 2019 and research is underway to inform its management. To establish accurate baselines of marine life and assess change over time, extensive historical sources were examined. 139 interviews were also conducted to identify perceptions of change in the marine environment by past and present Ascension Island inhabitants. Historical sources indicate seabird and turtle populations declined substantially following human settlement, and despite recent population recoveries, pre-settlement abundance has not been reached. Reported fish abundance was high and remained relatively consistent throughout the historical references, but residents have noticed recent changes, notably in fishing effort, declines in yellowfin tuna (Thunnus albacares), and increases of Galapagos sharks (Carcharhinus galapagensis). Two shark attacks occurred in 2017, with their increased aggression completely new to most interviewees. However, previous periods of high shark abundance with threatening behaviour were noted, including a likely shark attack in 1879. Overall, Ascension appears to have largely avoided depletion of fish stocks from commercial fishing pressure, but recent changes highlight the need for precautionary management with strong protection to safeguard the island's extraordinary assets.

11:30 - Global significance of seagrass fishery activity

Dr. Lina Mtwana Nordlund[1], Dr. Richard Unsworth[2], Dr. Martin GullstrÃűm[1], Dr. Leanne Cullen-Unsworth[3]
[1]*Stockholm University,* [2]*Swansea University and Project Seagrass,* [3]*Cardiff University and Project Seagrass*

Fisheries are vital for the maintenance of global food security, and seagrass meadows are one of the most important coastal habitats considered as significant contributors to fisheries productivity. This is the first global scale study demonstrating the extent, importance and status of fisheries exploitation of seagrass meadows. The study used a literature review and an expert opinion survey to demonstrate the widespread significance of seagrass-based fishing activity. Survey questions focused on four key areas: the purpose of fishing in seagrass habitats, the methods used, target species, and how fishers access seagrass fishing grounds. The study highlights that seagrass-based fisheries are globally important and are present virtually wherever seagrass exists supporting subsistence, commercial and recreational activity. Seagrass fisheries target any fish or invertebrate that can be eaten, sold or used as bait. A wide range of fishing methods and gear are used which is largely a consequence of the spatial distribution patterns of seagrass meadows and their depth ranges from intertidal (accessible by foot) to deep water (where commercial trawls can operate). In developing countries, the importance of the nearshore seagrass fishery for livelihoods and wellbeing is irrefutable. While on the other hand, in developed countries, the seagrass fishery is often more recreational and/or more highly species specific. Regardless of location, this study is the first to highlight the global scale of the exploitative nature of seagrass fisheries and emphasise the need for targeted management to support their continued viability as a global ecosystem service provider.

OS-4B: Conservation and Management 1 (10:00 - 12:00, FJ Event Hall)

10:00 - Can the "Blue Economy" be the Answer to Marine Conservation?

Dr. Peter Kareiva[1], Ms. Jennie Dean[1]
[1]*UCLA*

In all habitats and realms, there has been a push towards melding economic growth with conservation. In theory this sounds good-but the challenge is making it practical and real. A partnership between the Waitt Foundation and UCLA is developing a toolkit of "blue economy" options that is being tested via case studies in small island developing states (SIDS). The project is combining expertise from international law and aid, business entrepreneurship, fisheries, and ecosystem services. We do this by drawing on graduate students from the business, law, public affairs and environment programs at UCLA who work in teams focusing on one SIDS at a time. Upon completion, the project will present a synthesis of existing options that belong to the âĂIJblue economyâĂİ portfolio, as well as initial methods for

evaluating their likely return on investment. Obvious options include tourism and fisheries, including aquaculture, but many islands have additional land-based opportunities that interact with marine systems. Moreover, there are lessons to be learned from terrestrial conservation efforts that have centered on sustainable development. We highlight those lessons and how our "blue economy" inquiry will be illuminated by them.

10:15 - What's happening in the epi-center of marine biodiversity? Status and trends of the reefs of the Bird's Head Seascape MPA Network

Mr. Purwanto Purwanto[1], Ms. Dariani Matualage[1] , Mr. Awaludinnoer Ahmad[2] , Mr. Nur Ismu Hidayat[3] , Mr. Defy Pada[3] , Mr. Abdi Hasan[3] , Mr. Ronald Mambrasar[3] , Mr. Evi Nurul Ihsan[4] , Mr. Adrian Kaiba[5] , Dr. Dominic Andradi-Brown[6], Dr. Gabby Ahmadia[6]

[1]University of Papua (UNIPA), [2]The Nature Conservancy, [3]Conservation International, [4]WWF Indonesia, [5]Raja Ampat Government, [6]WWF-US

The Bird's Head Seascape (BHS) in Papua has been identified as the highest marine conservation priority in Indonesia, due to its megabiodiversity. A network of Marine Protected Areas (MPAs) has been established to minimize local threats in the region, such as destructive fishing practices and over fishing. The reef health monitoring program was designed to evaluate the MPAs performance and inform management in the region. Coral cover and fish biomass are measured every two years at 226 sites inside and at 58 sites outside the total of 9 MPAs, before and after MPAs were established from 2010 to 2016. There was variation in and among different zones and MPAs within BHS. On average, there were no significant increases in key fisheries species biomass or herbivore biomass through time. Interestingly, in general, no take zones did not outperform multi-use zones. Does this mean that the MPAs are failing? The short answer is no; while there is some evidence of decline in fish biomass in BHS, levels of fish biomass are still on average much higher than in many other places in Indonesia and beyond. In addition, initial conditions at these MPAs were relatively high to begin with. However, continued development and increases in tourism in the region are encroaching on the balance between sustainable use of marine resources, and need to be considered in conservation management to continue to safeguard this region.

10:30 - Prelimenary Results of Long-term Seagrass Monitoring and Dugong Feeding Trail Observations at Permamanent Sampling Stations in Lawas, Sarawak of East Malaysia

Mr. Toloy Keripin Munsang[1], Mr. James Bali[1]

[1]Sarawak Forestry Corporation

Long-term monitoring on seagrass and dugong feeding trail at permanant sampling stations in Lawas, Sarawak was initiated in 2017. Fixed-wing single rotor Skywalker 2015 drone was used to map the distribution of seagrass beds along intertidal areas of 30 km stretches of beaches in Lawas, Sarawak of East Malaysia in January 2017 and February 2018. The survey area is divided into six flight mission survey sectors ranging 1.2 km2 to 2 km2 from Kebab Putus-Sari Damit to Bangkulit. The presence of dugong's feeding trail within the permanent sampling station were observed and recorded. The median percentage of seagrasses coverage in 2017 and 2018 was 50% and 10% respectively. Halophila pinifolia was the dominant species which recorded at 23 out 26 stations in 2017, while in 2018 the species occurred in 20 stations. Cymodocea rotundata and Halophila ovalis were two species recorded in the permanent stations but the median percentage of the coverage for both species in the was less than 3% for the both years. Dugong feeding trails were observed at 6 stations in 2017 and 3 stations in 2018. Ninety percent of those feeding trails observed between Punang to Pantai Bangat area.

10:45 - Connectivity between shallow and deep reef communities around Bermuda

Dr. Lucy Woodall[1], Dr. Paris Stefanoudis[2], Prof. Alex Rogers[3]

[1]University of Oxford/ Nekton, [2]Nekton, [3]University of Oxford

Benthic megafauna significantly differ depending on depth. From data collected in Bermudian waters using submersibles and technical divers, we explore these relationships for the first time across depths of 15 m to 300 m. Here we present the faunal communities and show that there are distinct assemblages at each depth with substantial species turnover. Typically, faunal changes occur across wider depth zones, but we reveal this is not the case and the differential is much greater, even in areas that are exposed to a high degree of human activities. The assemblages we describe include species that are abundant but new to science and others that are endemic to Bermuda, thus revealing these assemblages are novel. This benthic megafauna heterogeneity includes habitat-forming organisms, has potential implications for the 'deep reef refugia' hypothesis and is an important consideration for spatial planning and ocean management.

11:00 - A new endangered marine species - marine conservation scientists in academia?

Prof. Chris Parsons[1], Dr. John Cigliano[2]

[1]George Mason University, [2]Cedar Crest College

Many marine conservation scientists are based in higher education institutions but increasingly academia does not value factors important to conservation when considering promotion and tenure. There is pressure in academia to published in academic journals (especially high impact factor journals; conservation journals typically have an impact factor of &l) but these typically have poor readerships, especially by those that need the information (conservation practitioners, managers, and policy makers). Promotion is often dependent on gaining grants with proportion of the grant overhead going to the institution, whereas conservation typically has small grants with low overheads. In the US, R1 universities are even worse with their status being dependent upon federal funds, yet much conservation is funded by NGOs and Foundations, thus little credit is given for receiving these grants. Little to no credit is given by academic institutes to important conservation activities if it does not have a dollar value: helping to establish protected areas, protective laws and regulations; conducting public outreach; advising managers and policy makers; aiding conservation capacity building. It is unlikely that an academic institution will grant tenure to faculty whose practical work saved a species or ecosystem. Either, academic institutes start to better value the work of conservation scientist or the "academic conservation scientist" might themselves become endangered.

11:15 - A collaborative effort among conservation institutions to conduct the first wild whale shark health assessment using techniques developed in public aquariums

Ms. Katelyn Herman[1], Dr. Alistair Dove[1], Mr. Harry Webb[1], Mr. Abraham Sianipar[2], Dr. Paola Unda Marron[3], Dr. Paulus Boli[4], Mr. Eko Setyawan[5], Mr. Masrul Jaya[6], Mr. Jefry Manuhutu[4], Dr. Alfonso Lopez, Dr. Mark Erdmann[2]

[1]Georgia Aquarium, [2]Conservation International, [3]MarineLife Animal Management Advisors, [4]The State University of Papua, [5]Cenderawasih Bay National Park Authority, [6]Agency for Marine and Coastal Resources Management Sorong

Joint research efforts among the marine conservation community can result in unique opportunities and data collection otherwise unattainable. In 2017, Georgia Aquarium (GAI) and Conservation International (CI) collaborated to conduct health assessments on wild whale sharks (Rhincodon typus) in Cenderawasih Bay, West Papua, Indonesia. Our work required cooperation with the Cenderawasih National Park, local government, and local fishermen. In this bay, there is a unique interaction between whale sharks and bagans, fishing vessels with framed nets that are targeting baitfish. The whale sharks will consistently come near or into the nets in order to feed on the baitfish, presenting an opportunity for less challenging sample collection when compared to sampling free-swimming sharks. Working in the nets, we were able to collect biological samples, attach satellite or acoustic tags, and obtain morphometric data. A ten-day expedition resulted in assessments of 22 individuals. When possible, blood samples were taken pre- and post- tag application for comparative stress analysis. Telemetry data thus far indicates that the sharks stay near or in the bay and do not undergo long migrations as other populations are thought to. Based on previous tag deployments, we hope to acquire approximately two years' worth of location data, with tag detachment potentially occurring during summer 2019. Handling conditions were similar to the veterinary exams performed at GAI, allowing our team to utilize in-house blood collection strategies in the field. This collaboration allowed GAI and CI to participate in a joint expedition resulting in the exchange of field techniques and data.

11:30 - Phylogeography of Dugong: Molecular Insights from Indian Subcontinent

Mr. Srinivas Yellapu[1], Dr. Sivakumar Kuppusamy[1], Dr. J.A Johnson[1], Dr. Samrat Mondal[1]

[1]Wildlife Institute of India

Dugong (Dugong dugon) is the only existing herbivorous marine mammal of the order Sirenia which inhabits nearshore Indian waters. Interviews with fishermen have estimated its number to have declined to less than 200 individuals and hence regional assessment considers its population to be endangered in the Indian sub-continent. Despite its endangered status and continually degrading habitat, limited studies within the country deal with all aspects of species conservation. As part of the Dugong Recovery Program, current study aims to address gaps in Dugong conservation in India. Along with generating ecological data on the species, this study targets lacunae in genetic information on Dugong populations to identify Evolutionary Significant Units (if any) for planning conservation strategies for the species. In this study, we collected eleven samples across dugong range states. Phylogeographic analysis was carried out using Mitochondrial DNA control region (mtDNA CR) sequences. Analysis of 400-bps mtDNA CR sequences from India revealed four haplotypes with six polymorphic sites as well as three additional haplotypes in comparison to globally available dugong haplotypes. Median joining network analysis suggests that Indian samples along with Mauritius form a separate clade within Australian clade separating them from other south east Asian countries. None of the Indian haplotypes were shared with any other globally available haplotypes indicating that Indian population might have diverged from the main Australian clade and thus forms a sub-clade. Phylogeographic analysis highlighted the importance of Indian dugong population in the global perspective and future conservation strategies should consider and plan accordingly.

S-128: The value of entrepreneurship for conservation: sourcing, developing, and scaling ocean conservation solutions (10:00 - 12:00, Tubau 2-3)

10:00 - Incentivizing scalable solutions for ocean conservation problems through entrepreneurship and open innovation

Dr. Barbara Martinez[1], Ms. Cassie Hoffman[1]

[1]Conservation X Labs

How can we solve the greatest challenges facing our oceans? The field of conservation biology recognizes the need to broaden the tent and work with experts in a variety of disciplines, and at Conservation X Labs, we are using a variety of open innovation techniques to source, develop, and scale conservation problems in ways that reach innovators beyond the conservation field. We encourage solvers to build teams and communities in our Digital Makerspace, where members can respond to conservation problems and collaborate on early-stage solutions. Teams are incentivized to create prototypes in Make for the Planet and our Con X Tech Prize competitions. Through partnerships, Conservation X Labs runs global grand challenges to source solutions to conservation problems from around the world. In 2016, we launched the Blue Economy Challenge, a grand challenge with the Australian government and WWF-U.S. to find and support early and late stage innovations that could revolutionize aquaculture, and achieve the dual goals of environmental sustainability and food security. In order for solutions to have an impact, it is not enough to incentivize solutions and reward them with prize money - they need good business models with a path to financial sustainability. One mechanism to support companies along this path is through incubation and acceleration. Thus, we launched Oceans X Labs (OXL), and welcomed a cohort of companies from the Blue Economy Challenge into an accelerator as a joint initiative with the World Wildlife Fund-U.S. (WWF) to help the enterprises in their path to commercialization.

10:25 - Conservation Entrepreneurship: Scale and Sustainability

Dr. Alex Dehgan[1]

[1]Conservation X Labs

We are in the midst of a sixth mass extinction driven by human activity. Conservation faces an inflection point. The problems are exponential, but current approaches and solutions are incremental. Conservation efforts have been too siloed, backward-looking, technophobic, and fail to integrate design and entrepreneurial principles. The future of conservation relies on addressing the underlying causes of human-induced extinction from the need to feed a growing global population to demand for extractives like rare-earth minerals. How can we harness the scale and sustainability of technology innovation and entrepreneurship to solving critical conservation problems? At Conservation X Labs, we are applying partnerships, direct technology development, and open innovation to source, develop, and

scale new innovations in the conservation field. Our work has offered insight into how conservation entrepreneurship can drive positive change and what tools are necessary to reach revolutionary solutions. Examples of the potential for change in conservation exist and offer lessons for future efforts to design and scale solutions to growing conservation challenges. This session will explore the nature of conservation entrepreneurship, core principles to its success, and the path forward for the field.

10:40 - Growing spirulina for the masses with a small footprint

Mr. Saumil Shah[1], Dr. Ezra Noon-song[1], Ms. Lorit Kampoutsi[1], Ms. Cody Kugler[1]

[1] *EnerGaia Co Ltd*

Traditional food production sectors will not be able to sustainably meet the food consumption needs of our multiplying global population without innovation. The population at the base of the pyramid will be the first to lose access to critical food resources. Developing alternative food sources as well as new approaches for sustainable production are critical to meeting these growing demands. By partnering with NGOs, donor groups and aid agencies, EnerGaia is introducing a new contract farming model tailored particularly for women entrepreneurs in coastal communities of developing countries. EnerGaia has the potential to work with both farmers in Bangladesh and store owners in Kalimantan to dramatically improve diets and combat micronutrient malnutrition while simultaneously enhancing local livelihoods through development of spirulina microentrepreneurs. As a social enterprise with over 5 years of commercial experience operating our innovative spirulina production system on rooftops and rural areas, we seek to amplify our impact by spreading our technology around the world. Our company's mission is to provide a clean, healthy and sustainable food source.

10:55 - Bringing Conservation Technologies Into Financial Sustainability: The DNA Barcode Scanner as a Case Study

Mr. David Baisch[1]

[1] *Conservation X Labs*

Bringing a specialized technology to financial sustainability while solely relying on conservation markets is extremely challenging due to many factors, including limited organizational budgets and a small relative market size. This challenge can be met by adapting the technology to serve multiple purposes by increasing adaptability and capability, growing the total number of markets which can be utilized for sale and profit.This presentation will focus on the development of the DNA Barcode Scanner Project at Conservation X Labs which has the goal of creating a handheld POC device which utilizes barcode sequences in animal genomes. Our project is bringing together a diverse team to engineer a decision support tool: a low cost, simple to use, robust, highly modular molecular sensing device that allows citizens or officials to rapidly determine whether to investigate retail seafood product fraud or a corporate seafood buyer to detect problems in their supply chain. We need to develop a product that supports decision making and traceability in the environments where they matter - in the field, within the developing world, with the least number of steps possible, at lowest cost, with the highest resilience, and lowest complexity, while also making a defensible business case for financial investment and growth.

11:10 - Pay-to-volunteer model to facilitate marine conservation interventions: an NGO case study from the Philippines

Mr. Gonzalo Araujo[1], Ms. Jessica Labaja[1], Ms. Sally Snow[1], Dr. Alessandro Ponzo[1]

[1] *Large Marine Vertebrates Research Institute Philippines*

Large Marine Vertebrates Research Institute Philippines (LAMAVE) is the largest independent non-profit non-governmental organisation dedicated to the conservation of marine megafauna in the Philippines, namely elasmobranchs, cetaceans and turtles. In order to operate effectively, funding mechanisms must be in place to fulfil conservation objectives. LAMAVE works by first identifying conservation priorities or loopholes with marine megafauna species and their habitats. We then calculate the expected cost of a given intervention at a site, involving local stakeholders, and clarifying what deliverables can be expected from such an intervention. Pay-to-volunteer models can provide an effective way of achieving conservation outputs, assuming the objective is clear. Some schemes have failed to deliver conservation outputs, and have thus been branded 'voluntourism', where volunteers participate in conservation-branded activities as tourists. LAMAVE operates a different model under similar grounds: volunteers pay to participate in educational research-to-conservation programmes. The aim of such a model is to ensure conservation outputs and deliverables are met, and not to profit from such a scheme. The income generated is used to cover the conservation intervention in which volunteers participate for a minimum amount of time to ensure an educational, real research, hands-on experience. We have replicated this model across multiple sites involving different species and their habitats in the Philippines. The priority remains the maximization of marine conservation outputs whilst ensuring the active involvement of volunteers in the research. Such a model can complement traditional grant-dependent funding by which large-scale interventions can be pursued and are thus not mutually exclusive.

11:25 - Cultural Conservation Priorities: A methodology for integrating Indigenous values into marine protected area network design.

Dr. Caroline Butler[1], Mr. Chris Mcdougall[2] , Mr. Aaron Heidt[3] , Ms. Allison Paul[4] , Mr. Steve Diggon[5]

[1] *Gitxaala Fisheries Program, Gitxaala First Nation,* [2] *Haida Oceans Technical Team,* [3] *Central Coast Indigenous Resources Alliance,* [4] *North Coast Skeena First Nations Stewardship Society,* [5] *Coastal First Nations - Great Bear Initiative*

A network of marine protected areas for the north coast of British Columbia is being designed through a trilateral process co-governed by Canada, British Columbia, and 17 First Nations. The primary goal of the network is to conserve biodiversity, but other goals and objectives of the Network commit to protecting First Nations cultural use, food security, and rights. The First Nations' technical team developed a methodology to integrate the ecological knowledge and cultural values of the participating Nations into network design. A rigorous community-based analysis of existing First Nations spatial data supported the identification of Cultural Conservation Priorities: areas that are important for food security, for the life stages of culturally significant species, and for culture and spirituality. The CCPs were harmonized and provided as a spatial layer for Network design and analysis, in parallel with the identified Ecological Conservation Priorities. This approach was intended to maximize the protection of First Nations food security, cultural practice, and sacred sites while also meeting the ecological objectives of the Network. In addition to the utility of CCPs as a data layer for the Marxan analysis, they provided Nations' governments with a secure tool for presenting and working with sensitive data in multi-party settings.

This presentation provides an overview of the development of the CCP framework and criteria, and the methodology for community-based analysis and harmonization. The CCP approach is discussed as a potential solution for respectfully and effectively including indigenous community values in co-governed marine spatial planning processes.

S-155: Conservation research in urbanized marine environments (10:00 - 12:30, Tubau 1)

10:00 - Marine urbanisation in Singapore and potential mitigation strategies

Dr. Peter Todd[1], Ms. Samantha Lai[1], Ms. Shelley Chan[1], Dr. Lynette Loke[2]

[1]National University of Singapore, [2]National

Globally, habitat loss associated with land reclamation, coastal defences, and shoreline development is becoming increasingly prevalent. Over the last 200 years Singapore has reclaimed 169 km2 of land, and provides a striking example of large-scale and intense urbanisation. The majority of Singapore's mangrove forests, coral reefs, rocky shores and sand/mudflats disappeared between the 1920s and 2000s. Only 17% of its coastline is natural, with the remainder dominated by seawalls. When comparing the species assemblages on seawalls with their natural analogs: rocky shores, we found that, as in temperate regions, seawalls in Singapore host lower diversity but share a substantial number of species with rocky shores. Stable isotope analyses showed that turf algae was the largest contributor to the diets of intertidal herbivores, but was present in significantly lower abundances on seawalls. These results are not unexpected, as seawalls are generally designed with civil engineering goals and do not function as surrogates for natural habitats. In Singapore, they are made of materials chosen for strength, not for their ability to attract wildlife. They are structurally "simple" compared to rocky shores, and experience very high temperatures. Given the prevalence of artificial coastal defences in Singapore, 'hard' engineering mitigation options such as retrofitting topographically complex "tiles" made of materials that encourage colonisation and offer thermal refuges provide the most practical approach to enhancing seawall biodiversity. Here, I will present what we have learnt from our ecological engineering experiences in Singapore and discuss how our findings provide important practical insights for successful seawall reconciliation.

10:15 - Effect of habitat area and fragmentation on tropical seawall biodiversity: A landscape scale experimental study

Dr. Lynette Loke[1], Dr. Ryan Chisholm[1], Dr. Peter Todd[1]

[1]National University of Singapore

Habitat loss and fragmentation is one of the largest areas of study in ecology and conservation biology and the use of species-area relationship (SAR) models to predict species extinctions and community changes are fundamental to this field. However, empirical work has lagged behind the many theoretical advances as isolating the effects of habitat fragmentation experimentally is considered especially difficult. This is because the level of fragmentation often co-varies with habitat area and hence their effects can easily be confounded. In our study, we addressed this issue by using moulded concrete tiles to create standard units of 'habitat patches' and arranged them in nine different, fully replicated, plot configurations on seawalls in Singapore. By doing so, we were able to test both the independent and interactive effects of habitat area and fragmentation on the diversity of the macroscopic intertidal community. We adapted the countryside SAR model to incorporate the roles of both matrix and fragmentation pattern to test our hypotheses and explored the mechanisms underlying our results. To our knowledge, no previous manipulative experiment has simultaneously manipulated both these factors independently in a marine ecosystem. We found a unimodal relationship between species richness and habitat fragmentation and postulate that a combination of high-level processes can give rise to this observed pattern. We discuss how these results can help inform efforts to ecologically engineer coastal defences worldwide.

10:30 - Urban coral reefs of East and Southeast Asia: A case study approach

Dr. Eliza Heery[1], Dr. Nicola Browne[2], Dr. Bert Hoeksema[3], Dr. James Reimer[4], Prof. Put Jr Ang[5], Dr. Daniel Friess[1], Dr. Danwei Huang[1], Prof. Loke Ming Chou[1], Dr. Andrew Bauman[1], Dr. Lynette Loke[1], Mr. Daisuke Taira[1], Dr. Peter Todd[1]

[1]National University of Singapore, [2]Curtin University, [3]Naturalis Biodiversity Center, [4]University of the Ryukyus, [5]The Chinese University of Hong Kong

Hard corals and coral reefs are common in many coastal cities in Asia. Understanding how urban coral reefs are structured and how they function is crucial for informing conservation. We compiled available data on hard coral composition and abundance from four main case study cities (Singapore, Jakarta, Hong Kong, and Naha), as well as qualitative information from several additional coastal cities in East and Southeast Asia, with the aim of identifying unifying patterns of urban coral reefs and clarifying the effects of urbanization on hard coral assemblages. Through this case study approach, we highlight several key characteristics of urban coral reefs. "Reef compression" and (a decline in bathymetric range with increasing turbidity and decreasing water clarity), dominance by domed growth forms, and low reef complexity were common. Inshore-offshore gradients in urban coral reefs varied considerably between cities, but were strongest for the largest case study city considered, Jakarta. Declines in urban coral cover in the 20th Century have been followed more recently by fluctuations from acute impacts and rapid recovery. We highlight the major urban-related stressors that likely shape these patterns and present hypotheses for urban reef community dynamics, which should be expanded upon and tested empirically in future research. Additionally, coral colonization of urban infrastructure was recorded in several cities, and constitutes an important component of restoration and enhancement efforts for coral reefs in urban areas. We discuss the potential for ecologically engineering urban shorelines to enhance ecosystem services provided by coral reefs to urban populations.

10:45 - Tales of an Urban Whale: Science and Conservation of Cook Inlet Belugas

Dr. Leslie Cornick[1], Dr. Verena Gill[2]

[1]Eastern Washington University, [2]NOAA Fisheries

Biodiversity conservation in urban environments is challenging on a variety of fronts: multiple anthropogenic stressors include habitat loss and degradation, cross-sector stakeholders with competing interests, socio-economic pressures regulatory requirements, and disconnected management agencies to name a few. Cook Inlet beluga whales are a geographically isolated population whose contemporary

range lies largely beside the most urbanized environment in Alaska - the Municipality of Anchorage, a sprawling metropolis of 300,000 people. The Cook Inlet beluga whale stock may once have numbered as many as 1,300 individuals but declined dramatically during the 1990's as a result of unregulated subsistence hunting. In 2008 NOAA designated this iconic whale as endangered under the U.S. Endangered Species Act. However, they have failed to recover despite a moratorium on hunting; an abundance survey in 2016 estimated 328 belugas left. The population faces a myriad of ongoing threats, including noise, continued urbanization and development, oil and gas development, contaminant pollution, shipping, military activities, disease, and prey reduction. This presentation will discuss current (e.g., quantifying contaminants in prey from pharmaceuticals and personal care products) and future (e.g., using teeth to look at age of first reproduction) research aimed at recovering the population, Belugas Count! a new outreach and engagement effort to build awareness, and lessons learned for improving conservation of urban wildlife sentinels.

11:00 - Habitat enhancement for augmenting seawall utilisation by reef fishes in a tropical urban shoreline

Mr. Daisuke Taira[1], Dr. Eliza Heery[1], Dr. Lynette Loke[1], Dr. Andrew Bauman[1], Dr. Peter Todd[1]

[1]National University of Singapore

Natural habitats in nearshore coastal zones are increasingly being transformed by the addition of coastal defence structures (e.g. breakwaters, seawalls and jetties) that are widely used to protect shorelines and coastal developments from erosion, wave action and sea level rise. These artificial structures typically support lower fish diversity than the natural habitats they have replaced due to limited availability of food and shelter. As seawalls become an increasingly prominent habitat type, understanding how they are utilized by mobile organisms such as reef fishes is important for determining their effect on marine ecosystems. Previous research has shown that abundance and species richness of epilithic organisms on seawalls can be increased by attaching moulded concrete tiles that enhance structural complexity, however, there is limited information on whether these enhancements also affect fish assemblages. In this study, we quantified and compared fish community structure and fish activity (e.g. feeding, taking shelter) between seawall study plots (2.4 m x 2.4 m) with and without habitat enhancement tiles using stationary underwater video cameras during high tides. Video footage revealed that ~30 fish species utilize the seawalls, but the families Pomacentridae and Labridae dominated most of the fish assemblage. Increases in foraging activities by some detritivores and invertivores were observed within the enhanced seawall plots, compared to the bare seawall plots. Several fish species, including Choerodon anchorago, Dischistodus fasciatus and some gobiids, used the tiles for shelter. Collectively, these results suggest that eco-engineering habitat enhancements increases the utilization of shallow seawalls by some fish species.

11:15 - World Harbour Project (Penang): Does structural complexity hold the key to enhancing biodiversity on artificial structures?

Mr. Jean Chai Yee[1], Dr. Elisabeth Strain[2], Dr. Louise B Firth[3], Dr. Su Yin Chee[4]

[1]Centre for Marine and Coastal Studies (CEMACS), Universiti Sains Malaysia, [2]Sydney Institute of Marine Science, [3]School of Biological & Marine Sciences, University of Plymouth, [4]Centre for Marine and Coastal Studies (CEMACS), Universiti Sains Malaysia

Extensive development in coastal and marine environments is occurring worldwide. This phenomenon has led to the growing number of artificial structures including seawalls, breakwaters, and rock armour which are design to protect against sea level rise and coastal erosion (termed as ocean sprawl). While development offers economic growth, it is often built at the expense of natural coastal habitats. As concerns continue to grow, we embark on the World Harbour Project to test the efficacy of retro-fitting complex habitats to coastal protection infrastructure in Penang using green engineering approach. The experiment was set up on artificial structures at two locations. Three different treatments of flat, 2.5 cm and 5.0 cm height enhancement settlement plates with five replicates each were installed at mid-water level. Trimonthly monitoring for one year beginning in September 2016. We calculated multi-trophic richness and relative abundance correlated with net primary and secondary productivity. Although increasing primary producer abundances show a proportional increase in net primary production, there were no detectable differences between the 5.0 cm and the flat, 2.5 cm plates. There were also no differences in the number of species or abundances of key functional groups: algae and bivalve communities across all three settlement plates suggesting that the organisms were indifferent to the degree of complexity of the plates. Our results suggest increasing habitat complexity is not sufficient to enhance diversity and productivity of coastal infrastructure. These results differ from other locations and could be driven by the increased wave action or temperatures in the region.

11:30 - Effects of eco-engineering drill-cored rock pools on rock revetment biodiversity on Penang Island

Mr. Jian Rong Loh[1], Dr. Firth Louise B.[2], Dr. Ally Evans[3], Dr. Pippa Moore[3], Prof. Steve Hawkins[4], Prof. Richard Thompson[2], Dr. Su Yin Chee[1]

[1]Centre for Marine and Coastal Studies (CEMACS), Universiti Sains Malaysia, [2]School of Biological & Marine Sciences, University of Plymouth, [3]Institute of Biological, Environmental and Rural Sciences (IBERS), Aberystwyth University, [4]Marine Biological Association of the UK

Rock pools are known to be an important habitat given the harsh nature of intertidal areas. While artificial rock pools mimicking the functions of natural rock pools were shown to provide valuable habitat on intertidal breakwaters in the UK, the design has yet to be tested in a tropical setting. We hereby tested their ability to improve biodiversity on existing structures in Penang Island. The objectives of this study were to compare species richness and abundance between (1) drill-cored rock pools and adjacent rock surfaces, and (2) drill-cored rock pools of different depths. Thirty cylindrical drill-cored rock pools with diameters of 15 cm, separated into two depths: 12 cm (deep) and 5 cm (shallow), were drilled into granite rock revetments at three locations on Penang Island. The rock pools were monitored monthly for the first 12 months, followed by once every 6 months for 12 months. A total of 24 and 13 species were recorded within the rock pools and adjacent rock surfaces respectively. After 24 months, mean species richness was significantly higher in drill-cored rock pools than on adjacent emergent rock. There was no significant difference in mean species richness between deep and shallow drill-cored rock pools. Species abundance was higher in artificial rock pools than emergent surfaces except for barnacles, but similar between deep and shallow pools. These findings suggest that drill-cored rock pools could be installed on existing or new rock revetments in tropical as well as temperate settings to improve habitat heterogeneity and local biodiversity.

S-73: Can MPA's save sharks? (10:00 - 12:00, Kerangas)

10:00 - Can MPAs save sharks?

Prof. Colin Simpfendorfer[1], Dr. Michelle Heupel[2], Prof. Nicholas Dulvy[3], Dr. Amy Diedrich[1]

[1]James Cook University, [2]Australian Institute of Marine Science, [3]Simon Fraser University

Sharks face an unprecedented global conservation crisis. One commonly advocated tool for tackling this crisis are protected areas, ranging from small marine reserves to 'Shark Sanctuaries' that vary in size and extent of protection. However, there is limited information on which to evaluate the effectiveness of these approaches in reversing the global decline of sharks and rays. Furthermore managers and policy makers require a means to define areas where conservation outcomes for sharks and rays may be best achieved with marine reserves. This symposium will explore the ecological, socioeconomic and design drivers that influence the success of spatial management for improving the conservation outcomes for sharks and rays.

10:15 - Shark and ray MPAs: the current state of play

Dr. Cassandra Rigby[1], Prof. Colin Simpfendorfer[1]

[1]James Cook University

A rapid increase in areas of the ocean designated as shark and ray MPAs has led to debate about their effectiveness. We reviewed the available literature on how sharks and rays benefit from spatial protections, as well as the more general MPA literature. The effectiveness of spatial protection depends a wide range of factors, including level of planning, governance, socioeconomic considerations and enforcement. The species most commonly reported to benefit from spatial protection are those that use reef habitat for part or all of their lives with the key biological attributes of residency, philopatry, site fidelity and critical habitat use. Wide ranging species that do not regular use a particular area derive less benefits from spatial protection as the scale of their movements is beyond the size of even large MPAs. The main MPA design and management features that benefit sharks and rays are isolated location, long-term protection, no-take or reduced fishing pressure and high value habitat. It is crucial to reduce shark and ray mortality for long-term maintenance of viable populations and spatial protection achieves this to varying degrees. MPAs can make a significant contribution to sharks and ray conservation but could be markedly improved by a systematic approach that establishes well-defined goals and conservation targets, and incorporates the best available science on shark movement, habitat use and information on socioeconomic factors. When combined with sufficient resources, this would ensure that spatial protection of shark and rays has the capacity to make long-term significant advances for shark conservation.

10:30 - Sharks, rays and MPAs: a critical evaluation of current perspectives

Ms. Tracy MacKeracher[1], Dr. Amy Diedrich[1], Prof. Colin Simpfendorfer[1]

[1]James Cook University

Marine protected areas (MPAs) are increasingly advocated for the conservation and management of chondrichthyans (hereafter, "sharks"), however substantial uncertainty remains regarding which species can benefit from spatial protection. Meanwhile, international area-focused protection targets have spurred recent and rapid gains in the creation of large MPAs, many of which carry vague objectives set by a diverse group of stakeholders with potentially different notions of 'success'. We conducted a global survey with a varied group of stakeholders (n = 53) to explore current views on the use of spatial protections for shark conservation and management. Specifically, we interviewed scientists, MPA managers, fisheries experts, conservation practitioners, advocates and policy experts to explore perceptions regarding: (1) the effectiveness of MPAs as a tool for shark conservation; (2) what factors influence the success of MPAs designated to protect sharks; and (3) the desired outcomes of these MPAs. Overall, spatial protections were perceived to be somewhat effective as a tool for shark conservation. While the social factors influencing success were emphasized over biophysical factors, biological outcomes were emphasised over social outcomes, suggesting a lack of understanding regarding what motivates people to support shark conservation. The relative emphasis placed on different success factors and outcomes also varied across stakeholder types and governance contexts in which participant experience was primarily based. By exploring the perspectives of a varied group of stakeholders, this study contributes to a better understanding of what may be driving MPA design, and whether this reflects current scientific understanding.

10:45 - How policy inconsistencies may hinder mortality reduction of sharks and ray âĂŤand fuel misconceptions of actual levels of protection

Ms. Jessica Cramp[1], Prof. Robert Pressey[2], Dr. Michelle Heupel[3], Prof. Colin Simpfendorfer[1]

[1]James Cook University, [2]Australian Research Council Centre of Excellence in Coral Reef Studies, James Cook University, [3]Australian Institute of Marine Science

Sharks and rays are the most threatened vertebrates on Earth. While conservation policies have expanded significantly over the past 20 years, mortality levels remain too high and criticism of shark and ray protection measures is persistent. The critiques include listing too few species, lack of implementation, inadequate funding and low capacity for enforcement; however, studies have not assessed whether the policies are actually enforceable, whether policy inconsistencies reduce the likelihood of species listings and management effectiveness, or whether the levels of protection and the public perception of protection are uniform. We conducted an international, regional and national level policy analysis looking for inconsistencies that may hinder reduction in mortality of sharks and rays. Policies and fishery management tools were assessed for levels of threat versus level of protection and whether country signatories, species, areas, penalties, and exemptions are consistent across interventions. We identified gaps that may limit management effectiveness and identified loopholes where continued exploitation is possible. Strengthening of shark and ray conservation and management policies is possible if the same rigor applied to conservation science is also applied when writing policy interventions. Without uniform definitions underlying policy, the interpretation of management decisions, and of success, are likely to be based less on science and more on social values and political expediency. This talk will discuss the gaps identified by our analysis and explore our perceptions of protection of threatened sharks and rays.

11:00 - Social Indices of Conservation Impact for Planning Shark and Ray Spatial Protection

Ms. Meira Mizrahi[1], Dr. Stephanie Duce[1], Dr. Ross Dwyer[2], Dr. Amy Diedrich[1]

[1]James Cook University, [2]The University of Queensland

Shark and ray sanctuaries are primarily established to alleviate threats that humans pose through overfishing and destructive fishing practices. Despite the 'human' nature of these threats, socio-economic factors are often given less consideration than ecological factors when designing shark and ray spatial protection. Furthermore, the needs of communities who depend on shark fisheries for their livelihoods are often overlooked. We developed a series of spatially explicit, national level indices based on publically available socio-economic data to guide decisions related to the effective placement of shark and ray sanctuaries. These include: 1) Conservation Likelihood; 2) Strength of Management; 3) Biodiversity Impact; and 4) Livelihood Impact. We considered effective sanctuary placement to be determined not only by areas where socio-economic and political conditions were most favourable for conservation, but also by locations that were most likely to have a positive impact on shark biodiversity and associated human livelihoods. Because impact potential (i.e. the outcome arising from protection relative to the counterfactual scenario of no protection) is influenced by factors such as fishing pressure and fisheries dependence, it may contradict other measures reflecting socio-economic conditions that traditionally favour conservation (e.g. enforcement capacity, public support for shark conservation). We will present our indices and demonstrate their use in identifying potential contradictions, as well as areas of synergy, between conservation likelihood and impact, and between social and ecological outcomes. In combination with biophysical factors, these indices will help identify optimal locations where conservation is most likely to be achieved with maximum ecological and social benefits

---

11:15 - Scale of shark and ray movements and its importance in spatial management success

Dr. Vinay Udyawer[1], Dr. Christopher Mull[2], Dr. Michelle Heupel[1], Prof. Nicholas Dulvy[2], Prof. Colin Simpfendorfer[3]

[1]Australian Institute of Marine Science, [2]Simon Fraser University, [3]James Cook University

Movements and dispersal capacities of sharks and rays can be characterised over a continuum between highly site attached species with very limited dispersal capacities to highly mobile roamers with a capacity to disperse over great distances. Understanding where species lie within this continuum can help assess the effectiveness of spatial management policy, like Marine Protected Areas (MPAs) and Shark Sanctuaries. Although larger spatial closures are known to be more effective in protecting species that disperse large distances, closing off large expanses of open ocean may not be practical or effective spatial management in many regions of the world. In these cases, designing a network of smaller, carefully spaced MPAs may provide just as much benefit as expansive closures. Here we characterise the scale and capacity of movements in sharks and rays which can be used to better inform the design of spatial management policies. We conducted a global, multi-species meta-analysis of shark and ray home range size and dispersal capacity using movement data obtained from fisheries mark-recapture records, acoustic and satellite telemetry datasets. Dispersal capacities for 47 shark and 17 ray species were characterized using dispersal kernels. Dispersal capacities for species where tracking or mark-recapture data was not available were imputed using dispersal records, home range estimates, biological and phylogenetic attributes extracted from previous literature. Here we demonstrate that understanding species-specific dispersal capacities can be used to model the ideal number, size and spacing of spatial closures needed to maximize the success of MPA networks for sharks and rays.

11:30 - A decision support tool for designing effective MPAs for sharks and rays

Dr. Ross Dwyer[1], Ms. Meira Mizrahi[2], Dr. Vinay Udyawer[3], Dr. Cassandra Rigby[4], Dr. Christopher Mull[5], Dr. Amy Diedrich[4], Ms. Jessica Cramp[4], Prof. Nicholas Dulvy[5], Dr. Michelle Heupel[3], Prof. Colin Simpfendorfer[4]

[1]The University of Queensland, [2]James, [3]Australian Institute of Marine Science, [4]James Cook University, [5]Simon Fraser University

Sharks and rays are facing a global crisis, with a quarter of all species threatened with extinction. In response to these concerns, there is growing support for spatial management actions such as marine protected areas to protect species from overfishing. While species occurrence information and the current global reserve network are widely available to managers, geographic information system (GIS) techniques are often required to inform reserve formulations. Furthermore, a countries' capacity to effectively manage protected areas means there is often uncertainty of where to invest efforts to limit exploitation and maximise return on investment. We describe a new decision support tool that visualises global hotspots for sharks and rays, and overlaps these areas with spatial jurisdictions and existing protected areas. This interactive web-based tool uses extent of occurrence and movement information from ~1000 shark and ray species, along with economic and social factors to help inform where to allocate resources to achieve a higher likelihood of success. Our R-Shiny application is free and open source and can be used without any prior knowledge of GIS, software licences or fluency in computer programming. In this talk we outline current features and limitations, and illustrate how researchers and conservation practitioners may use these metrics to guide spatial conservation priorities for sharks and rays.

Focus Group: Mapping Priority Areas for Marine Conservation Part (12:00 - 13:50, Kabu

Dr. John Cigliano[1], Prof. David Johns[2], Prof. Chris Parsons[3]

[1]Cedar Crest College, [2]Portland State University, [3]George Mason University Fairfax

Research has shown that Marine Protected Areas (MPAs), and especially no-take and adequately staffed and funded MPAs, work to safeguard and recover marine species and ecosystems. Many marine scientists have argued that at least 30 per cent of the global ocean needs to be in such reserves, including both high seas and national waters. To be effective, however, it must be the right 30 percent, representing all ecosystems in all biogeographic regions, and taking into account special elements and foreseeable anthropogenic impacts. Identifying that 30 per cent or more is an important initial step in putting MPAs in place. Conservation resources are limited and the forces diminishing ocean life and health are great. This focus group will bring together experts at the conference, and others by electronic means as possible, to create and begin to carry out a strategy for identifying MPA locations and connectivity. Prior to the focus group the organizers will bring together existing data on, e.g. EBSA's (ecologically or biologically significant marine areas), and provide this information to prospective attendees as well as an agenda for the focus group. The focus group will be open to conference attendees, as well as invited experts from every marine region.

Focus Group: Setting the scene for a global reef conservation and innovation challenge

Dr. Alex Dhegan[1], Dr. Petra Lundgren[2], Dr. Line Bay[3], Mr. Tom Moore[4], Dr. Kenneth Anthony[3], Mrs. Theresa Fyffe[2], Dr. Britta Schaffelke[3], Dr. Tali Vardi[5], Ms. Jennifer Koss[6], Dr. Jennifer Moore[7]

[1]Conservation X Labs, [2]Great Barrier Reef Foundation, [3]Australian Institute of Marine Science, [4]National Oceanic and Atmospheric Administration, [5]NOAA, Coral Reef Consortium[6]NOAA's Coral Reef Conservation Program, [7]NOAA

With the world locked in to a trajectory of climate change, global mitigation efforts must go hand in hand with actions to preserve and restore resilience of our most vulnerable ecosystems. In response to two years of mass coral bleaching and devastating impacts of tropical storms, Australia's lead marine research, and management institutions joined forces behind a comprehensive proposal to deliver a 10 year, multi-institutional program focused on reef restoration and adaptation. In response to this bold ambition, the Australian Government has now announced a funding package that includes A$100 million towards this program. These efforts are closely aligned with the core goals of other global partners, such as the newly formed Coral Restoration Consortium, led by NOAA and TNC to scale-up and expand restoration work globally. This focus group builds on these initiatives and the outcomes of two associated symposia and invites Congress delegates to work with an expert panel to identify global conservation and innovation challenges to restore and enhance the resilience of reefs to mitigate the impacts of climate change. Challenges will be focused on issues of scalability, the definition and subsequent restoration of functionality, adaptability and sustainability in a changing environment, and how to create exponential conservation outcomes through innovation and re-thinking current practice. The focus group will be facilitated by Dr Alex Dehgan from of Conservation X Labs with a mission to harness exponential technologies, open innovation, and entrepreneurship to dramatically improve the efficacy, cost, speed, scale and sustainability of conservation efforts.

Communication Workshop Part 2: Policy Engagement and Becoming an Agent of Change (12:00 - 13:30, Tubau 2-3

Ms. Heather Mannix[1]

[1]COMPASS

Conservation scientists have a tremendous amount to contribute to solving today's most pressing problems. As both the need and the opportunities to communicate scientific information to different audiences increase, it can be difficult for scientists to know exactly how and where to engage most effectively. Grounded in the latest research on science communication, this two-part, hands-on workshop is designed to help scientists build their communication skills, understand paths to engagement and make their science matter to the audiences they most want to reach. Participants may take either Part I, Part II or both. In Part I, "Communicating your Science," participants will learn to share what they do, what they know - and most importantly, why it matters - in clear, lively terms, using a tool called the Message Box. Participants will be introduced tools and strategies to help you communicate and distill what you know and why it matters for different audiences. This workshop will involve hands-on practice, feedback and an interactive exercise practicing your "elevator pitch." In Part II "Becoming an Agent of Change," participants will learn the components of successful science engagement, and explore their own avenues to engagement. They will receive an introduction to, and practice with, tools and frameworks for developing a personal plan for bringing about change through their work. Previous experience with the Message Box is recommended for this workshop.

Workshop: Bringing resilience to the classroom

Dr. Jennifer Selgrath[1]

[1]University of British Columbia

So you want to teach about resilience, but are not sure where to start? Come to this dynamic introduction to teaching social-ecological resilience in the classroom. The workshop will be based around the lesson Regime shifts and spatial resilience in a coral reef seascape- from the new edition of Learning Landscape Ecology. It's an interactive lesson and useful for people who are interested in teaching this complex idea to upper level undergraduate and graduate students. The lab investigates how social and ecological factors influence resilience across scales using simple nested models and maps within Excel. We'll talk through useful introductory points and do a quick run through of how calculations in the spreadsheets work. Participants will be given supporting teaching materials and resources. There will also be time for participants to discuss ideas, experiences, and opportunities for making resilience of social-ecological systems come alive in the classroom. Please bring your laptop.

OS-5A: Fisheries and Aquaculture 5 (13:30 - 15:30, FJ Auditorium)

13:30 - Making Waves: Myanmar's emerging marine conservation

Mr. Robert Howard[1]

[1]Fauna & Flora International

Following decades of military rule, Myanmar has recently opened its borders, with democratic elections inaugurating in 2015. As the country emerges, opportunities are surfacing for conservation pitched against a tide of pressures from illegal, unreported and unregulated fishing, poor land use practices, and environmentally damaging aquaculture to poor waste management. Strong commitments are being made to address biodiversity loss and to ensure biodiverse areas are managed sustainably. Central to this has been the development of the National Biodiversity Strategy and Action Plan, which, in alignment with Aichi Target 11, commits to have 10% of coastal and marine areas under effective, equitable management by 2020. While the target is ambitious, in the last several years Myanmar has made progress to gaining baseline marine knowledge through reviews of paper parks, broad-scale ecological surveys, identification of key biodiversity hotspots and threatened areas, and socio-economic assessments to understand resource use and livelihood vulnerabilities. Here we provide a summary of the wealth of biological and social data collected to date and how this is being used to guide management raise the profile of marine environments in Myanmar. Importantly we present how MyanmarâĂŹs move from top down to participatory approaches has led to active marine conservation. Most notably how this new equitable approach has driven the establishment of MyanmarâĂŹs first Locally Managed Marine Areas, promoted comprehensive consultations with local fishers and wider civil society for three new Marine Protected Areas and encouraged spatial planning for community based sustainable mangrove management.

13:45 - Projecting the ecological and economic impacts of fisheries reform in Myanmar

Ms. Katherine Siegel[1], Mr. Gabriel Englander[2], Mr. Frank Errickson[3], Mr. Gavin McDonald[4], Dr. Kristin Kleisner[5], Ms. Willow Battista[5], Ms. Jennifer Couture[6], Dr. Kendra Karr[5], Dr. Rod Fujita[5]

[1]Department of Environmental Science, Policy, & Management, University of California-Berkeley, [2]Department of Agricultural & Resource Economics, University of California-Berkeley, [3]Energy and Resources Group, University of California-Berkeley, [4]University of California, Santa Barbara, [5]Environmental Defense Fund, [6]Environmental Defense Fund; New England Aquarium

Myanmar's marine fisheries provide foreign currency and support domestic food security and livelihoods. Anecdotal evidence of overfishing suggests that many of these fisheries have declined and are underperforming relative to their potential; current fishing rates likely threaten the health of Myanmar's marine ecosystems and their associated benefits. The status of these fisheries is unknown, as are potential ecological and economic impacts of implementing more sustainable management measures. A lack of comprehensive landings data or repeated ecological surveys precludes application of conventional stock assessments or management strategy evaluation to assess effects of management options. Size-spectrum models are a useful approach for extremely data-limited contexts, but projections of fish stock recovery and yield require estimates of fishing mortality. We estimate fishing mortality from available length composition data, filling gaps with existing and novel methods based on Productivity Susceptibility Analysis and economic proxies. Using fishing mortality estimates and a size-spectrum model parameterized with data compiled by Environmental Defense Fund from scientific surveys, we project stock recovery and yield trajectories in response to management scenarios including reducing fishing mortality and implementing size limits. The model accounts for interactions between changing fishing activity and recovery of predator and prey populations, including the full range of trophic levels historically present. By projecting the impacts of various management interventions, the model helps managers and stakeholders understand potential benefits of fishery management and identify appropriate management strategies. Because the model and fishing mortality estimation methods have relatively minimal data requirements, they may be useful for other data-limited fisheries.

14:00 - Assessing the vulnerability of marine life to climate change in the Pacific

Dr. Jonatha Giddens[1], Dr. Donald Kobayashi[1] , Dr. Mark Nelson[2]

[1]NOAA Pacific Islands Fisheries Science Center, [2]National Oceanic and Atmospheric Administration

Our changing climate poses growing challenges for the effective management of marine life, ocean ecosystems, and the human communities that depend upon them. Which species are most vulnerable to climate change and where should science and management focus efforts to reduce these risks? For the first time in the Pacific region, the Pacific Islands Vulnerability Assessment (PIVA) project is implementing a practical and efficient tool for assessing the vulnerability of 83 marine taxa to the impacts of climate change. This collaborative project utilizes expert knowledge, literature review, and climate projection models to assess the relative vulnerability of marine species. This research: 1) provides a relative climate vulnerability ranking across species; 2) identifies key attributes/factors that drive this vulnerability, and 3) identifies key data gaps in understanding and mitigating climate change impacts to living marine resources. Ultimately, this project aims to advance our understanding of the research needs and the management options to both sustain marine life and seafood security in the Pacific Ocean and beyond.

14:15 - Seasonal Changes of Length-Weight Relationship and Condition Factor of Fish Species in Santubong Estuary, Sarawak, Malaysian Borneo

Ms. Adriana Christopher Lee[1], Dr. Farah Akmal Idrus[1], Dr. Fazimah Aziz[1]

[1]University Malaysia Sarawak

The length-weight relationship (LWR) and condition factor (K) of the same species may be different in the population because of feeding, season and fishing activities. Hence, it is important to know the LWR of fish which were caught at a given place and time. The objective of this study was to evaluate the LWR and K of five dominant fish species from Santubong estuary namely Coilia dussumeri, Nemapteryx nenga, Nibea soldado, Setipinna taty and Anodontostoma chacunda. A total of 210 fishes were collected during non-monsoon season and monsoon season at three different stations in Santubong estuary using three-layered gillnet. For each fish, the weight (g) and length (cm) were recorded. Then, the LWR and K were determined. The b values in non-monsoon season varied from 2.57 to 3.25 with only 2 species showing positive allometric growth while b values in monsoon season varied from 2.61 to 3.10 with only 1 species showing positive allometric growth. Then, the mean K in non-monsoon season ranged from (0.40 ± 0.09) to (1.35 ± 0.14) while the mean K in monsoon season ranged from (0.39 ± 0.06) to (1.38 ± 0.15). The mean K of four species in non-monsoon season were higher than the mean K in monsoon season except for A. chacunda that showed higher mean K during monsoon season. The LWR and K were important for fish stock assessment tool, thus the data obtained through this study will be very useful for fishery managers, scientists and researchers to enforce better regulations for sustainable fisheries management and conservation.

14:30 - Towards the Light: Reducing mobuild bycatch in small-scale fisheries using light

Mr. Andrew Harvey[1], Ms. Vidlia Rosady[1], Ms. Retno Ningrum[1], Ms. Willy Angraini[1], Prof. Ron Johnstone[2]

[1]MantaWatch, [2]University of Queensland

Mobulid ray fisheries are largely unregulated and unreported. Global landings increased by an order of magnitude from 1998-2009, with bycatch forming a major component. The devil rays (Mobula spp.) are charismatic migratory species with circumglobal ranges. Members of the genus are vulnerable to extinction, and listed under several multilateral environmental agreements, including the Convention on Migratory Species and the Convention on International Trade in Endangered Species of Wild Fauna and Flora. While mobulid conservation and management efforts have achieved notable successes worldwide, they have predominantly focused on target fisheries and the illegal wildlife trade. The significant issue of bycatch, particularly within widespread small-scale fisheries, remains largely overlooked. We present preliminary results from a randomized control trial to evaluate the technical, social and economic feasibility of using light to reduce mobulid bycatch within Indonesia's small-scale drifting gillnet fisheries. Our findings suggest that installing devices that emit specific wavelengths has the potential to reduce mobulid bycatch and to maintain or enhance target catches. However, stated preferences revealed via choice modelling highlight the urgent need to strengthen regulatory frameworks and to leverage market forces in order to create the incentives that will drive small-scale fisheries to adopt technologies and practices that enhance sustainability.

14:45 - Building fisheries management and resilience at the community level in Manus, Papua New Guinea: a bottom up approach to maximizing adaptive capacity

Mr. Anthony Nagul[1]
[1]*Wildlife Conservation Society*

In Manus, Papua New Guinea, population growth and increasing access to modern fishing gears is placing additional pressure on its diverse fisheries: a trend observed by villagers keen for mitigation measures. The Wildlife Conservation Society recognised the need to assist communities in managing their fisheries, and is working with ten coastal villages to initiate community-level fisheries management. The adaptive capacity of villagers is being strengthened through marine ecology awareness, and the establishment of village-based Marine Management Committees to implement management initiatives. These include FADs (transferring fishing effort from reef fisheries to more resilient pelagic fisheries), rotational fishing zones, minimum size limits, and gillnet mesh-size restrictions. To assist villagers in complying with the latter, we implemented a 'net exchange programme' so fishers can swap small-meshed nets with less destructive larger-meshed nets. Key species catch-and-effort surveys and stock assessments provided baseline fisheries data in this poorly studied region and will continue to monitor the success of management initiatives, informing adaptive management. With the focus on key fisheries, management implementation combined modern science with customary needs, enabling the development of site-specific initiatives - approaches we hope can be used elsewhere in Melanesia.

15:00 - Understanding spatial and temporal fisheries trends to inform multilevel coastal fisheries management in Melanesia

Ms. Tracey Boslogo[1]
[1]*Wildlife Conservation Society-PNG*

In New Ireland Province, Papua New Guinea, the Wildlife Conservation Society is working with 13 island villages and the provincial government to manage coastal fisheries. Central to this process has been the collection of fisheries catch and effort data to better understand spatial and temporal fisheries health trends at a regional and sub-regional level. So far, data has been analyzed from over 3000 fishing trips accounting for over 35,000 fish and 13,000 invertebrates - primarily from coral reefs, seagrass and mangroves. Relative to comparable data from 1983 and 2004, current catches indicate significantly smaller fish sizes, lower catch rates and large ecosystem shifts from higher trophic ordered and more vulnerable species to lower trophic ordered and more resilient species. Length-based stock assessments also suggest that many key fisheries are either approaching, or have exceeded critical spawning biomass thresholds indicating recruitment overfishing. At a sub-regional scale, fisheries health indicators have identified considerable differences between local island groups suggesting the need for spatially based management. In response, we have implemented fisheries management measures at our partner communities on a needs basis, including spawning site fishing bans, assistance with upgrading to more sustainable gears and the deployment of inshore FADs. At a regional level, we are working with the local provincial government to implement marine spatial management and build staff capacity. We feel that our approach to addressing observed trends through management initiatives at multiple levels has good success potential and could serve as a model for fisheries management throughout the broader region

---

OS-5B: Conservation and Management 2 (13:30 - 15:45, FJ Event Hall)

13:30 - Marine Protected Area Design to Increase Benefits to Coastal Communities

Ms. Sizakele Sibanda[1], Dr. Kerry Sink[1], Ms. Mari-Lise Franken[2]
[1]*South African National Biodiversity Institute,* [2]*The Pew Charitable Trusts*

Marine Protected Areas (MPAs) have been identified as globally useful tools to fulfill multiple objectives. The benefits of MPAs are well established in the management of fisheries and biodiversity which rely on well preserved natural features. A common perception of the current MPA network in South Africa is that coastal communities derive few if any benefits from them. South Africa is currently in a process of declaring a new representative Marine Protected Area network that increases mainland marine territory protection from 0.42% towards 10% with a 5% expansion focused offshore. Further MPA expansion requires an innovative approach which focuses on delivering benefits to its coastal communities while meeting conservation targets. To support this, thirty-five case studies, 22 from developing and 13 cases from developed countries were assessed to identify categories of non-consumptive benefits. The study identified five categories of benefits of MPAs: a) Economic b) Biodiversity d) Fisheries Sustainability e) Social and f) Climate Change Resilience. More than 30 new spatial data layers, associated with the categories of benefits have been developed and collated to be included in MPA design optimisation tools. Examples include tourism assets and infrastructure (economic), priority estuaries and ecosystem condition (biodiversity), spawning and nursery areas, culturally important sites and ecosystem condition. Furthermore, data layers such as the poverty index along coastal areas have been developed and included to identify a representative network of MPAs which meet conservation targets and detect areas delivering benefits with the least costs to coastal communities.

13:45 - Assessing the Impact of Underwater Sound on Marine Mammal Hearing in R Shiny: Increasing Accessibility of Tools for Managers and Stakeholders

Ms. Emily Markowitz[1], Dr. Amy Scholik-Schlomer[2], Dr. Mridula Srinivasan[3], Dr. Jason Gedamke[1]
[1]*NOAA NMFS Protected Species Science Branch,* [2]*NOAA Fisheries,* [3]*NOAA*

Shiny is an open source R package that provides an elegant and powerful web framework for building web applications using R. Shiny helps turn analyses into interactive web applications without requiring HTML, CSS, or JavaScript knowledge. Many projects are using this application to increase accessibility of tools and knowledge between scientists, managers, and the public. One such project that has greatly benefited from this is NOAA Fisheries' Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing. The Technical Guidance describes and provides criteria to quantify the effects of human-made sounds on marine mammal hearing. The criteria is can be used to predict the onset of permanent and temporary changes in marine mammal hearing for all underwater sound sources. Currently, an optional user spreadsheet tool created in Microsoft Excel that predicts impact calculations, based on the Technical Guidance's criteria, has been made available for end users. However, this Microsoft Excel tool can be an overly complicated and overwhelming interface for most end users.This presentation describes how these impact calculations were translated from Microsoft Excel to R to provide a cleaner and more succinct interface for the end user. This is an example of translating complex scientific calculations and programming code into a more intuitive and

management-friendly decision-making tool to predict the impacts of anthropogenic sound on marine mammal hearing.

14:00 - Design and implementation of MPAs network in the Russian Arctic: lessons and opportunities

Mr. Boris Solovev[1], Mrs. Irina Onufrenya[2], Dr. Vassily Spiridonov[3]

[1]A.N. Severtsov Institute of Ecology and Evolution of Russian Academy of Sciences, [2]WWF-Russia, [3]P.P. Shirshov Institute of Oceanology of Russian Academy of Sciences

The Arctic is among the regions experiencing the most significant changes. At the same time, it is still one of the most pristine areas of the World Ocean. Area-based conservation measures are considered among the effective measures of conservation. Although there are a few existing protected areas in the Russian Arctic, they were established on an ad-hoc basis primarily to protect terrestrial biodiversity.To design an ecologically connected and representative network of conservation areas is the most effective way to protect the biological diversity and ecological processes of the marine environment. A key step on the way to this, is to identify conservation priority areas. To make this step, a study based on a systematic conservation planning approach was conducted by a group of experts under WWF Russia and the Russian Academy of Sciences' guidance. Marxan algorithm was used to produce initial results; then it was discussed and refined to select 47 conservation priority areas in the Russian Arctic seas. The resulting network covers almost 25% of the Russian Arctic seas and provides proportional representation of their biodiversity as well as achieving connectivity, sustainability and naturalness.The Conservation Priority Areas identified during the analysis will be included in the Federal List of Prospective Protected Areas (2020-2030); some of them are already being implemented (Novosibirskie Islands, Severnaya Zemlya Archipelago). The approach caused a series of regional studies intended to provide detailed plans for the new MPAs establishment and integration of systematic conservation planning in Marine Spatial Planning in the Pechora Sea.

14:15 - Phylogenetic distribution and functional group analysis of Indian horseshoe crab found in coastal region of Bay of Bengal

Ms. Bhubaneswari Bal[1], Mr. Alok Prasad Das[1]

[1]Department of Chemical & Polymer Engineering/ Tripua University (A Central University)

Phylogenetic studies are significant for addressing diverse biological relationships among species, their origin, the demographic changes and migration patterns of species. There are two species of horseshoe crabs, Tachypleus gigas and Carcinoscorpius rotundicaeuda found in the regions coast of Odisha, India. Conservation of Indian horseshoe crabs become a challenge as their number decreases due to various human activities. Therefore, studies were planned to assess their distribution by determining phylogenetic relationship and functional group analysis. Exploration of molecular phylogenetics of Indian horseshoe crabs collected from three different locations of Odisha, India, a set of genetic data was required. To evaluate the genetic relationship, partial sequencing (~700bp) of mitochondrial cytochrome c oxidase subunit I gene (COI) from three individual horseshoe crab gills using Universal" DNA primers were carried out. Phylogenetic and BLAST analyses revealed that all the species collected in this study were Tachypleus gigas having genbank accession numbers: KU880543, KU880544, KT380891. Investigation on the functional groups of Tachypleus Amebocyte Lysate was carried out by FTIR analysis. Spectra validated strong peaks between 3299.61cm1 to 1449.24 cm1 and1238.08cm1 to 1078.98cm-1 for O-H stretching N-H stretching bend respectively. The structural identity represents signifying secondary group of amides and fatty acids where as N-H stretching validates the occurrence of protein group. The conclusion reveals that molecular phylogenetic and functional analysis will be helpful in understanding divergence of evolution of T.gigas

---

14:30 - Ecosystem Services: Bridge or Barrier for Marine and Coastal Management

Dr. Emma McKinley[1]

[1]Cardiff

Across disciplines, the concept of ecosystem services has become an accepted concept through which the complexities of the natural world and its relationships with human society are explained and embedded into global environmental policy. At a time when global ecosystems are continually under pressure due to anthropogenic influences and interactions, it aims to provide policy makers, practitioners and scientists with a common language. In spite of this widespread acceptance, the concept of ecosystem services is in its very nature complicated and full of complex, and sometimes, intangible interactions. As the field of ecosystem service research has grown, the ecosystem services framework has developed, most recently through the Follow on to the UK's National Ecosystem Assessment (2014), to encompass: four different categories of ecosystem services, various ecosystem processes and characteristics, and many associated benefits. While stakeholders have, for the most part, adopted this language and terminology, questions remain as to whether the ecosystem services concept provides the common language it promotes. There are concerns that the complexities associated with ecosystem services as a concept make it inaccessible. Through a questionnaire survey, this presentation examines the perceptions of UK marine and coastal stakeholders, researchers and policy makers towards the concept of ecosystem services. The study evaluates respondents' views about its role as either a barrier or a bridge, or both, within the marine and coastal science-policy-practice interface. Finally, the presentation sets out a series of recommendations to support the future use of the ecosystem services concept in UK coastal and marine management.

14:45 - Multi stakeholder participation in planning for mangrove for future in Klang Islands, Malaysia

Dr. Hong Ching Goh[1], Dr. Caroline Hattam[2], Dr. Amy Yee Hui Then[1], Dr. Heng Hing Moh[1], Mr. Andrew Edwards-Jones[2], Ms. Nur Fatin Nabilah Ruslan[1], Ms. Jennice Shu Ee Yap[1]

[1]University of Malaya, [2]Plymouth Marine Laboratory

The trade-off with urbanization in tropical coastal areas is often seen in the form of mangrove destruction. While the multiple ecosystem services of this coastal flagship resource are widely recognized, they are often under-valued and -appreciated especially when land scarcity is a critical issue faced by the developing cities. This in return, poses a threat to the survival of the mangrove and the mangrove-dependent local communities, as well as any indigenous cultural attachment to them. This paper reveals the outcomes of a study in Klang Islands, Malaysia, which are experiencing fast paced economic development and where fishery is a traditional livelihood activity among the locals. A series of workshops have been undertaken aimed at bringing together stakeholders with different interests to discuss and envision the future for the mangroves, with particular attention to fisheries and community well-being. The findings indicate that the multiple stakeholders acknowledge the importance of mangroves, yet the necessity of physical development is a priority. Consequently, the future for mangroves in Klang Islands, as preliminary proposed by the

stakeholders, includes introducing tourism activities in the existing mangrove forests and mangrove replanting to support an ecotourism network as well as a forest plantation. This would offer an alternative livelihood for the local communities, economic return at large, as well as support the maintenance of essential ecosystem services.

15:00 - Streams, stories, and stakeholders: Protecting small island coral reefs through integrated watershed management planning

Mr. Malcolm Johnson[1]
[1]*BECQ CNMI*

Talakhaya, a priority watershed and conservation area with the only flowing streams on the island of Rota in the CNMI, has changed drastically over the last century. Once full of pristine native limestone forest, historic land use changes left major areas of the watershed somewhere between barren land and grassland, resulting in erosion and sedimentation of the coral reefs below. Yearly revegetation efforts are beginning to show progress with sediments stabilizing in the most exposed areas. However, the impact of intentional burning, used to aid in deer hunting, and a lack of familiarity of the watershed, as seen in survey responses, has limited the continued successful implementation of a "ridge to reef" conservation approach towards coral protection. Engaging in a participatory process, stakeholders are exploring the methods used to measure watershed and coral health, offering stories about their connection to the island and the conservation area, and learning about the characteristics of streams to connect reefs to mountains to people. Utilizing geospatial data assembled in the open grasslands, water quality information gathered throughout the streams, invertebrate and fish biomass statistics collected in the nearshore reef, and social and cultural evidence amassed through interviews and workshops, this project attempts to integrate not only the various conservation approaches required for effective watershed and coral reef management, but also the residents of Rota and their stories into a community-based management plan that provides biocultural resilience to the threats of climate change, pollution, and beyond.

S-173: Toward science-informed, increased marine protected area targets (13:30 - 15:30, Tubau 2-3)

13:30 - Increasing Global Marine Protected Area Target and Coverage under the Convention on Biological Diversity

Dr. Winnie Lau[1]

[1]*The Pew Charitable Trusts*

In 2010, the Convention on Biological Diversity (CBD) adopted the Strategic Plan for Biodiversity for 2011-2020, including the Aichi Targets. Aichi Target 11 set a goal of protecting at least 10% of marine and coastal areas by 2020. The United NationsâĂŹ Sustainable Development Goal 14.5 provided further political support toward this target and timeline. Since the adoption of Aichi Target 11, scientific research has provided evidence that an area-based target of 10% is insufficient to meet sustainability goals. In 2014 at the Sixth IUCN World Parks Congress, participants recommended that at least 30% of each marine habitat be protected, and at the 2016 IUCN World Conservation Congress, members adopted a resolution encouraging State members to increase MPAs in their national waters to at least 30%, and Parties to the CBD to consider a process for an MPA target of 30% by 2030. As we approach 2020, CBD Parties have been ramping up efforts to meet Aichi Target 11, with large marine reserves and protected areas announced recently by the governments of Palau, Mexico, and Chile. With progress being made towards the Aichi Target and new global ambitions expressed, what comes after 2020? The CBD Secretariat is undertaking a participatory process to develop the Post-2020 Biodiversity Framework. Marine conservation biologists can seize the opportunities for stakeholder and public input into this process before the 2020 CBD Conference of the Parties, which will consider and potentially adopt the Framework. Some key considerations might include effectiveness, specific objectives, climate change, and getting buy-in.

13:45 - Global Survey: Area-based conservation Post-2020

, Dr. Stephen Woodley[2], Mr. Harvey Locke[2]

[1]*UN Environment World Conservation Monitoring Centre (UNEP-WCMC),* [2]*International Union for Conservation of Nature*

The Strategic Plan for Biodiversity 2011-2020 and its 20 Aichi Biodiversity Targets adopted by governments in 2010 represented a major step forward for biodiversity. The Aichi Targets set objectives to the year 2020, but not beyond. IUCN's World Commission on Protected Areas (WCPA) has established a "Beyond the Aichi Targets Task Force," to advise countries on area-based targets that ensure the conservation of biological diversity. The Task Force conducted a formal survey of 363 conservation scientists in 81 countries and in 3 languages. This presentation provides the results of that survey, which will be used to inform disucssions on development of the post-2020 biodiveristy framework. Globally, conservation scientists feel strongly that the current Aichi Targets are not sufficient to halt biodiversity loss. They strongly support ambitious, large-scale conservation targets, and wish to see increased emphasis on effectively conserving areas of importance of biodiversity and ensuring ecological connectivity between protected and conserved areas.

14:00 - Effectiveness and connectivity of Protected Areas Network (PAN) System in Palau

Dr. Yimnang Golbuu[1]

[1]*Palau International Coral Reef Center*

To enhance its efforts to protect its biodiversity and support local management, Palau established the Protected Areas Network in 2003. Currently, there are 14 MPAs within the PAN, covering 11.2% of Palau's reef area. Conditions of the MPA sites was assessed through ecological surveys, while connectivity among sites within the PAN was determined with hydrodynamic modelling. Results indicate that the PAN network is effective, with fish biomass in the PAN sites being twice as much as the biomass in the reference sites. An even greater distinction is seen among the top fish predators, whose biomass is five times greater inside the PAN sites than outside. Overall, the PAN as a network has good connectivity. However, it remains an incomplete system, due to a few gaps in the MPA network, where there are no established PAN sites. Therefore, additional PAN sites are still needed to improve connectivity. Factors that we identified to be contributors of PAN sitesâĂŹ success include (1) time of protection, (2) size of the MPA, (3) presence of high coral cover, (4) and distance from land. While PAN network is generally effective, there remains several threats outside of the PAN sites, including climate change and pollution that affect the condition of Palau's reefs, and ultimate success of the PAN. Therefore, while efforts to ensure PAN's success and effectiveness should continue, greater efforts must also be made to address non-site-specific threats, as well as to design the network to take climate change into account.

14:15 - Are the benefits of MPAs enough to make them successful, fully utilized global conservation tools?

Dr. Ameer Abdulla[1]

[1]*Wildlife Conservation Society and University of Queensland*

Globally, marine conservation practitioners advocate designing and developing coherent networks of MPAs in different ecoregions and large marine ecosystems of the world. The science is clear that highly protected, ecologically connected, and spatially replicated MPAs afford marine biodiversity the best opportunity to persist and to recover from impacts (local or global, natural or anthropogenic). Science has also described how current targets of 10% under the Convention of Biological Diversity or the Sustainable Development Goals may not be sufficient to maintain ecosystem integrity and functioning. At the same time it has described how we are failing geographically and systematically to reach even the current international target. Although the benefits of MPAs are evident and the calls for representative networks of MPAs have been frequent and global, progress toward on-the-ground protection has faltered severely due to several reasons, not least of which is stakeholder opposition as well as the lack of financial resources, technical capacity, and institutional will. Understanding the socio-economic and geopolitical challenges to MPA designation and enforcement and addressing them is critical for the global community to reach the current modest target, or to have the hope to increase this target to a more scientifically accepted percentage for adequate marine biodiversity management.

14:30 - Making MPAs Matter: Re-framing Marine Protection in South Africa

Dr. Kerry Sink[1], Ms. Kristal Maze[1], Dr. Judy Mann[2]

[1]*South African National Biodiversity Institute,* [2]*South African Association for Marine Biological Research*

Only 0.4% of mainland South Africa is protected within 23 coastal Marine Protected Areas (MPAs) established between 1964 and 2013. The 2011 National Biodiversity Assessment identified offshore ecosystems as the most poorly protected ecosystems across all realms. Comprehensive systematic conservation planning, with stakeholder engagement from the outset, was used to develop an optimal network of proposed MPAs. A network covering 5-7% was advanced towards implementation through a 'Presidential Oceans Economy' initiative. A key challenge has been effectively communicating the purpose, need and benefits of MPAs to government officials, politicians and decision makers. We share experience in reframing Marine Protection using the findings of two South African studies that informed communication about MPAs. Research to investigate how to frame biodiversity as integral to the development trajectory of South Africa identified three of eight different concept messages as most relevant in a developing country. Framing biodiversity as a 'national asset'; linking conservation to "our children's legacy" and framing action as 'practical solutions' were most likely to inspire action among decision makers. Similarly, a study that investigated the impact of an environmental behaviour change campaign demonstrated the importance of emotional connections, linking communication to specific behavioural requests, the influence of language and the significance of "responsibility to future generations" in motivating behaviour change. We applied these lessons in a communication strategy to "Make the case for MPAs". Lessons shared focus on the challenges and advances in Making MPAs Matter in a developing world context.

14:45 - Effective coverage targets for ocean protection

Prof. Callum Roberts[1], Dr. Bethan O'Leary[1], Dr. Julie Hawkins[1]
[1]*University of York*

When nations of the world agreed to establish national networks of marine protected areas (MPAs) at the 2002 World Summit on Sustainable Development, it was a major leap for ocean conservation. The UN Convention on Biological Diversity quickly added detail, setting a target of 10% of the sea as MPAs by 2012. Ten percent was a political, rather than a scientific target: not so little as to appear trivial, and not so much as to deter nations from signing up. Notwithstanding its modesty, the target was missed by a long way, but has been given new legs in UN Sustainable Development Goal 14, which wants 10% ocean protection by 2020. As we near this date, there are real hopes the target will be reached this time. However, scientific evidence now makes it clear that 10% is insufficient to achieve many of the desired goals for ocean management, such as recovering threatened species, representing biodiversity and supporting fisheries. Furthermore, a new purpose for MPAs has become appreciated: helping to mitigate and promote adaptation to climate change. Meeting such objectives will require higher targets and a figure of 30% protection by 2030 is being widely deliberated. The science, however, can equally well support another much-discussed target of 50% protection. Such figures are averages and do not apply equally to all habitats. Some habitats are so vulnerable to damage that any left unprotected will be lost, while others warrant greater precaution, like the high seas where governance is weak.

S-178: Linking 'Social Science' with 'Policy Windows': Lessons from implementing research at the right time, in the right place (13:30 - 15:30, Tubau 1

13:30 - From One to Many: The Journey to Social and Natural Sciences Monitoring in the Pacific island region

Dr. Supin Wongbusarakum[1], Mr. Matt Gorstein[2]
[1]*University of Haw,* [2]*National Oceanic and Atmospheric Administration*

This talk illustrates experiences and lessons learned in the efforts to integrate social and natural sciences in monitoring the conditions of human communities and marine and terrestrial ecologies in the Pacific island regions. While integrating monitoring is desired and increasingly recognized by different collaborative partnerships at regional and site levels as a better way to gain a holistic view of social-ecological systems, and to generate results to help solve marine environmental problems and to better support human well-being, there have been challenges in designing and implementing integrated monitoring. Better strategic planning for the integrated monitoring design and challenges in interdisciplinary research need to be addressed. Different cases will be used to illustrate challenges and efforts to address them: Community-Based Subsisting Fishing Areas in Hawaii, the NOAA Habitat Blueprint Site Manell-Geus in Guam, the NOAA Socioeconomic monitoring, and socioeconomic monitoring efforts with the Micronesia Challenge countries (including Guam, the Commonwealth of Northern Marianas, the Republic of the Marshall islands, Federated States of Micronesia, and Palau). The paper shares how the governmental agencies, research partners, conservation organizations, and communities came together to integrate the different types distinct types of monitoringâĂŤdespite their methodological differences and the various points at which they were initiated-to move towards integrated research practices. The talk will end with recommendations based on the lessons learned that may better help support policy relevant research and better bridge sciences with marine management decision making.

13:45 - From manager to student: using my experiences as a fisheries manager to drive social science research on Belize's fisheries management reform

Mr. Eric Wade[1], Dr. Kelly Biedenweg[1], Dr. Ana Spalding[1]
[1]*Oregon State University*

Evidence of declines in fish stock and degraded ecosystems in Belize, coupled with illegal fishing activity and an outdated Fisheries policy, calls for new management approaches. Indeed, Belize recently moved to reform its fisheries industry from an open access system to managed access, a rights-based territorial system aimed at recovering its fisheries through empowering fishers and promoting stewardship. As a former fisheries manager, a key component in fostering the sustainability of managed access meant understanding stakeholder's perceptions, attitudes and knowledge around the program. As researchers, we sought to determine how managed access could address the sustainability of Belize's fisheries sector. Managed access presented an opportunity in which social science approaches could work together with management needs to answer key questions to provide new insights in understanding the introduction and implications of this new policy. In this respect, Managed Access is a unique "policy window" for integrating research and practice into a policy-relevant research project that can contribute to the sustainability of Belize's fisheries industry. Tapping into existing relationships from a network of governmental, non-governmental and community leaders, I discuss how my experiences as a fisheries manager in Belize allowed me to integrate a human-dimension centered project using an environmental psychology and policy approach. Transitioning from fisheries manager to researcher brought many advantages and drawbacks that are important to consider in social science research

such as established relationships and trust but also potentials for bias. I discuss navigating these hurdles and provide examples of how my management perspective drove my research.

14:00 - Engaging the Human Dimension of Coastal Research: Small Scale Fisheries Data Collection to Support Management and Conservation in Panama

Dr Ana Spalding[1]
[1]*Ore*

It is widely recognized that small-scale fisheries (artisanal, commercial, and subsistence) are grossly underestimated in global reports by the FAO, creating serious challenges for resource management and local stewardship. Indeed, fisheries reform increasingly calls for a better understanding of fisheries data, broadly defined, and is emerging as an important policy tool for sustainability. Panama is no exception. In 2016, a year-long process led by the national government, with funding from UNDP, promoted active participation from industry representatives and civil society to generate a National Fisheries Dialogue report. The report outlines the objectives for future management, including the sustainable use of aquatic resources that guarantees the social and economic wellbeing of the fishing industry. The report also highlights the importance of obtaining better and more consistent data about Panamanian fisheries. As a result, a collaboration between Oregon State University, MarViva Foundation and Rare was established for the implementation of a digital fisheries data collection system that provides systematic data processing and monitoring for small-scale fisheries. Preliminary testing of the OurFish App data collection system was carried out in spring of 2017 in 2 communities of the Gulf of Montijo, Panama. This paper presents key findings from interviews with community members who used the App, including a broader discussion about the challenges and opportunities of the introduction of web-based technologies in rural fishing communities.

14:15 - Integrating Ecosystem Services and Human Wellbeing in Puget Sound Planning

Dr. Kelly Biedenweg[1]
[1]*Oregon State University*

Every two years, watershed organizations within the Puget Sound develop strategic plans for estuarine restoration activities. Historically, these plans have been focused on political and ecological goals. With greater political will and new tools developed over the past five years, social science is being increasingly integrated in the decision-making process. This presentation describes the policy window created through the backbone government agency called the Puget Sound Partnership and the ways in which social scientists are leveraging these windows to build more holistic approaches to managing social-ecological estuarine systems.

S-99: The FinPrint project: from global surveys of coral reef sharks and rays to conservation success (13:30 - 15:30, Kerangas)

13:30 - How Global FinPrint works: from sampling to data model and beyond

Ms. Taylor Gorham[1], Dr. Aaron MacNeil[1], Prof. Colin Simpfendorfer[2], Dr. Michelle Heupel[3], Prof. Michael Heithaus[4], Prof. Euan Harvey[5], Dr. Mark Meekan[3], Dr. Demian Chapman[4]
[1]*Dalhousie University,* [2]*James Cook University,* [3]*Australian Institute of Marine Science,* [4]*Florida International University,* [5]*Curtin University*

The Global FinPrint project is a three-year research project that has developed a systematic approach to gathering and annotating baited remote underwater visual systems (BRUVS) in an effort to estimate the relative abundance of coral reef-associated sharks and rays from around the world. To do this, our team developed protocols for BRUVS design and deployment that we have used to train NGOs, governments, and other local partners in how to conduct BRUVS-based surveys. Global FinPrint has also supplied equipment and baseline data to local organisations so they can continue sampling after our initial project is complete. We have also built and developed open source annotator software so they can annotate their videos and collect data online, alleviating several structural impediments to monitoring reef shark and ray populations. The BRUVS monitoring approach also allows local collaborators to develop video highlights for local communities, facilitating outreach well beyond what would have previously been possible. Here we will discuss these aspects of the project and outline how new collaborators can engage with this global conservation initiative.

13:45 - Global FinPrint: quantifying reef sharks and rays around the world.

Dr. Aaron MacNeil[1], Dr. Michelle Heupel[2], Prof. Colin Simpfendorfer[3], Dr. Demian Chapman[4], Prof. Michael Heithaus[4], Prof. Euan Harvey[5], Dr. Mark Meekan[2]
[1]*Dalhousie University,* [2]*Australian Institute of Marine Science,* [3]*James Cook University,* [4]*Florida International University,* [5]*Curtin University*

Exploitation of sharks has led to depletion of shark populations around much of the world, with severe declines reported for dozens of species. However, the majority of shark and ray population assessments have been conducted in temperate regions, often where industrialized fisheries are required to report catch to management agencies. A major knowledge gap remains in the tropics, where assessments of reef-associated sharks have been few and far between. The Global FinPrint project is a pioneering effort to address this problem, using baited remote underwater video surveys (BRUVS) to estimate the relative abundance of coral reef-associated sharks and rays from around the world. Here we outline the overall achievements of the project, providing first-ever estimates of where and why reef shark densities vary across the tropics and exploring how various social-ecological factors influence the current state of reef sharks in the world today. In doing so, we uncover multiple avenues for shark and ray conservation appropriate across a range of social and environmental contexts.

14:00 - Global FinPrint sampling in the western Atlantic region

Dr. Demian Chapman[1], Ms. Gina Clementi[1], Dr. Mark Bond[1], Dr. Jeremy Kiszka[1], Ms. Camila Caceres[1], Mr. Diego Cardenosa[2], Ms. Elizabeth Whitman[1], Ms. Kathryn Flowers[1], Ms. Jasmine Valentin[2], Prof. Michael Heithaus[1]
[1]*Florida International University,* [2]*Stony Brook University*

The western Atlantic is a region where shark populations are reportedly at critical levels. The Global FinPrint Project has surveyed reefs in 24 countries in this region using baited remote underwater video systems (BRUVS; over 3,000 hour-long deployments). Eleven shark and 8 ray species were video-captured, with an overall sightings rate of 0.65 sharks and 0.23 rays observed per hour. The most common species observed were Caribbean reef shark (Carcharhinus perezi), nurse shark (Ginglystoma cirratum), southern stingray (Hypanus americanus), and white spotted eagle ray (Aetobatus narinari). Sightings rate varied widely between countries and reefs within countries, which we are attempting to explain by assessing a wide range of potential environmental, habitat, and anthropogenic factors. Although shark populations in this region have been characterized as severely overfished there remain areas of relatively high abundance and diversity, including The Bahamas, the Sea Flower Biosphere Reserve, and Tobago. Importantly we sighted a majority of the expected species in many countries, suggesting widespread recovery is possible from in-country refuges.

14:15 - The status of Indian Ocean shark and ray communities

Dr. Conrad Speed[1], Dr. Jordan Goetze[2], Prof. Euan Harvey[3], Prof. Michael Heithaus[4], Dr. Mark Bond[4], Dr. Jeremy Kiszka[4], Dr. Demian Chapman[4], Dr. Mark Meekan[5]

[1]Australian Institute of Marine Science / Global FinPrint, [2]Curtin, [3]Curtin University, [4]Florida International University, [5]Australian Institute of Marine Science

Sharks and rays in the Indian Ocean are thought to be under increasing pressure from over fishing and habitat degradation, although the current status of populations is unknown in many countries. To address this gap in knowledge, shark and ray communities throughout the region were surveyed using baited remote underwater video stations as part of the Global FinPrint Project. More than 6,700 deployments across 13 countries were made during daylight hours for 60-minute periods. A total of 38 species of sharks were recorded of which ~77% of observations were Carcharhinus melanopterus, C. amblyrhynchos and Triaenodon obesus. A total of 32 species of rays were recorded of which the most common species Neotrygon Kuhlii made up 12.5% of observations. Mean relative abundance hr-1 across the region for sharks was 0.86 $\pm$ 0.02 SE, while it was considerably lower for rays at 0.15 $\pm$ 0.01 SE. Countries that had relatively high shark abundance (~0.5 sharks hr-1) included Australia, Maldives, Mozambique, Seychelles, and South Africa. Rays were relatively high in abundance (~0.2 rays hr-1) in Mozambique, South Africa, and Maldives. Only 45% of countries surveyed had all components of the trophic community represented (High, Medium, and Low trophic positions). Drivers of community level patterns are discussed and related to current management and conservation measures.

14:30 - Exploring occurrence and abundance of reef sharks in the Pacific

Dr. Michelle Heupel[1], Dr. Leanne Currey[1] , Prof. Colin Simpfendorfer[2] , Prof. Michael Heithaus[3] , Prof. Euan Harvey[4] , Dr. Jordan Goetze[4] , Ms. Gina Clementi[3] , Dr. Matt Rees[1] , Dr. Mark Bond[3] , Dr. Jeremy Kiszka[3], Ms. Naomi Farabaugh[3], Dr. Laurent Vigliola[5], Dr. Eric Clua[6], Dr. Demian Chapman[3]

[1]Australian Institute of Marine Science, [2]James Cook University, [3]Florida International University, [4]Curtin University, [5]Institut de Recherche pour le Développement, [6]Centre de Recherches Insulaires et Observatoire de lâĂŹEnvironnement

There is increasing concern over the status of global sharks and rays with as many as 25% of species threatened with extinction. In conjunction with pressure from fishing activities, at-risk populations also face the threats of changing climate conditions and other human impacts. Based on these concerns it is important to understand the current status of populations to allow future investigation and understanding of how species and populations respond to pressures and management interventions. The Global FinPrint project is an international initiative to define the relative abundance of sharks and rays that occur in coral reef habitats. Baited remote underwater video surveys are being conducted to define species occurrence, richness and relative abundance to provide a baseline from which to define future species and population trends. Here we present data collected from 14 countries in the Pacific region and examine the variability among locations and potential capacity to improve the status of sharks and rays where needed. Differences in species richness were evident among countries ranging from 4 to 18 species as well as variability in relative abundance among species and locations. Potential reasons for variability will be explored and discussed. With coral reefs being some of the world's most threatened ecosystems, this research is critical to our future management of these habitats and the predator populations that rely on them.

14:45 - Identifying primary drivers of reef elasmobranch relative abundance and distribution across a suite of biotic and abiotic gradients.

Ms. Naomi Farabaugh[1], Dr. Eric Clua[2], Dr. Mark Bond[1], Dr. Jeremy Kiszka[1], Dr. Serge Planes[3], Dr. Frederic Torrente[3], Prof. Michael Heithaus[1]

[1]Florida International University, [2]Centre de Recherches Insulaires et Observatoire de lâĂŹEnvironnement, [3]CRIOBE

The Exclusive Economic Zone of French Polynesia covers an area half the size of Europe, contains 5% of the world's living coral biomass, and has relatively intact shark populations. Indeed, reef-associated elasmobranchs have not been subjected to commercial fisheries and in 2012 the entire EEZ was declared a shark sanctuary. Within French Polynesia there are considerable gradients of human population density, cultural background, and socio-economics coupled with natural gradients of island size and type (e.g. high islands vs atolls), reef structure, productivity and abiotic factors. Therefore, during the Global FinPrint project, we used French Polynesia as a model for understanding how the abundance and diversity of reef-associated sharks and rays varies across natural and anthropogenic gradients in the absence of commercial fishing. From 2017-2018, we conducted baited remote underwater videos surveys (n=1,750 camera deployments in forereef habitats) across 35 islands and atolls; complemented by 300 semi-structured social science interviews from a variety of ocean-users, particularly to assess the extent of cultural variations in attitude to sharks and overall awareness of the regulations in place protecting them. A Generalized Linear Model was used to assess the relative importance of natural and anthropogenic factors in the spatial variation of elasmobranch species richness and relative abundance. Abundance was greatest in areas of higher productivity and species composition varied spatially. We found that although there was relatively little reported pressure on shark populations, knowledge about the shark sanctuary and shark protections were comparatively limited. Better communication about the sanctuary could help increase compliance

---

15:00 - Translating Global Finprint results into conservation outcomes

Prof. Colin Simpfendorfer[1], Dr. Michelle Heupel[2] , Prof. Michael Heithaus[3] , Dr. Aaron MacNeil[4] , Prof. Euan Harvey[5] , Dr. Mark Meekan[2] , Dr. Demian Chapman[3]

[1]James Cook University, [2]Australian Institute of Marine Science, [3]Florida International University, [4]Dalhousie University, [5]Curtin University

The Global Finprint project is producing a huge amount of information on sharks and rays that occur on coral reefs. While the information is interesting from a purely marine ecology perspective, greatest benefit will flow by ensuring that it is translated into products that can be used by conservation and management decision makers to improve the status of populations where necessary. To achieve this Global Finprint has a multi-pronged strategy that involves: 1) analyses to maximise the scientific evidence for where the greatest changes in abundance and diversity in communities of coral reef sharks and rays have occurred, 2) identification of priority countries and regions of greatest concern, 3) input into processes that assess the status of populations and at times provide protections for at risk species and places (e.g. IUCN Red List, CITES, CMS), 4) production of summary data and conclusions for locations that have been sampled by the Global Finprint team, 5) partnering with NGOs to provide information useful for their conservation programs, and 6) engagement with decision makers at regional workshops to explain project outcomes and provide guidance on possible management responses. Examples of each of these strategies will be provided, and the benefits for coral reefs, sharks and rays will be discussed.

OS-6A: Food Security 1 (16:00 - 18:00, Kabu)

16:00 - Public health and personal livelihoods: socioeconomic impacts of the response to shellfish-transmitted norovirus in Hammersley Inlet, Puget Sound

Ms. Marisa Nixon[1]

[1]Washington State Department of Health

This research focuses on Hammersley Inlet in Washington State, U.S.A. Hammersley Inlet is a highly productive shellfish growing area, where shellfish farming is a significant source of income and employment. In 2014 and 2017, it was linked to a series of shellfish-transmitted norovirus outbreaks. Norovirus, which is bioaccumulated in shellfish, is not naturally occurring in the marine environment but enters it via human sewage. These outbreaks resulted in recalls and closures of shellfish growing parcels by the Washington State Department of Health (DOH). While the source of the 2014 outbreak was identified, the source of the 2017 outbreak remains unclear. DOH, along with federal and county-level partners, continues to study the hydrology, environmental conditions and pollution sources in Hammersley Inlet. DOH also created a survey that focuses on the impacts the 2014 and 2017 norovirus outbreaks had on shellfish growers in Hammersley Inlet. The survey gathers information on six key themes: economic impacts, cultural importance of the industry, familiarity with norovirus prevention, risk perception of the likelihood of shellfish illness, adaptability, and satisfaction with the response of DOH. Results show that many shellfish growers suffered significant economic losses during the outbreaks, including long-term damage in public perception. Water quality, in this case, is imperative not just to human health but to economic security. Making it clear that closures and recalls impact people's livelihoods highlights the need to prioritize responsible shoreline development, especially as population growth and climate change affect the waste management infrastructure around Puget Sound.

16:15 - Relationship between food security and material assets in villages inside and outside five Indonesian marine protected areas (MPAs)

Mr. Nara Wisesa[1], Ms. Ignatia Dyahapsari[1], Ms. Estradivari Estradivari[1], Ms. Louise Glew[2], Mr. Matheus De Nardo[2], Mr. Philip Mohebalian

[1]WWF-Indonesia, [2]WWF-US

Marine Protected Areas (MPAs) are expected to have effects on local communities, including affecting food security levels and local economic conditions. Past studies in terrestrial villages indicate these parameters may influence each other. This study aims to see if this is also present in villages within and nearby MPAs. The study uses baseline data from a WWF-Indonesia led large scale and long-term socio-economic monitoring on the impact of MPAs, sampling 109 villages both inside and outside five MPAs within Indonesia's Sunda Banda Seascape. Analysis results indicate no significant difference (a=0.05) in means of baseline food security and material assets indexes between villages inside and outside MPAs. This lack of difference is expected for a baseline data and the MPAs are newly established. Analysis results also indicate a significant relationship (a=0.05) between material asset index and food security index levels for all sampled villages. This was also detected when only villages located within MPAs was analyzed, while no significant effect (a=0.05) was detected when only villages outside MPAs was analyzed. This suggests that the level of household economic conditions significantly affects a household's access to food resources, which seems more significant in villages located within MPAs, possibly in relation to differing main sources of income between the villages. Further investigation is needed to flesh out the relationships between different socio-economic parameters in coastal villages, and that continuous monitoring would be needed to ascertain whether the MPAs significantly impacts the socio-economic conditions of local communities.

16:30 - Empowering Community Action for Seagrass Conservation in Southeast Asia

Dr. Leanne Cullen-Unsworth[1], Dr. Richard Unsworth[2]

[1]Cardiff, [2]Swansea University and Project Seagrass

his work outlines the conservation value of seagrass meadows by evidencing their role in food security, demonstrating the significant threats that seagrasses face across SE Asia and highlighting positive community action being taken to reverse their decline. We use a case study approach to demonstrate links between seagrass meadows and food security and support development of appropriate management strategies that build on stakeholder engagement leading to strategy ownership.

Seagrasses are critical components of marine systems supporting a diversity of taxa. Important fishing grounds in their own right; they also play a significant role in supporting other fisheries productivity. At different stages of their lifecycle, many economically important fish and invertebrates utilise seagrass for shelter and food. Protecting seagrasses as foundation species can protect species richness, biodiversity, ecosystem structure, fisheries support, climate regulation through carbon sequestration and other essential ecosystem services. However, seagrass meadows are declining globally at an unprecedented rate and marine conservation priorities often do not recognise the value of the goods and services provided.

Southeast Asia is one of the world's marine biodiversity hotspots. However, knowledge of seagrass meadows, recognition of their social and ecological importance and effective conservation strategies

are lacking. With rapid coastal development, these nearshore marine ecosystems are subject to increasing pressure from anthropogenic sources. This research is engaging local scientists, stakeholders, community groups and public administrators to evidence of the value of seagrass meadows, highlight conservation priorities for marine biodiversity protection using food security as a primer, and aiming to develop realistic management strategies.

16:45 - Developing High Resolution Baseline Coast Resource Maps Using World View 2 Imagery for a Coastal Village in Fiji

Dr. Ashneel Ajay Singh[1], Mr. Anish Maharaj[1], Mrs. Michelle Kumar[1], Ms. Priyatma Singh[1], Mr. Lionel Joseph[1], Mr. Herve Damlamian[2], Mr. Zulfikar Begg[2]

[1]The University of Fiji, [2]Geoscience Division, Pacific Community (SPC)

In Fiji, like most Pacific Island countries, there have been numerous reports of degradation of coastal resources. In order to develop effective management plans, base referencing of quality data on site and distribution of the coastal resources is pertinent. Using high resolution satellite imagery in combination with GIS for baseline mapping and monitoring of coastal resources provides a baseline tool for developing effective and improved management plans. The purpose of this study was to develop a baseline map of the intertidal benthic cover in Komave village, Coral Coast, Sigatoka, Fiji. Resource mapping was based on high resolution WorldView2 generated image. Ground-truthing was attained by means of on-site data logging of the intertidal resources, image capturing and GPS recording. Based on these records, the benthic cover was classified into seven classes, 'coral', 'algae', 'brown algae', 'volcanic rocks', 'sand and gravel', 'seagrass' and 'bare'. Ground referencing points were used for supervised classifications as well as accuracy assessment. A series of village consultations were also conducted to assimilate information on fishing sites and coastal land use activities.

The coastal resource map generated through this study serves as a baseline for monitoring the status and spatial distribution of the coastal resources in Komave. Annual mapping of the resources and enrichment of maps will enable the determination of the degree of influence from climate change and anthropogenic sources. This high resolution map is particularly relevant to Fiji as it is the first of its kind and provides a great tool for monitoring and evaluation.

17:00 - "They Caught Our Billfish": Implications of shared resources between artisanal and recreational billfish fisheries in the Western Indian Ocean.

Ms. Nelly Isigi Kadagi[1], Dr. Robert Ahrens[2], Dr. Julian Pepperrel[3], Dr. Nina Wambiji[4]

[1]University of Florida (USA) and African Billfish Foundation (Kenya), [2], [3]Pepperell Research, [4]Kenya Marine and Fisheries Research Institute

Several user groups catch billfish; they are caught as bycatch in tuna longline and purse seine fishing fleets, and as a target species in recreational and artisanal fishing sectors. Despite their importance, most fisheries management actions for billfish are usually dependent on factors such as time series catch rates, fishing intensity, and spatial and temporal dynamics associated with large industrial fishing operation, but little consideration for artisanal and recreational fisheries. Differences in the mean weight of billfish caught could be caused by factors such as seasonality, type of fishery or fishing techniques, and distance travelled for fishing. Here, we examined the relationship between the mean weight of billfish and several predictor variables (seasonality, distanced fished, boat size and the type of fishery).

We used Generalized Linear Models fitted to aggregate average weight data from artisanal and recreational fisheries. The model that combined seasonality and fishery type best explained the observations. The mean weight of billfish in artisanal fisheries increased during periods of low fishing activity. The interaction between fisheries and season particularly for recreational fisheries had the strongest effect. Other factors such as boat size and distanced fished were not significant which indicated an overlap and interaction between these fisheries. This study demonstrates the need to evaluate competing interests and the perception that a species belongs to one group: "They Caught Our Billfish" particularly in a shared fishery resource. This is also critical for local and regional management of billfish, given their highly migratory nature.

17:15 - Assessment of Marine Megafauna in artisanal gillnet and longline fisheries in Kenya

Dr. Nina Wambiji[1], Mr. Andrew Temple[2], Dr. Per Berggen[2], Dr. Jeremy Ksizka[3], Mr. Chris Poonian[4], Ms. Nelly Isigi Kadagi[5], Dr. Edward Kimani

[1]Kenya Marine and Fisheries Research Institute, [2]Newcastle University, [3]Florida International University, [4]Community Centred Conservation (C3), [5]University of Florida (USA) and African Billfish Foundation (Kenya), [6]Kenya Marine and Fisheries Research Institute

Globally, populations of marine megafauna continue to decline because of factor such as overfishing, use of their by-products, and capture as bycatch in various fishing sectors. Specifically, bycatch is one of the major threats to marine megafauna (elasmobranch, marine mammals, and sea turtles) in the Western Indian Ocean (WIO) placing them at a high risk of depletion. The challenge is further exacerbated by lack of information on the magnitude of bycatch in artisanal, commercial, and semi-industrial fisheries. Consequently, there are insufficient measures to reduce incidental capture of sea turtles, elasmobranch, and marine mammals at national and regional level.

This first-time regional project assessed target and bycatch of megafauna from artisanal gillnets and longlines in the WIO. In Kenya, the distribution of bycatch events was evaluated using catch data, seasonality, and the lunar cycle from 8 landing sites between 2016 and 2017. Our findings depicted a wide diversity in target and bycatch species composition. A total of 552 rays, 94 sea turtles, and 1303 sharks were caught in artisanal fishing gears. Notably, 66% of bycatch consisted of shark species which are considered as critically endangered and data deficient under the IUCN Status list. These findings emphasize the need for further research on the interactions of sharks and these fisheries. On a regional and global scale, the study addresses the existing gaps in information and data. This is significant in the formulation of guidelines for sustainable use and management of these species in Kenya, and the Western Indian Ocean.

17:30 - Cultural Conservation Priorities: A methodology for integrating Indigenous values into marine protected area network design.

Dr. Caroline Butler[1], Mr. Chris Mcdougall[2] , Mr. Aaron Heidt[3] , Ms. Allison Paul[4] , Mr. Steve Diggon[5]

[1]Gitxaala Fisheries Program, Gitxaala First Nation, [2]Haida Oceans Technical Team, [3]Central Coast Indigenous Resources Alliance, [4]North Coast Skeena First Nations Stewardship Society, [5]Coastal First Nations - Great Bear Initiative

A network of marine protected areas for the north coast of British Columbia is being designed through a trilateral process co-governed by Canada, British Columbia, and 17 First Nations. The primary goal of the network is to conserve biodiversity, but other goals and objectives of the Network commit to protecting First Nations cultural use, food security, and rights. The First Nations' technical team developed a methodology to integrate the ecological knowledge and cultural values of the participating Nations into network design. A rigorous community-based analysis of existing First Nations spatial data supported the identification of Cultural Conservation Priorities: areas that are important for food security, for the life stages of culturally significant species, and for culture and spirituality. The CCPs were harmonized and provided as a spatial layer for Network design and analysis, in parallel with the identified Ecological Conservation Priorities. This approach was intended to maximize the protection of First Nations food security, cultural practice, and sacred sites while also meeting the ecological objectives of the Network. In addition to the utility of CCPs as a data layer for the Marxan analysis, they provided Nations' governments with a secure tool for presenting and working with sensitive data in multi-party settings.

This presentation provides an overview of the development of the CCP framework and criteria, and the methodology for community-based analysis and harmonization. The CCP approach is discussed as a potential solution for respectfully and effectively including indigenous community values in co-governed marine spatial planning processes.

OS-6B: Climate Change & Ocean Acidification 1 (16:00 - 18:00, Tubau 1)

16:00 - Effects of ocean warming and acidification on the geographical distribution and calcification of the scleractinian corals of the Eastern Tropical Pacific

Mrs. Silvia Stranges[1], Dr. Héctor Reyes-Bonilla[1]

[1] Universidad Autónoma de Baja California Sur

The aim of this work is to understand how the individual and combined effects of ocean acidification and temperature increase will affect the geographic distribution and calcification of reef-building corals of the Eastern Tropical Pacific (ETP). In order to evaluate possible changes in the geographical distribution of the coral species of the ETP, projections based on forecasts of temperature increase and pH decrease under scenarios RCP 2.6, 4.5 and 8.5 for the year 2050 were made using MaxEnt software. The results show that reef habitats which are actually considered marginal, such as those of high latitude and in the equatorial part of the ETP, are projected to persist and expand in the future climate, highlighting the importance of alkalinity and temperature to describe the future distribution of the species. To determine the response of calcification in different species of scleractinian corals, fragments of three species were used in an experimental study, using a pH treatment (7.60), two temperature treatments (30 and 31C) and a combined one of temperature and pH (30C, pH 7.60). The results indicate that the pH of 7.60 significantly reduced the calcification rate while the combined treatment of pH and temperature did not have a significantly greater effect than the pH alone. The calcification rates did not vary significantly between species. The results of this study suggest that ETP corals could adapt or acclimate to the coupled effects of acidification and temperature increase.

16:15 - Ocean acidification indications from stable isotope analyses in carbonate shells and otoliths

time

Dr. Yongwen Gao[1], Mr. Russell Svec[1]

[1]Makah Fisheries Management The carbonate chemistry of the world's oceans has been changing due to the anthropogenic CO2 sinking into ocean and caused seawater pH to decrease and seawater temperature to increase. Ocean acidification will lead to a shift in DIC (dissolved inorganic carbon) equilibria and result in higher CO2 and lower carbonate ion (CO3 2) concentrations. This will affect the carbonate saturation state (o). The impacts of climate change thus can be revealed from stable carbon and oxygen isotope ratios (13 C/ 12C or 13C, and 18O / 16O or 18O) and the isotopic fractionation between blood DIC and the carbonate proxies of shells and otoliths. In this study, we report the results of using 13C values in detection of ocean acidification from shells of Pacific razor clam (Siliqua patula), Pacific geoduck (Panopea abrupta), and Pacific sea scallop (Patinopectin caurinus) along the Washington west coast; and using the 18O variations in study of climate driven regime shifts for Atlantic cod (Gadus morhua) and Pacific halibut (Hippoglossus stenolepis) populations. Among the carbonate powder samples analyzed the 13C values of the clam shells ranged from -2.88% to -0.30%, whereas 18O values of the same samples ranged from -2.16% to +1.39%. Overall our research suggests that the shell carbonate is a good proxy for reconstructing the life history of the clam and detecting the effects of ocean acidification by 13C signatures. The d<18O records of otoliths, in contrast, are useful techniques in examining the decadal-scale (e.g., the last 20-30 yrs) regime shifts that an individual fish encountered.

16:30 - Future climate scenarios threaten British Columbia's glass sponge reefs

Dr. Angela Stevenson[1], Dr. Stephanie Archer[2], Dr. Anya Dunham[2], Dr. Jeff Marliave[3], Ms. Jessica Schultz[3], Prof. Christopher Harley[1]

[1] University of British Columbia, [2] Fisheries and Oceans Canada, [3] Vancouver Aquarium

Many tropical sponges thrive under predicted scenarios of ocean warming and acidification, but there are also examples of sponge decline. In British Columbia (Canada), glass sponges (primarily made of silica), such as Aphrocallistes vastus form large intricate reefs unique and important to this region. These reefs are a highly productive water filtration system thought to impact major local and regional biogeochemical cycles and food webs. While protecting A. vastus from physical damage is a vital component of a successful conservation strategy, its sensitivity and resilience to climate change has not yet been explored. We tested the effects of elevated seawater temperature and pCO2 on the pumping capacity of A. vastus held in mesocosms and subjected to one of four treatments: ambient, elevated temperature, elevated pCO2, and combined (elevated temperature and pCO2) for four months. Pumping start time and strength were measured at three week intervals, and presence of necrosis was noted throughout the experiment. Both elevated temperature and pCO2 reduced sponge pumping capacity by 2-4x compared to control sponges. Necrotic tissue onset occurred earlier (within one month) in sponges exposed to elevated temperature (including the combined treatment) and 50-60% of sponges in these treatments ceased pumping after one month of exposure to elevated temperature (versus none in the control).

Overall, our findings suggest that temperature stress events and ocean acidification may negatively impact A. vastus filtration capacity and contribute to this species' mortality indicating that ongoing climate change is a serious threat to BC's glass sponge reefs.

16:45 - Effects of lowered seawater pH on the early life history of Crown-of-Thorns starfish

Dr. Chun Hong Tan[1], Dr. Seng Chee Poh[2], Ms. Ju Yee Loh Chuah[2]

[1]School of Marine and Environmental Sciences, Universiti Malaysia Terengganu, [2]School of Marine and Environmental Sciences,Universiti Malaysia Terengganu

Crown-of-Thorns starfish (COTs), Acanthaster planci is known as one of the most significance threats in coral reef ecosystem. During the COTs outbreak it caused extensive coral mortality and consequently lead to habitat loss of other reef-associated organisms. It is important to investigate the environmental tipping point on COTs early life history stages to understand the limits for normal development of this starfish. In this study, the effects of projected ocean acidification conditions (pH: 7.4 ~7.8) were tested on fertilization success and larvae development rate of the COTs. The larvae development rate was investigated by measured the length and width of the larvae on 4th and 14th day of the experiment. The results showed that lowered seawater pH has no significance impact on the fertilization success rate. However, larvae size in the lowered pH treatments were significantly smaller than the control treatment (pH: 8.1). Length and width of COTs in lowered pH 7.8 and 7.4 treatments were 40%-46% and 28%-47% smaller than the samples in control treatment, respectively. These findings indicated that COTs larvae may survived ocean acidification conditions. But, larvae growth rate may delayed and their size reduced in the lowered pH seawater conditions.

17:00 - Novel ecosystems: managing novelty in the marine realm

Dr. Marie-Lise Schläppy[1], Prof. Richard Hobbs[1]

[1]University of Western Australia

The concept of novel ecosystems is relatively new and has, over the last 15 years, been emerging in the field of terrestrial conservation and restoration. It is built on the realisation that ecosystems are changing at an increasing rate, through abiotic, and biotic changes (e.g. invasive species) and through (inadvertent) human activities. In terrestrial ecosystems, conservation activities often involve restoring ecosystems back to a specific historical baseline and the concept of novel ecosystems offers a framework to set conservation and restoration priorities in the light of an increasing discrepancy between restoration needs and available means. Of interest to marine ecologists and managers is whether the concept of novel ecosystems can be adapted to help advance marine conservation, restoration and management. Here the original concept of novel ecosystems is presented. A critical appraisal of the concept is made in relation to key marine ecological concepts and a new decision framework, fit for marine systems, is proposed as one of the possible way to use the novel ecosystem concept to advance the conservation and restoration of marine ecosystems.

17:15 - At-sea activity of Black-legged kittiwakes (Rissa Tridactyla) reveals dispersal strategies and exposure to anthropogenic pressures

Ms. Pia Ricca[1], Dr. Helen Wade[2], Dr. Beth Scott[1], Dr. Jared Wilson[3]

[1]University of Aberdeen, [2]Scottish Natural Heritage, [3]Marine Science Scotland

Until recently, knowledge of seabirds has been rather restricted to the breeding season, yet pressures during the nonbreeding season may significantly impact seabird breeding success and population demographics. Furthermore, the nonbreeding season is a time in the life cycle to replace feathers and restore energy reserves, during which seabirds can be vulnerable to anthropogenic pressures. This study tracked black-legged kittiwakes (Rissa tridactyla) from Isle of Canna, Scotland, using combined geolocators and wet-dry sensors to better understand dispersal patterns, overwinter distributions, oceanographic characteristics of overwintering grounds, the timing and location of winter moulting, and overlap with anthropogenic impacts. Three dispersal strategies were evident in this population: 1) residents, where birds remained around the UK; 2) short-distance migrants, where birds travelled no further than the Central Atlantic, west of the mid-Atlantic ridge; and 3) long-distance migrants, where individuals reached North America. Long-distance migrants departed the colony on average 19 days earlier than residents, and 9 days earlier than short-distance migrants. Date of departure was not significantly related to distance travelled from the colony, which is a proxy for dispersal strategy. Activity data revealed a potential moulting period of the outer primaries between September and October. The three dispersal strategies overlapped with significantly different levels of anthropogenic impacts, indicating that subsections of the population will be differently affected by human activities. This study provides insight on the variability in nonbreeding dispersal strategies of a relatively unstudied population of kittiwakes, highlighting the drivers of dispersal and factors that may affect them during overwintering.

17:30 - Sea star wasting syndrome impacts on intertidal and human communities

Ms. Jenna Sullivan[1], Dr. Bruce Menge[2]

[1]Oregon State University, [2]Oregon State University/Oregon Sea Grant

The recent outbreak of sea star wasting syndrome (SSWS) along the North American west coast is one of the most widespread disease outbreaks ever documented in a marine species. SSWS has caused system-wide depletion of Pisaster ochraceus, a charismatic tidepool sea star species. As the original keystone predator, Pisaster is disproportionately responsible for maintaining the structure and functioning in intertidal communities. Thus, the SSWS outbreak presents a rare opportunity to improve scientific understanding of community response to top predator loss, test major tenets of ecological theory at an unprecedented scale, and connect the public with ecology and ocean science.

Since 2013, Pisaster population densities have declined dramatically along the Oregon coast. However, recent surveys suggest relatively high juvenile abundance, indicating potential for population recovery. Effects on intertidal communities vary spatially; understanding what is driving these differences is relevant to marine ecosystem management as disease outbreaks will likely increase with global change. In addition to conducting basic research on the spread and ecological consequences of SSWS, we have employed a multipronged approach to engage different audiences in our science. We have presented our research at academic conferences, interest group meetings, and public events. We have engaged citizen scientists in documenting SSWS virulence, geographic spread, and sea star population recovery. Finally, we have explored new outreach pathways including through the creation of a corporate partnership with Rogue Ales and Spirits to raise public awareness about ocean health and research funding.

17:45 - Feeling the heat: the susceptibility of African Penguins to hot weather events and climate change

Ms. Noelle Tubbs[1], Dr. Lorien Pichergu[2], Prof. Peter Ryan[1], Dr. Jonathan Green[3]

[1]*Percy FitzPatrick Institute of African Ornithology, University of Cape Town,* [2]*Percy FitzPatrick Institute of African Ornithology & Institute for Coastal and Marine Research, Nelson Mandela Metropolitan University,* [3]*School of Environmental Sciences, University of Liverpool*

The African Penguin was classified as endangered by the IUCN in 2010. Among the threats facing this species is breeding failure due to heat stress. Historically, most African Penguins bred in guano burrows, providing buffered microclimates and shelter from predators. Guano scraping led to habitat loss, an issue that exacerbates heat stress. Without a burrow's protection, adults may leave their nests to cool down in the sea. This is often fatal for broods in surface nests due to predation and exposure. Climate change is increasing extreme weather, worsening the situation. Previous studies indicate that artificial nests can reduce impacts, but it was not understood if they could fully replace natural burrows. This study sought to determine the temperature when heat stress begins in African Penguins, understand behavioral responses to temperature, evaluate artificial nests' effectiveness, and investigate how climate change affects penguins. Laboratory experiments showed that penguins could not cope with ambient temperatures above 28.5C, almost 2C lower than similar species, suggesting that African Penguins are particularly sensitive to climate change. Field studies using penguin models showed that heat stress may occur more often and at lower temperatures than anticipated. Artificial nests experienced high summer temperatures, above penguins' heat stress point. Sun exposure increased temperature in all artificial nest types, but did not significantly affect natural burrows, indicating that artificial burrows do not adequately protect penguins from heat stress. Our analyses provide tools to predict how African Penguins may be affected by future climate change, limiting impacts by directing management actions.

OS-6C: Fisheries and Aquaculture 6 (16:00 - 18:00, FJ Auditorium)

16:00 - Developing a DNA Barcode Scanner for Seafood Product Identification

Mr. David Baisch[1], Dr. Hal Holmes[1]

[1]*Conservation X Labs*

Seafood fraud rates average 30 percent across the world, with some markets reaching 90 percent. This mislabeling is typically motivated by potential economic gain and can drive demand for endangered or at-risk species and for product from illegal, unreported, and unregulated (IUU) fishing efforts. This mislabeling is typically motivated by potential economic gain and can drive demand for endangered or at-risk species and for product from illegal, unreported, and unregulated (IUU) fishing efforts.

Our DNA Barcode Scanner Project is a collaborative effort between Conservation X Labs, Smithsonian Institution, Consortium for the Barcode of Life, WWF, Oceana, University of Washington, and others, with the goal of creating a handheld POC device which utilizes barcode sequences in animal genomes. Our project is bringing together a diverse team of engineers, geneticists, and conservationists whose goal is not to make a 100% clinically accurate device, but to engineer a decision support tool: a low cost, simple to use, robust, highly modular molecular sensing device that allows citizens or officials to rapidly determine whether to investigate retail seafood product fraud or a corporate seafood buyer to detect problems in their supply chain. We need to develop a product that supports decision making and traceability in the environments where they matter - in the field, within the developing world, with the least number of steps possible, at lowest cost, with the highest resilience, and lowest complexity.

16:15 - Connecting fishery science to health policies for diet-specific solutions in low-income low food access communities: a population health approach

Mr. Zach Koehn[1], Dr. Edward Allison[2], Dr. Jennifer Otten[2], Prof. Ray Hilborn[1], Prof. Christopher Anderson[3]

[1]*School of Aquatic and Fishery Sciences, University of Washington,* [2]*University of Washington,* [3]*School of Aquatic and Fishery Sciences, University of Washington*

Fisheries will not alone feed the world's growing population. However high micronutrient density of seafood will play a critical role in alleviating health concerns among nutrient-deficient communities. After two decades of careful conservation-based management, US West Coast assessments indicate that many of its stocks have rebuilt from severe overfishing. Amidst these ecological successes, rural communities rank high among coastal regions for poverty and diet-based noncommunicable diseases (NCDs) to the detriment of wellbeing. This follows a pattern of inequity increasingly common across the development spectrum: households with low income and low access to healthy foods (LILA) incentivize residents to select more affordable, calorie-rich but nutrient-poor foods. Without developing a relational understanding of sustainable fisheries production, healthy diets and NCDs, it is impossible to consider how nutritional value of local fisheries might reconcile with the ecological and economic paradigms that dominate current management discourse. As a result, conservation decision-making may inadvertently ignore the potential for development of local seafood supply focused on health outcomes, and a benefit of marine science to contribute to public health is lost. This transdisciplinary research synthesizes place-based data from fisheries landings, socioeconomic and food access surveys, and public health information. We use a population health approach to identify where nutritious and underutilized fish are landed and evaluate whether this fish might become available to LILA households. In doing so we encourage equitable and inter-sectoral solutions to alleviate diet-based health concerns that respect the need for continued conservation of fisheries resources and livelihoods in coastal communities.

16:30 - Not all boats are equal: Understanding variations in bycatch among individual operators to improve environmental performance of fisheries

Ms. Leslie Roberson[1], Dr. Chris Wilcox[2]

[1]*University of Queensland,* [2]*CSIRO Oceans and Atmosphere*

Fisheries bycatch continues to drive the decline of many threatened marine species such as sharks, mammals, and turtles. Bycatch is usually treated as an inevitable environmental phenomenon, but fishers have agency in how, when, and where to fish. Bycatch management measures are typically fleet-level, command and control approaches such as bycatch quotas and time-area closures that overlook variable skill and behavior among operators. These methods are effective in many instances but are difficult and expensive to enforce and can potentially stymy innovations to further reduce bycatch. Incentive-based measures are gaining traction as a potentially more efficient alternative. The appropriate set of incentives-both economic and social- can encourage changes in fisher attitudes and behavior that could reduce environmental impacts and enforcement costs.

This study investigates variations in threatened species bycatch between individual operators in Commonwealth Fisheries in Australia, representing different geographic areas, gear types, and target species. Results from Australia's tuna longline sector show target catch to be negatively correlated with seabird bycatch, with a small number of operators generating the majority of the bycatch. We then test this pattern in different contexts by comparing the catch to bycatch ratios of individual operators across fishing sectors, gear types, and different types of bycatch species. Results illustrate the highly variable dynamics in different fishing sectors, indicating the importance of context-specific solutions, and suggest there is potential to increase overall environmental performance with incentive-based interventions that target specific performance groups within a fishery.

16:45 - Species interactions can alter fishing-induced maturation size trajectories in an eco-evolutionary trait-based community model

Mr. Romain Forestier[1], Dr. Asta Audzijonyte[1], Dr. Kirsty L. Nash[2], Prof. Elizabeth A. Fulton[3], Prof. Craig Johnson[1], Prof. Julia L. Blanchard[2]

[1]University of Tasmania, [2]Centre for Marine Socioecology, University of Tasmania, [3]CSIRO

Human impacts on natural systems are driving rapid ecological change and adaptation. Fishing is a strong selective force and is expected to select for earlier and smaller maturation size in heavily exploited species. Interspecific and size-based interactions may also pose substantial selective pressures.

Reductions in maturation size from size-selective fishing have usually been reported from single-species experiments and observations. However, species and size-based interactions may also pose substantial selective pressures. To study the potential role of eco-evolutionary dynamics in marine ecosystems multi-species models that integrate temporal trait dynamics are needed.

We developed a trait-based size spectrum model with stochastic adaptive (selection driven) trait dynamics, where new phenotypes are introduced in the model and their invasion success is tracked through time. We use the model to explore the evolutionary changes in maturation size in the presence and absence of predation and fishing, and their consequences for population and community structure.

Our results show enables greater coexistence of species and prevents the declines in maturation size typically expected from fishing-induced evolution. In the absence of predation, fishing generally has a stronger effect on maturation size, causing decreases in maturation size for the largest species, leading to cascading effects on the size of smaller species.

Models used to support ecosystem-based fisheries management are typically based on trophic interactions and demography without eco-evolutionary processes or changes in species composition through time. Our results demonstrate how species interactions and stochastic introduction of phenotypic variation can alter expected outcomes of trait changes in responses to fishing.

17:00 - Understanding species composition of fish maw trade in China using COI analysis for conservation

time

Mr. Baian Lin[1], Ms. Priscilla Leung[2], Ms. Meng Yan[2], Mr. Jianlong Li[3], Prof. Min Liu[1]

[1]Xiamen University, [2]City University of Hong Kong, [3]University of Hull Fish maw is made of fish swim bladderafter dried and has been used for food and traditional Chinese medicine forhundreds of years. Fish species of the maws, however, are poorly documented,although the major taxa were believed from Sciaenidae (Perciformes).In thisstudy, 23 different morphological types of fish maws consisting of 405 samples(including 39 fried maw samples) were collected from dried seafood markets inmainland China and Hong Kong. Totally 206 individual fish maw samples and 4fried maw samples were successfully obtained the COI gene sequences, i.e. 52%success rate. Totally 37 fish species from 5 orders, 10families and 27 generawere identified, among these, 26 were confirmed to species level and 11 wereconfirmed to genus level. Our study revealed the active international fish mawtrade in China because among the 26 fish species confirmed, only 7 occur indomestic waters. The rest 19 fishes distribute in Africa, Americaand Indo-West Pacific beyond China. Two fish species, Totoaba macdonaldi and Bahaba taipingensis in Sciaenidae, were listed as âĂIJCritically EndangeredâĂİ (CR) in IUCN RedList, both their dried maw were found trading in China; the former listedin CITES Appendix I since 1977 and the latter listed in Grade II of NationalProtected Animals of China since 1988. Based on international and national regulationand law, the commercial capture and trade of the two species are banned. Thefish maw trade internationally, regionally and nationally merits closemonitoring to ensure the conservation of endangered fish species and thesustainable use of fish maws.

17:15 - Can MPAs conserve fish on marine soft sediments?

time

Mr. Lachlan Fetterplace[1], Dr. Nathan Knott[2], Mr. Kye Adams[1], Dr. Matthew Taylor[2], Prof. Andy Davis[1]

[1]University of Wollongong, [2]New South Wales Department of Primary Industries - Fisheries Soft sediments make up a large proportion of the total area of the ocean under protection in marine protected areas (MPAs). It is widely considered that on relatively homogenous marine soft sediment habitats, fish are unlikely to show site attachment and therefore will not remain inside MPAs for long enough to be afforded protection. However, as there is no movement information for the majority of fish species found on these habitats, it is currently impossible to say whether MPAs really are an effective conservation measure for these species. The bluespotted flathead (Platycephalus caeruleopunctatus) is a commercially and recreationally exploited species found on sand in South East Australia. Prior to this study there was no published data on movement patterns. Here we aimed to quantify movement and habitat-use of bluespotted flathead to: (1) determine whether site attachment is shown, (2) identify migration or aggregation movements, (3) compare movement to current no-take MPA design. We used acoustic tags and 48 acoustic receivers within Jervis Bay MPA to assess movement. Forty-six bluespotted flathead were tagged within the MPA and tracked for over 600 days. Bluespotted flathead exhibited strong short-term site attachment, with 37 fish detected within an 81 ha no-take zone for at least 2 months. Fifty percent of tagged fish exhibited long-term site attachment and remained in the no-take zone for 300âĂŞ618 days. Taken together these outcomes indicate that bluespotted flathead show considerable site attachment on marine soft sediments. Current MPA design may well be adequate to afford this species protection.

OS-6D: Conservation and Management 3 (16:00 - 18:00, FJ Event Hall)

16:00 - Population estimates and range of movement of Irrawaddy dolphins (Orcaella brevirostris) in Bintulu, Malaysian Borneo.

Ms. Cindy Peter[1], Prof. Andrew Alek Tuen[1] , Ms. Anna Norliza Zulkifli Poh[1] , Ms. Jenny Ngeian , Dr. Gianna Minton[2]
[1]*Universiti Malaysia Sarawak (UNIMAS),* [2]*Megaptera Marine Conservation*

Cetacean surveys were conducted using line transect and photo-identification methodology to determine the abundance and range of Irrawaddy dolphins along the coastal waters of Bintulu, Malaysia. During surveys from June 2008-September 2013, dolphins were photographed and group size and behavior were recorded. Locations of re-sighted dolphins were mapped and ranges of movement were measured using ArcGIS.

After filtering for photo quality and distinctiveness of dorsal fins, the best mark-recapture estimate for Irrawaddy dolphins based on a weighted mean of estimates derived from individuals represented by photos of their left sides and right sides was 189 (CV = 23%, 95% CI 122-292). These estimates overlap well with those derived from line transect analysis using DISTANCE (170, CV=38% 95% CI 81-356). A number of individuals showed a high-degree of site fidelity. Juveniles and calves were observed during 33 of the 77 sightings of Irrawaddy dolphins. Feeding and probable feeding behavior were observed during 44.2% of the sightings.

The high rate of site fidelity, coupled with the dolphins' utilization of the entire study area and observations of calves and feeding demonstrate that these coastal waters are important habitat for the species. The baseline data presented here are crucial for the evaluation of the conservation status of Irrawaddy dolphins in Sarawak and for the design of effective management strategies in an area of coastline that is undergoing rapid agricultural and industrial growth, including coastal oil palm plantations, a new deep water port and industrial complex situated between a national park and a fishing village.

16:15 - The Distribution of Marine Mammals and the Selected Environmental Parameters, Associated with Fishing Gears Observed of Kuching Bay, Sarawak

Ms. Samantha Ambie[1], Ms. Cindy Peter[1], Dr. Aazani Mujahid[1]
[1]*Universiti Malaysia Sarawak (UNIMAS)*

Cetaceans are marine mammals that spent their whole life in the water, and exploited all types of marine, estuarine and major riverine habitats. This study aims to document the distribution of marine mammals and the fisheries activities at Kuching Bay, Sarawak. Next, are to determine the possible relationship of selected environmental parameters with the distributions of marine mammals. Boat-based surveys which include line-transects method was conducted in our main study site. This study has sighted three coastal cetacean species which are the Irrawaddy dolphin (Orcaella brevirostris), Indo-Pacific finless porpoise (Neophocaena phocaenoides) and Indo-Pacific humpback dolphin (Sousa chinensis). Kruskal-Wallis test showed a statistically significant of pH ($p = 0.027$), salinity ($p = 0.017$) and distance to river mouth ($p = 0.017$) to the distribution of Irrawaddy dolphin and finless porpoise. There is an overlapping pattern between the distribution of fishing gears and dolphins. Highest number of recorded fishing gear, which is unattended drift net could be a main threat to dolphins in Kuching Bay as it has a long soak time which could result in by-catch fisheries. There are few threats faced by the cetaceans in the nearshore habitats of Sarawak waters that may put them at a higher risks including the by-catch fisheries, coastal development and pollution.

16:30 - Making Waves in Papua New Guinea with New Marine Mammal Research

Ms. Wilma Mavea[1]
[1]*University of Pap*

There has been very little study of marine mammals in Papua New Guinea (PNG) waters, most confirmed records from opportunistic sightings or limited dedicated surveys. As of 2007, 16 marine mammals were known to inhabit PNG waters. Although large whales are protected in PNG under a National Fisheries Whaling Act, there is no formal protection for small cetaceans. With the lack of dedicated study on marine mammals and lack of appropriate legislation results in limited knowledge of, and subsequent protection for, small cetaceans in PNG waters. The aims of this project were to a.) provide a comprehensive review of marine status in PNG waters, and b.) critically evaluate factors that may influence the success of coastal boat based surveys in PNG. The comprehensive review resulted in 19 marine mammal species being confirmed from PNG waters and this review included confirmation of two Vulnerable coastal dolphins inhabit PNG waters, the Australian snubfin dolphin (Orcaella heinsohni) and Australian humpback dolphin (Sousa sahulensis). These two species are not currently found elsewhere in the Pacific Islands. Limited local expertise, lack of government awareness and funding, high expense of surveys were identified as primary constraining factors. The study have provided the PNG Government with a comprehensive summary of marine mammal diversity and important habitats in PNG waters. The data will be entered into a custom-made database facilitate incorporation of marine mammals in marine protected area planning. It is hoped that this study can now contribute information towards development of appropriate legislation to protect small cetaceans.

16:45 - Simple modelling of the natural and social benefits of artificial structures in an MPA over time

Prof. Rick Stafford[1], Mr. Zach Boakes[2], Dr. Alice Hall[1], Dr. Roger Herbert[1]
[1]*Bournemouth University,* [2]*Bournemouth University & North Bali Reef Conservation*

Hard substrata are limiting in the marine environment. Artificial structures can therefore provide direct habitat or structural complexity for marine organisms. A recently established MPA in north Bali, has supplemented existing hard substrata with large cement and lime-based structures to attract fish and provide a foundation for colonisation from coral and other invertebrates.

We model this case-study using Bayesian belief networks (BBNs); intuitive and easy to produce models. BBNs have been previously criticised due to their inability to model feedback loops common in ecological systems. We have modified BBNs to include both positive and negative feedback. The BBN predictions show that, in isolation, and over short time-frames (~1 year) they benefit the ecological community, especially in terms of small fish numbers - and results agree with initial monitoring results from the site.

However, by increasing the number of iterations of the BBN, we examine the development of the community over longer time periods, looking at the colonisation of sessile invertebrates and how this further enhances the habitats for fish (positive feedback), and how the fish remove algal growth (negative feedback). Equally predictions on incentives from tourism and money into the local economy improved over time (linking natural and social systems).

The study provides evidence for the long-term conservation effectiveness of artificial structures in the marine environment as well as the ability of BBNs to integrate data from a wide range of sources, and provide information based on ecological feedback processes.

17:00 - Fish communities as an indicator of coral reef degradation in the East Central Red Sea

Ms. G.L. Short[1], Dr. Darren Coker[1], Ms. Lucia Pombo Ayora[1], Prof. Michael Berumen[1], Prof. Burton Jones[1], Dr. Susana Carvalho[1]

[1]*Kaust*

Coral reefs are priority habitats which are vulnerable to natural and anthropogenic disturbances. These can cause phase shifts from pristine coral habitat to degraded algal-dominated states. As a result, changes in the distribution and abundance of associated species may become apparent. In the Eastern Red Sea, human-induced reef degradation is likely to increase with planned development along the Saudi Arabian coast and with the changing climate. The present study therefore investigates the ecological effects of coral-algal phase shifts in reef-associated fish communities, along gradients of habitat degradation. Six inshore reef areas, each showing within-reef gradients in benthic cover, from coral to algal dominance, were studied. Communities were assessed via visual census in areas dominated by: hard coral, co-dominance of coral and turf algae, and macroalgal canopies. Water quality parameters (temperature, salinity, chlorophyll a content and nutrient concentrations) were quantified and related to the biological patterns. We hypothesise changes in fish community composition, with reduced diversity and abundances of organisms in degraded habitats; as well as potential shifts in the dominance of species and functional groups. The present study aims to identify the ecological tipping point at which increased algal dominance induces a change in fish community composition and propose potential bioindicators of habitat degradation. The findings will have critical implications for the management and conservation of understudied Red Sea coastal systems.

17:15 - Extreme poverty drives the socioecological conflicts in Brazilian Marine Protected Areas

Mr. Jose Oliveira[1], Dr. Joao Campos-Silva[1], Dr. Davi Santos[1], Dr. Richard Ladle[1], Dr. Vandick Batista[1]

[1]*Institute of Biological and Health Sciences-ICBS, Federal University of Alagoas, Maceió, AL, Brazil.*

Socioecological conflicts within Marine Protected Areas (MPAs) have a huge impact in conservation outcomes, especially in tropical developing countries, often immersed in a weak enforcement scenario, ineffective management, and lack of funding and human resources. Understand the causes of these conflicts is fundamental to establish proper management solutions. Here we show a broad assessment modelling the diversity of socioecological conflicts in function of several landscape and socioeconomic factors across more than 3000 Km of Brazilian coastline. We quantified the occurrence and type of conflicts from systematic social surveys carried out as part of WWF-Brazil's RAPPAM assessment and data gathered from news covert by Brazilian media. Socioeconomic and landscape variables were extracted from official statistics and GIS analysis. We identified 461 conflicts cases from more than 35 types in 54 MPAs. Our results show that the extreme poverty was the major factor explaining almost 60% of the diversity of conflicts within MPAs. Our findings reinforce that conservation interventions may be ineffective when not preceded by focused efforts to alleviate social inequalities. Government and NGOs should target socioeconomic improvement of local communities in parallel with the implementation of MPAs, otherwise the management system will be doomed to failure.

17:30 - Community structure and tagging data as tools for parrotfishes management in subtropical reefs of Brazil

Dr. Carlos Ferreira[1], Dr. Cesar Cordeiro[1], Dr. Moyses Cavichioli Barbosa[1], Prof. Marcos Lucena[1], Prof. Erico Camboim[2], Dr. Carlos Hackradt[2]

[1]*Universidade Federal Fluminense,* [2]*Universidade Federal do Sul da Bahia*

Parrotfishes are iconic component in tropical reefs, influencing distribution, diversity and biomass algae. Integrity of parrotfish populations had get status of conservation strategies in many tropical reefs around the world. In Brazilian tropical and subtropical reefs, parrotfishes have been captured by spearfishers in the last two decades. The biggest species, endemic to the Brazilian Province, the blue parrotfish Scarus trispinosus, was considered nowadays functional extinct in some of the subtropical habitats. We worked in the marine sustainable reserve of Arraial do Cabo, southeastern Brazilian coast, where rich subtropical reefs predominated. We collected data on abundance and distribution, tagging the most abundant species (Sparisoma frondosum and Sparisoma axillare), and analyzing fidelity of sleeping sites, in order to help specific management goals for these fishes. Parrotfishes are restricted to warm, sheltered rocky reefs, with S. axillare (0.15 Kg/100m2) and S. frondosum (0.12 kg/100m2) as the most abundant, large parrotfishes in this area. Tagging effort identified an average home range for these two species of 150 square meters. Despite S. frondosum and S. axillare presented high fidelity for sleeping sites, no specific substrate was selected while resting on the reefs. Data generated indicated that a few sheltered reefs are important for parrotfish to forage and sleep. While most of these reefs are quickly accessible by boat, there still no full enforcement to banning parrotfish fishing species in the region. Conservation of parrotfish functional role in the region needs more than ecological and biological data, but strong awareness of local environmental agencies and users.

17:45 - Their Future Our Future: Lessons learnt from using video as a tool to engage stakeholders and governments in national policy for wildlife tourism interaction in the Philippines

Ms. Sally Snow[1], Mr. Gonzalo Araujo[1], Mr. Vince Cinches[2], Ms. Samantha Craven[3], Mrs. Chloe Harvey[3], Ms. Anna Oposa[4], Dr. Alessandro Ponzo[1], Ms. Jean Asuncion T. Utzurrum[5], Dr. AA Yaptinchay[6]

[1]*Large Marine Vertebrates Research Institute Philippines,* [2]*Greenpeace Southeast Asia,* [3]*The Reef-World Foundation (International Coordinators - Green Fins),* [4]*Save Philippine Seas,* [5]*Institute of Environmental and Marine Sciences, Silliman University,* [6]*Marine Wildlife Watch of the Philippines*

National legislation for marine wildlife tourism interaction guidelines does not exist in the Philippines, despite increasing visitor arrivals. A Joint Administrative Order (JAO) on regulations for marine wildlife tourism interaction drafted by government Departments in 2014 hopes to address this with the objectives to enhance visitor experience and safety, and to preserve the environment, the animals involved and the livelihoods relying on it, through guidelines, regulation and prohibition of activities.To engage stakeholders and the public, a video campaign 'Their Future Our Future' was launched in 2016 using the drafted JAO policy as a foundation to promote sustainable marine wildlife tourism. Five communities engaged in wildlife tourism were featured in the films. To instil cooperation and ownership, local tour guides delivered the guidelines, while community workshops aimed to inspire local pride by developing a message on the value of the guidelines. The films targeted national and international guests calling them to follow the guidelines and be responsible tourists. The final call to action was a petition in support

of the JAO.The impact of the campaign was measured against predetermined targets based on commitment and outreach. Over 200,000 people engaged with the campaign, 60,000 via 16 public screenings, 140,000 online, and 2,300 signed the petition. Seven NGOs collaborated on the campaign, two government Departments and five local government units signed their support. To date, the JAO remains unpassed. Challenges, successes and failures to meet targets provided invaluable lessons on how best to use video as a tool to engage stakeholders.

S-136: Putting marine science in to practice for conservation and management of sharks and rays in South East Asia (16:00 - 18:00, Kerangas)

16:00 - Finding unlikely allies: The prospect of shark fishers role in sustainable management of sharks and rays fishery

Ms. Peni Lestari[1], Mr. Efin Muttaqin[1] , Mrs. Benaya Simeon[1] , Prof. E.J. Milner-gulland[2] , Ms. Hollie Booth[1]

[1]Wildlife Conservation Society - Indonesia Program, [2]Oxford University

Overfishing is the primary threat to conservation status of sharks and rays. Indonesia which has 2.3 million fishers is the world's biggest producer of sharks and rays, contributing 13% of global production. A common conservation approach to address overfishing is the attempt to provide alternative employment, which may be an option for Indonesia's elasmobranch fisheries. A typical example of shark and ray fishery in Indonesia is Tanjung Luar, East Lombok. This study aims to understand the dynamics of the Tanjung Luar shark fishery, and predictors that influence fishers' decisions to switch livelihoods. The result shows that fishers' intention to switch livelihoods is significantly influenced by their support for species protection and employment position in the boat (crew vs. captain). Furthermore, fishers with higher position are more likely to support species protection, but have less intention to switch livelihood. We found that it is important to differentiate between roles in the fishery when trying to plan and implement alternative livelihoods interventions for shark fishers. Livelihood diversification has potential to encourage fishers to exit fishery. However, our study shows that it is challenging to identify feasible alternatives that provide real economic incentives to change as there are no legal, sustainable, marine-based alternatives that offer similar profits to shark fishing. Further, support for regulating shark fishing is low for fishers who are directly impacted by regulations. To manage sharks and rays sustainably, instead of pushing fishers out of this industry, the government should involve them in the management of shark and ray fishery

---

16:15 - Scalloped Hammerhead (Sphyrna lewini) Critical Habitat Identification To Support Marine Protected Area Development In Aceh Jaya Indonesia

Mr. Muhammad Ichsan[1], Mrs. Benaya Simeon[2] , Mr. Efin Muttaqin[2] , Ms. Hollie Booth[1] , Mr. Kusuma Banda Naira[3]

[1]Wildlife Conservation Society, [2]Wildlife Conservation Society - Indonesia Program, [3]Aceh Jaya Marine and Fisheries Agency

The scalloped hammerhead shark (Sphyrna lewini) is a top ocean predator, with important ecological and economic values in Indonesia. Their morphology and life-history characteristics make them particularly vulnerable to overexploitation, and scalloped hammerheads are now classified as endangered according to the IUCN Red List of threatened species. Hammerheads are one of the most commonly caught shark species groups in Indonesia and in several fisheries in Aceh Province, juvenile scalloped hammerhead sharks are frequently caught as unintentional secondary catch. This study was conducted in Aceh Jaya, Aceh, to provide information on habitat and fisheries characteristics of scalloped hammerhead sharks, as a basis for management and protection. Data was gathered during July-September 2017, and included habitat surveying and landings monitoring. Observers joined fishing vessels to record shark capture locations, while data on landings was also collected from boats in the Rigaih fishing harbour. Our results show that all recorded scalloped hammerhead sharks are juveniles, with average lengths of 63 - 68 cm. The fishing ground where scalloped hammerheads are caught is within 12 miles from the shore of Aceh Jaya. Most of the vessels are small, below 5 GT, and using gillnets as their primary fishing gear to target reef fish, shrimps, and small pelagic fish. The results suggest that the coastal waters of Aceh Jaya are critical habitat for sharks, acting as a nursery ground for scalloped hammerheads. This data is now being used to inform marine spatial planning to improve protection and management of hammerhead sharks in Aceh.

16:30 - Aquatic Wildlife DNA Forensics: Tracking Illegal Shark Trade in the Philippines using DNA Barcodes

Dr. Mudjekeewis Santos[1], Ms. Angelli Marie Jacynth Asis[2], Ms. Joanne Lacsamana[1], Dr. Jo Marie Acebes[3], Ms. Jacqueline Marjorie Pineda[1], Ms. Jennifer Poniente[1], Mr. John Dela Pena[1], Ms. Minerva Fatimae Ventolero[1]

[1]National Fisheries Research and Development Institute, [2]National Fish, [3]Ateneo de manila University

Sharks and rays are an important part of the Philippine fisheries. At present, there are at least 100 species occurring in Philippine waters. However, like many top predators, several species are showing signs of depletion. Hence, some species have been placed under CITES Appendices, which automatically makes them fully protected under current Philippine national laws. Moreover, local government units have started implementing blanket bans of shark fishing in their areas. To support implementation of shark and ray regulations the DNA Forensics capability of the National Fisheries Research and Development Institute - Genetic Fingerprinting Laboratory was developedfor monitoring of trade and providing species identification to law enforcement agencies. Here, we present the results of applying DNA barcoding to identifying illegal trade of shark and rays species in the Philippines.We analyzed samples from confiscations made by regulatory units and law enforcement agencies, and those sent for species identification validation. Some key species in trade include the protected manta ray (Manta birostris), found in a shipment of dried sharks skin, meat and bones sent by Customs from the Manila North Harbor; the reef manta ray (Manta alfredi) in landings in Bohol; and great white shark (Carcharodon carcharias) in Baler and Aurora. All DNA barcodes have been stored in a database specifically developed to store and manage DNA data,and be used as a tool for conducting DNA forensics. Our experiences illustrate the benefits of DNA barcoding for trade monitoring, traceability and implementing CITES, and provide some lessons learned for future application.

16:45 - Shark Conservation in the Tubbataha Reefs

Mrs. Angelique Songco[1]
[1]*Tubbataha Management Office*

The Tubbataha Reefs Natural Park in the Philippines was established in 1988 'to protect and preserve the coral reef atoll with its abundant and diverse reef assemblage, including the marine turtles and water birds found roosting in the area' (Presidential Proclamation 306). Although shark conservation was not a specifically expressed objective, management activities resulted in the protection of sharks. In 2004, top predators, including sharks, were chosen by a multisectoral evaluation team as one of the biophysical indicators for management effectiveness. A baseline study of top predators conducted by Walker and Palomar (2005) showed a shark density of 5.5 individuals/hectare. Robbins' (2006) research in Cocos Keeling Island, an area he believed to be one of the last pristine reefs in the world, established a population density of whitetip reef sharks approximately 2 individuals /ha. A 2010 study conducted by Alava resulted in the observation of 3.9 individual/ha. Shark surveys conducted by LAMAVE (2016) revealed a density of 3.7/has. This density of whitetip reef sharks (Triaenodon obesus) is one of the highest known in the world. Management efforts in the last 30 years, focusing on vigilant law enforcement and public outreach, are believed to be the main factors that led to the successful conservation of sharks in Tubbataha.

17:00 - Singapore's Shark and Ray Imports: towards sustainability and traceability in the region

Ms. Naomi Clark-Shen[1]
[1]*Independant Researcher*

A quarter of sharks and rays are threatened with extinction, and improved fisheries and trade management is urgently needed to prevent further declines. Without a domestic fishery for sharks and rays, imports are the primary means of meeting local demand for shark products in Singapore. Our study looked at two fishing ports in Singapore that import fresh, whole sharks and rays to understand what comes into the country, and what this reveals about fisheries management in the region. We then investigated the local supply chain. Surveys at the ports identified the species, sex, size and country of origin of the sharks and rays. While catch was reported to come from Indonesia and Malaysia, merchants know very little about their products, including the exact area of catch in these countries. Seven species of shark and thirteen species of ray were identified. 90% of these are listed on the IUCN Red List of Threatened Species and Near Threatened or Vulnerable, including three species of wedgefish and one species of guitarfish. A large portion of the catch is juveniles. The findings call for further research and collaboration in the region to better understand trade routes, conservation implications for target species, and gaps in fisheries management. With a high number of juveniles and threatened species, areas of catch could represent critical habitats, which call for stronger fisheries management measures and more traceable supply chains.

17:15 - Shark and Ray Conservation in Myanmar

Mr. Barry Flaming[1]
[1]*The Wildlife Conservation Society*

Despite a nationwide ban on shark fishing in Myanmar put into place in 2009, recent survey efforts of markets and landing sites reveal significant quantities of sharks and rays sourced from an active fishery. During 2017-2018, seasonal surveys of six sites across Rakhine State in western Myanmar have identified at least 11 species of sharks and 32 species of rays being traded (from an estimated 58 and 71 recorded species, respectively) âĂŞ a number of which are threatened or CITES listed, such as hammerhead sharks and mobulid rays. A prevalence of juvenile sharks indicates the importance of fisheries by-catch as a significant factor impacting their populations, while a multitude of ray species appear to be directly targeted for their meat, gills, and skins. In response, WCS in collaboration with Fauna & Flora International (FFI) are supporting the Myanmar Department of Fisheries (DoF) to develop and implement a National Plan of Action (NPOA), informed by evidence from the field, to increase protections for key shark and ray species in Myanmar. Complimentary efforts include installing vessel monitoring systems on targeted fishing boats to identify important fishing grounds and potential spawning or nursery grounds for future protection. In addition, we are also investigating the trade routes for shark and ray products within Myanmar as well as to neighbouring countries such as China and Thailand.

17:30 - Conservation ethics and real-life impacts of shark protection on marginalized communities: why short-cutting conservation delays real impacts

Ms. Shannon Arnold[1], Dr. Jo Marie Acebes[2]
[1]*Manta Trust,* [2]*Balyena.org*

Sharks and rays have become a well-funded focus of marine conservation advocacy work over the last decade. With increasing concern about the status of many elasmobranch species a split has emerged in the conservation community - some seeing sharks and rays as 'wildlife' to be fully protected and others seeing them as 'fish' that can, like other fish, be managed sustainably. These tensions play out at global fora like CITES or fisheries management organizations. During the push for high-level policy 'wins' often their real-world impacts on fishing communities making a marginal living are overlooked. This paper focuses on one such fishing community in Bohol, Philippines caught in the push for protection of sharks and rays. In April 2017, Jagna's century-long fishery for mobula rays that supported hundreds of families was closed with only two weeks' notice. Following the fishing ban, we documented the impact on households and struggled to support them with implementation. We worked through community organizing and with the local government to advocate participatory decision making as rushed alternative income schemes were pursued. To date, households are falling further into debt and there is evidence that with no alternative, fishing for mobulas has continued 'underground'. The case shows the necessity of supporting not just policy 'wins', but long term social preparation and adaptation work. Understanding the impacts on communities and engaging them is critical if we are to tackle the challenge of implementing conservation policies that are both equitable and effective for the species they strive to protect.

17:45 - Using Fisheries Data to Inform Practical Approaches for Improving the Sustainability of a Targeted Shark Fishery - Lessons from Tanjung Luar

Mrs. Benaya Simeon[1], Mr. Muhammad Ichsan[2], Ms. Hollie Booth[3], Mr. Efin Muttaqin[1], Dr. Irfan Yulianto[1]
[1]*Wildlife Conservation Society - Indonesia Program,* [2]*Wildlife Conservation Society,* [3]*The Wildlife Conservation Society*

Overfishing is a major threat to sharks, driven by demand for high-value fins, as well as meat, liver oil, skin and cartilage. Several shark species have recently received increased international protection under the Convention on the International Trade of Endangered Species (CITES), however, trade regulations alone will be insufficient to reduce overexploitation, practical fisheries management measures are essential for reducing fishing mortality. Tanjung Luar is a major targeted shark and ray fishery in Indonesia. WCS conducted daily

landing monitoring at Tanjung Luar from January 2014 to December 2016, with the aim of understanding the biological and operational characteristics of the fishery to inform management. We recorded 20,725 landed individuals across 82 species, a high proportion of which were threatened and protected.

We found that 62% are caught by drift longline, 35% are caught by set bottom long line and 3% are caught as bycatch in gillnets, with differences in species composition and catches size for the different gear types. The most significant factors influencing catch of threatened and protected species are month, fishing ground, engine size and hook number. We also observed significant negative relationships between catch per 100 hooks per haul and several indicators of fishing effort, suggesting diminishing returns above relatively low levels of effort. Our results suggest that management measures focusing on fishing effort controls, gear restrictions and modifications and spatio-temporal closures could have significant benefits for the conservation of shark species, and may help to improve the overall sustainability of the Tanjung Luar shark fishery.

S-183: Simple solutions to complex fisheries impacts on ecosystems (16:00 - 18:00, Tubau 2-3)

16:00 - Rapid and direct recoveries of predators and prey through synchronized ecosystem management

Dr. Jameal Samhouri[1], Dr. Adrian Stier[2], Ms. Shannon Hennessey[3], Dr. Mark Novak[3], Dr. Ben Halpern[2], Dr. Phil Levin[4]

[1]NOAA Northwest Fisheries Science Center, [2]UCSB, [3]Oregon State University, [4]The Nature Conservancy

One of the twenty-first century's greatest environmental challenges is to recover and restore species, habitats and ecosystems. The decision about how to initiate restoration is best-informed by an understanding of the linkages between ecosystem components and, given these linkages, an appreciation of the consequences of choosing to recover one ecosystem component before another. However, it remains difficult to predict how the sequence of species' recoveries within food webs influences the speed and trajectory of restoration, and what that means for human well-being. Here, we develop theory to consider the ecological and social implications of synchronous versus sequential (species-by-species) recovery in the context of exploited food webs. A dynamical systems model demonstrates that synchronous recovery of predators and prey is almost always more efficient than sequential recovery. Compared with sequential recovery, synchronous recovery is twice as fast and produces transient fluctuations of much lower amplitude. A predator-first strategy is particularly slow because it counterproductively suppresses prey recovery. An analysis of real-world predator-prey recoveries shows that synchronous and sequential recoveries are similarly common, suggesting that current practices are not ideal. We highlight policy tools that can facilitate swift and steady recovery of ecosystem structure, function and associated services.

16:15 - A risk-based approach to evaluating marine mammal bycatch

Dr. Margaret Siple[1], Dr. André Punt[1], Dr. Tessa Francis[1], Dr. Rob Williams[2], Dr. Philip Hammond[2], Dr. Jeffrey Moore[3], Dr. Andrew Read[4], Dr. Randall Reeves[5], Dr. Maritza Sepulveda[6], Dr. Gujón Már Sigursson[7], Dr. Gísli Víkingsson[7], Dr. Paul Wade[3], Dr. Alexandre Zerbini[3]

[1]University of Washington, [2]University of St Andrews, [3]NOAA, [4]Nicholas School of the Environment, Duke University, [5]Okapi Wildlife Associates, [6]Universidad de Valparaíso, [7]Marine Research Institute

Bycatch by fishing vessels is a threat to marine mammal populations and is costly to the fishing industry. In 2017 the United States released a new rule requiring nations exporting fish and fish products to the U.S. to adhere to bycatch standards comparable to those of the U.S. This rule offers an opportunity for countries to assess the impacts of bycatch in their fisheries that are exported to the US, and to improve conservation outcomes. It also presents a challenge to develop management solutions that are robust to biological and implementation uncertainty, and are accessible when data on marine mammal abundance and fishery interactions are limited. Thus, countries that export fish to the U.S. would benefit from additional guidance about where data collection and changes in management would be most helpful. A multi-disciplinary working group assembled by the Ocean Modeling Forum (OMF) at the University of Washington plans to develop analytical tools that countries could use to assess the sustainability of their marine mammal bycatch. These tools will vary based on the type of data and the nature (gear type, target species) of their export fisheries, and be designed to address a range of data qualities. If applied, these tools could also be included in a plan that would lead to compliance determination for countries that export seafood and seafood products to the U.S. Here we introduce a possible risk-based framework for this tool and introduce three case study fisheries that will be used to develop and test the framework.

16:30 - Distribution Shifts Associated with Changing Environmental Parameters in Two Demersal Species Summer Flounder (Paralichthys dentatus) and Black Sea Bass (Centropristis striata)

Ms. Emily Markowitz[1], Dr. Skyler Sagarese[1], Dr. Michael Frisk[2], Dr. Janet Nye[2]

[1]NOAA, [2]Stony Brook University

Shifts in fish population distributions are a growing concern for fishermen and fisheries management scientists. Temperature has been implicated as the main driver of poleward distributional shifts in many marine fishery stocks, including two abundant and commercially valuable fish along the Northeast US coastline: summer flounder (Paralichthys dentatus) and black sea bass (Centropristis striata). Besides temperature, drivers may be different for different age and size classes within a species. Juveniles may select for different aspects of their environments and may be found at a wider and warmer range than have been experimentally found to support positive growth in adult conspecifics. This study will use fishery-independent Northeast Fisheries Science Center (NEFSC) bottom trawl survey data to develop cumulative distribution functions, generalized additive model based habitat suitability models, and projections over Regional Ocean Modeling System (ROMS) datasets to determine what parameters (surface and bottom temperature and salinity, depth, and bottom type) are selected for and influence distribution in different length classes in winter, spring, and fall. We will also assess whether these factors change the availability of these fish to the NEFSC bottom trawl survey in such a way that impacts estimates of stratified-mean biomass and abundance.

16:45 - Moving beyond static thinking to manage a dynamic world

Dr. Elliott Hazen[1], Dr. Kylie Scales[2], Ms. Heather Welch[3], Dr. Matt Oliver[4], Dr. Alistair Hobday[5], Dr. Sara Maxwell[6], Dr. Larry Crowder[7], Dr. Steven Bograd[1], Dr. Rebecca Lewison[8]

[1]NOAA Southwest Fisheries Science Center, [2]University of the Sunshine Coast, [3]University of California Santa Cruz, [4]University of Delaware, [5]CSIRO Oceans and Atmosphere, [6]Old Dominion University, [7]Stanford, [8]San Diego State University

The concept of dynamic ocean management was first introduced as pelagic marine protected areas that shift to track ecologically relevant ephemeral ocean features. However, the majority of implemented marine spatial management approaches remain static. One potential reason for this is the disruptive nature of dynamic ocean management approaches that requires a fundamentally new paradigm that embraces change instead of permanence, and requires technology to ensure ongoing implementation and review. Here we discuss the history, present state, and future of dynamic ocean management, focusing on both voluntary and mandatory tools and exploring the barriers and bridges towards their implementation. Some of the first examples include voluntary tools such as TurtleWatch implemented in 2007 and mandatory tools such as for southern Bluefin Tuna bycatch avoidance used from 2003-2016. More recently, species distribution models have been introduced that that can predict fundamental habitat for bycatch species to aid in avoidance and maintenance of sustainable harvest goals, such as for sturgeon in Delaware Bay (Eco4Cast) and multi-species bycatch in the California swordfish fishery (EcoCast). Understanding the governance arrangements in places where tools have been successfully implemented in concert with the state of resources at the time of implementation could aid our ability to both identify new industries that would benefit from dynamic ocean management, and to develop a blueprint for how best to introduce such disruptive technologies can best aid marine management in the future.

17:00 - Operationalizing a dynamic ocean management tool for fisheries sustainability

Ms. Heather Welch[1], Dr. Stephanie Brodie[1], Dr. Elliott Hazen[2], Dr. Michael Jacox[2], Dr. Steven Bograd[2], Dr. Sara Maxwell[3], Dr. Kylie Scales[4], Dr. Rebecca Lewison[5]

[1]University of California Santa Cruz, [2]NOAA Southwest Fisheries Science Center, [3]Old Dominion University, [4]University of the Sunshine Coast, [5]San Diego State University

Spatial management is widely applied to manage and conserve marine resources. Many applied spatial management schemes are static in space and time (e.g. marine protected areas) and are unable to accommodate the movements of highly mobile species. Dynamic management schemes have boundaries that are flexible in space and time, allowing scales of management to align with scales of environmental variability, biological movement, and human uses. Here we present an operationalized dynamic ocean management tool - EcoCast - designed to maintain target catch and minimize bycatch in a U.S. swordfish fishery. EcoCast integrates species distribution models with near real-time outputs from a data assimilative configuration of the Regional Ocean Modeling System to produce a daily fishing suitability map. The map indicates areas that are good and poor to fish relative to the predicted distributions of target species (swordfish) and bycatch species (leatherback turtles, California Sea lions, blue sharks). Species risk weightings allow managers to weight the contributions of each species in reflection of changing management priorities or recent bycatch events. A hindcast analysis was run to test the ability of EcoCast to avoid historical bycatch events while maintaining historical catch under different scenarios of species weightings. Fisheries sustainability tools such as EcoCast allow for the protection of highly mobile species while still maintaining healthy target catch, serving as a win-win for conservation and fisheries economics. Dynamic ocean management schemes offer solutions that are flexible to anomalous environmental conditions, thereby increasing management capacity to respond effectively to climate variability and change.

IMCC5 Day 4 (27/6)

Plenary 4: Juanita Joseph, Ph.D.

8:30 - 9:30, Ranyai Ballroom

Saving Sea Turtles in Malaysia: Current Status and Challenges

Dr. Juanita Joseph is one of the leading sea turtle biologist and conservationist in Southeast Asia. She had been involved in sea turtle conservation since 1996. She obtained her M.Sc. from University Putra Malaysia and Ph.D. from Royal Holloway University of London. Her research focused mainly on the nesting biology and molecular ecology of sea turtles. Dr. Joseph runs a sea turtle conservation at Redang Island (2009 - 2017), and organised many outreach programmes in Malaysia, such as the SEATRU Volunteer Programme. Working closely with the Department of Fisheries Malaysia and WWF-Malaysia, she hopes that one day the State Governments in Peninsula Malaysia will enact a legislation to ban the commercial sales of sea turtle eggs. Juanita is currently working with the Borneo Marine Research Institute of University Malaysia Sabah.

OS-7A: Communicating Marine Conservation 1 (10:00 - 12:00, FJ Auditorium)

10:00 - Who lives, who dies, who tells their story: Sharks through various culture lenses and how policy reflects that perception

Ms. Melissa Marquez[1]

[1]*The Fins United Initiative*

Public opinion and attitude towards wildlife can significantly affect the implementation and success of conservation initiatives. In extreme cases, negative public perception towards species of concern can result in failure of conservation efforts. A universal fear of sharks has not always been present and the portrayal of sharks has evolved over the years from worship to disdain. There are a myriad of factors that may influence attitude towards wildlife. This includes the attitude towards wildlife and perception of the value of wildlife. Understanding these factors that influence attitudes will in turn influence wildlife management decisions and their success. Numerous studies have been conducted on the ecology and biology of Chondrichthyans (sharks, skates, rays, and chimaeras), but few have highlighted peoples' attitudes towards these species in particular. This research delves into the history, mythology, legends, and folklore around Chondrichthyans worldwide and if the portrayal of sharks in a culture (good or bad) is reflected in their policy and conservation protections. Results found that the region's beliefs was not always reflected in policy, conservation efforts, or protection. This presentation will suggest ways to involve locals (including indigenous communities) in citizen science projects for a goal of achieving a long-term "co-existing with wildlife" mindset.

10:15 -Marine scientists' perceptions of our audience may hinder the positive reception of our message

Ms. Katie Walters[1]

[1]*Griffith University*

Little attention has been given to the way scientists view the public as the "audience" for their science messages. In this case study, a group of marine science professionals were interviewed on the CSIRO Marine National Facility RV Investigator to examine how they perceive the public as recipients of scientific information, what "good" science communication looks like, and whether there should be a duty for scientists to share the results of their research with the public.

The interviewed marine scientists face common barriers to effective communication with the public. In particular they identified: a lack of professional incentives for communicating; doubts about the public's interest and understanding; and a lack of training beyond the knowledge-deficit model of science communication. In addition, the scientists expressed a need to address some critical misconceptions held by the public, before a productive and positive science-public relationship can be achieved.

Analysis of scientists' assumptions about the public highlight a need for increased diversification of science communication approaches, and recommendations are made to draw from communications strategies outside those traditionally used in the field of science. Psychology, new media marketing, community engagement, and the arts are indicated as fields which have much to offer science communication. Common to all useful approaches is a deprioritisation of "building education and awareness" through the knowledge-deficit model, in favour of multi-directional communication and meaningful engagement.

10:30 - Marine Birds Require Conservation On Land and At Sea

Mr. Bradford Keitt[1]

[1]*American Bird Conservancy*

Marine ecosystems are under siege: overharvesting, pollution, ocean acidification and climate change all contribute to declining ocean health. In light of these threats it is important to prevent additional extinctions and restore populations of key species to maintain intact marine ecosystems. The trend of MPA creation over the past

60 years, with coverage now approaching 5% of the Earth's oceans, is a step in the right direction. However, threats to seabirds at sea and on land continue to compromise their critical role in marine ecosystems. Seabirds account for a disproportionate 25% of all past marine extinctions. Seabirds are among the most threatened of all marine animals, with 28% of ~350 species listed as threatened by the IUCN Red List. Global populations of all seabirds have declined by 70% since 1950. While the ramifications of these changes are not well understood, seabirds are key top level marine predators and consume an amount equal to the global human fishery effort. Seabirds also play a key role in nutrient cycling, integrating large amounts of marine nutrients onto land that then disperse through terrestrial, coastal, nearshore and eventually pelagic systems. Seabirds provide further services as indicators of fish schools for human fishers, food for indigenous harvesters, guano for fertilizer, and attractions for ecotourists. To maintain seabird diversity and abundance, management plans for MPAs and ocean conservation in general must increase protections against seabird bycatch in fisheries and incorporate land based conservation action to protect seabirds on their nesting sites.

10:45 - Importance of science communication for highlighting the plight of the overlooked heroes of conservation

Mr. Benjamin Jones[1], Dr. Richard Unsworth[2], Dr. Leanne Cullen-Unsworth[1], Mr. Richard Lilley[3]

[1]Cardiff University and Project Seagrass, [2]Swansea University and Project Seagrass, [3]Project Seagrass

Effective communication of the importance of conservation is needed now more than ever. Yet academia generally does little to help by valuing publications over public perceptions. As a result, numerous conservation issues remain out of sight and out of mind to the general public. Nowhere is this more apparent than within the field of seagrass conservation. Seagrass ecosystems provide services that are vital to humanity. Yet everyday activities across society reduce the health of these ecosystems and undermine their ability to provide these vital services. Seagrass loss occurs daily and there is increasing recognition of the need to engage society to deliver behaviour changes as part of solutions to marine issues; the issues of plastics is one such example. While a range of concepts have been proposed to engage society with the sea in response to challenges, even the simplest of methods may benefit seagrass due to its limited public appeal. In a 2014 survey on public perception of key marine animal and plant species in the UK, seagrass was deemed the least interesting, with few respondents interested in learning more about the species. However, recent media attention and programmes such as Blue Planet II have given visibility to the plight of seagrass meadows. Here we present a case study of how the simplest of communication can be key to bringing conservation issues to light.

11:00 - Does teaching about solutions change how students think about ocean acidification?

Mr. Brian Erickson[1], Ms. Tracy Crews[2] , Ms. Flaxen Conway[2]

[1]Oregon State University, [2]Oregon State University/Oregon Sea Grant

With 94% of all peer-reviewed papers published since 2010, ocean acidification can be considered is a relatively new and active area of scientific research. While scientific knowledge of ocean acidification is expanding rapidly, the American public remains largely unaware of the issue despite efforts by outreach and education professionals. This suggests the need to raise public awareness; however, often implicit in awareness-raising efforts is the belief that "if people know about the problem, then they will take action to fix it." Behavior change research has shown that knowledge is only a precursor to action. If knowledge will not lead students to action, can we at least provide information in a way that primes students for action?

Multiple psychological theories suggest that for someone to try to fix a problem they must i) perceive an issue as a threat to something they care about and ii) think that there is something they can do to fix the problem. While there are numerous teaching materials on ocean acidification freely available, very few emphasize solutions to the problem. This mixed-methods research project tests whether teaching students using a solutions-focused lesson changes their perceived threat and control over the problem, when compared to students completing a standard ocean acidification lab. We present findings from an experiment conducted in high school classrooms in coastal Lincoln County, Oregon with nearly 300 students. Our findings have implications for how scientists, educators, and communicators engage with the public about ocean acidification.

11:15 - How biologists and artists can collaborate for the safe future of marine protected areas

Prof. Paul Rosero Contreras[1]

[1]Universidad San Francisco de Quito

We would like to raise a discussion about possible formats of artists' and scientists' joint efforts in the marine protected zones on the example of the "Dark Paradise" project - the expedition of biologists and artists to Galapagos Islands (spring 2018). An interdisciplinary team composed by Ecuadorian artist Paul Rosero Contreras, Russian cultural projects producer Anna Shvets, British philosopher and curator Nadim Samman and Ecuadorian marine scientists Nataly Guevara and Margarita Brandt traveled together to investigate the hydrothermal vents of Roca Redonda, an active underwater volcano north of Isabela Island. In a science and art scheme, this project joints a multi-talented team to explore unknown phenomena in an access restricted area of the Galapagos Archipelago. The expedition includes two main activities:

- ON-FIELD ART Program (Video Production, Underwater volcano 3D scanning, Photogrammetry).
- ON-FIELD SCIENCE Program (Sample gathering, Prelaboratory storage).

When the expedition is completed the team focuses on next components of the project:

- EDUCATIONAL Program (Science & Art encounters, Academic workshops: Sustainable and Space Architecture, Biology, and Future resources);
- CULTURAL Program (Exhibition, Sound/Music Performances, Art Installations, Public talks and walkthroughs). This interdisciplinary collaboration of marine biologists and culture triggers can serve to increase awareness and visually represent the main maritime problematics for the future generations as well as to find innovative solutions for description and protection of these zones.

We want to invite to take part in this discussion representatives of different fields related to the topic, participating in the symposia.

11:30 - The rise of politics-based marine conservation

Dr. Luiz Rocha[1]

[1]California Academy of Sciences

Every marine conservation biologist is familiar with the term "science-based conservation", which applies to processes where conservation management actions and policy making are driven by scientific evidence. For example, the scientific way to determine the best place and shape for a marine protected area often involves conducting detailed biodiversity surveys and identifying critical habitat, such as nurseries, spawning areas, and migration corridors. On the opposite side of the spectrum is what I call "politics-based conservation": the process by which conservation policy making is entirely driven by conflict avoidance. In this case, the decision about where to place a marine protected area or how big it should be always starts by excluding areas that are heavily used by fishers, the oil and gas industry, tourists, etc, thus avoiding conflict. Here I will show that, contrarily to what is always portrayed by the media, every large marine protected area created over the past 10 years has followed a politics-based rather than a science-based approach. These MPAs are often in very remote locations that didn't need protection to begin with, and are being used to meet arbitrary international targets for conservation. Therefore, they remove the pressure for any further conservation measures without actually protecting anything, and their creation has the potential to do more harm than good to biodiversity in the long run.

11:45 - Encouraging Responsible Behavior: An Objective in Achieving Effective Management in Hawaii's Nearshore Waters by 2030

Shea Alessandra[1]

[1]*Hawaii Division of Aquatic Resources*

The State of Hawai'i is currently developing a plan to effectively manage 30% of Hawai'i's nearshore environment by 2030. The goal of the Marine '30x30' Initiative is to ensure sustainability in Hawai'i's marine environment, which allows the people of Hawai'i and our visitors to enjoy nearshore waters, support local livelihoods, and feed their families. One of the four objectives of the Marine 30x30 Initiative is to encourage responsible behavior through education and enforcement activities. This objective will require a close collaboration between two state agencies, the Division of Conservation and Resources Enforcement (DOCARE) and Division of Aquatic Resources (DAR). Strategic education and communication tactics will reach key audiences to promote responsible ocean use and compliance to state rules, while tailoring specific campaigns to stakeholder groups such as fishers, recreational users, and legislative decision makers. Enforcement actions include pursuing increased marine enforcement units and streamlining the enforcement officer training process in order to increase efficacy. Initiating programs that focus on encouraging responsible behavior on several levels from community to individual will help to achieve effective management for thriving nearshore environments of Hawai'i, the ultimate goal of the Marine 30x30 Initiative.

OS-7A: OS-7B: Conservation and Management 4 (10:00 - 12:00, FJ Event Hall)

10:00 - Crash of a living fossil: conservation genetic assessment for horseshoe crabs around East Asia

Dr. Ming-Che Yang[1]

[1]*IUCN SSC horseshoe crab specialist group*

The horseshoe crab, a living fossil, is a marine species that has lived on earth for more than 400 million years. Three of four species horseshoe crabs distributed in Asia were under long-term stress due to coastal development, marine pollution and over-harvest. The conservation assessments for their population and habitat are evaluated by IUCN SSC horseshoe crab specialist group. Otherwise, loss of genetic variation within a species may affects its ability to adapt to changing environmental conditions but currently lacks explicit considerations of range-widegenetic condition in conservation assessments. In this study, population demography, habitat and genetic condition of horseshoe crab in Asia were compared. Generally, the populations with related higher genetic diversity were found in south east Asia compared to northwestern Pacific area. The full loss of genetic diversity were found in some populations in Taiwan and Japan due to population crash. Temporal haplotypes shift and loss of genetic connectivity in T. tridentatus at Kinmen were also found due to construction of port through a 13 years genetic data tracked from 2002 to 2014. Marine protected area network can also be designed based on genetic connectivity along China coast. Long term and regional scale population monitoring are not easily applied on each locations, but conservation genetic assessment may make a contribution on broader view of population status.

10:15 - Status Of Coral Reefs In Marine Parks And Reserve Units In Mainland Tanzania

Dr. Nsajigwa Mbije[1]

[1]*Sokoine University of Agriculture*

This survey was done between May 2016 and January 2017 under the South West Indian Ocean Fisheries Governance and Shared Growth (SWIOFish) with the purpose of assessing the status of coral reef ecosystems in four marine protected areas (MPAs0 in Tanzania. Data was collected through three methodologies namely; (1) the Line Intercept Transect (LIT) method to assess benthic cover categories, (2); a 5 x 10 m belt transect method which was used for macroinvertebrates and (3) a 5 x 50 m belt transect for assessing fish density. Results indicated that hard coral percentage cover was 40% in Mafia Island Marine Park (MIMP) and lowest cover of about 25% in Mtwara and Ruvuma Estuary with significant difference in among MPAs (Kruskal Wallis test H, P &; 0.011. Similarly, the coral diversity varied among MPAs showing significant differences whereby MIMP had the highest diversity. Rubbles present were mainly results of bad fishing practices in the MPAs, these included but not limited to dragnets or dynamite blasting. Fish survey showed that there is significant difference among MPAs (Kruskal Wallis's test; P &; 0.001) with MIMP having the highest diversity whereby damselfish was the most abundant (n = &; 80%). Invertebrate community was dominated by class Echinoidea whose most members were sea urchins with significant difference among parks MPAs (Friedman's test = 36.036, P & 001). The observed decline of coral reef necessitates the need for introduction of diversified livelihoods to compensate for intense resource extraction in the reefs thus to deter further decline.

10:30 - Dugong (Dugong dugon) Surveys Using Unmanned Aerial Vehicle (Drone) in Lawas, Sarawak of East Malaysia

Mr. James Bali[1], Mr. Toloy Keripin Munsang[1]

[1]*Sarawak Forestry Corporation*

Fixed-wing single rotor Skywalker 2015 drone with 3-hours flying endurance was used to determine the distribution and density of Dugong (Dugong dugon) at the seagrass meadow in Lawas, Sarawak of East Malaysia from May 2016 to October 2017. The drone powered by 16 Volt, 4 cell Lithium-Ion batteries and fitted with GoPro Hero4 or GoPro Hero6 camera with 128 GB micro-SD memory card to record video footages during the flight missions. The drone flies autonomously according to pre-loaded flight mission using ArduPilot software with 70 m elevation and ground speed of 42.5 km per hour (12 m/s). The survey area is divided into four flight mission survey sectors ranging from 3.6 to 4.1 km2 namely Kebab Putus-Sari Damit (Sector A), Sari Damit-Bukit-Sari (Sector B), Bukit Sari-Kuala Lawas (Sector C) and Kuala Lawas-Bangkulit (Sector D). After 68.8 hours of total survey efforts (8 flight missions per sector), a total of 10 sightings with 16 dugongs were recorded (0.15 sighting/hour). Most of the sightings were recorded in Sari Damit-Bukit Sari sector B with four sightings and eight individuals.

10:45 - Hidden functional groups may play critical roles in recovery processes in post-disturbed coral reefs

Dr. Teresa Alcoverro[1], Dr. Rucha Karkarey[1], Dr. Rohan Arthur[2]
[1]Nature Conservation Foundation, [2]Nature

With climate change mortalities become increasingly frequent in tropical systems, coral reef system dynamics is increasingly driven by the strength of its recovery trajectories. The ability of fish functional groups to maintain algal-free substrates after coral mass mortalities is a critical first step in ensuring successful settlement and growth of coral recruits. There has been a growing acknowledgement of the essential role that herbivore fish play, with several studies identifying them as cornerstones of resilience in recovering reefs. We examined the direct and indirect role of other trophic groups in contributing to the maintenance of algal-free substrates on post-disturbed reefs. We quantified the capacity of fish assemblages to control algal growth and to examine the species responsible for this control. We developed an underwater video assay that involved observing bite rates taken off bits of dead coral colonised by turf algae, collected from territorial damselfish gardens. The bits were recorded for two hours. Our results indicate that while a range of species within the assemblage contribute to algal offtake, a few species like the herbivore Ctenochaetus striatus is disproportionately important. More interestingly, several other microinvertivore species of fish played vital roles, both directly and indirectly in algal offtake. These species were often the initiators of algal offtake, incidentally removing large amounts of algal turf from the substrate while foraging for microinvertebrates. These could represent hidden functional groups that contribute significantly to the resilience of reefs by providing a function that goes beyond their trophic roles.

11:00 - Assessing threats to seabirds in the West Indian Ocean to inform conservation priorities

Dr. Tammy Davies[1], Mr. Rob Martin[1], Ms. Lizzie Pearmain[1], Dr. Maria Dias[1], Dr. Ian Burfield[1], Dr. Cleo Small[2], Prof. John Croxall[1]
[1]BirdLife International, [2]RSPB

Seabirds are the most threatened group of birds globally. The West Indian Ocean is an important area for seabirds - including 20 globally threatened species. The region is also undergoing rapid change, with increasing cumulative impacts (Halpern et al. 2015). However, specific threats to seabirds and the spatial distribution of such threats in the West Indian Ocean are poorly understood. Understanding threats to seabirds are important in order to inform appropriate conservation responses and decision-making processes.We use an innovative approach to evaluate seabird species-specific threats and their spatial distribution by combining a range of data, including spatial threat layers, seabird tracking data, and species threat assessment data from the 2017 IUCN Red List. We use the latter to assess: a) population status and trends; b) the nature and severity of threats, and; c) appropriate conservation actions for species. We found six main threats to seabirds within the West Indian Ocean, with invasive alien species and pollution being the top two. We also assessed the spatial distribution of threats within marine Important Bird and Biodiversity Areas in the region to identify priority species and sites for conservation action.

11:15 - Surveying environmental DNA (eDNA) from marine environments

Prof. Michael Bunce[1]
[1]Curtin University

DNA isolated and characterised from a variety of substrates including sediments and water is collectively referred to as environmental DNA (eDNA). DNA is shed into the environment from a variety of biological secretory processes leaving genetic footprint that acts lens into species composition. When combined with next generation sequencing (NGS) and metabarcoding, eDNA can provide a wealth of information for studies of biodiversity, food web dynamics, diet analysis, invasive species monitoring and disturbance gradients. Metabarcoding eDNA has become feasible only because it is now possible to simultaneously sequence millions of copies of DNA from complex multi-species environmental samples. The research in the trace and environmental DNA (TrEnD) laboratory has been developing a variety of eDNA workflows to investigate how best to conduct eDNA work in a variety of applications. This presentation will explore how (i) eDNA correlates with video technologies (ii) how eDNA signatures vary with substrate selection (iii) how eDNA survey vary temporally and spatially and (iv) the use of eDNA in measuring disturbance gradients. Lastly this presentation will also highlights that sensitivity of eDNA metabarcoding also comes with risks - false positive/negatives and contamination. A number of recommendations will be discussed from sample collection to data analysis that will maximise the potential of eDNA metabarcoding as a tool in marine biomonitoring.

S-147: Priorities and goals for conservation of elasmobranchs in Asia (10:00 - 12:00, Kerangas)

10:00 - Documentation and conservation status of Sharks, Skates, Rays and Chimaera from Andaman Islands, India.

Mr. Ravi Ranjan Kumar[1], Dr. Venu S.[1], Dr. Bineesh K.k.[2]
[1]Department of Ocean Studies and Marine Biology, Pondicherry University, Brookshabad Campus, Port Blair., [2]Zoological Survey of India, Andaman and Nicobar Regional Centre, Port Blair.

Andaman and Nicobar Islands is one of the largest oceanic archipelago system, located between lat. 6 - 14 N and Long. 92 - 94 E in southern reaches of Indian Ocean. About 28% of country's Exclusive Economic Zone falls under its territorial jurisdiction encompassing 1,192 km coastline (Comprising 572 Islands). Taxonomic study of chondrichthyans (Sharks, Skates, Rays and Chimaera) from Andaman Islands is very limited. This study highlights the recent record of species distributed and their conservation status based on previous literature as well as from the present findings from these Islands.

This attempt is undertaken considering the collection of specimens from fish landing centers, fish market and deep-sea oceanographic exploratory surveys (FORV Sagar Sampada) around Andaman Islands during 2014 - 2017. Present study found the occurrence and addition of 17 species to the chondrichthyans fauna that makes a total of 81 species, covering 10 orders and 30 families with Chimaeras (2), sharks (49), Skates (1), Rays (22), Sawfishes (3) and Guitar fishes (4)]. The conservation status of chondrichthyans from these islands is presented, which comprehended to 10% as Least Concern (LC), 15% Data Deficient (DD), 5% Critically Endangered (CR), 9% Endangered (EN), 30% Vulnerable (VU), 30% Near Threatened (NT) and 1% Not Evaluated (NE). An integrated approach in order to tackle problems on over exploitation and environmental degradation needs to be established for sustainable utilization and formulating conservation and management of these resources.

10:15 - Identifying Priorities of Elasmobranch Conservation in the Bay of Bengal, Bangladesh

Ms. Fahmida Khalique Nitu[1], Mr. Mahatub Khan Badhon[2] , Mr. Md. Kutub Uddin[1] , Mr. Enamul Mazid Khan Siddique[3]

[1]Save Our Sea Trust, [2]University of Dhaka, [3]Bangladesh Youth Environmental Initiative

The study evaluates current scenario of elasmobranch conservation in Bangladesh and identifies future priorities. Literature review, key informants interview, and investigations at fish markets and landing stations including information gathered while building rapport with different stakeholders were used in the study. Review finds a total record of 77 species, however, key informants affirmed that they are not satisfied with the taxonomic credibility in existing literature. Owing to the limited focus of research on elasmobranch, the current knowledge base is fraught with significant Linnaean, Wallacean and Prestonian shortfalls. The 2015 national IUCN Red List of Threatened Species did not assess elasmobranch due to the knowledge shortfalls, yet 34 species of globally threatened sharks and rays have been reported from Bangladesh. Wildlife (Conservation and Security) Act, 2012 identifies 29 species as 'protected wild animal' and prohibits elasmobranch fishing in the Sundarbans Reserve Forests. Being a party to CITES has arguably little impact as ports have no monitoring mechanism, resulting in export of shark products. Based on the built scenario, we recommend that credible information on species and their habitat; data on diversity, abundance, and distribution is necessary to assess the conservation status of elasmobranch fauna in Bangladesh's water. Besides, a collaboration mechanism among the regulatory agencies, sensitization of fisheries, private sector engagement, and trans-boundary collaboration should be the priority areas.

10:30 - Detecting drastic declines in a poor elasmobranch fisheries region

time

Ms. Alissa Barnes[1], Mr. Muralidharan Manoharakrishnan[1], Dr. Naveen Namboothri[2]

[1]Dakshin Foundation, Bengaluru, Karnataka, [2]Dakshin Foundation

India has contributed largely to global elasmobranch stocks and yet there is a paucity of biological, socio-economic and ecological data to construct effective management plans. While Odisha does not rank highly (2%) in elasmobranch fisheries in India, there has been a 47.1% reduction in elasmobranch catch in just the past year. We conducted a scoping study to understand the trends in elasmobranch fisheries with respect to demographics, evolution of crafts and gear and trade in coastal Odisha. Based on gear use and the scale of fishing, three major fishing harbours were considered. Using a semi structured questionnaire, we interviewed 40 fishers, representative of trawl and long line fisheries. We established that elasmobranchs are still largely a part of by-catch and are seasonal in nature. Approximately 50% of the fishers mentioned a reduction in size classes, quantities, absence of species once abundantly captured (such as the sawfish shark), increase in catch post mechanization and longer fishing durations in deeper waters to compensate for the money invested per fishing trip.Understanding these dynamics in elasmobranch fisheries enables us to explore the drivers of stock declines and check the extent to which they contribute to species specific declines. Such information may also allow us to gain crucial insights on the causes and the declines of elasmobranch fisheries elsewhere in country.

10:45 - Mapping ecological distribution of chondrichthyan species in western India.

Dr. Shaili Johri[1], Dr. Elizabeth Dinsdale[1], Mr. Jitesh Solanki[2], Ms. Asha Goodman[1]

[1]San Diego State University, [2]Junagadh Agricultural University

The west coast of India, a part of the Arabian Seas Region, is home to a rich biodiversity of chondrichthyan species and is the highest contributor to India's shark exports. All life stages of sharks are targeted by fisheries and caught as bycatch. In spite of increased mechanization and improved efficiency of fishing gear, there has been a 20% decline in fisheries catch, a typical sign of declining fish populations. Protecting and preserving remnant populations is thus imperative. However, knowledge of chondrichthyan species distribution is sparse, which makes it challenging to establish marine sanctuaries to protect chondrichthyes. Our research focuses on mapping seasonal chondrichthyan species distributions through non-invasive environmental DNA sampling in collaboration with local fishing communities in Gujarat, India. Fishers collect water samples using sterile sampling methods, along transects in several locations in Gujarat and record GPS location and depth for each sample collected. These water samples are filtered to obtain sloughed cells from skin or scat of free swimming marine species in the area. DNA is extracted from cells and chondrichthyan specific universal primers are used to amplify multiple genetic loci within the mitochondrial genome. Field-based sequencing techniques are used to determine species identities. Using these methods, we have identified the presence of previously unreported Chondrichthyes at three locations in Gujarat. Our ongoing and future efforts are focused on identification of ecologically important chondrichthyan habitats and on co-developing a draft MPA establishment plan in collaboration with fishing communities.

S-157: Integrating social sciences to ensure human well-being in marine conservation4 (10:00 - 12:00, Tubau 1)

10:00 - Developing indicators: incorporating local priorities and perspectives to foster linked human and environmental well-being in marine and coastal systems

Dr. Eleanor Sterling[1], Ms. Pua'ala Pascua[1], Dr. Joe McCarter[1], Ms. Amanda Sigouin[1], Dr. Simon Albert[2], Ms. Erin Betley[1], Dr. Sophie Caillon[3], Dr. Jennifer Caselle[4], Dr. Joachim Claudet[5], Dr. Rachel Dacks[6], Dr. Emily Darling[7], Mr. Nadav Gazit[1], Dr. Stacy Jupiter[8], Dr. Alexander Mawyer[6], Dr. Manuel Mejia[9], Dr. Kanoe'ulalani Morishige[6], Dr. Tamara Ticktin[6], Dr. Supin Wongbusarakum[6]

[1]Center for Biodiversity and Conservation, American Museum of Natural History, [2]School of Civil Engineering, The University of Queensland,

[3]National Center for Scientific Research, CEFE UMR 5175, [4]Marine Science Institute, University of California Santa Barbara, [5]National Center for Scientific Research, CRIOBE, [6]University of Hawai'i at Mãnoa, [7]Marine Program, Wildlife Conservation Society, [8]Wildlife Conservation Society, Melanesia Program, [9]The Nature Conservancy Hawai'i

As marine managers, conservation practitioners, and researchers explore ways to address today's complex environmental challenges, it is imperative that management policies and actions account for linked human wellbeing and environmental integrity. Identifying indicators that capture the connections and feedbacks between humans and their environment is crucial to support sustainability assessments at the community, national, and global scales and ultimately fosters social-ecological resilience. Using a 'biocultural approach' that explicitly builds upon place-based perspectives, knowledges, and values, we conducted several workshops in the Pacific Island to identify aspects of well-being important for local management and decision-making. We used the results to refine a list of elements that can describe community resilience and well-being from a Pacific perspective, which were grouped into a framework of broad themes and mapped onto the Sustainable Development Goals and Aichi Biodiversity Targets. We identified overlaps and gaps and developed a typology that characterizes the ways in which global indicators can be difficult to measure at the local scale. This exercise brought to light values prevalent in locally-derived biocultural frameworks but not reflected in the prominent global agendas to achieve sustainability. For instance, 'connectedness to place' resonated with Pacific Islanders as a means to characterize the wealth of relationships both among people and between people and their environment that are perceived as critical to both human and environmental well-being. We will discuss additional underrepresented elements and how a biocultural approach can be used to develop indicators that assess these crucial aspects underpinning human and environmental well-being.

10:15 - Working towards incorporating human well-being and cultural importance into the West Hawaii Integrated Ecosystem Assessment

Ms. Rebecca Ingram[1], Dr. Kirsten Leong[2], Dr. Supin Wongbusarakum[1], Dr. Jamison Gove[1]

[1]NOAA Pacific Islands Fisheries Science Center, [2]NOAA

Ecosystem-based management is increasingly recognizing the importance of the reciprocal relationships that exist between humans and ecosystems, and the critical links between human well-being and ecosystem services. These links are not linear, but rather create dynamic, interwoven, and complex networks of social-ecological interactions. The National Oceanic and Atmospheric Administration's West Hawaii Integrated Ecosystem Assessment (IEA) is a program grounded in ecosystem-based methods and recognizes the importance of place-based human dimensions. Initial IEA work with stakeholders in West Hawaii revealed detailed social-ecological system dynamics and highlighted both the importance and lack of understanding of the links between ecosystem services and human well-being, particularly services that enhance and maintain cultural connections to a place. Without an understanding of these links, it is almost certain that crucial ecosystem services will be left out of resource management strategies, as has been witnessed in numerous regions globally. Our strategy was to begin deciphering how West Hawaii communities interact with intangible, non-material ecosystem services (through spiritual, social, and emotional avenues) and learn how people value services differently. This required developing a process for including human dimensions in marine management that is place-based, informed by communities, and addresses social needs. Using a biocultural approach and qualitative research methods, and referring to previous West Hawaii community-based research endeavors and other projects examining cultural ecosystem services, we created a method for the IEA to begin incorporating human dimensions into the framework. From here, we will develop an index of biocultural indicators using guidance and responses from the community.

10:30 - Developing and implementing a human wellbeing framework for restoration planning in the Puget Sound

Dr. Kelly Biedenweg[1]

[1]Oregon State University

We present a study on the development of human wellbeing indicators for Washington State's ecosystem recovery agency. Over two years, we engaged stakeholders, policymakers, and social scientists in the identification, modification, and prioritization of wellbeing indicators that were adopted by the agency for biennual monitoring and strategic planning. We conducted 61 interviews with diverse stakeholders, reviewed 91 documents associated community values and priorities, and held 8 workshops to modify and prioritize indicators among local stakeholders. Indicators were then rated by social scientists and regional policymakers, resulting in 15 new indicators of human wellbeing that were broadly accepted and important to all audiences. These indicators have been formally adopted by the state agency and are used for restoration monitoring and planning.

10:30 - Efforts to integrate Socio-economic Monitoring with Biophysical Monitoring in in South Asia

Dr Vineeta Hoon[1]

[1]Centre for Action Research on Environment, Science and Society

Coastal communities rely on goods and services provided by coral reefs and related ecosystems for their livelihood and nutritional needs. These resources get degraded by over-extraction and harmful extraction techniques.

It was recognised in the 1990's that managing marine ecosystem goods and services meant managing people who use and impact them. Hence the need to integrate socio-economic monitoring with biophysical monitoring and arrive at a holistic understanding of how the marine resources are used and impacted. This information is deemed necessary for adaptive management and actions to be taken that would encourage compliance. GCRMN introduced a Socioeconomic Assessment and Monitoring manual in 2000 to complement biophysical monitoring efforts. Regional specific guidelines for coastal managers in South Asia were introduced by 2008. In South Asia where poverty is an issue with coastal communities, we used participatory appraisal tools to ensure that the voices of the most disadvantaged people are also included. Visualisation techniques in conjunction with Focus group discussions were effective in creating joint learnings. These studies have been carried out at selected sites in India, Srilanka, Maldives and Bangladesh in 2002, 2011 and 2015. Special care was taken to integrate biophysical knowledge while conducting the community based socioeconomic assessments. This paper will discuss key learnings from these efforts.

It will highlight the tools we found most effective in: 1. ensuring that no stakeholder group is left out 2. integrating socio-economic and biophysical monitoring, 3. Creating Joint learnings and 4. Communicating the knowledge to a wider audience.

10:45 - Puna I'a, Biocultural Linkages, and the Well-Being of Governance in Taiarapu, Tahiti

Dr. Alexander Mawyer[1], Dr. Tamatoa Bambridge[2], Ms. Pauline Fabre[3]

[1]University of Hawai'i at Mānoa, [2]PSL Paris University: EPHE-UPVD-CNRS, USR 3278 CRIOBE, [3]EPHE

The vulnerability of coral reef systems to natural and anthropogenic disturbances is evident when ecologically rich but vulnerable coral dominant systems transition post disturbance into ecosystems with algal dominance and reduced fish biodiversity. However, in French Polynesia's Taiarapu coast on the island of Tahiti, reefs coupled to several Ma'ohi communities offer evidence of decreased vulnerability and demonstrate a high level of adaptation and resilience to multi-driver changes of reef wellness. Importantly, these communities have begun to implement a hybrid governance scheme over nearshore marine resources in which bureaucratized and scientized reef management is complemented by local actors' socials norms and values, traditional knowledge, and management practices called rahui (Bambridge 2016). Ongoing work in these small-scale MPAs (Designated Rahui Areas) associated with specific communities suggests that fostering such hybrid approaches during the design, implementation, and monitoring phases of a conservation program, in a culturally sensitive fashion can increase compliance and conservation effectiveness. But, this raises the question, how is cultural sensitivity constituted? How does it materialize? What aspects, dimensions, or characteristics of cultural sensitivity best contribute to desired marine protection, governance outcomes, and community well-being? While the official, state-recognized and locally valued implementation of rahui-based small-scale MPAs is already showing highly suggestive results and potential for decreasing vulnerability and enhancing local agency, the dynamic linkages involved in coupling human and non-human systems around Taiarapu's coral reefs and communities in an enduringly effective manner will require active attention to methods drawn from across the social sciences.

S-193: Advancing an ecosystem-based approach to Marine Spatial Planning in South Africa (10:00 - 12:00, Kabu)

10:00 - Advancements in ecosystem-based approaches to Marine Spatial Planning in South Africa

Prof. Amanda Lombard[1], Prof. Rosemary Dorrington[2], Dr. Gwenith Penry[1], Dr. Lorien Pichergu[1], Ms. Jodie Reed[1], Ms. Kaylee Smit[1], Ms. Estee Vermeulen[1], Dr. Kelly Ortega-Cisneros[3]

[1]Nelson Mandela University, [2]Rhodes University, [3]Rhodes University and Nelson Mandela University

South Africa's large exclusive economic zone includes the Indian, Atlantic and Southern Oceans. Management of this ocean space has traditionally been undertaken within sectors, leading to conflict amongst sectors, and between sectors and the need for environmental protection. As the demand for ocean space and marine resources increases, in response to a growing oceans economy, a more integrated approach to management is required to ensure that both ecological and socio-economic objectives are met. Marine spatial planning (MSP) has emerged in many countries as an effective process to achieve this integration, and in 2016, South Africa became the first African country to draft MSP legislation. In this Symposium, we present seven trans-disciplinary research projects that address challenges for implementing an ecosystem-based approach to MSP in South Africa. We discuss the analysis of microbial community dynamics as a measure of marine ecosystem health and the response to environmental change; the use of biological traits to assess ecosystem condition of rocky reefs; a model to assess the impacts of warming and ocean acidification on the southern Benguela food web and fisheries; spatial management options for marine fisheries in South Africa; the use of low-cost fishing exclusions to improve the conservation of a top predator; the assessment and development of sustainable boat-based marine tourism; and the development of a system-dynamics model to support marine spatial planning in Algoa Bay, South Africa. We conclude with lessons learned, and recommendations to advance ecosystem-based approaches to MSP globally, within a systems-thinking framework.

10:15 - Microbial community dynamics: a sensitive tool for assessing marine ecosystem health and the response to environmental change

Prof. Rosemary Dorrington[1], Dr. Thomas Bornman[2], Ms. Danielle De Vos[1], Dr. Gwynneth Matcher[3], Dr. Siddarthan Venkatachalam[1], Ms. Ross-Lynne Weston[4]

[1]Rhodes University, [2]South African Environmental Observation Network, [3]Rhodes University and South African Institute for Aquatic Biodiversity (SAIAB), [4]Rhodes University and SAEON

Microbial communities, accounting for up to 90% of the total biomass of the oceans, play a critical role in driving global biogeochemical cycles. Community analysis of microbial biomass reveals extraordinary taxonomic diversity with distinct communities in different water masses. Their diversity is reflected by metabolic versatility that allows marine microbes to respond rapidly to changes in their physical and chemical environment, including anthropogenically-driven change. These responses, including shifts in the diversity and structure of microbial communities and their metabolic activity, can be used as a sensitive tool for assessing ecosystem health, anthropogenic impact and responses to climate change. We recently launched a multi-disciplinary project to develop a marine spatial plan (MSP) for Algoa Bay to inform South Africa's new MSP process. The first objective is to produce a bioregional plan. This requires fundamental knowledge of the extent and distribution of biodiversity, the ecosystem processes that sustain this biodiversity and the anthropogenic factors that impact ecosystem functioning. Algoa Bay is influenced by oceanographic features including warm subtropical waters from the Agulhas Current, upwelling of cool, nutrient-rich bottom waters and significant nutrient-rich freshwater inflow. In a bottom-up approach, we used next generation sequencing analysis to characterise the pelagic and benthic bacterial and phytoplankton communities of the Bay, including the Sundays and Swartkops estuaries. The data provide insight into macro- and mesoscale variability that reflect the complexity of freshwater and marine influences and anthropogenic impact with important implications for the development of a bioregional plan for the Algoa Bay system.

10:30 - Using biological traits to develop an ecosystem condition assessment of rocky reefs in the Natal bioregion of South Africa

Ms. Kaylee Smit[1], Prof. Amanda Lombard[1], Dr. Anthony Bernard[2], Dr. Kerry Sink[3]

[1]Nelson Mandela University, [2]South African Institute of Aquatic Biodiversity, [3]South African National Biodiversity Institute

To promote ecosystem-based approaches to marine spatial planning (MSP), we need to be able to measure the ecological condition of marine systems. This requires that we use credible and defensible indicators for ecosystem condition assessments. South Africa lacks a data-derived approach to assess the condition of marine ecosystems. It is extremely challenging to collect ecological data from multiple

ecosystem components at a national scale with such diversity of biota, habitat types and complex physical environments. In order to ground truth current estimated condition assessments, and to identify indicators that can be used for ecosystem condition assessments, this project aims to determine the effectiveness of a trait-based approach to measure ecosystem condition of rocky reef habitats. We used demersal fish and benthic invertebrate community data to identify and test key indicators of condition, and to develop quantitative indices that can be used to spatially assess the condition of rocky reef ecosystems. We also measured the effects of multiple anthropogenic pressures on ecosystem structure and function. Preliminary results highlight the differences in fish functional structure between protected and exploited reef sites, emphasising which functional traits and indices are indicative of reefs in good ecological condition. Furthermore, this study models the response of various taxonomic and functional indices to a gradient of cumulative anthropogenic pressures, to determine the main drivers of rocky reef structure and function. This is the first step to establishing a standardised method to assess the condition of marine ecosystems in South Africa using an ecological data-derived approach.

10:45 - Low-cost fishing exclusions improves penguin conservation in Africa

Dr. Lorien Pichergu[1], Dr. Alistair Mcinnes[1], Ms. Tayla Ginsburg[1], Ms. Gwendoline Traisnel[1], Mr. Reason Nyengera[2], Prof. Peter Ryan[3]

[1]Nelson Mandela University, [2]BirdLife South Africa, [3]University of Cape Town

No-take zones can be important tools within an ecosystem-based approach to achieve sustainable fishing and re-establish ecosystem integrity. However, the potential benefits of these exclusion zones for vagile species such as small pelagic fish and top predators remain questionable. In South Africa, the population of the endemic African penguin Spheniscus demersus has halved since 2004. They predominantly feed on sardines and anchovies which are also the target species of the purse-seine commercial fishery. Since 2008, a 20 km radius experimental purse-seine fishing exclusion has been initiated around two pairs of penguin colonies with alternating closure regimes in three-year cycles. Here, we report results of the experiment around two of the largest African penguin colonies, Bird and St Croix islands in Algoa Bay, currently supporting over half of the global population. Between 2012 and 2017 we collected information on the birds' foraging performance and reproductive success and the acoustically-determined relative abundance of pelagic fish around their colonies. We related these to fishing exclusion patterns and size of catches in the bay, while controlling for monthly environmental conditions. In parallel, we compared fishing patterns (locations, landings) during and outside closures to estimate the potential socio-economic cost to the industry. Our results show that while costs to the fishing industry remained relatively low, fishing exclusions largely benefited penguins in terms of breeding success and foraging performance. Results of the experiment support the expansion of similar measures to improve the conservation status of African penguins and other predators reliant on small pelagic fish.

11:00 - Spatial management options for marine fisheries in South Africa: a review of legal instruments

Ms. Jodie Reed[1], Prof. Amanda Lombard[1], Dr. Kerry Sink[2]

[1]Nelson Mandela University, [2]South African National Biodiversity Institute

The spatial nature of ecosystems, natural resources and human activities requires that their management should incorporate spatial strategies. This includes fisheries management and, as such, ecosystem-based fisheries management is fundamentally a spatially explicit approach. Numerous benefits of spatial fisheries management have been demonstrated, including conservation benefits as well as increases to fishery yields and profits. In order for South African fisheries management to fully adopt an ecosystem-based approach, the full range of spatial management tools needs to be identified and considered for implementation. We investigated spatial management options by reviewing current legislative tools for spatial management in the ocean. Seven Acts and Bills were reviewed, including the Marine Living Resources Act, the National Environmental Management Act (including Integrated Coastal Management and Marine Protected Areas components), the Mineral and Petroleum Resources Development Act, the Draft Aquaculture Bill and the Marine Spatial Planning Bill. We identified ten spatial legislative tools that may be used to improve place-based management in the ocean, including measures that could be used to implement marine spatial planning. Results showed eight of the legislative tools identified have relevance to fisheries management. Key opportunities to support improved spatial fisheries management were identified by assessing the potential to meet multiple objectives in management of ocean space through implementation of these existing legal instruments in South Africa. The potential to contribute to stock and bycatch management, conflict management and ecosystem interactions were identified for four fisheries as case studies and future research needs and management actions are advanced in this regard.

11:15 - Assessing and Developing sustainable boat-based marine tourism in response to a growing blue economy

Dr. Gwenith Penry[1], Ms. Minke Witteveen[1], Dr. Mark Brown[2], Prof. Amanda Lombard[1]

[1]Nelson Mandela University, [2]Natures Valley Trust

Wildlife tourism is a rapidly growing industry worldwide and provides substantial social and economic benefits to many countries. The industry depends on positive human-wildlife interactions to ensure its long-term sustainability. In order to create or maintain this sustainability, the economic and social benefits of the industry must not outweigh the environmental costs. In the marine environment whale and dolphin watching is the fastest growing tourism sector in the world, creating economic, social and environmental benefits. The South African boat-based whale-watching industry was formalized in 1998 and is globally perceived as one of the most sustainable of its kind worldwide. This is largely due to the early development of permit regulations and operating protocols to minimize disturbance to the target species. However, the efficacy and compliance of these regulations has not been measured. This study will adopt a transdisciplinary approach to assess the current status of and develop sustainable practices for the industry. The objectives are to: measure the behavioural responses of whales and dolphins to vessel approaches; assess the effectiveness of existing guidelines to mitigate potential negative impacts; quantify the direct and indirect economic value of the industry; and determine levels of customer satisfaction in relation to their perceptions and expectations based on marketing of the industry. The overall goal is to develop a sustainable marine tourism sector with minimal impact on the resource that it is dependent on. A systems thinking approach will be adopted for this study using existing system-dynamics modelling tools.

11:30 - Impacts of warming and ocean acidification on the southern Benguela food web and fisheries

Dr. Kelly Ortega-Cisneros[1], Prof. Kevern Cochrane[1], Prof. Elizabeth A. Fulton[2]

[1]Rhodes University, [2]CSIRO

South African marine environments are forecast to experience an increase in sea surface temperature of ~3C and a decrease of ~0.3 pH units by the end of the century. Sensitivity to acidification is intensified when taxa are simultaneously exposed to increased seawater temperature. The warming and acidification forecast for South Africa can be expected to have detrimental effects on a number of species and potentially on the ecosystem as a whole. The effects of acidification and warming were evaluated for the southern Benguela system using climate projections of temperature and pH derived from the NEMO-MEDUSA 2.0 model under the RCP 2.6 and 8.5 emission scenarios. In the simulations, because of limited information, acidification is assumed to affect only the mortality of plankton, squid and macrobenthos. Of the drivers examined in this study, warming had the greatest effect on species biomass and the effect was mainly negative. The magnitude of the effects of warming were stronger under the RCP 8.5 than under the 2.6 emission scenario. Our results suggest that the southern Benguela system is likely to experience substantial changes in the abundance of some species important to the region's fisheries as a result of climate change. Future planning for fisheries needs to account for these changes including management measures that strive to maintain the resilience of key species and the system as a whole. Our results reinforce the importance of including consideration of the indirect and combined impacts of climate change and fishing in management and planning.

11:45 - Applying a system-dynamics approach to support marine spatial planning in Algoa Bay, South Africa

Ms. Estee Vermeulen[1], Prof. Amanda Lombard[1], Prof. Ursula Scharler[2], Dr. Louis Celliers[3]

[1]Nelson Mandela University, [2]University of KwaZulu Natal, [3]Climate Service Center Germany (GERICS)

The recent introduction of marine spatial planning (MSP) legislation in South Africa (SA) provides an opportunity to learn from global and local history, data and experience, and to make sensible, equitable decisions about the future management of SA's marine environment. To date, a feasible method for translating this attractive concept into operational management practice in SA has not yet emerged, thus creating a niche to develop practical tools to make the MSP process more tangible. The Algoa Bay project aims to develop a local-scale marine spatial plan that will inform the development of plans for larger areas within SA's national MSP process. The biophysical, socio-economic and legal systems within Algoa Bay are complex. MSP typically requires a thorough analysis of legal frameworks and human and environmental requirements. This study will test the feasibility of using a system-dynamics approach to model the interactions within the complex marine environment in Algoa Bay. The first stage of the study will focus on the environmental assessment through the development of a biophysical system-dynamics model, using available data, spanning all habitats, physical oceanographic processes and levels of biodiversity. Once spatially explicit socio-economic data becomes available in the second stage of the study, the model will integrate the new data to quantify and evaluate trade-offs between human and environmental needs. The objective of the model is to provide an interactive decision-support tool for stakeholders and decision makers to evaluate the outcomes of different management strategies, under global change scenarios, to inform ecosystem-based marine policy development.

S-79: From science to evidence - innovative uses of biodiversity indicators for effective marine policy and conservation (10:00 - 12:00, Tubau 2-3)

10:00 - 'How do we tell policy-makers that marine biodiversity is "on target" or "missing the mark"?'

Dr. Ian Mitchell[1]

[1]Joint Nature Conservation Committee

This presentation will focus on one of the main driving goals for policy on marine biodiversity in Europe: "Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions." - as required under the European Union's Marine Strategy Framework Directive. The complexity of marine biodiversity, our limited knowledge on the linkages between human pressure and environmental impacts and the lack of comprehensive data for many components, make it extremely challenging to set objectives and then assess progress towards them.

I will describe how science and policy have had to rapidly evolve in order to deliver a series of indicators and targets that will help policy leaders to better assess progress towards the goal described above. This has involved scientists and policy makers from different countries working together to assess the state of biodiversity and our impacts on it at an ecosystem scale that crosses national borders. I will provide examples of how we have translated long-term observations on marine birds, mammals, fish and benthic habitats into international indicators and how we have set baselines and targets to assess the status of these indicators.

The work described in this presentation has been undertaken by the OSPAR Commission - the mechanism by which 15 Governments and the European Union cooperate to protect the marine environment of the North-East Atlantic. Full results of the OSPAR biodiversity assessments are available at https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/biodiversity-status.

10:15 - Integrating biodiversity indicators and decision triggers into conservation management

Dr. Prue Addison[1]

[1]Oxford University

Biodiversity indicators assessed against decision triggers or management thresholds can assist conservation practitioners in making difficult decisions about when to intervene in marine systems to address undesirable changes. Biodiversity indicators should reflect management objective(s) set by a responsible management agency, that show a quantifiable and measurable relationship with a desired ecosystem state. Decision triggers can represent a point or zone in the status of an indicator, which shows when management intervention is required to address undesirable ecosystem changes. Decision triggers can be derived using expert judgement, statistical or multi-objective models; but all varieties of biodiversity indicators and decision triggers rely on an overarching process to guide robust indicator and trigger development. A process recommended to develop biodiversity indicators and decision triggers is structured decision-making. The development of biodiversity indicators and decision triggers following the steps of structured decision-making is illustrated using examples from marine protected areas in Victoria, Australia. These case studies illustrate the application of a decision triggers approach in data-rich and

data-poor contexts, with single or multiple management objectives. The relevance of structured decision-making and the decision triggers approach will be discussed in relation to progressing evidence-based management of marine biodiversity beyond the public sector. Particularly in light of international biodiversity strategies, like the Convention for Biological Diversity, and the push to mainstream biodiversity in the private sector. This means that similar approaches can and should be developed to help integrate biodiversity into business decision-making.

10:30 - MarClim: Marine biodiversity and climate change indicators for policy.

Dr. Nova Mieszkowska[1], Prof. Michael Burrows[2], Prof. Steve Hawkins[1]

[1]Marine Biological Association of the UK, [2]The Scottish Association for Marine Science

Data on the abundance and distribution of rocky intertidal invertebrates and macroalgae around UK coastlines has been collected by the Marine Biological Association since the 1950s. In 2001 these datasets were brought together and restarted under the MarClim project, which currently surveys 100 time-series sites annually. MarClim has shown some of the fastest biogeographic range shifts in response to climate change in any natural system, echoing changes recorded in plankton and fish communities in UK regional seas. MarClim is funded by UK Country Nature Conservation Bodies and forms part of their statutory monitoring objectives as an indicator of climate change impacts. MarClim has been developed as Good Environmental Status indicators for the EU Marine Strategy Framework Directive using the Community Temperature Index indicator.

10:45 - Plankton as prevailing conditions: a surveillance role for plankton indicators within ecosystem-based management

Mr. Jacob Bedford[1], Mr. David Johns[2], Dr. Abigail McQuatters-Gollop[1]

[1]Plymouth University, [2]Sir Alister Hardy Foundation for Ocean Science

Indicators are used to monitor changes in the state of marine ecosystems. For example, an indicator approach to ecosystem assessment is adopted by the EU Marine Strategy Framework Directive (MSFD), where indicators of ecosystem state are assessed as to whether they are in 'Good Environmental Status' relative to prevailing oceanographic conditions. Here we use examples from the literature to illustrate that climate-driven plankton community changes are necessary prevailing conditions that need to be understood for more effective ecosystem assessment, and are therefore useful as surveillance indicators. Plankton indicator surveillance could provide useful diagnostic information for assessing ecosystem status, both within plankton communities and other biodiversity components. It also has the potential to have a more strategic role in the assessment of other biodiversity components by affecting targets and influencing the programmes of measures needed to achieve them. Plankton indicators can therefore have multiple roles with ecosystem-based marine management frameworks such as the MSFD; both the detection of direct anthropogenic pressures, and the surveillance of underlying environmental change.

11:00 - Fishing for food in a warm and acidic ocean requires adaptive size-based policy targets

time

Dr. Christopher Lynam[1]

[1]Cefas Body-size indicators are used worldwide in research that supports the management of commercially exploited wild fish populations, because of their responsiveness to fishing pressure. Observational and experimental data, however, have highlighted the deeply-rooted links between fish size and environmental conditions, that can drive additional, inter-annual changes in these indicators. Here, we have used biogeochemical and mechanistic niche modelling of commercially exploited demersal fish species to project time-series to the end of the 21st century for one such indicator, the Large Fish Indicator, under global CO2 emissions scenarios. Our modelling results, validated against survey data, suggest that its previously proposed policy target may be unachievable under future climate change. In turn, our results help to identify what may be achievable policy targets for demersal fish communities experiencing climate change. Whilst fisheries modelling has grown as a science, climate change modelling is seldom used specifically to address policy aims. Studies such as this one can, however, enable a more sustainable exploitation of marine food resources under changes unmanageable by fisheries control. Indeed, such studies can be used to aid resilient policy target-setting by taking into account climate-driven effects on fish community size-structure

---

11:15 - Indicator to assess the extent of physical damage on benthic habitats

time

Dr. Cristina vina-herbon[1], Ms. Bryony Meakins[1]

[1]Joint Nature Conservation Committee We present an indicator that enables the assessment of the extent of damage to benthic habitats caused by human activities, even when we have little habitat monitoring data available. In the North East Atlantic, the impact of bottom trawling on the seafloor is the most widespread physical impact, although other activities are equally or more intense, they are also spatially more limited. However, assessing the effects of those impacts at large scale, without compromising the quality of the results or downgrading the evidence available at local scale, is very challenging. A key issue to address on large scale assessments is the lack of extensive habitat data from monitoring and gaps on our knowledge on the state-pressure-impacts relationships, with data being collected only at a handful of sites or experimental areas. To address these shortcomings the indicator uses a method to combine data on the spatial distribution and intensity of activities with the distribution and range of habitat sensitivities using a GIS spatial analysis models. The indicator structure provides a framework where different type of biological data can be included, from point species data to large habitat models of broadscale habitats. The flexibility of this framework also allows the incorporation of new data or additional variables in the future, therefore ensuring the indicator can be updated when new evidence becomes available.

11:30 - Recent advances in indicator development and performance validation for ecosystem-based management

Dr. Saskia Otto[1]

[1]University of Hamburg

Because of the general definition of the term 'indicator' as well as its broad applicability, misunderstandings of the function of an indicator are inevitable. For instance, indicators are an increasingly used tool to define the status of an associated (but non-measurable) variable or to identify changes in a system or system component. Indicators can also be used for providing signals prior or after trending or oscillating changes and for reflecting a system process itself or the impact of this process on the system. In conservation and ecosystem-based management a key role of an indicator is to inform on the effectiveness of specific management measures as required by legal frameworks such as the European Marine Strategy Framework Directive (MSFD). However, linking indicators to management measures requires a good understanding of the indicator responses to pressures and a sound testing of the indicator performance, which is often lacking. But recent advances in quantitative frameworks and software tools allow now the evaluation of the indicators suitability for specific management objectives. This study will provide an overview of indicator usages and developments in marine conservation based on a systematic literature review and introduce a new R package (INDperform) for testing indicator performances. The package will be demonstrated on a European cross-comparison of zooplankton metrics as ecosystem state indicators for ecosystem-based management.

11:45 - From evidence to policy: developing pelagic biodiversity indicators for marine conservation

Dr. Abigail McQuatters-Gollop[1]
[1]*Plymouth University*

Ecological time-series data are essential for informing management and policy, particularly in supporting the new generation of marine legislative drivers, which take a holistic ecosystem approach to management. In Europe, for example, the Marine Strategy Framework Directive (MSFD) seeks to achieve Good Environmental Status (GES) of European seas through the implementation of such a management approach. From a pelagic habitats perspective, regional scale management approaches such as the MSFD must recognise the importance of plankton communities in marine ecosystems; ecological data at the appropriate spatial, temporal and taxonomic scales are therefore required for implementation. At the base of the marine food web, plankton time-series play an important role in delivering good environmental status through the development and informing of biodiversity indicators, the setting of targets against a background of climate change and the provision of supporting information used to interpret change in non-plankton indicators. Efforts must be made to preserve long-term ecological time series, which supply vital ecological information used to inform evidence-based environmental policy.

Social Science Working Group (SSWG) Business Meeting

12:00 - 13:30, Kabu

Focus Group: Overcoming ethical challenges in marine conservation communication (13:30 - 15:30, Kabu

Mr. Md. Kutub Uddin[1]
[1]*Save Our Sea Trust*

Communications and Public Relations are getting rapidly increasing attention and allocation of resources within marine conservation organizations. But Mainstream Media (MSM) is struggling with either huge lack of institutional capacity or editorial priority to cover related affairs as part of regular news agenda. In many cases, high resource needs to operate in remote marine areas and the novelty of the subjects to the newsroom are related to this scenario. This dynamic is making way for 'embedded' journalism covering conservation efforts without clearly laid-out ethical safeguards on both sides. I've observed many such cases in Bangladesh, Thailand, Singapore, and the USA, where MSM is being engaged to disseminate contents while being directly or indirectly guided and sponsored by the subjects, that is nature conservation and conservation groups, but this kind of communication and PR contents are not the replacement for objective journalism. This practice consequently deprives the nature conservation of objective reporting and critical coverage which are cornerstones for transparency, accountability and public trust. A strong, responsive and dynamic ethical regime is imperative to address this challenge.

The Focus Group is designed to gather information about ethical challenges faced in marine conservation communication, identify key values and ethics, and prepare a draft for an ethical guideline. Before the conference, the host and other contributors will prepare a working-paper and distribute among the registered participants for their feedback and inputs.

13:30 - Bouncing Boulders and Buoyant Seaweeds: developing indicators to tease human from natural disturbance on rocky intertidal shores

Mrs. Elisabeth Morris-Webb[1], Dr. Martin Austin[1], Mr. Tim D'urban Jackson[1], Mr. Guy Walker-Springett[1], Mr. Harry Goudge[2], Prof. Michel Kaiser[1], Dr. Freya St John[1], Prof. Stuart Jenkins[1]
[1]*Bangor University,* [2]*Marine Ecological Solutions Ltd.*

Impacts of unregulated activities within Marine Protected Areas (MPAs) may undermine the objectives for which the MPAs were instigated. UK governments have started investigating these impacts within their MPA network but gathering evidence of unregulated activities is particularly problematic when the activities have persisted prior and subsequent to MPA designation. The current research aims to develop a simple indicator of human impacts within protected areas. The 'tool' builds on previous monitoring trials that sought to monitor human impact whilst avoiding the need for surveillance of beach users within a Special Area of Conservation (SAC). Most disturbance of algal dominated boulder communities on sheltered, tide swept shores is assumed to be anthropogenic. Rocks are disturbed whilst collecting animals for food, bait or for recreational interest. If rocks are replaced in the wrong position their diverse under-boulder communities dry out and algae become trapped under the rock, creating an anoxic environment instead of a sheltered refuge for a variety of mobile species. This research uses novel accelerometer technology to differentiate between natural and anthropogenic disturbance. Counter to expectations, the presence of large algae causes drag on rocks that is sufficient to displace them. This unexplored form of natural disturbance on sheltered shores could become more prolific with increasing storm frequency and severity. Policy makers and site managers must consider all sources of disturbance in a protected area, including from currently unregulated activities. A human disturbance indicator on suitable shores may reduce the risk of mistakenly attributing all disturbance to anthropogenic activities.

Focus Group: From science to evidence - innovative uses of biodiversity indicators for effective marine policy and conservation (13:30 - 15:30, Tubau 2-3)

Dr. Abigail McQuatters-Gollop[1], Dr. Ian Mitchell[2], Dr. Saskia Otto[3]

[1]*Plymouth University,* [2]*Joint Nature Conservation Committee,* [3]*University of Hamburg*

Indicators are effective tools for summarising and communicating key aspects of ecosystem state and have a long record of use in marine pollution and fisheries management. Application of biodiversity indicators to assess the status of species, habitats, and functional diversity in marine conservation and policy, however, is rapidly developing and multiple indicator roles and features are emerging. For example, some operational biodiversity indicators trigger management action when a threshold is reached, while others play an interpretive, or surveillance, role in informing management. Additionally, links between pressures and biodiversity indicators may be unclear or obscured by environmental change. Finally, much practical work on applying biodiversity indicators to marine policy is developing rapidly in the management realm, with a lag before academic publication. Making best use of biodiversity indicators depends on sharing and synthesising cutting-edge knowledge and experiences. This session will provide examples of biodiversity indicator application in policy and conservation followed by a discussion of common themes and challenges. Presenters will describe a diverse range of applied case study uses of biodiversity indicators. Diversity and inclusivity are key to aggregating the widest-ranging collection of experiences and examples and we specifically encourage abstract applications from workers from Eastern regions and from developing countries. The session will conclude with a discussion addressing the question 'How can we move forward with biodiversity indicator use in marine policy and conservation?' This overarching question will be further discussed in the associated focus group session, with the objective of publishing a scientific paper on the topic.

OS-8A: Communicating Marine Conservation 2 (13:30 - 15:30, FJ Auditorium)

13:30 - Financing Seychelles' Marine Protected Areas

Mr Andrew Rylance[1], Mr. Daig Romain[1]

[1]*Programme Coordination Unit, Ministry of Environment, Energy and Climate Change*

The Seychelles is recognized as a biodiversity hotspot its Protected Areas (PAs) act as banks for preserving nature for future generations. The presentation highlights the analysis and activities of a Government of Seychelles-UNDP-GEF project on Protected Area Finance, aimed to strengthen the financial sustainability and strategic cohesive of its marine protected area system. The research primarily provides an analysis and impact of the first national-level Sustainable Financing Plan for Protected Areas (PAs) in Seychelles calculated that the current financing available for PA management equates to USD 5 million. However, this is below the target of USD 8.7 million annually to meet their basic management needs or USD 11.8 million annually to enable optimal management (Rylance &a Barois, 2016). Further, as the Marine Spatial Planning process, underway in Seychelles, aims to expand its PA system to cover up to 30% of its Exclusive Economic Zone (EEZ), financing becomes an even more important task. Secondly, it outlines the significant changes in the Government's Seychelles National Parks Authority which have enabled it to retain its revenue, strengthen and diversify its income streams in order to improve its conservation effectiveness. Finally, the presentation highlights the lessons for other national-level PA systems on how the application of economic analysis, financial planning and business development contribute to improved conservation management.

13:45 - Exploring mangroves of the Manukau, New Zealand; the secret lives of animals

Ms. Amrit Dencer-Brown[1]

[1]*Auckland University of Technology*

Accelerated seaward growth of the mangrove Avicennia marina subsp. australasica over the last century has altered the ecology of estuarine and coastal ecosystems throughout North Island, New Zealand. Expansion has created a myriad of real and perceived social-ecological issues regarding the future of the local communities who live in these areas and potential impacts to New Zealand biodiversity. As a result, there have been many applications submitted to regional councils for their removal. However, the social-ecological issues and related impacts are not yet well understood and there are significant knowledge gaps. Further research is necessary for making informed and evidence-based decision-making around the removal and preservation of these mangrove systems. Whilst there has been a strong effort to quantify benthic community compositional change following mangrove establishment and subsequent removal, there is a lack of long-term monitoring of other groups of organisms, particularly terrestrial vertebrate and invertebrate species. This research presents the findings of integrated biodiversity surveys collected at four sites in mangroves of Manukau Harbour (March-Apr 2018). A range of different non-invasive techniques were employed to record presence/absence data of reptiles, mammals, fish and birds utilising mangroves. These integrated assessments are the first of their kind in New Zealand mangroves and will provide valuable insights into species present and differences between and within sites. It will also provide information regarding ecosystem function and health of degraded and fragmented mangroves. The results of these assessments could be implemented in policy for both national and international mangrove biodiversity monitoring.

14:00 - Content analysis of shark conservation media coverage suggests bias contributing to public misunderstanding

Dr. David Shiffman[1]

[1]*Simon Fraser University*

harks are some of the most threatened vertebrates on Earth, and the scientific and environmental communities disagree on the best solutions (aim for sustainable fisheries management vs. aim for banning all fisheries and trade, respectively). Mainstream media coverage of environmental topics is a primary mechanism by which concerned non-expert citizens learn about these issues. A content and discourse analysis of media coverage of shark conservation issues was performed, focusing on approximately 3,000 mainstream media articles from 2008-2017. Results show a bias in the framing and topic of media coverage in favor of banning all fisheries and trade, along with numerous examples of factual inaccuracy in coverage of related topics. This may be a contributor to large-scale public misunderstanding about shark conservation and management policy, with important implications for policymaking.

14:15 - Making Citizen Science Data Actionable: Leveraging Mobile Technology To Inform Mariner Situational Awareness: Connecting Managers and Maritime Industry

Mr. Jacob Levenson[1], Mr. Virgil Zetterlind[2], Mr. Jason Holmberg[3], Dr. Shane Gero[4]

[1]U.S. Department of Interior, Bureau of Ocean Energy Management, [2]Conserve.IO, ProtectedSeas, [3]Wildme, [4]Aarhus University

Scientists, resource managers, and conservationists face an ever-present challenge of collecting substantial data of sufficient rigor that it can be used to inform management. Mobile apps offer a unique opportunity to leverage everyday citizens to collect important ecosystem information while providing managers the opportunity to disseminate management information via the same app to improve situational awareness of regulations and potential hazards in near real-time. The Whale Alert app and effort-based companion Spotter Pro have been in active use since 2015. Focused specifically on North American Cetaceans, the platform has undergone numerous iterations to make it more responsive to both the public and management user groups. Based on these lessons learned, a new tool combines citizen science with dynamic ocean management. Known as Ocean Alert, this tool is under development to expand the concept of two-way communication between managers, industry, and the public via a singular app that covers a extensive set of marine megafauna, navigation hazards, and other areas of concern. Using 'smart' forms, Ocean Alert will self-configure to a user's location and interests for reporting citizen sightings as well as displaying overlays with associated restrictions of permanent and dynamic management areas. Ocean Alert will also directly support effort-based surveys by more savvy users. To ensure maximum data value, Ocean Alert will automatically connect sightings to existing scientific networks that conduct photo ID. After validation, sightings are archived in a central standards-based repositories, such as OBIS enabling long term use in environmental impact assessment.

14:30 - Touching hearts, reaching minds - Galvanising public action to support a marine protected area under threat

Dr. Judy Mann[1], Dr. Bruce Mann[2], Prof. George Branch[3], Dr. Jean Harris[4], Prof. Amanda Lombard[5]

[1]SAAMBR, [2]Oceanographic Research Institute, [3]University of Cape Town, [4]WILDOCEANS, [5]Nelson Mandela University

In 2007 and 2010 proposals were made to open the Tsitsikamma National Park (TNP), South Africa's oldest Marine Protected Area (MPA), to recreational fishing for adjacent communities. In both cases the Environment Ministers followed scientific advice and decided that, as the marine resources of Tsitsikamma were a national asset, opening the reserve would provide short term benefits to relatively few people - but to the detriment of local communities and the people of South Africa. However in 2015, 20% of the TNP was opened to recreational shore fishing. This was done without sufficient prior public consultation and did not follow due legal process. This action led to the formation of the Friends of Tsitsikamma, a small group determined that this disregard for due process should not go unchallenged. The group, initially made up of scientists, embarked on a legal route to challenge the decision. However, it was recognised that there was an urgent need for a public awareness campaign to highlight the issue. This led to the realisation that most South Africans are oblivious to the existence of MPAs and their value to people. This paper will describe the communication campaign that resulted in over 700 personal letters being written to oppose the opening. These were written largely by people who had been sensitised to the value of MPAs though the campaign. Lessons learnt on the best methods and messages to engage citizens in conservation action will be addressed, as will lessons learnt on addressing conflict in marine resource management.

14:45 - Extending The Impact - Citizen Science As An Entry Point For Marine Citizenship

Dr. Angela Dean[1], Ms. Jennifer Loder[2], Ms. Emma Church[3], Dr. Kelly Fielding[1], Prof. Kerrie Wilson[1]

[1]The University of Queensland, [2]Reef Citizen Science Alliance, [3]Monash University

Citizen science enables community involvement in research. In addition to generating data about marine ecosystems, many marine citizen science programs aim to foster marine citizenship. Citizen science events may provide entry points for marine citizenship, but there are little data available to inform how to communicate about, and design citizen science experiences to maximize engagement.

Study 1. Promoting citizen science events. We examined whether messages about citizen science increases intentions to engage in citizen science, using a representative community sample. Participants randomly received either (i) a message about local marine citizen science or (ii) a control message. Most participants had not heard of citizen science (89.8%). Providing information about citizen science led to an increase in: likelihood of attending a citizen science event, seeking information, and willingness to share information with others, but that these effects were only observed in political liberals. These findings suggest that effectiveness of typical messages about marine citizen science may be limited to those with shared values.

Study 2. Impact of citizen science events. We surveyed individuals after attending one of seventeen ReefBlitz events. Half of participants (51%) reported intentions to adopt a new conservation behavior. Key elements of the citizen science experience associated with new behavioural intentions were learning about actions (procedural learning), and experiencing negative emotions about environmental problems. Importantly, factual learning was associated with reduced behavioural intentions. When designing citizen science programs, these findings suggest highlighting environmental impacts while providing meaningful experiences and building stewardship skills, to maximize marine citizenship outcomes.

15:00 - Training citizen scientists in science communication to create Reef Ambassadors

Ms. Jennifer Loder[1], Dr. Angela Dean[2], Dr. Merryn Mckinnon[3]

[1]Reef Check Australia, [2]The University of Queensland, [3]Australian National University

Reef Check Australia (RCA) has coordinated and trained citizen scientists to undertake reef health surveys across Queensland for over 15 years. However, research shows that citizen science participants may not represent the broader population. This raises the question of how to extend the impact of marine citizen science across the broader community. Between 2015 and 2018, RCA recruited and trained 37 Reef Ambassadors. Ambassador training included workshops on reef science, science communication and event management. After completion, the Ambassadors are invited to coordinate or contribute to community outreach events to promote awareness, stewardship opportunities, and RCA's work. Evaluation of the Reef Ambassador program utilised both quantitative surveys and qualitative interviews, to examine the impact of training and participation in the program, describe models of 'successful outcomes', and identify program elements most associated successful outcomes. Most frequently cited motivations for participating included getting involved in conservation (97%), work experience and career development (77%) and meeting people (59%). Ambassadors have engaged 7,500 people at 60 events. Preliminary qualitative analysis suggest that knowledge

acquisition throughout training generated greater Ambassador confidence, and that using a citizen science framework provided greater opportunities to connect with broader audiences. One training need identified related to dealing with issues subject to polarized debates, such as dealing climate change denial. Ambassador-led initiatives have prompted program revisions, to incorporate project planning and behaviour change modules in 2018. This co-development approach is fostering a new framework for how RCA empowers volunteers and the community to engage in reef health issues.

OS-8B: Conservation and Management 5 (13:30 - 15:30, FJ Event Hall)

13:30 - Coral Reef Socio-Ecological Systems Restoration

Mrs. Natalia Uribe-Castañeda[1], Ms. Alice Newton[1], Prof. Martin Letissier[2]

[1]Universidade de Algarve, [2]University of Cork

Coral reef analysis and restoration strategies should be based on socio-ecological system assessments that provide key information about establishing future interventions and strategies for practitioners, program monitoring and evaluation efforts. To support this integration, it is necessary to develop conceptual frameworks that allow us to understand coral reef socio-ecological systems and its restoration. This research focuses on developing frameworks that help to analyze a coral reef socio-ecological system and to develop a successful and holistic coral reef socio-ecological restoration initiative. The Ostrom Framework for analyzing socio-ecological systems and the Kittinger human dimensions' framework of coral reefs socio-ecological systems were coupled to construct one framework to analyze the subsystems, the interactions, and the outcomes of a coral reef socio-ecological systems framework. The most cited and commonly used research papers and guidelines regarding coral reef restoration were checked and utilized to construct a coral reef socio-ecological system restoration framework. Both frameworks can potentially be used as a guide for managers, researchers and decision-makers to analyze a coral reef socio-ecological system and for developing a successful restoration initiative, which includes the basic social and ecological criteria for designing, implementing and monitoring a successful initiative from a holistic approach.

13:45 - Does the protection afforded by a large no-take Marine Protected Area provide any resistance to coral bleaching and/or subsequent mortality?

Dr. Catherine Head[1], Dr. Dominic Andradi-Brown[2], Mr. Daniel Bayley[3], Prof. Alex Rogers[1]

[1]University of Oxford, [2]WWF and University of Oxford, [3]Natural History Museum, London

During 2015-2016 the Chagos Archipelago (central Indian Ocean) was subject to prolonged increases in sea surface temperatures (SSTs) above the regional bleaching threshold of -30.9C from late-March to mid-May for two consecutive years. Here we begin by presenting the extent and spatial heterogeneity of bleaching induced by these high SSTs, and the resulting mortality across the Archipelago. The Chagos Archipelago's reefs have proven resilient to climate change impacts in the past, recovering from heavy coral mortality following the 1998 bleaching event. This resilience is partly attributed to the lack of direct human stressors on the reefs, including an absence of reef fisheries, afforded by the uninhabited and remote nature of the Archipelago. Since 2010 the Archipelago has been a no-take MPA, however, whether the MPA and the area's uninhabited nature provides a degree of resistance to bleaching and/or potential mortality has not been tested until now. The second half of our presentation will focus on comparing the bleaching responses within the Chagos MPA to other remote, but unprotected, western Indian Ocean locations. This enables us to disentangle the effects of the Chagos MPA on coral bleaching from any effects caused by remoteness.

14:00 - Fungal Infection in Green Sea turtle, Chelonia mydas, Eggs and nest soil at Setiu and Chagar Hutang, Malaysia

Dr. Abdulmula Hamza[1], Mr. Pavithran Purushothaman[2]

[1]University Malaysia Terengganu, [2]Universiti Malaysia Terengganu

Green turtles Chelonia mydas is a breeding species of sea turtles in Malaysia. Fungal infections pose serious threat to eggs and nest productivity. Limited surveys were conducted in Malaysia to study the relationship between fungal infection and types of incubation practices. This research was conducted at both Penarik Turtle Hatchery, Setiu (ex-situ incubation site) and Chagar Hutang, Redang Island (in-situ incubation site) to identify and compare number of fungal species present in green turtle nests (egg shells and soil), and to relate infection to hatching success. Fungi from both eggshell and sand samples were cultured separately in Potato Dextrose Agar (PDA). Once pure fungal colonies were obtained, slides were prepared for microscopic morphological analysis. Four species of fungi were isolated from both sites which were, Aspergillus niger, Fusarium sp., Aspergillus sp., and Penicillium sp. An additional unidentified species was also found among slides of Aspergillus niger. The most dominant species of fungi in both sites were Aspergillus niger. A Spearman correlation test between number of fungal species and hatching success showed negative correlation between these variables in Setiu but not at Chagar Hutang. This shows that in an in-situ incubation site (Chagar Hutang), the number of isolated fungal species had no effect on hatching success, while at an ex-situ incubation site (Setiu) a higher number of isolated fungi resulted in lower hatching success. Handling of eggs by rangers in Setiu may contribute to additional fungal species there.

14:15 - Population structure and connectivity of green turtles (Chelonia mydas) in Southeast Asia

Dr. Juanita Joseph[1], Dr. Hideaki Nishizawa[2]

[1]Borneo Marine Research Institute, UNIVERSITY MALAYSIA SABAH, [2]Graduate School of Informatics, Kyoto University

Genetic diversity, migratory routes and genetic connectivity are essential for conservation of endangered animals. Previous genetic data of green turtles (Chelonia mydas) in Southeast Asia were incomplete due to limited samples, and were obtained only from nesting rookeries. In this study, we compared the genetic relationships among and between rookeries, and foraging grounds of green turtles in Southeast Asia. Mitochondrial DNA control region sequences of 511 turtles from 11 rookeries (Malaysia and Vietnam), in combination with previously reported Indo-Pacific rookeries, indicated the presence of a genetic barrier in the Torres Strait and Celebes Sea. Mitochondrial DNA region was also determined in 149 green turtles from seven foraging sites in Malaysia. Bayesian mixed stock analyses indicated contemporary movement across this historical genetic barrier, from Micronesian rookeries to foraging grounds in the Celebes Sea (i.e. Sipadan Island and Tun Sakaran Marine Park). Isolation by distance was generally supported for relationships among rookeries, and the

high migratory connectivity did not result in a lower genetic distance between rookeries. Differences between rookery connectivity and migratory connectivity in green turtles in Southeast Asia are likely due to migration to natal regions after long-distance movement.

14:30 - Putting the Coral Back Into 'Coral Reef Restoration': Proactive Coral Mitigation in Hawaii.

Mr David Gulko[1], Ms. Laura Del Rio Torres[1], Dr. Norton Chan[1], Ms. Chelsea Wolke[1]
[1]*Hawaii Division of Aquatic Resources*

The State of Hawaii has recently implemented an innovative program which combines collection of small live coral colonies from within Hawaii's public harbors; placing them into the State's land-based Coral Restoration Nursery where they are fast-grown using aquarium husbandry techniques into large-sized colonies in a fraction of the time it would take to occur naturally. The resulting large colony modules are then placed onto degraded natural Hawaiian coral reefs in an effort to restore these reefs back towards their earlier ecologically-complex state. The outplanted colonies are evaluated using the State's Coral Ecological Services and Functions Tool and the resulting offset can be used by developers and Responsible Parties to pay for coral and habitat loss incurred elsewhere in Hawaii. The result is a dynamic program to put out large, live coral colonies, paid for without large expenditures of public monies, and without the extremely long natural recovery rates for large corals normally seen in Hawaii. The program is now expanding to focus on extremely rare coral species to re-introduce them back into the wild using similar mechanisms.

14:45 - Significant sea turtle nesting populations under intense anthropogenic pressure in Northern Madagascar

Mr. Chris Poonian[1], Ms. Lalarisoa Rakotoarimino[2]
[1]*Community Centred Conservation (C3),* [2]*C3 Madagascar*

Centuries of human exploitation have resulted in severe declines and localized extinctions of sea turtles in Madagascar. However, the rich foraging habitats and beaches of the remote northern coast are believed to support regionally and potentially globally significant nesting populations. Between 2012 and 2018 we conducted track counts, key informant interviews of local fishers and nightly beach monitoring surveys in five key biodiversity areas. We found significant nesting populations of green turtles and smaller numbers of hawksbills as well as occasional olive ridleys and loggerheads. However, turtles were intensely exploited by humans at all nesting sites. Turtles were primarily hunted to provide meat for local consumption, offering an alternative source of protein to more costly zebu meat. Turtle bycatch in artisanal fishing nets was also widely reported. Although of secondary importance, there was a significant commercial trade in turtle shells. Local people were found to be knowledgeable about turtle ecology and understood turtle protection legislation. However, they reported a lack of enforcement of relevant laws, particularly in areas outside Nosy Hara Marine Park. Management for turtle conservation must be carefully considered, because in a region where poverty and a lack of alternative livelihoods and food sources are driving local use, excluding local needs is liable to foster resentment towards conservation, undermine conservation efforts and create further difficulties for enforcement. We recommend that areas that combine evidence of high levels of nesting activity and exploitation should be prioritized for management actions in the future, in close collaboration with local resource users

---

15:00 - Evaluating approaches for scaling up community-based marine protected areas into socially equitable and ecologically representative networks

Ms. Alessia Kockel[1], Prof. Natalie Ban[1], Prof. Maycira Costa[1], Prof. Philip Dearden
[1]*University of Victoria*

Marine protected areas (MPAs) are vital to marine conservation, but their coverage is insufficient to address declines in global biodiversity. In response, many countries have committed through the Aichi Target 11 of the Convention of Biological Diversity to conserve 10% of the marine environment through 'ecologically representative' and 'effectively and equitably managed' MPAs by 2020. The rush to fulfill this commitment has raised concerns on how efforts to increase MPA coverage will impact other elements of Target 11, including representation and equity. We used a Philippines case study to assess and compare MPA planning approaches for biodiversity representation and equitable distribution of costs to small-scale fishers. Specifically, we explored three approaches: (1) an opportunistic approach where MPAs were identified and supported by coastal communities, (2) a donor-assisted approach that utilised local knowledge to select MPAs through a national-scale and donor-assisted conservation project, and (3) a systematic conservation planning approach that identified MPA locations to achieve biodiversity objectives with minimal and equitable costs to fishers. The opportunistic approach was ineffective at representing biodiversity and resulted in inequitable costs to fishers. Similarly, MPAs selected through the donor approach disproportionately impacted fishers, but provided near-optimal representation of the study region. With approximately the same MPA coverage, the systematic approach was the only approach that achieved all representation targets with minimal and equitable costs to fishers. Our results demonstrate the utility of systematic conservation planning to address key elements of Target 11, and highlight opportunities and pitfalls for planning MPAs in similar contexts.

S-162: Increasing effective partial protection approaches for tropical marine conservation (13:30 - 15:30, Tubau 1)

13:30 - Increasing effective partial protection approaches for tropical marine conservation

Dr. Dominic Andradi-Brown[1], Ms. Estradivari Estradivari[2], Dr. David Gill[3], Dr. Nils Krueck[4], Dr. Helen Fox[5]
[1]*World Wildlife Fund,* [2]*WWF-Indonesia,* [3]*Conservation International,* [4]*University of Queensland,* [5]*National Geographic*

Establishing effective marine protected areas (MPAs) is a major goal of many marine conservation programs. For example, the CBD Aichi Biodiversity Target 11 commits governments to 'effectively and equitably' manage 10% of global marine and coastal areas in MPAs by 2020, and the World Conservation Congress in September 2016 called for 30% of the oceans to be protected from extractive activities. While many tropical marine conservationists pursue no-take marine protection, in areas with large reef-dependent communities, extensive no-take zones are often incompatible with equitable management. Therefore, increasingly conservationists are implementing spatial and temporal partial protection, with dual aims of conserving reef biodiversity while allowing sustainable extractive fisheries. Approaches can include spatial gear restrictions, periodic harvest closures, and increased local ownership and management rights. However, the effectiveness of partial protection is still untested in many

locations, with variable results depending on whether evaluation is framed around human livelihood or biodiversity gains. For partial protection to contribute 'effectively and equitably' to global coral reef management, a holistic view is required, bringing together an understanding of maintaining reef biodiversity and crucial ecosystem functions, while allowing extractive human uses. In this symposium-framing talk we: (i) evaluate reef fish biomass responses to mixed-use MPAs in comparison to no-take zones and unprotected areas from a large global MPA dataset, (ii) use modelling approaches to estimate protection benefits from different partial protection methods, and (iii) identify key considerations to ensure partial protection approaches can have benefits for both biodiversity and local communities.

13:15 - Effects of marine customary management on coral reef fish biomass

Ms. Estradivari Estradivari[1], Dr. Dominic Andradi-Brown[2], Ms. Amkieltiela Amkieltiela[3], Ms. Ignatia Dyahapsari[1], Mr. Fikri Firmansyah[1], Ms. Christian Novia Handayani[3], Dr. Megan Barnes[4], Ms. Louise Glew[2], Dr. Gabby Ahmadia[2], Mr. Matheus De Nardo[5]

[1]WWF-Indonesia, [2]World Wildlife Fund, [3]WWF Indonesia, [4]University of Hawaii at Manoa, [5]WWF-US

Customary management is a set of cultural systems designed to conserve environmental resources, embedded in the belief systems and traditional practices of local people. In Indonesia, customary management, such as sasi, panglima laot, awig-awig, among others, limit resource use by imposing spatially-explicit fisheries rules. These practices have been carried out for generations, and existed long before conventional marine conservation approaches such as Marine Protected Areas (MPAs) were implemented. Few studies have investigated the effect of customary management on coral reefs and fish biomass in Indonesia, and those that do are restricted to a narrow range of customary management practices. In this study, we explored fish biomass differences between customary closure and fished reefs across a wide spectrum of customary management approaches. We also examine how customary management affects food security among settlements that have customary closed areas or those which do not. We used ecological, social, and governance data from 109 settlements across five regions in the Sunda Banda Seascape, Indonesia. We employed linear mixed-effect models to examine the relationship between customary management practices and both ecological and social outcomes. Our results inform how local knowledge and practices can be applied to support biodiversity conservation and marine protection goals, while still allowing extractive resource use.

13:30 - Catalysing locally-led conservation in Madagascar: from temporary fishery closures to long-term management

Mr. Nick Piludu[1], Mr. Marc Fruitema[1], Dr. Alasdair Harris[1]

[1]Blue Ventures

Declaring areas of ocean permanently off-limits to fishing often puts conservation at loggerheads with the needs of coastal communities, causing conflict between conservation, fishing and food security interests. For the 1.4 billion people who live around our tropical coasts, foregoing fishing in protected areas can represent too severe an economic sacrifice, and the promised 'spillover' benefits of marine protection can be slow to accrue. Permanently closing areas to fishing is often deemed unacceptable for communities that depend on fishing for survival. Small (~200 ha), short-term (2-3 month) fishery closures for fast-growing species can represent an intermediate step for communities interested in piloting fisheries management but wary of the economic risk of permanent closures. We present experiences from 12 years of supporting community-led temporary octopus fishery closures in Madagascar, where over 300 closures have been organised by communities since 2004. Across a growing number of sites, closures have delivered compelling short-term fisheries benefits. These have been instrumental in building local support for broader management interventions within locally-managed marine protected areas (LMMAs), including gear restrictions, destructive and industrial fishing bans, and permanent reserves, some of which have demonstrated positive conservation outcomes. In Madagascar, temporary closures have provided an entry point for broader conservation efforts across the majority of the country's 70 LMMAs, which cover over 17% of Madagascar's coast. Although not a biodiversity conservation measure in and of itself, temporary closures deliver conservation benefits that would not have been achievable without the prior demonstration of economic benefits achieved through this management model.

13:45 - Periodically harvested closures provide short-term fisheries benefits

Dr. Jordan Goetze[1], Dr. Stacy Jupiter[2] , Dr. Joachim Claudet[3] , Dr. Tim Langlois[4] , Dr. Fraser Januchowski-Hartley[5] , Dr. Rebecca Weeks[6] , Dr. Crow White[7] , Dr. Shaun Wilson[8]

[1]Curtin, [2]Wildlife, [3]National Center for Scientific Research, [4]University of Western Australia, [5]University of Exeter, [6]Australian Research Council Centre of Excellence in Coral Reef Studies, James Cook University, [7]California Polytechnic State University, [8]Department of Biodiversity, Conservation and Attractions

Periodically harvested closures (PHCs) are one of the most common forms of fisheries management in the Western Pacific and vary from being mostly closed to mostly open to fishing. We provide the first comprehensive assessment of PHCs to provide short-term fisheries benefits and a framework to assess long term fisheries and conservation benefits. PHCs in Fiji consistently decreased the wariness of large targeted fish species, but were less likely to increase abundance or biomass. PHCs in the Western Pacific had a 48% greater abundance and 92% greater biomass of targeted species when compared with areas open to fishing, suggesting they are capable of providing short-term protection benefits. Harvesting PHCs results in a rapid increase in wary behaviour and a significant decrease in the abundance and biomass of targeted fishes. Factors affecting the ability of PHCs to provide short-term protection and harvest benefits include size, duration of closure and compliance. Strict controls are needed during openings to optimize future benefits and one year of protection is insufficient for the recovery from a harvest. Highly vulnerable species should be avoided altogether when harvesting. Despite the ability of PHCs to provide some short-term fisheries benefits, a broader range of fisheries management and conservation strategies are needed for the long term sustainability of small-scale fisheries in the Western Pacific.

OS-8B: Conservation and Management 5 (13:30 - 15:30, Kerangas)

13:30 - Illegal Sea Turtle Trade In Sabah, Malaysia: New Model Of Operation With National And Regional Linkages

Mr. Gavin Jolis[1], Mr. Mohd. Soffian Abu Bakar[2], Ms. Sheelasheena Damian[1]

[1]WWF-Malaysia, [2]Sabah Wildlife Department

Sabah, a state located at the eastern part of the country Malaysia has important nesting beaches, foraging grounds and migratory corridors for commonly green and hawksbill turtles. Despite the legal protection status of both species, direct take and eggs being traded threaten the populations. Here provide an overview on the current trade status of turtles and eggs in Sabah, Malaysia. Between 2004 and 2016, at least 11 direct take cases amounting more than 784 turtles were recorded. Current investigations revealed that community members were involved with foreign fishermen in catching turtles at foraging grounds. Cases of turtle eggs seized in various amounts for the purpose of trade were also documented. Between 1999 and 2016, at least 111 cases amounting more than 200,000 eggs were recorded. It was found that foreign fishermen involved in trading turtles with community members were from China, to fulfill the demand of turtle meat and shell for consumption and ornamental purposes respectively. Furthermore, eggs were smuggled from neighboring countries such as the Philippines and Indonesia to Malaysia via sea and air for consumption. Nonetheless, efforts will and have been done to reduce this threat such multilevel and joint enforcement programmes between countries, establishment of taskforce, improved prosecution and conviction of cases with high penalty and sentencing, and revised of existing laws on the penalty of possession to be equal to the penalty of hunting or killing of Totally Protected Species under the Wildlife Conservation Enactment 1997.

13:45 - Lessons learned and insights to share from researching the human dimensions of sea turtles

Dr. Jarina Mohd Jani[1], Ms. Seh Ling Long[1], Mr. Muhamad Allim Jamalludin[1]

[1] *Universiti Malaysia Terengganu*

Sea-turtles face increasing threats to their sustainability despite existing legal protection because policies and initiatives taken to provide their protection often fail to take into account the livelihood reality of human interactions with the species. A better understanding on what sea-turtles mean in the lives of those with whom they share important marine resources for various usages (habitat, food and well-being) is required because human activities in natural settings and their use of natural resources could also positively contribute towards ecosystem enhancement and marine endangered species' well-being. This paper firstly reviews the lessons learned from past studies that sought to better understand the contingencies that riddle social behaviour that ultimately interact with sea-turtle conservation. Secondly, it shares the findings of a research conducted mainly in Terengganu - the most important sea turtle nesting site in Peninsular Malaysia, that focussed on the multiple perspectives of the human actors on sea-turtle conservation and investigated the significance of sea-turtle conservation on the livelihood of local people. Using the livelihood approach as the research framework and ethnographic and participatory field methods for data collection, the research also covered Brunei Bay in Borneo and Natuna Island, Indonesia - other known habitats for Terengganu sea-turtle population. The paper argues that although there are many challenges in the governance of this species at various levels, readily applicable solutions are available too. These findings provide important insights towards improved protection and conservation measures, ensuring the sustainability of both people's livelihoods and sea-turtle populations at local, national and regional levels.

14:00 - Preliminary Study on Geomorphology of Terengganu Turtle Nesting Beaches and its Vulnerability to Climate Change.

Mrs. Noor Azariyah Mohtar[1], Ms. Sharifah Ruqaiyah Syed Mustafa[1], Dr. Aazani Mujahid[2], Mr. Muhammad Mazmirul Abd. Rahman[3], Ms. Syakirah Ruzana Sazali[2], Ms. Hazwani Azirah Ramlee[2]

[1] *WWF-Malaysia,* [2] *Universiti Malaysia Sarawak (UNIMAS),* [3] *UNIMAS*

Climate change is affecting turtles in multiple ways and at all life stages, from the loss of nesting beaches resulting from sea level rise and increased erosion, to feminization of turtle populations caused by elevated nest temperatures, changes in reproductive periodicity, shifts in latitudinal ranges, and decreased reproductive success. Nesting season for green turtles (Chelonia mydas) in Terengganu state starts in March and ends in September annually. Nesting activities decrease rapidly during the monsoon seasons due to rough seas. Terengganu has distinct monsoon seasons, namely the post monsoon (April-May), pre-monsoon (September - November) and the Northeast monsoon (December - March) which dynamically shape the shoreline and beaches. In 2016 and 2017, a study was conducted in the coast of Kemaman and Setiu which covers six main nesting beaches of Kerteh, Ma'Daerah, Chakar hutang, Paka (Kemaman) and Kuala Baharu Selatan as well as Telaga Papan (Setiu). The main aim was to determine the vulnerability towards exposure of monsoonal storms during the period. The study was conducted using beach profiling, shoreline tracing using GPS and Coastal Integrity Vulnerability Assessment Toolkit (CIVAT) which were done before and after Northeast monsoon. The Northeast monsoon severely impacts the coastline as the beach profile showed great changes of beach slopes. Monitoring the changes of the shoreline is needed to measure the potential loss of nesting areas for green turtle and thus the mitigation measures to prevent the erosion causes by other than climate change should be reduced to prevent the impact on the nesting areas.

14:15 - Turtle Watch Camp, Pulau Tengah - findings and recommendations from the first sea turtle conservation project in Johor, Malaysia.

Ms. Tanya Leibrick[1], Ms. Mariana Pereira[1]

[1] *Conservation Camp, Batu Batu Resort*

Turtle Watch Camp, Batu Batu Resort, Pulau Tengah, as the first sea turtle conservation project in Johor, aims to protect green (Chelonia mydas) and hawksbill (Eretmochelys imbricata) nests from poaching, conduct conservation research and educate tourists and local communities on conservation issues affecting sea turtle populations. Since 2015, our hatchery has received 20,455 eggs from 175 nests, collected from 12 islands resulting in the release of 10,766 hatchlings (1,353 green, 9,413 hawksbill). Throughout the three years of the project, numerous nests were poached from both patrolled and unpatrolled beaches and islands, suggesting that poaching of eggs in the region remains high and current legislation is inadequate. Boat strikes in the area are frequent, with 10 turtles from 2016-2017 washing up on Tengah Island alone with fatal lacerations, pointing to a high mortality rate of adults within the population. There is a lack of current research on the overall status of the turtle population within Johor. However, the high rates of adult mortality combined with egg poaching suggest that the population is likely to be in decline. Overall, this highlights the need for assessment of the efficacy of current sea turtle legislation and enforcement, combined with community-level education and engagement programs, as well as a large scale population assessment in the region to establish the current conservation status of sea turtles throughout Johor.

14:30 - The Status Of Sea Turtle Populations And Conservation Activities In Vietnam

Mr. The Cuong Chu[1]

[1]*Institute of marine environment and resources, Vietnam Academy of Science and Technology*

Five species of foraging and breeding sea turtles have been identified in Vietnam, they are Green turtle (Chelonia mydas), Loggerhead turtle (Caretta caretta), Olive ridley turtle (Lepidochelys olivacea), Hawksbill turtle (Eretmochelys imbricata) and Leatherback turtle (Dermochelys coriacea). Among them, with the exception of Loggerhead turtle (Caretta caretta), four species have been being lay eggs on the beaches along the country. However, these populations have been strongly suffered by human activities for decades. The number of foraging and breeding Hawksbill and Leatherback sea turtles have dramatically decreased, and Olive Ridley turtle has almost disappeared on their traditional nesting beaches. Beside the reason of harvesting eggs and nesting turtles by catch or by purpose, the developments in coastal areas where sea turtles laying eggs such as in shrimp aquaculture, tourist resort and residential area developments etc., also contributed to this decline of sea turtles. Despite the fact that the recent raising awareness programs on protection and conservation of the sea turtle were very well done with the participation of many organizations and provinces, these important creatures still face the risk of extinction in Vietnam.

14:45 - Finding the balance: sea turtle tourism interaction in Apo Island, Philippines

Dr. Alessandro Ponzo[1], Mrs. Sue A. Ong[1], Ms. Mary Jane Lamoste[1], Ms. Jessica Micklem[1], Ms. Kristina Pahang[1], Ms. Sally Snow[1], Ms. Jessica Labaja[1], Mr. Gonzalo Araujo[1]

[1]*Large Marine Vertebrates Research Institute Philippines*

The Apo Island Protected Landscape and Seascape (AIPLS) is one of the best examples of a marine protected area in the Philippines but no dedicated work has ever been done to assess the population of green turtles (Chelonia mydas) that use the area, despite becoming a major driver of tourism on the island in recent years. Diving tourism and dedicated snorkeling interactions with turtles have grown fast, with ~17,000 tourists (51% Filipino) visiting the island in 2015. To assess the effect of the tourists on the presence and habitat use of the turtles, behavioral observation, habitat surveys and photographic identification were conducted in June-July 2017 and daily since November 2017. Temperature-Depth Recorder archival tags were also deployed on 2 resident turtles to further understand habitat use and complement visual observation data. Over 2000 encounters with green turtles were recorded, with an average of 30.5 individuals identified per day (range 6 - 60). To expand our understanding on the presence and site fidelity of the resident turtles, the photographic catalogue has been integrated with systematic but opportunistic photo-identification data collected since 2013 by a resident dive operator and online citizen science searches, with the longest photographic match dating back to 2007. Over 500 questionnaires were administered to tourists and local stakeholders to assess their perception on the interaction and areas for improvement. AIPLS is an important hotspot for green turtles and the local community heavily rely on their economic value for tourism, therefore finding a balance is of outmost importance.

15:00 - Understanding the Movement of Green Turtles in Terengganu, Malaysia through a Shared Photographic Identification Database

Ms. K.L. Chew[1], Ms. Seh Ling Long[2], Mr. Sebastian Szereday[1], Ms. Wan Zuriana Wan Sulaiman[3], Ms. Bee Ling Chan[4]

[1]*Lang Tengah Turtle Watch,* [2]*Universiti Malaysia Terengganu; Perhentian Turtle Project, Fuze Ecoteer,* [3]*Perhentian Turtle Project, Fuze Ecoteer,* [4]*College of the Atlantic; Perhentian Turtle Project, Fuze Ecoteer*

Photographic identification (photo-ID) of sea turtles through facial scale patterns has been increasingly used for population studies. This study aims to determine the movement patterns of green turtles between Lang Tengah Island and Perhentian Island in Terengganu, Malaysia through a shared photo-ID database. The database consisting of photographs of the left and right facial scale patterns of green turtles from Perhentian Turtle Project (PTP; 181 nesting and 66 in-water individuals) and Lang Tengah Turtle Watch (LTTW; 12 nesting individuals) were consolidated in 2017. All photographs were run through an automated pattern matching software, Interactive Individual Identification System Pattern (I3S), which produced a list of matches based on a match score starting from 0 (perfect match) to over 100, or "No Match". The list was visually checked for any correct matches. A nesting green turtle from LTTW database was successfully matched to an in-water green turtle from PTP database, suggesting movements between nesting and foraging sites that is 20 km apart. The turtle has been sighted 44 times at the same foraging site at Perhentian Islands from 2013-2016, and was found nesting once at Lang Tengah Island on 2 June 2017. This study shows the efficacy of I3S in matching individuals within a shared database, provided that the photographs are of high resolution and the facial scales are visible. The match found indicates the potential of a shared photo-ID database in having a better understanding of the movements of sea turtles between nesting and foraging grounds in a wider geographical area.

15:15 - Operationalizing Turtle Excluder Device (TED) use in Malaysia: A ten-year journey

Dr. Nicolas Pilcher[1], Ms. Liyana Izwin Bt Khalid[1], Mr. Syed Abdullah Syed Abdul Kadir[2], Mr. Lawrence Kissol[3]

[1]*Marine Research Foundation,* [2]*Department of Fisheries Malaysia,* [3]*Department of Fisheries Sabah*

Bycatch of sea turtles is of grave concern in Malaysia, where 2,000-4,000 turtles are estimated killed each year in trawl fisheries. Fortunately this mortality can be mitigated with Turtle Excluder Devices (TEDs).

The Marine Research Foundation (MRF) worked closely with the Department of Fisheries Malaysia (DOFM) and the Department of Fisheries Sabah (DOFS) to successfully introduce TEDs in Malaysia, starting in 2007 with volunteer trials in Sabah, and culminating with legal requirement for TEDs in 2017 with staged National implementation by 2022.

However, TED uptake requires buy-in from fishers and needs to be demonstrated to be effective. To boost buy-in, MRF commissioned a professional video in three languages, conducted site visits to the US with fishermen and DOFM and DOFS officers, developed a portable fuel-flow meter to measure fuel savings, and developed a real-time video system (TEDsCam) using GoPro cameras and drone technology to deliver live video feeds to boat captains.

To measure impact, MRF calculated fuel savings and translated these into CO2 emissions savings, and used fishing effort and past statistics to determine number of turtles potentially saved by the fishery. We estimate saving up to 1000 turtles per year and 150,000 kg of CO2 emissions per year at the current implementation stage, and for this to quadruple once full National adoption is reached. Together

with buy in from the government and fishing communities across Malaysia, the adoption of TED enhances the conservation of sea turtles and reduces the National carbon footprint, while ensuring preservation of fisher livelihoods.

Focus Group: Indicators of climate change vulnerability: practical measures from conservation physiology for monitoring and management (16:00 - 18:00. Kabu)

Ms. Rachel Skubel[1], Dr. Jodie Rummer[2], Dr. Bjorn Illing[2]
[1]*University of Miami,* [2]*James Cook University*

As the impacts of climate change in marine ecosystems become more frequent and severe, there is a growing need for resource managers and users to monitor ongoing impacts and plan for change. Climate change can lead to spatial shifts of target fishery species and/or increase stress on local populations. In turn, a socio-economic system including fishers, resource managers, distributors, and other stakeholders may need to adapt to sustain their activities in this changing environment. A growing body of climate vulnerability assessments take a coarse scale 'triage' approach, as well as more focused studies that experimentally assess response to climate stressors. The wide range of methodologies and indicators employed across these assessments and studies present a challenge in terms of finding common ground and interoperability. This focus group will present and discuss physiological and ecological indicators of vulnerability to climate change in marine species and populations, and explore practical pathways to implement these indicators in management and monitoring. Participants are encouraged to share case studies which address: traits or results indicating vulnerability, how findings or methods can be used pragmatically in an assessment context to inform management decisions and stakeholder groups, experiences in assessing climate vulnerability, and/or specific needs of management organizations or communities from such assessments. Participants will have the opportunity to contribute to a synthesis paper, addressing indicators across the continuums of data-poor to data-rich and resource-poor to resource-rich, with the goal of generating strategies for assessment techniques which meet the needs of management practitioners and resources users.

Focus Group: Increasing effective partial protection approaches for tropical marine conservation (16:00 - 18:00, Tubau 1)

Dr. Dominic Andradi-Brown[1], Ms. Estradivari Estradivari[2], Dr. David Gill[3], Dr. Nils Krueck[4], Dr. Helen Fox[5]
[1]*World Wildlife Fund,* [2]*WWF-Indonesia,* [3]*Conservation International/George Mason University,* [4]*University of Queensland, National Geographic*

Establishing effective marine protected areas (MPAs) is a major goal of many marine conservation programs, with the CBD Aichi Biodiversity Target 11 committing governments to 'effectively and equitably' manage 10% of global marine and coastal areas in MPAs by 2020. While many tropical marine conservationists pursue no-take marine protection, in areas with large reef-dependent communities, extensive no-take zones are often incompatible with equitable management. Therefore, increasingly conservationists are implementing spatial and temporal partial protection, with dual aims of conserving reef biodiversity while allowing sustainable extractive fisheries. Approaches can include spatial gear restrictions, periodic harvest closures, and increased local ownership and management rights. However, the effectiveness of partial protection is still untested in many locations, with variable results depending on whether evaluation is framed around human livelihood or biodiversity gains. for partial protection to contribute 'effectively and equitably' to global coral reef management, a holistic view is required, bringing together an understanding of maintaining reef biodiversity and crucial ecosystem functions, while allowing extractive human uses. This focus group brings together conservationists implementing partial protection approaches from a range of conservation organizations. Participants will discuss and critically evaluate encountered successes and failures for both human livelihoods and the ability of the protection to support long-term reef resilience. The focus group will aim to contribute to a new evidence base for the effectiveness of partial protection approaches.

OS-9A: Fisheries and Aquaculture 7 (16:00 - 18:00, Tubau 2-3)

16:00 - Preliminary study on the Elasmobranch fisheries in the Jaffna peninsula, Sri Lanka

Mr. Gobiraj Ramajeyam[1], Ms. Rosalind Bown[1], Mr. Akshay Tanna[1], Mr. Daniel Fernando[1]
[1]*Blue Resources Trust*

Fisheries are a major economic activity and source of livelihood for most coastal communities in northern Sri Lanka. National and district level information of elasmobranch fisheries are very limited, however it is known that many elasmobranchs encountered in Sri Lanka have low reproductive potential. Growing global demand for shark fins, mobulid gill plates and meat of both have led to overexploited and unregulated fisheries for elasmobranchs worldwide, and Sri Lanka is no exception. This research study is documenting the species diversity and abundance of Jaffna's elasmobranch fisheries in order to establish a baseline, with species level data collection including identification photographs of each specimen, dimensions, sex, maturity, fishing gear used, and catch location. Market surveys are carried out at the 6 main landing sites and 2 fish markets three days per week. We have surveyed 24 days to date, revealing that from 406 individual specimens recorded, 21 elasmobranch species are present, consisting of 9 shark species (n=72) and 12 ray species (n=260). They are primarily landed as non-discarded bycatch in teleost and shellfish fisheries using gillnets, longlines and trawlers. The data shows that the majority of landed elasmobranchs were immature males or females below their reported size of sexual maturity, which would negatively affect population growth, drawing concerns on the sustainability of this fishery. This project will continue to collect additional data and conduct population stock assessments to better manage these fisheries that are critical for food security and the financial future of local communities.

16:15 - High mercury levels and associated consequences in a critically endangered species being reconsidered for a U.S. fishery

Mr. Christoper Malinowski[1], Dr. Chris Koenig[2], Dr. Felicia Coleman[2], Dr. Justin Perrault[3]
[1]*Florida State University,* [2]*Florida State University Coastal and Marine Laboratory,* [3]*Loggerhead Marinelife Center*

Goliath Grouper Epinephelus Itajara is currently a protected species in the southeastern U.S. waters of the Atlantic and the Gulf of Mexico and is considered critically endangered throughout its now considerably compressed geographic range. In this study, we evaluate the mercury levels in the tissues of Goliath Grouper in Florida waters - their center of abundance - revealing extraordinarily high levels in the liver and muscle of adult fishes that increase with size and age. The levels far exceed the recommendations for consumption designated by either the U.S. Environmental Protection Agency or the U.S. Food

and Drug Administration. So why the concern? After all, there is no fishery extant in the U.S.. There are two issues that we investigate here: (1) the lack of agreement among federal agencies for the level of mercury considered dangerous for human consumption; and (2) the apparent lack of interest in curtailing the sale of fish that exceed this level of consumption. We also question the legitimacy and purpose of opening a fishery for a species of conservation concern, of unknown population recovery status that could pose a serious health risk to potential consumers. Further, we found that such high levels of mercury are cause for concern for the fish itself. High body burdens are correlated with various health effects and with reduced offspring survival.

16:30 - Putting science into management at local level: implementation of biological reference points for reef fisheries at Saleh Bay, West Nusa Tenggara

Ms. Heidi Retnoningtyas[1], Ms. Siska Agustina[1], Mr. Tezar Rafandi[1], Mr. Tasrif Kartawijaya[1], Dr. Irfan Yulianto[1]
[1] *Wildlife Conservation Society - Indonesia Program*

Small-scale fisheries have been long recognized to be poor-data, thus it is inevitably challenging to manage. In Indonesia, definition of small-scale fisheries strongly correlates with 'small fishers' terminology which defined as fishers who operate fishing fleets less than 10 GT. Number of fishing fleets in this category makes up more than 90% of total vessels operated within Indonesia waters, yet monitoring of resources utilized by those vessels are still lacking. The increasing number of GT fleets is alarming, particularly when there is no certain management to ensure the stock sustainability while efforts continuously intensify. In Sumbawa Island, West Nusa Tenggara (WNT) Province, reef fisheries significantly contribute to local income as such commodities are not only traded domestically but also exported in high volume. The increasing trend of fish harvesting is not followed by proper monitoring, thus no reliable information of stock health was available. WNT Government then committed to take action, decided to develop reef fisheries management initiative by applying indicators to monitor stock health. Length-based spawning potential ratio (LB-SPR) is used as one of indicators as for poor-data fisheries, SPR can be applied as biological reference points. Monitoring surveys were undertaken for grouper and snapper catch in Sumbawa Island, involving fish length measurement and collecting fishing trip information to estimate catch per unit effort (CPUE). Results show that certain species of fish have reached limit reference point, indicating that the stock is over-exploited. This information is fundamental for fisheries manager to propose harvest policy to ensure stock sustainability.

16:45 - Making models matter for ocean conservation: a Pacific herring case study

Dr. Tessa Francis[1], Dr. Phil Levin[2], Dr. André Punt[3]
[1] *UW,* [2] *The Nature Conservancy,* [3] *University of Washington*

Pacific herring in the North Pacific region have recently experienced stock declines, fishery closures, and conflict among resource users. Herring management is currently guided by standard single-species approaches without consideration for potential ecosystem interactions. Here, we describe efforts to support ecosystem-based management (EBM) and sustainable fisheries using multiple models, and engaging management in developing tools to evaluate tradeoffs across multiple objectives. We describe analyses grounded by the development of a conceptual model of the social-ecological system using an inclusionary, facilitated stakeholder process. Using this conceptual framework, we develop multiple novel models, including a spatially-explicit assessment model, and an operating model that explores hypotheses of herring stock structure and the role of environmental and food web factors on herring populations, for use in a management strategy evaluation (MSE) framework. We link model outputs to economic, socio-cultural, and ecological objectives to enable tradeoff analyses. We incorporate compliance into the MSE framework to show how issues of governance can change model predictions. Last, we incorporate traditional and local knowledge in the modeling and analysis. This work is conducted in a cross-disciplinary and cross-institutional working group that includes managers, modelers, and stakeholders to improve how models are employed to inform EBM.

OS-9B: Ocean Science Technology 1 (16:00 - 18:00, FJ Auditorium)

16:00 - Video technology facilitates broad scale synthesis of ecological data

Dr. Jordan Goetze[1], Prof. Euan Harvey[1] , Dr. Tim Langlois[2] , Dr. Demian Chapman[3] , Dr. Michelle Heupel[4] , Prof. Michael Heithaus[3] , Dr. Mark Meekan[4] , Prof. Colin Simpfendorfer[5] , Dr. Aaron MacNeil[6]
[1] *Curtin University,* [2] *University of Western Australia,* [3] *Florida International University,* [4] *Australian Institute of Marine Science,* [5] *James Cook University,* [6] *Dalhousie University*

With increasing anthropogenic impacts across the globe, it is becoming more important to collect accurate ecological data over broad spatial scales in a timely manner. This will facilitate synthesis over regional and/or global scales and provide information that can be translated into conservation and fisheries management outcomes. The use of video technology to monitor the marine environment, has facilitated the rapid collection of a broad range of ecological data over large spatial scales. In particular, methods such as baited remote underwater video and diver operated video can provide information on the abundance, biomass, length and behaviour of marine organisms, simultaneous to habitat assessments, reducing data collection time. Here I discuss the advantages and limitations of video technology and give examples of broad scale projects such as the Global FinPrint project (the world's first global assessment of sharks and rays) and GlobalArchive (an online repository that facilitates collaborative data synthesis). Finally, I discuss the implications and potential advantages of using video technology in the future.

16:15 - Whale Alert - Advancing Whale Conservation Through Mobile Technology & Citizen Science

Mr. Virgil Zetterlind[1], Dr. David Wiley[2], Mr. Michael Thompson[2] , Mr. Patrick Ramage[3]
[1] *Conserve.IO Inc,* [2] *NOAA,* [3] *IFAW*

Entering its 6th year, the Whale Alert app has made significant contributions to whale conservation for the US and Canada. Whale Alert provides mariners location and time aware information on whale speed restrictions, areas to be avoided, and recommended routes to reduce the risk of ship strikes via both Android and Apple supported mobile applications. It also provides all users a direct way to electronically report whale sightings. In the case of dead, entangled, or stranded whales Whale Alert routes sightings automatically to the appropriate response networks. Since inception, Whale Alert has collected over 7,000 whale sightings.

In 2017, major new capabilities were added in the form of curated human sightings and acoustic whale detections from autonomous gliders and buoys, app translation into French (with support for

adding other languages), addition of North Pacific right whale critical habitats and native fishing areas in Alaska, and the addition of a new whale zone in the Indian Ocean. This year, Whale Alert will be expanded to support effort-based data collection via individual user and organizational accounts. Whale Alert is a collaborative effort led by NOAA, IFAW, and Conserve.IO.

16:30 - The role of Typhoon Maysak on the dispersal of Montipora sp. in Ulithi, Federated States of Micronesia

Prof. Giacomo Bernardi[1], Dr. Peter Nelson[1], Dr. Michelle Paddack[2], Mr. John Rulmal[3], Prof. Nicole Crane[4]

[1]University of California Santa Cruz, [2]Santa Barbara City College/One People One Reef, [3]Ulithi Falalop Community Action Program, [4]Cabrillo College/One People One Reef

The Atoll of Ulithi, Yap State, Federated States of Micronesia, has experienced an increase in abundance of a "weedy" coral, Montipora sp., in the past few decades, with significant detrimental effects on the local coral reefs. It has been proposed that this sudden increase followed a Typhoon that occurred in the 1960s. In April 2015, Typhoon Maysak directly hit Ulithi, causing severe damage on land and on the shallow reefs. A few weeks later, and again a full year after the Typhoon, fragments and colonies of Montipora were collected. RAD genomic sequencing was performed to evaluate the potential role of Typhoon Maysak on the spread of Montipora. Relatedness analysis allowed to unambiguously identify colonies and determine which individuals were genetically identical. Colonies were found to be surprisingly diverse genetically, for a fast colonizing species. We were also able to estimate dispersal, and quantify the role of the Typhoon in spreading Montipora over the seafloor. Fragments were spread by tens of meters, and were found to survive a full year after the Typhoon had passed, indicating that fragments lived long enough to reattach and start new colonies. With the predicted increase in frequency and intensity of Typhoon events in the near future due to global climate change, this study shows that subtidal ecological effects of reoccurring Typhoons may have a significant impact on the overall health of reefs.

16:45 - Climate-driven declines in 3D structure of shallow reef slopes in the central Indian Ocean

Mr. Daniel Bayley[1], Dr. Andrew Mogg[2] , Prof. Heather Koldewey

[1]Natural History Museum, London, [2]The Scottish Association for Marine Science, [3]Zoological Society of London

The physical structure of coral reef habitats is known to be a strong driver of the abundance and diversity of associated marine organisms, and furthermore gives a clear indication of a reef's health and resilience to disturbance. Alongside the morphological structure of the reef, the composition of reef benthos gives an indication of the level of carbonate accretion or erosion occurring and therefore how well the ecosystem functions.

The Chagos archipelago lies approximately 500 km south of the Maldives archipelago. Less than 1% of the 650,000 km2 Exclusive Economic Zone is inhabited, and the remaining area has been a UK managed no-take MPA since 2010, making this area one of the least disturbed coral systems in the world. In early 2015 to late 2016 the region was affected by an intense El Nino heating episode which caused much of the region's corals to bleach. We used 'Structure from Motion' (SFM) photogrammetry to quantify and measure subsequent changes to reef forms. The SFM methodology allows reefs to be analysed quantitatively using a number of relevant metrics such as rugosity, surface texture, volume, and coral growth-form composition.

This work quantitatively shows how the physical structure of these reefs have changed through time due to climate-induced mortality, away from the various confounding anthropogenic impacts normally experienced in such systems. The effects of the recent bleaching episode have been severe, causing widespread die-off of the shallow-lying coral reef areas across the archipelago, followed by rapid loss of structure through physical and biological erosion.

17:00 - Building good management from great science through the Bertarelli Programme in Marine Science

Ms. Rachel Jones[1]

[1]Zoological Society of London

Large, remote marine reserves pose particular challenges to effective conservation management. Inaccessible to most, sometimes all, visitors they increase the complexity and cost of doing research, implementing management activities and can become almost invisible to the audiences we want to reach. The Bertarelli Programme in Marine Science has committed to an ambitious four year programme of science in one of the most remote parts of the Indian Ocean - the British Indian Ocean Territory. Our goal is to draw together world class science and put it in support of conservation management activities that reduce pressure from IUU fishing, control invasive species and restore key habitats and protect key species and regionally important populations. This talk will briefly outline how our programme builds good management from great science and the challenges and value of remote marine reserves.

17:15 - Costs and benefits of changing sampling methods in marine protected area long-term monitoring

Mr. Iwao Fujii[1], Dr. Jennifer Selgrath[2], Dr. Amanda Vincent[1]

[1]Project Seahorse, University of British Columbia, [2]Stanford University

To confirm their effectiveness, long-term monitoring of marine protected areas (MPAs) is critical. Such longitudinal sampling can, however, pose problems of methodology, particularly as the preferred tools may evolve over time and new approaches emerge. My project evaluated how data from two methods, line intercept transect (LIT) and photoquadrat (PQ), which were used sequentially in MPA monitoring, estimated percent coral cover in a series of MPAs in the central Philippines. Ideally, of course, one survey method would be used well and consistently, but what happens when procedures are suboptimal and must be changed?

Analyzing three years of data when both LIT and PQ were applied, we found that LIT generated higher cover estimates than PQ, perhaps because of the smaller sample sizes in LIT. However, subsampling LIT data to increase sample sizes allowed comparison of estimates by these two methods. This led me to realize that PQ data detected significant cover change over three years whereas LIT data did not, probably because PQ data had larger sample sizes from wider spatial ranges (and thus more statistical power). Our study addresses realities in long-term monitoring about how to reconcile different data sets. The results also contribute to MPA development and management.

17:30 - Can marine conservation really benefit from environmental DNA?

Prof. Stefano Mariani[1], Dr. Owen Wangensteen[2], Dr. Andjin Siegenthaler[3], Dr. Rupert Collins[4], Ms. Ana Soto[1], Ms. Judith Bakker[1], Dr. Martin Genner[4]

[1]University of Salford, [2]University of Tromsoe, [3]University of Guelph, [4]University of Bristol

The analysis of trace DNA retrieved from seawater has recently come to the fore as a potentially game-changing tool for marine biodiversity assessment and monitoring. Superficially, the idea of recording species presence (and relative abundance) from vast stretches of the marine environment, based on the retrieval of tiny molecules isolated from generally small volumes of water can induce scepticism. Yet, several studies are now showing that this is a real possibility, with environmental DNA (eDNA) typically showing a significantly greater detection-per-effort ratios than traditional capture-based methods. Nevertheless, what remains unclear is whether, and to what extent, eDNA screening can be of use in marine conservation management. Here, we present empirical data from several coastal marine habitats around Britain, demonstrating fish eDNA detection performance between two and four times greater than established netting techniques. We also caution against issues related to sequence databases, sampling methods and data interpretation, which currently hinder the applicability of eDNA for marine conservation, and discuss existing mitigation strategies and prospective targets that will transform eDNA science into an effectively applied conservation tool.

17:45 - Completing the picture: collecting data on small vessels for underwater noise impact assessment in Canada

Ms. Norma Serra[1], Dr. Lauren Mcwhinnie[1], Dr. Rosaline Canessa[1], Dr. Patrick O'hara[2]

[1]University of Victoria, [2]Environment and Climate Change Canada

Due to an expected increase in vessel traffic in the Salish Sea, Canada, it is of paramount importance to assess current underwater noise levels from vessel activities and their disturbance on acoustically sensitive cetaceans, particularly to the endangered killer whale population. In order to carry out these assessments, many studies rely on marine traffic data collected using Automatic Identification System (AIS) onboard vessels. However, AIS only captures a fraction of the actual vessels present because it omits many of the smaller vessels, which are not legally required to carry AIS. Without this information, our assessments of vessel-associated disturbances based on AIS are inherently flawed, and underestimated.

The NEMES (Noise Exposure to the Marine Environment from Ships) project is particularly interested in this unknown component of marine traffic as non-AIS vessels are likely contributing a considerable amount to the overall noise budget of the Salish Sea. With the assistance of various technologies and data analysis (e.g. aerial surveys, satellite imagery analysis, and shore-based cameras, we have been able to collect vessel traffic information for both AIS and non-AIS vessels. Preliminary results indicate that non-AIS vessels can account for up to 60% of the overall vessel traffic in surveyed areas. The majority of these vessels are recreational vessels, particularly during the summer months.

Through this work, we are now able to build a more complete picture of the distribution and type of vessels using the Salish Sea, and contribute to have a better understanding of their potential impacts to the marine ecosystem.

OS-9C: Conservation and Management 6 (16:00 - 18:00, FJ Event Hall)

16:00 - Building a global marine mammal stranding response community

Dr. Mridula Srinivasan[1]

[1]NOAA Fisheries Office of Science and Technology

Marine mammal strandings are a ubiquitous phenomenon, yet there are few well-established response networks in most parts of the world. However, in most cases, with minimal training and supervision, individuals can collect basic data that can eventually contribute to the management and conservation of marine mammal populations. To enable fledgling networks to have access to globally-accepted practices, NOAA Fisheries, International Fund for Animal Welfare, The Marine Mammal Center, and Woods Hole Oceanographic Institution, came together to develop a platform for collaboration and information sharing - Global Marine Animal Stranding Training Toolkit (GMAST.org). This site provides an elementary introduction to the rescue and investigation of stranded marine mammals, as well as guidance to build a successful response network. Standardized training modules guarantee consistent messaging of best practices across different training programs with the flexibility of adapting individual lessons to the target audience and regional conditions. The plan is to equip key local personnel to be trainers and active responders during stranding events. Investment in local personnel is fundamental to addressing regional threats to marine mammals. Long-term, through knowledge sharing and strategic training efforts, the pool of skilled individuals will likely expand to allow cross-fertilization of approaches and data, leading to a truly committed international stranding response community. The first phase of GMAST has been completed with the help of 34 experts from 12 countries and the materials are freely accessible to subscribed users. Over the next few years, the content will be evaluated and augmented to improve networking and information exchange.

16:15 - A framework for identifying and characterising coral reef "oases" against a backdrop of degradation

Dr. James Guest[1], Dr. Peter Edmunds[2] , Dr. Ruth Gates[3] , Dr. Ilsa Kuffner[4] , Dr. Andreas Andersson[5] , Dr. Brian Barnes[6] , Dr. Iliana Chollett[7] , Dr. Robin Elahi[8] , Dr. Travis Courtney[5] , Dr. Kevin Gross[9], Ms. Beth Lenz[3], Dr. Satoshi Mitari[10], Prof. Peter Mumby[10], Ms. Hannah Nelson[2], Dr. Britt Parker[12], Dr. Hollie Putnam[13], Dr. Caroline Rogers[4], Dr. Lauren Toth[4]

[1]Newcastle University, [2]California State University Northridge, [3]University of Hawaii at Manoa, [4]USGS, [5]Scripps Institution of Oceanography, [6]University of South Florida, [7]Smithsonian Institution, [8]Stanford University, [9]North Carolina State University, [10]Okinawa Institute of Science and Technology, [11]University of Queensland, [12]National Oceanic and Atmospheric Administration, [13]University of Rhode Island

Human activities have led to widespread coral reef decline; however, the severity of degradation is spatially heterogeneous due to some locations resisting, escaping, or recovering following disturbances. It is imperative to develop frameworks for identifying and characterising locations that have not degraded to the same extent as their neighbours ("oases"), as they may have considerable conservation value. Here we present such a framework to identify coral reefs using publically available time-series data on coral cover. We calculated standardised coral cover (z-scores) to distinguish sites that deviated positively from annualized regional mean coral cover, and used the coefficient of variation (CV) of coral cover to assess how these potential oases varied temporally. We first illustrate our z-score approach within a modelling framework by extracting z-scores and CVs from simulated data on coral cover, we then apply the approach

to time-series data from long-term reef monitoring programs in four focal locations in the Pacific and western Atlantic. Among the 123 sites analysed, 40 had positive z-scores for median coral cover and were categorised as oases. Of these, 32 (80%) were temporally stable as defined by a CV $\leq$ 50%. Only two sites (5%) recovered from disturbances by increasing coral cover. Our results demonstrate that escaping or resisting disturbances is more common on reefs than recovery over the last few decades. Finally, we found that standardised coral cover was positively associated with coral community calcification capacity, suggesting that our approach identified oases that are exceptional in at least one aspect of ecological function.

16:30 - MigraMar: Generating Science For The Conservation Of Marine Migratory Species In The Eastern Pacific

Dr. Olivier Chassot[1], Mr. Randall Arauz[2], Dr. Sandra Bessudo[3], Mr. Eduardo Espinoza[4], Ms. Kerstin Forsberg[5], Dr. Hector Guzman[6], Dr. Alex Hearn[7], Dr. Frida Lara[8], Dr. Mauricio Hoyos[8], Dr. Rodrigo Hucke[9], Dr. James Ketchum[8], Dr. A. Peter Klimley[10], Dr. Yannis Papastamatiou[11], Dr. César Peñaherrera[12], Dr. Robert Rubin[13], Mr. German Soler[3], Dr. George Shillinger[14], Mr. Todd Steiner[15], Mr. Felipe Vallejo[16], Dr. Bryan Wallace[17], Mrs. Ilena Zanella[18], Dr. Patricia Zarate[19]

[1]MigraMar, [2]CREMA, [3]Fundación Malpelo, [4]Dirección del Parque Nacional Galapagos, [5]Planeta Oceano, [6]Smithsonian Institution, [7]Universidad San Francisco de Quito, [8]Pelagios Kakunjá, [9]Universidad Austral del Chile, [10]University of California Davis, [11]Florida International University, [12]Pontificia Universidad Católica del Ecuador, [13]Pacific Manta Research Group, [14]Upwell, [15]Turtle Island Restoration Network, [16]Equilibrio Azul, [17]Conservation Science Partners, [18]Misión Tiburón, [19]Instituto de Fomento Pesquero

The Eastern Tropical Pacific is home to large populations of threatened marine migratory megafauna. It is also subject to intensive human impacts, including fishing pressure and climate change. Within the region, there are several World Heritage Sites, some of which have recently been upgraded and extended, while some others are in the process of being increased. Since 2006, MigraMar is dedicated to understanding the movements of marine migratory species between these marine protected areas. By combining innovative tracking and population assessment methods to identify key migratory routes for these species, MigraMar aims at the creation of two protected MigraVías (swimways) to link key habitat between Galápagos and Coco (Ecuador - Costa Rica), and Malpelo - Coiba (Colombia - Panama). MigraMar's data base (MigraBase) includes more than 1,200 tracks from iconic and endangered migratory species, including the scalloped hammerhead shark (Sphyrna lewini), whale shark (Rhincodon typus), silky shark (Carcharhinus falciformis), green turtle (Chelonia mydas), and leatherback turtle (Dermochelys coriacea). These tracks show strong connections between oceanic islands, along different systems of sea mounts. By engaging the governments of Costa Rica, Panama, Colombia and Ecuador, MigraMar's collaborative biological research efforts foster the use of innovative technologies to protect populations of marine migratory species. MigraMar is planning for the management of transboundary conservation areas for the protection of marine megafauna between the Gulf of California and Revillagigedo (Mexico), Revillagigedo and Clipperton (Mexico - France), and Revillagigedo - Guadalupe - Canal Islands of California (Mexico - United States).

16:45 - Contributions of traits and life history strategies to the temporal ecological resilience of coral communities.

Ms. Louise Anderson[1], Dr. Maria Beger[1], Dr. Joachim Claudet[2]

[1]University of Leeds, [2]National Center for Scientific Research

The global decline of coral reef ecosystems indicates that despite conservation efforts to manage for resilience, climate change and other anthropogenic disturbances are continuing to drive degradation. Current management approaches focus on minimising local impacts, but may be insufficient or inappropriate for reducing the risks from global climate change. However, the picture is not uniform, and the variable responses of coral reefs to disturbance, even at relatively small scales, have been well documented. This heterogeneity presents an opportunity to consider local management that can prioritise the most ecologically resilient reefs. Enhancing our understanding of ecological resilience temporally, and over smaller spatial scales, can support localised decision-making and facilitate adaptive management in to the future.This study examines changes in coral community composition in the Indo-Pacific, and attempts to identify traits via established life history strategies and how they relate to long-term resilience. Changes in the abundance of these strategies over time, with environmental gradients and disturbance histories will be discussed. Preliminary results from this ongoing analysis indicate that varying life history strategies in corals elicit different responses to disturbance. Using an approach based on traits and life history strategies makes these results more comparable at a global scale, and lends support to empirically-led conservation decision-making that can help to improve and adapt local management regimes.

17:00 - Investigating the risk to inshore dolphins from cumulative environmental stressors: A spatial risk assessment approach

Mr. Elizah Nagombi[1], Dr. Alana Grech[1], Dr. Isabel Beasley[1], Prof. Helene Marsh[1]

[1]James Cook University

Spatial risk assessments using geographic information system (GIS) can be an important decision making tool to rapidly assess risks to threatened species. Spatial modelling of species distributions combined with risk assessments that identify cumulative anthropogenic stressors is particularly useful in marine habitat and can inform reserve planning, invasive species management, marine spatial planning and conservation for threatened species. Most marine megafauna (i.e. dugong, dolphins and whales) have large geographic ranges that overlap with human activities which can threaten their populations. These species are often a priority for conservation. In this study, we used spatial modelling to consider the estimated home range of two inshore dolphin populations (Australian snubfin dolphin, Orcaella henishoni, and Australian humpback dolphin, Sousa shaulensis). Sighting data of the two species were collected from boat-based surveys throughout Cleveland and Halifax Bays off Townsville, Queensland, Australia in 2016. We overlaid the species' distributions with cumulative threat maps to identify hotspots of high habitat use and threatening factors, to inform a spatial risk assessment. Home range was estimated using 'adehabitatHR' package in R statistical software and subsequently plotted in ArcGIS 10.4.1. The resulting threat maps allowed identification of important dolphin areas that are facing significant threats in the Townsville region. These identified areas can be used by the local port and conservation agencies to mitigate risk and disturbance in these hotspot regions. This information provided managers and decision makers with priorities for conservation for the small, localised populations of snubfin and humpback dolphins off Townsville, Queensland, Australia.

17:15 - Mapping ecological and empirical knowledge as a tool for managing a protected area in Brazil

Ms. Whitney Goodell[1], Dr. Cesar Cordeiro[2], Dr. Carlos Ferreira[2]
[1]*University of Hawai'i at Mānoa,* [2]*Universidade Federal Fluminense*

The subsistence extractive reserve of Arraial do Cabo is one of Brazil's first marine extractive reserve, and it is setting a precedent for local resource management efforts in complex areas of multiple stakeholder interests. In order to establish an effective management plan, there must be a better understanding of the spatial dynamics of the RESEX. Here, we aim to 1) identify areas of high user conflict, 2) identify areas of greater ecological value, and 3) make recommendations of areas for fishing regulations which would cause the least conflict among stakeholders and provide valuable protection of marine resources. This integration of sociological and ecological information into a Geographical Information System is directly applied to local conservation efforts, and intended to enhance the participatory management process as well as provide an adaptive tool for future monitoring efforts. Stakeholder objectives and concerns were gathered from participatory meetings, as was spatial information on the use of the study area. Ecological data of fish distributions and benthic community composition were drawn from surveys carried out over the past two decades. Mapping products contribute to community efforts a better understanding of the spatial reality of stakeholder use and resource distribution. By incorporating knowledge from local stakeholders with information from ecological surveys, we provide a visualized evaluation of priority areas within the reserve for management considerations. We emphasize the value of integrating scientific data and GIS mapping with local stakeholder knowledge and interests in order to establish a resource management plan that is accepted, adaptive, and effective.

S-111: From small-scale to distant-water: Challenges and emerging opportunities for strengthening fisheries management in Asia (16:00 - 18:00, Kerangas)

16:00 - Promoting the multi-dimensional governance of fisheries in Japan: Science, Policy and Market

Ms. Polita Glynn[1], Prof. Isao Sakaguchi[2]
[1]*The Pew Charitable Trusts,* [2]*Gakushuin Univeristy*

Why are Japanese fisheries so unsustainable? The majority of its coastal stocks are overfished. TAC is set only for 7 species, often above sustainable levels. Without regulation, juvenile fish and spawning schools are intensively harvested. Aquaculture is also problematic. Antibiotics, which are designated as critically important for human medicine, are widely used. In addition, there is no public system for monitoring the industry's environmental impacts, and feed sustainability is not recognized as an issue. What drives this unsustainability in Japan? To answer this question, we need to understand the multi-layered structure of dysfunction: a lack of policy innovation, an unethical seafood market and silent science.

Firstly, concepts such as MSY and the precautionary approach have been ignored by Japanese fisheries management policies. Secondly, the market is so unethical that endangered bluefin tuna and eel are widely sold at supermarkets. In such a situation, the market cannot arouse bottom-up pressure on the government and fishermen/farmers. Thirdly, behind the outdated fisheries policies and unenlightened market, there is silent fisheries science, which keep media, politicians, fishermen, farmers, retailors, processors, and consumers uninformed. Under such a structure of multi-layered dysfunction, it has been difficult to progressively transform policy and/or the market toward sustainability.

However, momentum is building in the lead up to the 2020 Tokyo Olympic and Paralympic Games, with seafood sustainability attracting growing public attention. In response, the cabinet has begun to seriously consider the issue. This presentation will discuss key policy prescriptions that can help to maximize this opportunity.

16:15 - Management of Distant Water Fisheries in China: New Developments

Ms. Polita Glynn[1], Dr. Jianye Tang[2]
[1]*The Pew Charitable Trusts,* [2]*Shanghai Ocean Univeristy*

Distant water fisheries in China encompass two kinds of distinct fisheries: one operating within EEZs of coastal states, and another operating on the high seas. The year of 2016, which is the first year of China's 13th Five-Year Plan Period lasting to 2020, marked a watershed for China's distant water fisheries (DWF). In that year, two serious illegal fishing issues happened, attracting attentions at home and abroad, with one of them escalating instantly into a diplomatic incident. Consequently, new rules were introduced. First, a 'zero tolerance' policy was adopted. Until the end of 2017, 264 fishing vessels belonging to 78 Chinese distant water fishing companies received severe penalties and saw 700 million RMB (approximately 110 million US dollars) subsidies cancelled for their violations of either laws and regulations of coastal states or conservation and management measures adopted by relevant regional fisheries management organizations (RFMOs). Second, a blacklist of persons engaging in serious violations was developed; 15 persons were included in the first list of this kind, which was released by theMinistry of Agriculture in May 2017. Third, Guidelines for National Distant-Water Fisheries Development in the 13th Five Years were released in November 2017, laying out specific objectives and roadmaps for both kinds of DWF, and notably putting ceilings on the total number of vessels. All of these developments were made possible through the cooperation and support of relevant countries and organizations. At the same time, China is now active in establishing bilateral governmental mechanisms and engaging with RFMOs.

16:30 - A Community-designed Fish Catch Recording System: Will it be sufficient to manage local fisheries?

Ms. Polita Glynn[1], Mr. Raymond Jakub[2]
[1]*The Pew Charitable Trusts,* [2]*Rare Indonesia*

Although the government of Indonesia has been addressing the issue of unreported fisheries, its efforts have mostly been restricted to the industrial sector. In fact, 95% of the country's fishers are categorized as small-scale, and have no reporting mechanism. This loss of data has hindered effective management of small-scale fisheries. Therefore, local communities should be at the forefront in addressing this issue. Since 2015, Rare has facilitated a community in Mayalibit Bay, Raja Ampat in establishing their own fisheries targets and management methods, with an emphasis on the community's local knowledge. In the Bay, where the local tenurial system remains strong, these processes were led by the customary leaders of the area. To develop a catch recording system, stakeholders first had to determine "what success looks like," from both scientific and community perspectives. They also had to define the community's fishing area and eligible fishers, record their catches, and adaptively utilize the information to set a course. Using metrics such as the length distribution and production trends of the fisheries as indicators, stakeholders

could quickly assess the condition of the fishery and identify possible management options for adoption. The practice of catch recording has now been promoted and enacted through a customary law, and has been adopted by 400 fishers in the area. This facilitated process of catch recording system development is scalable to many small communities in Indonesia, where the government could empower local communities while also gathering catch data to enhance national fisheries management.

16:45 - Local knowledge, global markets: drivers of fishery choices in the Lakshadweep Archipelago and its unintended consequences

Ms. Polita Glynn[1], Dr. Rohan Arthur[2]
[1]*The Pew Charitable Trusts,* [2]*Nature Conservation Foundation*

As reefs are exposed to increasingly frequent, increasingly intense global climate change disturbances, local fishing can make the difference between recovery and decline. Efforts to rationally manage fisheries are often only marginally successful since they are unable to reconcile the economics of fishing with reef conservation. Attempts to evolve win-win solutions, while admirable in their intent, may result in only temporary reprieves, unwittingly eroding local institutions and changing underlying human-nature relationships in subtle but important ways. I present a history of fishing in the densely populated Lakshadweep Archipelago. The reduction of sustenance reef fishing was the epiphenomenal result of a highly successful pelagic tuna fisheries development programme in the 1980s. While transforming the local economy, this shift also meant Lakshadweep reefs were able to recover surprisingly well from the catastrophic 1998 coral mass mortality, despite high densities of dependent human populations. Over the last four decades however, there has been a fundamental shift in how fishers relate to their resource - from food to commodity. Also, any tradition of regulating reef harvest has vanished in institutional memory. The upshot of these changes is that as Lakshadweep connects rapidly to mainland markets, global demand for reef fish, together with temporary dips in tuna profitability have seen a sudden rise in commercial reef fishing. This commodification is doubly troubling as reefs experience more global bleaching-related mortalities with substantially reduced recovery. Our work shows that the commodification process can unravel human-nature relationships that are critical in maintaining the resilience of climate-fragile human-ecological systems.

POSTER SESSION (18:30 - 21:30, Ranyai Ballroom)

A comprehensive, standardized approach to MPA mapping

Mrs. Jennifer Sletten[1], Mr. Timothé Vincent[1]
[1]*ProtectedSeas*

Accurate, standardized data on marine managed areas is critical to assess the expected impact of existing MPAs and inform the creation of new areas and management plans. The ProtectedSeas marine managed area project collects global MPA data, supplements it with detailed information for each MPA, and distributes the data for free via an interactive public map and GIS file downloads. Our database provides detailed, easily digestible, and up-to-date information on the actual activity restrictions that apply within each MPA, with details such as rule exceptions, MPA purpose, and links to additional resources, including managing authority websites and official regulations.To generate the data, our team scours local and national laws to find all documented MPAs and marine managed areas, verifies that the spatial boundaries are current and correct, contacts authorities to verify these data, and provides a monthly data release with change notes. We have implemented a coding system to indicate the level of restriction for over 25 specific categories, including extraction, entry, speed, anchoring, certain types of fishing gear, commercial, and recreational fishing. This coding combined with verified boundaries supports complex analysis of MPA protections and protection comparisons between regions. We further advance our goal of accessibility to in-depth MPA information by establishing partnerships with governmental agencies, NGOs, and navigational charting companies. As of February 2018, our map includes the United States, the High Seas, the Caribbean, the Western Pacific, Chile, and Mexico. We are committed to completing a global MPA database and are adding new regions monthly.

Argos System: Improvements And Future Of The Constellation

Dr. Sophie Baudel[1], Mr. Yann Bernard[1], Mr. Stéphan Lauriol[1], Mr. Alexandre Tisserant[1]
[1]*CLS*

Argos is the main satellite telemetry system used by the wildlife research community for animal tracking and scientific data collection all around the world, to analyze and understand animal migrations and behavior and then propose conservation measures.

The Argos constellation with 6 satellites in orbit in 2017 is being extended in the following years with Argos-3 payload on METOP-C (launch in October 2018), and the new Argos 4 payloads on OceanSat-3 (launch in 2019), CDARS in December 2021, METOP-SG-B1 in December 2022, and METOP-SG-B2 in 2029.

Argos-4 will allow more frequency bands, new modulation dedicated to animal tracking allowing very low transmission power transmitters (50 to 100mW), with very low data rates (124 bps), enhancement of high data rates (1200-4800 bps), and downlink performance, at the whole contribution to enhance the system capacity (50,000 active beacons per month instead of 20,000 today).

French Space Agency CNES, which designs Argos payloads, is innovating and launching the Argos ANGELS project (Argos NEO Generic Economic Light Satellites). ANGELS will lead to a nanosatellite prototype with an Argos NEO instrument (30 cm x 30 cm x 20cm) that will be launched in 2019.

The design of the renewal of the Argos constellation, called Argos For Next Generations (Argos4NG), is on track and will be operational in 2022. This constellation will allow revisit time of less than 20 minutes in average between two satellite passes.

The presentation will then be an overview of the Argos system, present and future and new capacities coming with it.

Abundance of microplastic in seawater collected from tourism- and non-tourism sites at Mu Ko Similan National Park, Phangnga Province

Mr. Charernmee Chamchoy[1], Dr. Thamasak Yeemin[1], Dr. Makamas Sutthacheep[1]
[1]*Marine Biodiversity Research Group, Department of Biology, Faculty of Science, Ramkhamhaeng University, Huamark, Bangkok*

Although tourism provides economic benefits to local and national economy, environmental impacts caused by this sector, especially plastic pollution, should be highly considered. Microplastics, derived from the degradation of plastic waste, have been increasingly concerned as it might contaminate in marine and coastal ecosystems. The present study aims at investigating the distribution of microplastics in seawater collected from coral reefs at Mu Ko Similan, Phangnga Province, the Andaman Sea. Samplings were conducted at

three study sites, i.e. Ao Numchai, Hin Muandiaw, and Ao Faiwab, using a plankton net with its mesh size of 120 μm. Tourism utilization is found at Ao Numchai whereas the tourism is prohibited at Hin Muandiaw and Ao Faiwab. Our preliminary results revealed that the densities of microplastics were in a rage of 0.82 - 3.62 items/m3.The highest density was found at Ao Numchai (241 items/m3) while the lowest one was found at Hin Muandiaw (45 items/m3). Most of the microplastics had a size range of 500 - 1,000 μm. The higher density of microplastics recorded at Ao Numchai may link to the tourism. This study provide a scientific baseline data on microplastic pollution and also highlights the needs for proper waste management from tourism to further mitigate tourism impacts on marine and coastal ecosystem.

Analysis of the various impacts by enterprises in protected marine areas in Brazil.

Mr. Renan Smith[1], Ms. Fátima Oliveira[2], Ms. Fernanda Bucci[2], Dr. Fabrício Escarlate[3], Mrs. Luis Felipe Bortolon[4]

[1]University of Brasilia, [2]Chico Mendes Istitute, [3]Global Environment of Facility Marine Conservation, [4]Tamar Project

Anthropogenic activities produces significant impacts and changes to the marine environment. In Brazil, there are few studies on the effectiveness of marine protected areas and the potential damage caused by various enterprises. For the implementation of an enterprise in these areas, an Authorization for Environmental Licensing issued by the managing government agency, the Chico Mendes Institute for Biodiversity Conservation (ICMBio), is required. Conditions of approval are assigned for each authorization, whose requirements must be attended by the enterprise in the federal environmental licensing process, aiming to minimize the incidental environmental impacts. The offers of approval conditions should also address the biodiversity conservation needs of these environments and still need to be evaluated for their effectiveness individually. Based on the classification proposed in 2018 by the work of the Global Environment Facility Marine (GEF-Mar) and by ICMBio specialists, a preliminary survey and analysis of 33 authorizations issued by ICMBio between 2009-2017 was carried out for different types of enterprises in 74 marine protected areas. The authorizations resulted in 10 enterprise typologies, such: oil and gas, mining, electricity transmission lines, roads, ports, civil works, among others. The authorizations include 291 specific conditions classified in 15 categories: monitoring, restriction, adjustment, capacitation, supervision and others. The evaluation of the effectiveness of these conditions of approval resulted from the authorizations may support ICMBio and GEF-Mar in supporting the creation of new marine protected areas dedicated to integral protection, viewing the enormous pressure and environmental impacts caused by the enterprises in the current marine protected areas.

Applying Design Thinking in Co-creating Marine Conservation with Communities

Mr. Wint Hte[1], Dr. Tara Sayuri Whitty[2]

[1]Point B Design + Training, [2]International Union for Conservation of Nature

The close links between coastal communities and ecosystems presents huge challenges, but also great opportunities, for conservation. The conservation community has increasingly embraced interdisciplinarity to integrate these links into conservation planning. The rights of communities have also been increasingly recognized, including language in the Aichi Target for not only effective, but equitable, management of protected areas. However, critical gaps remain in how communities are included in the conservation process, including: meaningful participation in conservation research and planning, conflict sensitivity and resolution, anticipating and evaluating social impacts of conservation, and general "soft elements" in interacting with stakeholders.Design Thinking is an inherently transdisciplinary, systems-thinking, participatory approach can fill these gaps and promote collaborative, creative conservation solutions. Originally applied to the design of products, Design Thinking has increasingly been applied to develop solutions for communities. Its core values of empathy, mindfulness, creativity, optimism, collaboration, and experimentation promote sharing of perceptions, values, and ideas across stakeholders. In Myanmar, partnerships between a Design Thinking organization, Point B Design + Training, and various marine conservation groups demonstrate the potential for Design Thinking to produce valuable research, promote active stakeholder participation, and improve project implementation and evaluation. Key outcomes thus far include: descriptions of social tensions and perceptions in project communities that would likely impact project effectiveness; productive facilitation of multi-stakeholder planning workshops; and development of participatory project evaluation. Further integration of Design Thinking in marine conservation holds much potential for improving how conservation projects identify and optimize opportunities for working with communities for conservation.

BMON - Citizen science project for beach monitoring

Dr. Sompratana Ritphring[1]

[1]Kasetsart University

The BMON project (Beach MONitoring) is aimed at monitoring the coastline in the heart of Songkhla city, southern part of Thailand, with the involvement of local citizens. It can be expressed that this is one of the pioneer citizen science project in Thailand. Since 2015 a beach profiling method was informally proposed to the group of active young citizens called "Beach for life" in Songkhla. Beach profile survey bring about a better understanding of coastal processes by giving quantitative data on the spatial/temporal evolution of beaches, which is important for coastal management. Since the citizen science approach is using for this project, the methodology should be simple and fit with the capacity of all participants who have different background of education. The profiling method used to this project is based on the physical principle of fluid. All simple and low-cost homemade instruments made by citizen scientists at the beginning stage and compare with the standard techniques. About 70 participants were invited to the training workshop. The small group on-site trainings were also organized by the group of leaders several times. Every month, participants carry out this observation in three beaches along coast of Songkhla with the total length of 19 kilometers divided into 40 sections. This pioneer project provides the opportunity for local citizens to participate in coastal management issues and has raised public awareness of their coastal environment. Moreover, the senses of beach ownership have been developed among participants.

Characterization Of Recreational Spearfishing In A Subtropical Rocky Reef

Dr. Moyses Cavichioli Barbosa[1], Dr. Cesar Cordeiro[1], Dr. Vinicius Giglio[2], Dr. Carlos Ferreira[1]

[1]Universidade Federal Fluminense, [2]Universidade Federal do Rio de Janeiro

Spearfishing is a highly selective activity, but the selectivity does not necessarily make it a sustainable one, as the majority of defenders of this fishing method claim. This study aimed to evaluate which traits make fished species more or less attractive to spearfisher and the relationship between fisher expertise and characteristics of the catch in rocky reefs in the Southeastern Atlantic. The investigation was carried out in the Marine Extractive Reserve of Arraial do Cabo. In terms of abundance, the family Scaridae was caught most, and the biomass of the caught fish was mainly composed of herbivores

and macro-carnivorous fish. The main attributes that make a species a more preferential target of spearfisher are, firstly, a pelagic habitat, followed by a larger size, and a tendency to form schools. Our studies have also shown a direct relation between the fishers's experience and the catch composition, where experienced spearfishers catch mainly fish with larger sizes and weight. That the oldest spearfishers recognize that stocks of targeted fish have reduced throughout their practice can be taken as evidence that environmental reference is changing, a phenomenon reported in other areas of the world as well. Spearfishing permits selective fishing, but it is up to the fisher to exercise selectivity, so if the activity are not selective, itself will not be. To minimize the effects of spearfishing on target species and to enhance protection of functionally important fishes, we recommend that fishery managers adjust controls on the catch.

CMS COP12 - Advancing towards a holistic conservation policy for marine species

Heirdrun Frisch-Nwakanma[1], Ms. Melanie Virtue[1]
[1] *UNEP/CMS Secretariat*

Since its inception in 1979, the Convention on the Conservation of Migratory Species of Wild Animals (CMS) has produced many resolutions, recommendations and decisions that contribute to the overall goal of conserving species with an unfavourable conservation status and their habitats. Of course, threats and issues have changed over time, or are better understood today. The marine species-related outcomes of the 12th Meeting of the Conference of the Parties to CMS (COP12), which took place in Manila, Philippines, 23-28 October 2017, address a wide range of issues. These range from ways to address long-standing problems such as bycatch to managing increasing threats such as recreational interactions from boats or in-water. The resolutions and decisions also mandate work on the emerging research field of animal culture and its implications for conservation. The authors outline key actions foreseen for governments, the CMS Scientific Council and the wider scientific community, civil society and the CMS Secretariat that are directly relevant for marine species, covering Important Marine Mammal Areas (IMMAs), marine noise, aquatic wild meat, live captures of cetaceans, in-water interactions, marine debris, climate change, connectivity, conservation implications of animal culture, bycatch, and boat-based wildlife watching. In addition, several species-/population-specific action plans and "concerted actions" were agreed by Parties, addressing the needs of cetaceans, sharks and marine turtles. Further, the role of different actors in bringing issues relevant to the conservation of wildlife to the attention of CMS is explored, both to support future decision making and to facilitate implementation of the agreed actions.

Cetacean diversity and distribution along southeastern coastal and marine areas of Bangladesh.

Mr. Mohammad Islam[1], Mr. Abdul Wahab Akonda[1], Mr. Mohammad Ehsan[1], Mr. Rafat Adnan[1]
[1] *Marinelife Alliance*

Cetaceans have been monitoring along the southeast coast of Bangladesh during last 20 years by researcher of Marinelife Alliance. Small to large cetaceans have been recorded along the coast of Cox Bazar and Chittagong. Oobservation conducted by offshore marine survey, stranding record, dead washed specimen, live observation, data from offshore fishermen and marine megafauna bycatch information. Habitat diversity included estuary, rivers, coastal channels, intertidal flats, mangrove canals, offshore area etc. The diversity of the cetacean species is least as thorough survey not yet conducted. The region is very important trans-boundery habitat with Myanmar marine territory. The recorded species are Indopacific humpback dolphin (Sousa chinensis), Indo-Pacific bottlenose dolphin (Tursiops aduncus), Irrawaddy dolphin (Orcaella brevirostris), Short-finned pilot whale(Globicephala macrorhynchus), Risso's dolphin (Grampus griseus), Striped dolphin(Stenella coeruleoalba), Spinner dolphin (Stenella longirostris). Pantropical spotted dolphin(Stenella attenuate) and Finless porpoise(Neophocaena phocaenoides) The major habitat loss derived from the indiscriminate construction of dam for shrimp farming, use of estuarian and marine set bag net (ESBN and MSBN), as well as fishing gear setting in across waterways that entirely blocks cetacean movement specially in naf river, Moheskhali channel, canals of Sonadia -Moheskhali mangrove. Indopacific Humpback and Irrawaddy dolphins have been observed very close to coast at Matarbari, Kutubdia, Haserchar Sonadia, and several spots along the Teknaf peninsular coast. interactions with nearshore fishing activity was observed common along Sonadia west coast, near Reju canal. and Naf estuary. 30-40 dead washed each from St. Martin Island through Kutubdia area, and most of them due to fishing bycatch.

Challenges for a comprehensive and standardized MPA mapping

Mrs. Jennifer Sletten[1], Mr. Timothé Vincent[1]
[1] *ProtectedSeas*

Accurate, standardized data on marine managed areas is critical to assess the expected impact of existing MPAs and inform the creation of new areas and management plans. The ProtectedSeas marine managed area project collects MPA data and supplements it with detailed information for each MPA. Our maps provides detailed, easily digestible, and up-to-date information on the actual activity restrictions that apply within each MPA. We are committed to completing a global MPA database.To generate the data, our team scours local and national laws to find all documented MPAs and marine managed areas, verifies that the spatial boundaries are current and correct, and contacts authorities to verify these data. To make our maps comprehensive, detailed, comparable and accessible, our project and prior MPA mapping efforts face the following challenges:

- Lack of completeness of existing national databases.
- Data currency and boundary mismatch, where different data sources display contradicting boundaries of the same MPA.
- Jurisdictional overlaps, where in any given place, multiple, overlapping jurisdictions may hold simultaneously.
- Ambiguous boundary descriptions which use landmarks to define a boundary without specifying numeric latitudes and longitudes.
- Coastline mapping, done through surveys using different methods, results in more than one 'coastline' available for any given area. Simplifying a large scale high resolution coastline for display purposes is another source for mismatch.
- Data sourcing, where MPA data is often spread across different management authorities at different levels of government.

Changes in species composition in a complex environment - a challenge for the tools

Dr. Verena Häussermann[1], Mr. Günter Försterra[1], Ms. Stacy Ballyram[2]
[1] *Pontificia Universidad Catolica de Valparaiso,* [2] *Huinay Scientific Field Station*

One of the main aims in identifying conservation solutions is to ensure the preservation of high diversity areas while minimizing the cost to economic and social activities. Therefore, tools for determining priority areas in which the ratio between these goals is optimized are becoming increasingly popular among conservation scientists. While providing a good foundation for MPA identification, these tools are not without challenges, particularly for data-deficient areas such as Chilean Patagonia. Species distribution modelling (SDM) is a way of rapidly filling spatial knowledge gaps and thus reducing bias in the output of decision support tools. Apart from binary species distribution models, which show whether a species is present or not based on a variety of environmental variables, the response of a species to environmental change can be an effective method for predicting patterns of biodiversity. "gradientForest" is a R package that allows for the detection of biological composition patterns or 'beta diversity' along environmental gradients. It emphasizes where along a range of environmental gradients important changes of composition in species assemblages occur and the magnitude of the change along environmental gradients. By determining the relative importance of a predictor, it can help to optimize data assessment with limited time and resources and allows to make predictions on the impact that climate change related alterations of gradients may have on the biological patterns. This helps to plan effective MPA networks even under a changing environment.

Community-based tourism and participatory science as a catalyst for marine management: the case of Atauro Island, Timor-Leste

Mr. Nick Piludu[1]
[1]*Blue Ventures*

Atauro Island, Timor-Leste, is recognised as having some of the highest levels of marine biodiversity in the world, but until recently its marine resources were largely unmanaged. In 2016 local communities started working with international NGO Blue Ventures to establish two parallel initiatives in Beloi village: homestays and a participatory seagrass monitoring programme.The homestay association started in 2016 with eight households and by the start of 2018 had hosted 1246 tourist nights, generating a total income of 18,000 USD, substantially increasing household incomes. Homestays host Blue Ventures ecotourists and staff, who visit Atauro to monitor coral reefs and work alongside community members to map seagrass.Initial anecdotal evidence suggests that the homestays are having an impact on fishing, with participants reporting that the increased income has allowed them to decrease fishing effort. In addition the homestay association is adopting a marine stewardship role in the community, including sustainability in their mission statement and advocating for community-based natural resource management with local stakeholders. Participatory monitoring and data sharing has established Blue Ventures as a technical partner for marine management, and in 2017 we were invited by the villagers of Ilik-namu to support the establishment of a new locally-managed marine protected area, underpinned by customary Tara Bandu laws, as well as being granted ongoing access to other locally-managed reefs to continue underwater monitoring. Data collected by Blue Ventures staff, volunteer divers and community members provide the scientific foundation for local community groups to manage Atauro's marine resources.

Competition between Macro Algae and The Coral Reefs of The Thousand Islands, Indonesia

Ms. Kyra Wicaksono[1], Ms. Atika Rahmah[1]
[1]*University of Indonesia*

Competitive interactions between corals and macro algae has been recorded in several waters, and it affects the community structure of coral reefs. Human activities that lead to nutrient enrichment and overfishing of algae grazers contributes to this shifting community. To determine the competitive interaction between macro algae and corals, and if the coral reef community was shifting into a macro algae state in the waters of the Thousand Islands, we recorded the occurrence and effects of the macro algae and coral interactions on different coral lifeforms. The data was collected from the southeast and northwest of Pramuka Island, and northwest of Air Island. Methods used in this research are the line intercept transect and belt transect. The northwest of Pramuka Island has the most abundant macro algae on the coral reef among all sites. The first transect is dominated by branching corals, a fast growing lifeform, whereas the second transect is dominated by algae assemblage, and gradually changing into mostly slow growing lifeforms, such as encrusting on the third transect. The lifeform that has the most interaction with macro algae is the submassive. However, the interaction is most likely that macro algae outcompeted submassive corals. We also found that the encrusting corals have more resistance and 'wins' against algae while the submassive is the opposite. Moreover, the condition of the corals at the northwest of Pramuka Island is more severe than the other two sites, which indicates the impact of sedimentation to the health of the coral reefs.

Composition and estimation of shark size on coral reef ecosystem on Dampier Strait MPA, Raja Ampat

Mr. Fakhrizal Setiawan[1], Dr. Austin Humphries[2], Mr. Beginer Subhan[1], Mr. Regitri Darmawan[1], Mr. Mufti Afrizan[1], Mr. Chris Paight[2], Mr. Paul Carvalho[2], Dr. Alan Koropitan[1], Dr. Luky Adrianto[1], Dr. Hawis Madduppa[1]
[1]*Bogor Agricultural University,* [2]*University of Rhode Island*

Sharks are the top predators in coral reef ecosystems and played a role to maintain ecosystem balance through trophic cascade. Unfortunately, this important role is threatened by their declining population due to the trade of its fins in the international market. In response to this, the Regional Government of Raja Ampat Regency became the first in Indonesia to enforce the protection of shark and manta rays. This provision is implemented through Local Regulation No. 9 / 2012 on Fishing Prohibition on Shark, Manta Rays, and Certain Fish Types in Raja Ampat Sea Waters. The study conducted from 14-22 January 2018 in the Dampier Strait - Raja Ampat found 15 individuals from 3 species of reef shark using an underwater visual census (belt transect and long swim). From 20 dive spots, 8 locations are having sharks; with zonation type compose of 60% in the tourist zone, 33% in the core zone and 7% in open access. The species composition are 73% black tip reef shark (Carcharhinus melanopterus), followed by 20% of the white tip reef shark (Triaenodon obesus), and 7% of the Papuan walking shark (Hemiscylliium frecyneti). The sizes of the sharks found generally are adult (80%), initial phase (7%), and juvenile (13%). The large number of sharks found in mature size and being in protected areas suggests that this location still provides good area for shark regeneration in the future, and low levels of exploitation in the region are a strong signal of successfulness of the ongoing protection.

Cooperative behavior logic of common conservation of marine resources in South China Sea

Dr. Mingbao Chen[1]

[1]*Sun Yat-sen University*

In the conservation of regional marine resources, there is a willingness and action between stakeholders to work together to achieve a certain goal, namely cooperative conservation of marine resources based on cooperation. Based on marine resources, reciprocity is a prerequisite for cooperation. Finally, through mutual cooperation it can be achieved regional marine resources conservation and management. In this paper, taking the countries around the South China Sea joint conservation and marine resources in South China Sea as an example, it analyses the relationship between behavior and interest orientation among the stakeholders to explore cooperation in space stakeholders conservation of marine resources, and puts forward the system design possible to promote the sustainable utilization of marine resources in the South China.

Coral bleaching intensity at St. Martin Island, Bangladesh; status, conservation and restoration.

Mr. Mohammad Islam[1], Mr. Abdul Wahab Akonda[1], Mr. Rafat Adnan[1]

[1]*Marinelife Alliance*

St. Martin island and adjacent western reef location is only coral habitat in Bangladesh. Although not any formation of reef occurred, more than 70 species of species have so far been identified under 22 genera. The anthropogenic is considered less than recent tourism induced threats prevailing in the island coral ecosystem more due to recent development and tourism initiative. Current man made major threats are sedimentation, plastic pollution, damage by anchor damage, and coral mining. Global worming intensifying coral bleaching along with the entire world tropical coral habitat. Bleaching has been recorded in 1998, 2008 and in last several (2013-17) years with NOAA Coral Watch alert level 1. Bleached coral recovery difficult due to huge sedimentation and other pollution from the tourism activity. During peak tourist season 5-8 large vessel operates daily in Oct-April each year with carrying several thousand each day make huge plastic disposal in the sea that has no control yet in place. The vessels anchor nearshore that create extreme sedimentation by propeller movement. Large number of plastic items and huge sedimentation recorded in coral survey. Sewage and toilet facilities are not made suitable for coral habitat. The island has been declared as Ecologically Critical Area by Bangladesh Government in 1999, but other than no MPA still has been established and conservation management still in question. Research organization Marinelife Alliance is continuously monitoring the bleaching and dataloggers has been installed at various location for temperature monitoring.

CoralWatch - a citizen science tool to monitor coral bleaching and create reef awareness

Ms. Madeline Davey[1], Dr. Monique Grol[2], Mrs. Diane Kleine[2], Prof. Justin Marshall[2]

[1]*University of Queensland,* [2]*CoralWatch, Queensland Brain Institute, The University of Queensland, St. Lucia, QLD 4072, Australia*

Worldwide coral reefs are under serious threat from anthropogenic and climatic stressors. Now more than ever, reefs require careful management informed by science and supported by government, industry and community to ensure reefs for the future. Citizen science is recognised as an effective way to bolster information flow between these sectors.CoralWatch, based at The University of Queensland, Australia, is a well-established citizen science program founded in 2002. It integrates global coral health monitoring with education and public outreach creating reef awareness using simple and engaging tools that provide people with accessible information about coral reefs and climate change, and hands-on experience collecting scientific data on coral bleaching using the Coral Health Chart. The chart is an easy-to-use tool to quantify changes in coral colour associated with coral bleaching. It is so simple, no prior training is needed and anyone can get involved. The chart is used in the field and classroom, is available in 12 languages and data on ~1610 reefs from 78 countries is freely available. Unlike the majority of citizen science project designs, in which citizens collect data for scientists to analyse, CoralWatch was designed to provide users with a flexible tool that can be used in a variety of ways by all end users, from citizens, classrooms through to scientists. By allowing for a public, free, and easy to use tool, CoralWatch has been successful in engaging citizens globally in discussion about why coral reefs matter, and provided an avenue for engagement in shaping change.

Devil Rays (Mobulidae) Ecology Study IN Morotai North Maluku: How it can Improve Marine Tourism and Species Protection?

Mr. Darmawan Mukharror[1], Ms. Isnaini Baiti[1], Mr. Muhammad Ichsan[1], Ms. Niomi Pridina[1]

[1]*Shark Diving Indonesia*

There is a growing concern for the conservation of Devil Rays (Mobulidae) especially since all species of manta and mobula rays were listed in Appendix II CITES. Despite its vulnerability, this family of rays has very limited information, especially on their ecology and behaviour. In Morotai, Indonesia, there is a growing dive tourism industry involve sharks and rays as the main attraction that acts as an alternative livelihood for the local community. We are using Underwater visual census (UVC) for counting the sightings, abundance and behaviour of mobulids we encounter as well as information on the physical characteristic in every dive sites. From the data between 2014 - 2017, we record a Giant Manta (Manta birostris) and 49 bentfin devil rays (Mobula thurstoni) sightings in Matita Island and Galo-Galo Reef, South Morotai. In March to July 2017, Frequency of Occurrence (FO) of M. thurstoni in 50 dives is reaching 50% per single dive and the highest sightings in one dive were 30 individuals at 14th May 2017. It was found that physical characteristic of M. thurstoni sightings was at the depth of 30-35 m, the temperature of 30C, low current, while the only M. birostris sighting was at depth of 21 m with a strong current. Using this information, we aim to understand the ecology and behaviour of mobulid rays and hopefully can help to improve sustainable marine tourism as well as supporting the local government to implement protection to these species.

Description of the spatial distribution, seasonality, size and illegal trade of the Whale Shark (Rhincodon typus, Smith, 1828) in Venezuela.

Mr. Leonardo Sánchez[1], Dr. Rafael Tavares[1], Mrs. Yurasi Briceno[2], Prof. Luis Bermúdez Villapol[3]

[1]*Venezuelan Institute of Scientific Research/Shark Research Center-Venezuela,* [2]*Venezuelan Institute of Scientific Research,* [3]*Centro de Investigación de Cetáceos*

Data from 156 whale shark sightings were analyzed during the last 5 years in Venezuela. The information was obtained through direct observation and interviews with fishermen, divers, tourism operators, marine life photographers, coast guards and biologists throughout the Venezuelan coast. The sightings were recorded along the continental and insular shelves between 0.5 and 20 nautical miles from coast, in areas characterized by high productivity. The greatest georeferenced presence of whale sharks occurred in the central coast of Venezuela, and the lowest presence was recorded towards the eastern coast, where contrary to the greatest fishing events and illegal commercialization were registered. The sightings occurred between September and April, but it was more frequent during December and January (the months with lower SST of the year, 22-24 C). A total of 17 fishing and illegal trade events were recorded, 11 strandings of which 3 were rescued thanks to the creation of the Whale Shark Care Network of the Shark Research Center of Venezuela (CIT Spanish acronyms) and several education workshops with the fishing communities during 2017 and 2018. The total length registered for whale sharks was 3-16 meters, with 71% between 3-5 meters. Additionally, 52 images and videos of whale sharks were analyzed on the coast of Venezuela that will allow the creation of a database to identify individuals for ecological studies.

Designing Structures that Test and Optimize Recruitment: Coral Restoration Using Innovative 3D Technology

Ms. abigail engleman[1]

[1] *Florida State University*

Anthropogenic damage is causing a decline in physical coral reef structure, decreasing live coral coverage and consequently limiting ecosystem services coral reefs provide. With over 500-million people directly dependent on coral reefs for food, protection, and livelihood, developing effective and sustainable methods to restore coral ecosystems is essential. Reef restoration efforts aim to reestablish live coral coverage and/ or increase structure to damaged reefs. Traditional practices have severe limitations and show inconsistent success rates. The inability to retain coral larvae on reefs hinders the sustainability of these methods, without continuous human intervention. Research efforts prioritizing larval dynamics open possibilities for additional restoration tools in the future. Enhancing live coral on artificial substrates propagates larvae, increasing coral recruitment in physically degraded reefs. Deploying specially-designed settlement substrates provides immediate structural complexity to damaged reefs, encouraging fish and invertebrate colonization, simultaneously facilitating coral recruitment. By testing the role of multi-scale structural complexity on larval settlement, this study identifies characteristics that improve larval recruitment on substrates, adding to the tools available for reef restoration. This research uses 3D-technology to develop substrates that incorporate multi-level structural complexity, facilitating larval settlement and post-settlement survival. The resulting structures provide an example for 3D-technology use in marine conservation. Novel technologies, such as 3D-scanning and 3D-printing, allow researchers to address questions not previously considered due to experimental restraints, and increases ease of addressing some previously considered settlement questions. Methods in this research also showcase the scalability of 3D-models, setting the stage for this technology to revolutionize future reef restoration.

Ecological Status Of Coral Reef And Fish Communities Of Sawai Bay, Maluku Province, Indonesia

Mr. Adib Mustofa[1], Mr. Fikri Firmansyah[1], Ms. Navisa Nurbandika[1]

[1] *WWF-Indonesia*

The Government of Maluku Province, eastern part of Indonesia, has committed to contribute 1 million hectare of Marine Protected Area (MPA) of the total 20 million hectares of MPA targeted by Indonesian government by 2020. Sawai bay is one of the potential areas of a new MPA establishment in the Maluku region. However, there is still lack of ecological information on the area. This study was aimed to assess the ecological status of Sawai bay, specifically on its benthic and fish communities of the area. In total, 25 sampling sites was chosen based on satellite imaginary data. Underwater Visual Census (UVC) was used to collect benthic and fish community data. Result showed hard-coral cover in the bay was relatively in a good shape reaching at 32.25 $\pm$ 3.95%. However, rubble percentage was also relatively high at 22.3 $\pm$ 3.68% indicating the area experienced blast fishing practices in the past. Fish abundance and fish biomass in the Bay water were relatively high at approximately 6,733.16 $\pm$ 842.38 individual/ha and 2,074.31 $\pm$ 70.61 kg/ha, respectively. However, Reef fish, particularly from Serranidae and Lutjanidae family which are the main target fish of local fishermen, has fish biomass at only 21.98 $\pm$ 3.13 kg/ha and 190.58 $\pm$ 86.01 kg/ha, respectively. The good shape of hard coral cover and high fish biomass in the bay may indicate the need of management and protection of the area from any pressures that may contribute to the declining habitat and marine ecosystem of Sawai bay water.

EO4wildlife platform case study: Assessing marine mammal habitat preferences to inform conservation and management

Dr. Susan Gallon[1]

[1] *French Agency for Biodiversity*

Decision-making in todayâĂŹs contentious world requires high quality data and tools that are trusted by a wide range of stakeholders. New and evolving technologies provide managers/scientists with the potential to bring such data and decision tools into Marine Protected Area (MPA) discussions, hopefully reducing the cycle of disagreement and stalemate that characterize many forums. The easy-to-use EO4wildlife platform will allow querying, searching, mining and extracting information from different databanks (i.e. owner database, archive database and online database). Scientists or MPAs managers will be able to fusion and cross correlate heterogeneous data via advanced data analytics tools in order to discover patterns, validate or invalidate hypothesis, detect potential similar or reproducible behaviour or favourable conditions associated to the movement of animals (i.e. GPS and Argos data) or any kind of geo localized data (i.e. transects surveys). This platform will facilitate obtaining, visualizing and sharing extracted Earth Observation data that will be used to better understand the environmental factors that may influence the distribution and habitat preferences of tracked/surveyed species in order to better identify and predict important marine mammal areas (IMMAs).

Effect of tidal and wind-induced surface currents on the offshore hatchlings dispersion. A comparative study among green and hawksbill turtles on Redang Island, Malaysia.

Mr. Javier Oñate Casado[1], Dr. Mohd Uzair Rusli[1], Dr. David Booth[2]

[1]*Universiti Malaysia Terengganu,* [2]*The University of Queensland*

Sea turtle hatchlings emerge from underground nests at night and rapidly crawl to the sea to swim offshore. Once in the water, hatchling might undergo high predation rates while in shallow water before reaching deeper water where both encounters with predators and mortality rates likely decline. Behavioural studies have described different swimming strategies performed by hatchlings to counter nearshore predation. Dispersal away from nearshore to open ocean is also likely to be influenced by coastal and oceanographic conditions. This study, to be carried out at Redang Island (Malaysia), seeks to compare predation rates of green turtle hatchlings (Chelonias mydas) and hawksbill turtle hatchlings (Eretmochelys imbricata) as they disperse from the same beach (Chagar Hutang Bay) under the same environmental conditions as well as how tidal and wind-induced surface currents influence the early phase of dispersal of these species. These two species show differences in their swimming activity, including a frenzy period, in green turtles, that lasts about 24 while hawksbill turtles remain relatively inactive once they enter the water. An Acoustic Doppler Current Profiler will be used to measure oceanic conditions and direct observations of hatchlings will be taken by kayaking and using GPS loggers to track hatchling swimming paths. The findings of this study will determine how both hatchlings species differ when they migrate offshore in natural conditions as well as whether hawksbill hatchlings in the field behave as they do in the tanks, according to previous studies.

Effects of ocean acidification on the growth of Saccharina japonica in the sporophyte and gametophyte stages

Mr. Oh Ji Chul[1]

[1]*Korea National Park Service*

Aims of this study were examined the effects of global warming and ocean acidification on the sporophyte photosynthesis and gametophyte growth of cultivation algae, Saccharina japonica. Photosynthesis efficiency (Fv/Fm) of sporophytic frond discs (0 1cm) was measured after five day incubation under combination of three pCO2 (380, 750, 1000 ppm) x four temperature (5, 10, 15, 20 C) x two irradiance levels (40, 80 μmol m-2s-1). Growth was estimated with length of female gametophytes after 10 days in culture in the same environmental conditions except two temperature levels of 15 and 20 C. Fv/Fm value of S. japonica sporophyte was 0.63 in 380 ppm, increased to 0.67 in 750 ppm and then decreased 0.55 in 1000 ppm. Also, Fv/Fm values of S. japonica grown in the temperature of 5~15 C (0.63~0.66) were significantly greater than 0.55 of 20 C but no differences were found between irradiance levels. Female gametophytes of S. japonica was 2-3 times long under lower 380 ppm (39.40 μm) and getting grew slow with increasing pCO2 concentration: 15.60 μm in 750 ppm and 12.73 μm in 1000 ppm. At 15 and 20 C, the growth of S. japonica gametophytes were quite similar. In conclusion, photosynthesis of S. japonica sporophyte was enhanced as pCO2 concentration was increased from 380 ppm to 750 ppm. Gametophytes of both species grew well in 380 ppm. The growth of S. japonica gametophytes was not different between temperatures of 15 and 20 C.

Estimating the footprint of pollution on coral reefs to inform management of land-use change

Dr. Chris Brown[1], Dr. Richard Hamilton[2], Mrs. Laura Griffiths[1]

[1]*Griffith University,* [2]*The Nature Conservancy*

It is widely recognised that management of coastal marine ecosystems should encompass human impacts to watersheds. However, effective coastal management has been impeded by a lack of science that can link human activities in watersheds to their impacts on coastal ecosystems. We developed a new Bayesian model that estimates the areal footprint of pollution from gradients of change in coral reef communities. We tested the model on lagoonal coral reefs subject to sedimentation from logging in the Kia region of the Solomon Islands. The model detected a gradient of change from communities dominated by soft-sediment, dead branching coral and massive corals close to logging activities, toward communities dominated by live branching corals further from logging activities. The new model enabled us to estimate that 60% of lagoonal reefs in the region had been affected by historical logging. The widespread impact of historical logging is of concern to local communities, because lagoonal reefs support important fisheries. We then estimated the area of reefs that might have been affected if recent illegal logging had not been halted. We thus show that models of community turnover can be used to estimate the areal impacts of historical pollution and evaluate the benefits of conservation activities for reef ecosystems and associated fisheries.

Exploring the role of citizen science in securing a future for seagrass: a focus on Seagrass Spotter

Dr. Leanne Cullen-Unsworth[1], Dr. Richard Unsworth[2], Mr. Benjamin Jones[1], Mr. Richard Lilley[3]

[1]*Cardiff University and Project Seagrass,* [2]*Swansea University and Project Seagrass,* [3]*Project Seagrass*

Seagrass meadows are complex social-ecological systems that provide a myriad of essential ecosystem services supporting human well-being. But seagrass globally is suffering from degradation and loss, with increasing intensity of threats, and significant lack of data to support appropriate management action. The role of citizen science in data collection for terrestrial ecological monitoring is widely acknowledged as providing significant contributions to science, education, society, and policy formulation. Uptake of citizen science in the marine sector has been slower, but the situation is improving particularly with the help of citizen friendly research tools and technologies. Seagrass meadows are shallow near shore habitats that are easy to access and so lend themselves well to the engagement of citizen scientists. The growth of seagrass citizen science projects in recent years reflects this. Methodological and technological developments have been critical to this expansion, providing a suite of opportunities for citizens to engage with seagrass. Moreover, the increasing use of online tools has created opportunities to collect and submit as well as help process and analyse data. Here we present Seagrass Spotter, a phone application that is working towards supporting the collection of global data on the distribution, health and status of seagrass meadows. Citizen science has helped researchers integrate scientific and local knowledge and engage communities to implement conservation measures that would usually not be economically viable. Here we use Seagrass Spotter as an example to demonstrate how citizen science can contribute to useable global data bases and to securing a future for seagrass.

Fecal waste management: A challenge for coastal settlements in Cameroon

Ms. Azefor Nangah Asah[1]

[1]*ICENECDEV (International Center for Environmental Educcation & Community Development) / ASYOUSED (Assembly of Youths for Sustainable Development and Environment)*

Ocean litter is common to behold by coastal dwellers in some coastal settlements in Cameroon to an extent that fecal waste disposal is perceived as a minor issue in such area.Coastal settlements in Cameroon have a dynamic and multicultural ethnic setting, faced with the undetermined ownership of lands resulting in nomadic ways of life which pay allegiance neither to the land owners nor administrative bodies put in place. There exist no toilet facilities to ensure the personal hygiene of inhabitants resulting to the use of specific portions of the beaches as public toilets whereby thousands of humans pass out feces. During recent studies by various local organizations, the inhabitants expressed doubts of this act causing any harm on the marine ecosystem as they counter that heavy tides always wash away all the human waste whereas they are faced with huge quantities of solid waste brought in by the tides every morning. Contrarily, the act of depositing human waste along the shores has various disadvantages both for the settlers and marine life. The presence of fecal waste scares away fish mongers, scares away tourists, contaminates nearby freshwater bodies and destroys / distorts habitat for marine life.In order to help these coastal dwellers in Cameroon to contribute towards the conservation of marine ecosystems, there is urgent need for a public stakeholder discussion, education and the establishment of common human waste management facilities in these areas to facilitate knowledge dissemination and action for the conservation of marine ecosystems and human sustainance

---

Filtering Out the Bad From the Good: Sponge Effects on Coral Reef Microbes

Ms. Asha Goodman[1], Dr. Shaili Johri[1], Dr. Elizabeth Dinsdale[1], Mrs. Brandie White[1]

[1]*San Diego State University*

The local and global decline in coral reefs is concurrent with the growth of algae. Algal-dominated coral reefs are characterized by an increase in microbes, including opportunistic pathogens. The flow of organic matter in coral reefs is controlled by the "sponge-loop," whereby sponges consume and transform microbes into complex forms of carbon that become available to benthic organisms. Here we investigate whether sponges determine the structure and abundance of microbial communities in reefs with differing coral cover and subsequent microbial abundance. We compared the microbial community entering the sponge with the water exiting the sponge to show the differential consumption microbes by the sponge. We identified the effect sponges have on microbial communities by comparing the number and type of microbes outside and inside caves on coral reefs with either high or low coral cover. Microbial cell abundances in the caves of algae-dominated and coral-dominated coral reefs were 1,029,050 ($\pm$ 48,982) and 748,853 ($\pm$ 127,234) microbes per milliliter respectively, with an average difference of 280,197 ($\pm$ 27,862) microbes per milliliter, revealing the amount of microbes sponges are capable of filtering possesses an upper limit. After visualizing the metagenomics data using an MDS plot, sponges in algal-dominated reefs were shown to filter microbes selectively, propagating lower microbial diversity. Our findings suggest sponges cannot reverse the initial shift from coral to aglae-dominated coral reefs and subsequent increase in microbial abundance. Therefore, maintaining the integrity of the whole ecosystem is important and conservation efforts should focus on preventative measures for coral reef preservation.

Fish Larvae Diversity and Correlation with Whale Shark Based on Bongo net Sampling in the Whale Shark (Rhincodon Typus) Habitat of Cenderawasih Bay and Probolinggo, Indonesia

Dr. Mohammad Mukhlis Kamal[1], Ms. Diena Ardania[1]

[1]*Bogor Agricultural University*

This study present potential food of whale shark especially fish larvae, which is one of the main food of whale shark. Sampel was collected from Cenderawasih bay (October to December 2016) and Probolinggo (March and August 2017). Based on the result, in Cendrawasih bay there were 112 larvae fish consist of 17 families. The dominated was Engraulidae (54%), followed by Lutjanidae (9%), Bremacerotida (5%), In Probolinggo there were 139 larvae fish consist of 13 families. The dominated was also Engraulidae (42%), followed by Lutjanidae (19%), Gerreidae (10%). Between Probolinggo and Cenderawasih bay both of them dominated by Engraulidae and Lutjanidae. Based on the spearman correlation in Probolinggo March 2017, fish larvae Engraulidae and Lutjanidae have correlation to occurence of whale shark in Probolinggo, Contradiction with Probolinggo, result shown that in Cenderawasih bay whale shark does not has correlation with fish larvae. The result shown that Engraulidae and Lutjanidae are one of the most potential food for whale shark. In the future this data can be used for the future research about the main food of whale shark in Indonesia.Keyword: fish larvae, habitat, whale shark, Indonesia

---

Fisheries assemblage and exploitation patterns in the seagrass meadows of Gazi Bay, Kenya.

Mr. Peter Musembi[1], Dr. James Kairo[2], Dr. Bernerd Fulanda[3]

[1]*Pwani University/Kenya Marine and Fisheries Research Institute,* [2]*Kenya Marine and Fisheries Research Institute,* [3]*Pwani University*

Fisheries are important to coastal communities supporting livelihoods through provision of food and income. A significant proportion of marine fisheries are associated with seagrass meadows. High productivity and structural complexity within seagrass support high fisheries diversity. Seagrass meadows also provide a wide range of other ecosystem services such as erosion protection and carbon sequestration. The carbon sequestration ability of seagrass meadows provide an opportunity to use them for climate change mitigation strategies. This study assessed the assemblage of fisheries and their patterns of exploitation in seagrass meadow at Gazi Bay, South coast, Kenya. Catch assessment from fishing activities and in depth interviews with users in the bay was carried out to determine species diversity and biomass and seagrass usage. Fisheries in seagrass meadows within the Gazi Bay are exploited using basket traps, hand lines, drag nets and gleaning. A total of 2200 individual consisting of 26 finfish, 4 molluscs, 1 crustacean and 2 echinoderms were sampled from catch assessment. Leptoscarus vaigiensis was dominant species overall as well as in basket traps accounting for 36.6% and 51.4% respectively. Catch from gleaning the second dominant exploitation method was dominated by Conger cinereus cinereus (33.3%). Highest diversity and biomass was recorded in basket traps. Seagrass meadows in Gazi Bay provided a wide array of ecosystem services such as fishing ground, nursery ground and substrate for seaweed farming. This study provided baselines for fisheries diversity and livelihoods as additionality for potentially incorporating seagrass ecosystems in carbon payment scheme.

Fisheries dependent biodiversity survey of Chondrichthyes in Gujarat, India

Ms. Anjani Tiwari[1], Mr. Charan Kumar[2], Mr. Farukhkha Bloch[2], Mr. Jitesh Solanki[3], Dr. Shaili Johri[4]

[1]*Maharaja Sayaji Rao University of Baroda,* [2]*Wildlife Trust of India,* [3]*Junagadh Agricultural University,* [4]*San Diego State University*

The Arabian Sea Region (ASR) is one of the most productive marine area and supports chondrichthyan species-sharks, rays, skates and chimeras. Western India falls in the ASR and contributes heavily to India's chondrichthyan exports. Here, condrichthyans are targeted by fisheries and caught as bycatch. Chondrichthyes, play an ecologically important role in top-down regulation and structuring of marine ecosystems. Their slow generation time can make population recovery difficult under heavy fishing pressure. Their decline can negatively affect other commercial fisheries and cost millions of livelihoods. There has been a reported decline in the abundance of chondrichthyan catches in India in spite of increased fishing pressure. This likely indicates a decline in population abundance of Chondrichthyes resulting from intense unregulated fishing, habitat loss, and the shark fin trade. It is thus imperative to prioritize sustainable fishing practices and conservation of chondrichthyan populations. The western Indian state of Gujarat has the largest contribution (~40%) to India's chondrichthyan exports, thus making it a priority area for conservation and management of Chondrichthyes. Our objective is to study the seasonal biodiversity of chondrichthyan species found in Gujarat and to determine key ecological habitats through fisheries dependent sampling. Four main ports are chosen as field sites for this study. Seasonal sampling is done at each of these four sites in spring, summer, fall, and winter. Samples are species identified through molecular analyses. Our research has identified previously unidentified species. We expect these findings to help generate species distribution estimates and prioritize marine protected areas.

Fishing Gears Management in the Sultanate of Oman

Mr. Manaa Alhabsi[1]

[1]*Agriculture & Fisheries Development Fu*

The fisheries in the Sultanate of Oman characterized as small scale. The research is represented through project to manage and develop fishing gears in Omani through introducing new semi automatic long liner system. The main objective of the study was to estimate the new system efficiency for fishing in terms of the coast, time and effort saving, in addition to safety.

The work methodology was to based on training program for predefined fishermen based om specific requirements, some of them were selected based on the scores that got and retrain them to make sure that they well familiarize on the new system use.Through the preliminary and advanced fishing experiments on board fishing boats, there were many remarkable findings. The new system saves the preparing and fishing trip time by 30%, increases the catch value by 25%, saves the operations costs by 15% and the hazards decreases by 80%.

As conclusion, the introduction of the new system (semi automatic long liner) will improve the management of long line fishing in Oman. It will contributes in increasing the fishing efficiency through, time and costs saving, increase the quantity and value of the fishing and increase the safety of the operations.

Global metapopulation viability analysis determining relative extinction risk among threatened seabirds

Ms. Diana Ruiz[1], Dr. Donald Croll[1], Dr. Bernie Tershy[1], Dr. Timothy Tinker[1], Ms. Kelly Zilliacus[1]

[1]*University of California Santa Cruz*

Population viability analyses are frequently used to assess and manage threatened species. However incorporating metapopulation structure is an important, often lacking component. Here we apply a metapopulation viability analysis (mPVA) to all globally threatened seabirds. We incorporate demographic population data at the metapopulation level and including threat impacts, to formulate a stage-structured, stochastic mPVA. We apply to this mPVA to the world's 98 threatened seabird species to determine their relative extinction risk and help focus conservation efforts on the species at highest extinction risk. We identify and compare our results with existing extinction risk databases such as the IUCN RedList. Our results highlight the importance of including metapopulation structure in predicative modeling of threatened species and demonstrate the scalability of modeling extinction probability.

Gone for the winter: Finding the lost North Pacific right whale (Eubalaena japonica) calving grounds

Dr. Caroline Good[1], Dr. David Johnston[1]

[1]*Duke University Marine Lab, Duke University*

Despite decades of protection, the North Pacific right whale (Eubalaena japonica) remains critically endangered and the location of the whales' calving habitat remains unknown. We set out to identify the location of these winter calving grounds in the western North Pacific based on the habitat preferences of right whales calving in the Atlantic Ocean. We employed a previously developed log likelihood habitat model based on habitat conditions associated with right whale calf observations. Our evaluation focused on three habitat parameters: water depth, sea surface temperature and surface roughness. The model demonstrated that right whales prefer calving habitat that is characterized by shallow (mean 15.23m $\pm$ 0.19), cold (14.21C $\pm$ 0.07) and calm waters (-25.04db $\pm$ 0.08). Application of this model to the eastern North Pacific region yielded potential calving habitat along the coast of China and northern coast of Vietnam. The most robust habitat identified by the model occurred along coastal areas in the northern Gulf of Tonkin and to a lesser extent off Fujian Province in China. This region offered winter habitat that was consistent with the shallow, cold and calm waters preferred by right whales in other parts of the world. Limited historic records from these regions suggest right whales were once present, but additional aerial, shipboard or acoustic surveys are needed to verify if right whales currently use these areas for calving in winter.

Identifying climate change resilience factors for a coral reef in Sri Lanka

Mr. Nishan Perera[1], Mr. Akshay Tanna[1], Ms. Rosalind Bown[1]

[1]*Blue Resources Trust*

Coral cover and physical parameters at Kayankerni reef in eastern Sri Lanka were monitored to identify resistance and resilience factors related to coral bleaching. Rapid surveys in 2015 indicated bleaching of corals in shallow water with no significant mortality, and transect surveys in 2016 and 2017 recorded a live coral cover of approximately 38% dominated by the genera Acropora, Echinopora, Montipora and Porites. While 57% of corals showed signs of bleaching during the

2016 coral bleaching event, almost all corals appeared to have recovered by late June. Water temperature data indicated daily and weekly temperature fluctuations of approximately 1C - 2.5C throughout the calm season, suggesting natural variations in water temperature. Resilience may be enhanced by the presence of Montipora aequituberculata and Porites rus that are known to be more resistant to coral bleaching. Some of these corals have also colonized old dead Acropora stands, possibly as a result of a phase shift following a previous mortality event. Water temperature tends to reach a high around late May when seas are at their calmest. However, the onset of strong localized winds by mid June results in rougher conditions with lower temperatures and UV radiation. Survey results and general observations indicate that resilience to coral bleaching at Kayankerni reef is influenced by the time of onset of bleaching, local wind conditions, coral community structure, adaptation to regular temperature variations, and possible community phase shifts towards more resilient coral species.

Identifying the Format, Issues, and Delivery Methods for a Scalable "Blue Economy Toolkit"

Ms. Jennie Dean[1], Dr. Peter Kareiva[1]
[1]*UCLA*

Small island developing states (SIDS) are often challenged by structural barriers to economic development, dependence on official development aid, and increasing pressure on their natural resources by global phenomena such as climate change. UCLA's Institute of the Environment and Sustainability and the Waitt Foundation are embarking on a multi-year project to try to address these barriers and illuminate strategies for sustainable development in SIDS.Approaching this issue requires an examination of technical, administrative, legal and financial capacity. What existing data sets or tools can help SIDS quantify the services provided by their natural ecosystems? What are the barriers that prevent SIDS from accessing alternative funding sources? Are there policy constraints that are prolonging their dependence on official development aid? The project seeks address these questions and provide SIDS with an evaluation framework they can apply domestically along with case studies, lessons-learned and other supporting documentation to help them along their path to economic independence. We are in the beginning stages of the project so the poster will allow us to share our objectives with the marine conservation community and identify potential resources we could draw upon or collaborators we could connect with. We will sketch the "products" we anticipate from this project and invite input from poster viewers on those products.

Impacts of anthropogenic activities on Avian Composition in Awba Dam University of Ibadan, Southwest Nigeria

Dr. Samson Ojo[1]
[1]*University of Ibadan*

Awba dam (AwD) Reservoirs, habitat for several species of wildlife and spot for tourist attraction. It was dredged for ecotourism development during 2013. This paper assessed the effects of dredging on the present physico-chemical characteristics of the water, trace metal levels, and avian composition within the dam site.

Habitat assessment, physicochemical parameters assessment and bird survey was investigated. Stratified random sampling was used to allocate 7 transects into within the dam site. Bird surveys were carried out morning and evenings. (6:00-10:30 hrs and 16:00-18: 30 hrs). Birds heard and seen were recorded. These were monitored twice for two (2) wet and two (2) dry seasons of 2013-2014 respectively. Data obtained were analyzed using descriptive and inferential statistics.

Values of physicochemical parameters of the dam observed ranged as follows: water temperature, 24-26C, transparency 0.0-0.3m, TDS 143.2-151.5mg/L, conductivity, 289.2-391.5μmhos/cm respectively. The mean rainfall for 2013-2015 was 1550mm, while mean air temperature was at 22-23C respectively. Zn was (-0.641), Cu was (0.788) while Fe was (0.797) respectively. A total of 18 species of birds comprising of 11 families and 6 orders were recorded during this survey. These are seven (7) carnivores (38.8%), three (3) frugivores (16.6%), five (5) granivores (27.7%), two (2) insectivores (11.1%), and one (1) nectarinivores (5.55%) respectively. The AwD had no worker/staff as at the time of documenting the findings.

Impact of dredging has taken a heavy toll on the environmental indices as well as the flora and fauna species diversity with over sixty (60%) of the species lost.

Impacts of marine debris on coral communities at Hin Chalam, Chonburi Province

Ms. Wanlaya Klinthong[1], Mr. Sittiporn Pengsakun[1], Mr. Watchara Samsuvan[1], Mrs. Naengnoy Yossundara[2], Mr. Somyos Yossundara[2], Dr. Thamasak Yeemin[1]
[1]*Marine Biodiversity Research Group, Department of Biology, Faculty of Science, Ramkhamhaeng University, Huamark, Bangkok,* [2]*Save Our Sea Foundation*

Located at the south of Ko Samaesarn, about 15 km offshore, Hin Chalam is one of the most famous dive sites in Chonburi Province, the Inner Gulf of Thailand. A small rocky island has been used for military practices of the Royal Thai Navy. The healthy coral communities harbor high diversity of marine organisms are found in the depth of 5- 28 m. In this study, we presents the possible impacts of marine debris on coral reefs. Data collection was conducted through a reef cleanup program led by a volunteer group for conservation of Thai waters (Save Our Sea) and researchers during 21 - 22 November 2015. The results from the cleanup activities showed that all marine debris were abandoned fishing gears (about 1,000 kg) which can be divided into four categories, i.e. fishing nets (95%), fish hook lines (3%), squid hook lines (1%) and fish traps (1%). The negative impacts of abandoned fishing nets on corals were partial colony mortality (Porites lutea, P. rus, Pocillopora damicornis, Acropora divaricata, A. millepora, A. hyacinthus, A. valenciennesi, Pavona decussata and Platygyra sinensis), fragmentation (P. damicornis, A. divaricata, A. millepora, A. hyacinthus, A. valenciennesi, P. decussata) and white band disease (P. lutea) . Moreover, some fishes, crabs, sea anemones, sea urchins and several macrobenthic invertebrates were caught by the abandoned fishing nets.

Improving fisheries stock assessments through scientific advice: Comparison of national and international fisheries peer review systems

Dr. Manoj Shivlani[1]
[1]*Center for Independent Experts/NTVI*

Fisheries stock assessments are an essential component of fisheries systems, providing key and timely fisheries advice related to allowable catches, effort, and stock status and conservation. To make certain the stock assessments utilize the best available science, national and international fisheries systems have increasingly adopted peer review approaches to evaluate findings and advice, to develop internal capacity, and to build confidence among stakeholders and managers. This study evaluates how peer review is built into and

used across a series of national (US, Canada, EU, Australia, and New Zealand), international (tuna regional fishery management organizations, The Convention on the Conservation of Antarctic Marine Living Resources), and private (Marine Stewardship Council) systems. Peer review factors considered include the timing, type, and frequency of peer review, selection processes, and output consideration, among others. It is expected that the study findings will both identify the range of fisheries peer review systems across several systems and assist other systems in selecting those factors that may best be applied in establishing sustainable marine conservation approaches.

Improving fishing practices through fishing community participation: testing lobster traps in Peru

Ms. Paola Cisneros[1], Mr. Manuel Vera Mateo[1], Ms. Kelly Ortega-Cisneros[2]

[1]Instituto del Mar del Peru, [2]Department of Ichthyology and Fisheries Science, Rhodes University

The rocky lobster Panulirus gracilis population reaches its southernmost distribution in South America in the north region of Peru (Tumbes). This artisanal fishery faces several challenges related to a lack of regulation and management measures such as the use of bottom trammel nets, absence of minimal size, etc. The objectives of this research were to evaluate the performance of a trap that allows the capture of lobsters in a selective and friendly manner. Traps with one and two entrance doors were tried in experimental tanks and at sea. Local lobster fishermen participated in the trials at sea testing the traps during their regular fishing activities. The tank trials showed that although there is no significant difference between catching lobsters using traps with one or two entrance doors (T test, t=-0.872, p=0.386), there is a significant difference in the size structure between the captured lobsters and the lobsters found outside the traps (ANOVA, F=22,060, p=0). The results show the effectiveness of the trap to catch lobsters under controlled environments, while lobsters were not captured during the tests carried out at sea. Fishermen indicated they would change the current fishing gear for another one that ensures the sustainability of the resource as long as it is effective and/or secure a fair price. It is necessary to conduct more trials at sea to include other factors that cannot be evaluated in experimental tanks, and to include lobster fishermen's traditional knowledge in the design of other trap models.

Internationally endangered species Sea Horse habitat conservation management

Mr. Kim Jinseok[1], Dr. Jeong Juyeong[1]

[1]Korea National Park Service

The seahorse(the genus Hippocampus), an internationally endangered species, is a coastal sedentary fish that has low mobility and small home range due to its morphological characteristics without caudal fin as compared with general fish. In 2012, KNPS(Korea National Park Service) confirmed that seahorse appeared in Zostera marina community of seaweed in Soan island, Dadohaehaesang National Park, but marine ecosystem was disturbed due to neglect of useless fishing tools by fishing activity. To conserve seahorse communities, Soan island seahorse habitat, 1,000 zostera marinawere transplanted in 2016 and as a result of continous monitoring, the survival rate stood at 84%. In 2017, the waste fishing nets was removed with local residents and volunteers and KNPS also measured the area of Zostera marina by drone. According to the results of the survey, the area of 1.75 km2 out of 3.7 km2 was found to occupy 46% of the total area.

Introducing GOSSIP (General Ocean Survey and Sampling Iterative Protocol)

Dr. Lucy Woodall[1], Dr. Dominic Andradi-brown[2], Prof. Andrew Brierley[3], Dr. Malcolm Clark[4], Dr. Douglas Connelly[5], Dr. Robert Hall[6], Dr. Kerry Howell[7], Dr. Veerle Huvenne[5], Dr. Karin Linse[8], Dr. Rebecca Ross[7], Prof. Paul Snelgrove[9], Dr. Paris Stefanoudis[10], Dr. Tracey Sutton[11], Dr. Michelle Taylor[12], Dr. Thomas Thornton[1], Prof. Alex Rogers[1]

[1]University of Oxford/ Nekton, [2]World Wildlife Fund-US, [3]University of St Andrews, [4]National Institute of Water & Atmospheric Research, [5]National Oceanography Centre, [6]University of East Anglia, [7]University of Plymouth, [8]British Antarctic Survey, [9]Memorial University of Newfoundland, [10]Nekton, [11]Nova Southeastern University, [12]University of Essex

In marine science there are almost as many sampling methods as there are researchers. Our individual research questions are fundamental to how we conduct our research and the data we collect; however, understanding the patterns of diversity of ocean life over different temporal and geographic scales requires extensive data both biological and environmental. Therefore, to address these questions, extensive collaboration and comparable data are required. GOSSIP (General Ocean Survey and Sampling Iterative Protocol) is a multidisciplinary framework for generating globally comparable data for biological communities, which has been designed as a guide on how these data can be collected. In this presentation we will share the 20 parameters that have been chosen, explain why each is considered important and how the framework could be utilised. GOSSIP is intended to change over time as technology and techniques evolve. Alongside this recently published paper, we have produced a technical guide that simply pulls together data on current protocols and indicates where further information can be found.

Investigating Preferred Prey and Habitat Use of Blue Whales from Sri Lankan Waters

Dr. Lindsay Porter[1], Dr. Meng Yao[2]

[1]The University of St. Andrews, [2]The University of Peking

Pygmy blue whales (Balaenoptera musculus brevicauda) are recorded year round off the coast of Sri Lanka, northern Indian Ocean. Photo ID studies indicate that a small population of 40-50 individuals are resident year round with other individuals occurring seasonally. The predominant behaviour recorded in the area is feeding. An analyses of 20 faecal samples, collected between 2014-2017, indicate that several species of prey may be important, including Meganyctiphanes spp., Stylocheiron spp. Euphausia spp. and Thysanoessa spp, which predominate at various depths but are concentrated over the 1000m isobar. A major shipping lane also traverses the 1000m isobar and whales are often seen surfacing close to ships. The overlap of critical feeding habitat with a busy shipping lane has been highlighted as a cause for concern and risk of collisions between whales and ships should be mitigated.

Irrawaddy dolphins as flagship species for wetland conservation: The Bago-Pulupandan MPA experience

Mr. Manuel de la Paz[1], Dr. Romeo Teruel[1], Dr. Andrea Barcelona[2], Mrs. Jessica Pacalioga[1], Dr. Virgilio Aguilar[1], Dr. Rowena Banes[1]

[1]University of St. La Salle, [2]Barcelona Environmental Consultancy

The Negros Occidental Coastal Wetlands Conservation Area is the Philippines' seventh and newest Ramsar Site. It hosts three globally threatened species of marine turtles, namely the endangered green sea turtle, the endangered hawksbill turtle, and the vulnerable olive ridley turtle; more than 72 species of migratory birds, and the endangered Irrawaddy dolphin (Orcaella brevirostris). Here, the Irrawaddy dolphins are found in an estuarine habitat outside the Bago River where they overlap with important fishing grounds of 6 coastal villages from the Municipality of Pulupandan and Bago City. As coastal species, the Irrawaddy dolphins are threatened by net entanglement, boat collisions, pollution, habitat degradation, and the Philippine government's plan to build a bridge that dissects their core habitat. This prompted an alliance of local government units, fisherfolk, large corporations, and the academe to initiate the establishment of local resource management not just to conserve the dolphins, but the entirety of the ecosystem as well. In partnership with the Deutsche Gesellschaft fur Internationale Zusammenarbeit (GIZ) GmBH and the Department of Environment and Natural Resources, the University of St. La Salle, through the Protected Areas Management Enhancement Program, launched multidisciplinary researches that formed the baseline data for the establishment of the marine protected area. Research components included socio-economic profiling, stakeholder analyses, community perceptions and awareness, fisheries monitoring, and dolphin monitoring. The project trained more than 500 participants, including village leaders, fisherfolk, school teachers, and businessmen, on how to sustain the first locally managed marine protected area for dolphins in the region.

Key elements for managing whale shark tourism in the Gulf of California.

Dr. Dení Ramírez-Macías[1], Ms. Maritza Cruz Castillo[1], Mrs. Gabriela Moreno[2], Mrs. Lizbeth Meza[3], Mrs. Georgina Saad[4], Dr. Jorge Cáceres[2]

[1]Tiburón Ballena México de Conciencia México, [2]Secretaría de Medio Ambiente y Recursos Naturales, [3]Universidad del Medio Ambiente, [4]World Wildlife Fund

More than 10 years of monitoring have been a key factor in establishing La Paz Bay as a critical habitat of the whale sharks where an increasing tourist industry exists. Problems occurred as a result of increased boat traffic coupled with a lack guidelines to perform the activity, patrolling and enforcement. The first management plan was generated in 2006 and it remained permanent and without change until 2016, although the number of authorized boats increase from 26 in 2006 to 109 in 2013. Since 2009, the tour operators have been trained and a dissemination program was designed with the aim of communicating a code of conduct focusing on private boats. While the monitoring from 2004 to 2016 showed that up to 64% of sharks has been hit by boats, the monitoring also showed changes in abundance and seasonality dynamics that have to be considered on the seasonality of tour operators and in the carrying capacity study. In order to reduce the number of sharks affected by boats, government actions were taken based on the information from the monitoring and resulted in modifications to the current management plan: 1) Adjustment to the polygon, 2) Establishment of effective carrying capacity, 3) Changes in the tourist seasonality, 4) Implementation of a satellite tracking system, 5) Patrolling and 6) Integrated training and coaching strategies for service providers. These modifications and enforcement actions started in the 2017-2018 season. The success of the management plan will be measured with the fresh injury analysis.

Les Zones Potentielles pour la Conservation Marine à Madagascar pour l'atteinte de la promesse de Sydney

Mr. Rabetrano Tsiky[1]

[1]REBIOMA/WCS

Les écosystèmes marins et côtiers de Madagascar abritent une biodiversité marine et côtière exceptionnelle. Pourtant, face aux différentes menaces actuelles, il est nécessaire détendre les actions de la conservation marine et côtière, y compris la protection du littoral et de la pêche qui jouent un rôle dans le développement économique national en contribuant de manière significative aux moyens de subsistance locaux. En novembre 2014, lors du Congrès mondial des parcs à Sydney, Australie, Son Excellence Monsieur le Président de la république a annoncé que Madagascar triplera les aires marines protégées existantes dans les dix prochaines années. Avec cette déclaration présidentielle, connu sous l'appellation de "Promesse de Sydney", la communauté de la conservation marine et côtière à Madagascar engagera un processus, en collaboration avec le gouvernement sur les modalités pratiques de sa mise en oeuvre. Des ateliers et réunions techniques ont été organisés pour faire participer les institutions étatiques (Ministère chargé de la Pêche, Environnement, mines, hydrocarbures, ...), ONGs, associations et les opérateurs économiques dans la définition de la vision et les objectifs pour la conservation marine à Madagascar. Et des demandes de collaborations ont été effectuées en vu de mettre en place des échanges de données et d'expériences.Le résultat ainsi obtenu nous montre les zones potentielles pour la création des nouvelles Aires Marines Protégées à Madagascar, qui tient compte de la connectivité et la représentativité des espèces et leurs habitats.

Lessons learned from the impacts of intensive tourism on coral reefs at Ko Tachai, the Andaman Sea

Ms. Juthamart Putthayakool[1], Dr. Thamasak Yeemin[1], Mr. Prarop Plangngan[2], Dr. Makamas Sutthacheep[1], Mr. Watchara Samsuvan[1], Mr. Sittiporn Pengsakun[1], Ms. Monthaphat Thummasan[1], Ms. Kanwara Sangmanee[1]

[1]Marine Biodiversity Research Group, Department of Biology, Faculty of Science, Ramkhamhaeng University, Huamark, Bangkok, [2]Phuket Marine National Parks and Protected Areas Innovation Center, Department of National Parks Wildlife and Conservation, Phuket Province, Thailand.

Ko Tachai, Mu Ko Similan National Park, are among the most intensive tourism islands in the Andaman Sea where the number of tourists exceeded the carrying capacity of the island. The aim of this study is to assess tourist activities, tourism management and coral reef conditions at certain reef sites of Ko Tachai in order to determine impacts of tourism activities. Prior to an intensive tourism, the coral reef degradation at Ko Tachai had been occurred due to coral bleaching events, the 2004 Indian Ocean Tsunamis, outbreaks of crown-of-thorns starfish and exposure during low tides of the shallow reefs. Then, the intensive tourism activities resulted in coral damages from boat anchors, boat groundings, tourist walking to the beach and sediment. In addition, sewages from accommodations on the island and tourist boats and large volumes of solid waste impacted the reefs. We also found coral fragments at eh shallow reef site, most of which were the blue coral Heliopora coerulea and Porites cylindrica. The appropriate management action plan and effective enforcement of regulation are urgently required to ensure the sustainable tourism in Mu Ko Similan National Park. Fixation of the abundant broken but living coral fragments to substrates to increase their survival is also highly recommended. This lesson reflects the impacts of mass tourism on coral reefs while a needs for proper tourism management plan are highly required.

Leveraging Enterprise Partnerships for Coral Reef Conservation Outcomes

Ms. Kathryn Bimson[1], Dr. James True[2], Ms. Ponchanok Weeriyanun[1], Mr. Chieh Lin[3]

[1]Prince of Songkla University, Hat Yai, [2]Centre for Biodiveristy in Peninsular Thailand, Prince of Songkla University, Hat Yai, [3]Ludwig Maximilian University of Munich

As the health of coral reefs continues to decline worldwide, scientists must begin to broaden their engagement with stakeholders in marine conservation and restoration. Tropical beach destinations, such as Phuket, Thailand, depend on public perception of healthy coral reef ecosystems to continue to attract international tourists, whose visits constitute a significant proportion of the country's GDP. A large proportion of high disposable income visitors patronize corporate hotels, lured by the promise of exclusivity and highly aesthetic surrounds, and thus these businesses have a vested interest in protecting the marine resources surrounding their properties. By fostering mutually beneficial partnerships between NGOs, government agencies, and private enterprises, the agencies charged with protecting marine resources increase their potential scope for conservation activities. Highlighting conservation partnerships with local groups will also serve to increase the resorts' Corporate Social Responsibility (CSR) profile, a factor that is increasingly considered by travelers in trip planning. Reef rehabilitation is historically perceived as an expensive and highly technical endeavor, however this approach aims to scale-up low-cost models that have previously been proven effective on the community eco-tourism scale. Here, we analyze the strengths and weaknesses of traditional systems and highlight the effectiveness of de facto enterprise co-management in reducing fishing pressure, pollution and physical damage to corals. The goal is development of a standard model for corporate hotel house reef conservation engagement that, once proven in implementation, can be easily exported to similar localities whose tourism is heavily dependent on marine ecosystem goods and services

---

Linking forecasted effects of climate change on marine species ranges to cross-jurisdictional fisheries management

Dr. Stephanie Green[1], Dr. Elliott Hazen[2], Dr. Larry Crowder[3]

[1]Stanford University, [2]NOAA Southwest Fisheries Science Center, [3]Stanford

Climate-driven changes in species distribution are likely to shift fisheries species across management and regulatory boundaries. Yet current ecosystem modelling tools applied to forecasting target species abundance and distribution require detailed data on species interactions and diets that are not available at sufficiently fine spatial and temporal scales, limiting the accuracy of forecasts of fisheries distribution in the future. Using commercially targeted fishes in the eastern Pacific as a test case, we address these challenges by: (1) developing a spatial modeling tool that integrates trait-based biotic interactions into forecast of species range and abundance change, and (2) synthesizing potential shifts in jurisdictional authority that could accompany shifts target species distribution and abundance. Our work offers a flexible method for anticipating adaptive cross-jurisdictional management options for multiple fisheries that are most vulnerable to ongoing ocean climate change.

Local Knowledge of the Marine Environment to Promote Ocean Health and Sustainable Livelihoods in Suriname

Mr. Desire Simons[1], Ms. Monique Pool[1]

[1]Green Heritage Fund Suriname

The high productivity of Suriname's marine environment, a constituent of the North Brazil Shelf Large Marine Ecosystem, has been exploited by unregulated fishing, and is increasingly threatened by offshore and nearshore natural gas prospecting, coastal degradation from sand mining, and pollution from inland sources. Consequently, the unique, and sparsely explored, biodiversity of Suriname's marine environment, and the livelihoods and food security of Surinamese marine resource users are under threat. The Green Heritage Fund Suriname, WWF Guianas, and the Suriname Forest Service's Nature Conservation Division have initiated a marine spatial planning (MSP) process, through an EU-financed project to address the challenges the region faces to effectively and fairly manage its marine environment and biodiversity. Marine resource users and national regulatory agencies in Suriname have expressed support for the MSP process. Local knowledge will be gathered, catalogued and shared, and targeted capacity building with marine resource users and national regulatory agencies will be initiated to empower key ocean users and protect livelihoods, whilst also safeguarding biodiversity and enhancing food security. Enhancing knowledge of the marine environment and the capacity of marine resource users and national regulatory agencies will facilitate fair and sustainable management and coordination of human activities in the marine environment of Suriname.

Making the case for participatory research in ENGO practice

Ms. Shauna Mahajan[1]

[1]World Wildlife Fund

In an increasingly complex world, conservation planning and evaluation approaches are evolving to address the diverse challenges modern society presents. Part of this evolution includes developing meaningful ways to bring diverse perspectives, especially those of marginalized groups, into planning, implementation, and evaluation processes. Such a shift would create forums for both participation and equitable decision-making, and in certain cases, may translate to more effective conservation implementation and results. Participatory research methods and tools both from academia and sectors such as development and public health have been shown to foster co-production of knowledge, social learning, and trust building, all helping to create opportunities for more equitable decision-making based on local knowledge. While participatory research has been applied in some conservation cases, there has been little mainstreaming of participatory research practice and use in larger environmental NGOs. Thus, there is ample room to learn from what has already been done that can help shape the future trajectory of participatory research practice in ENGOs. Here, we conduct a review of participatory research approaches from the health and development sectors by exploring academic literature, reports, and toolkits produced by health, development and conservation organizations. Based on this review, we highlight approaches that demonstrate promise for conservation, particularly for marine conservation. Based on insights from the review, we also discuss the site level and institutional challenges and opportunities that may come with incorporating participatory research into environmental NGO practice.

Marine conservation with fisheries community at Kalpitiya Sri Lanka

Dr. Lalith Ekanayake[1], Mrs. Yamuna Kumari Karunarathna[1]

[1]Bio Conservation Society (BCSL)

Kalpitiya peninsula located in Gulf of Mannar which one side is sea and other side is Puttalam lagoon. It is biodiversity rich area including sea turtles and other marine mega fauna such as dolphins, whales & dugongs. Moreover, various habitats such as coral reefs, seagrasses and also largest mangrove coverage in Sri Lanka. Bar reef home to 156 species of coral and 283 species of fish. Fishing is the major industry in the area. Foraging sea turtles often entangled causing damage for each entanglement for fishing nets. In response, some fishers either beat the turtles' heads until they are rendered unconscious, or hack off the turtles' body parts to make disentanglement easier. Fishermen are highly contributing to destruct marine mega fauna and almost all the coastal biodiversity in the area. So the aims and objective of the BCSL programmes to increase the education and awareness on coastal biodiversity & conservation, legislation and law enforcement among the coastal communities. Awareness programmes were conducted at schools and villages for the school kids and community members. Several field activities such as beach cleaning and mangrove replanting were conducted with fisheries communities. Community members (both adult & schoolchildren) were actively participated for the above field activities and they were highly enthusiastic to do the field activities. Cotton bags were distributed to reduce ocean plastic pollution. We experienced that field activities are better than indoor awareness lectures for marine conservation. This abstract will be discussed progress of the programmes from 2017 to 2018.

Marine science for the masses: Community-based fisheries monitoring in the Lakshadweep Islands

Mr. Ishaan Khot[1], Dr. Kartik Shanker[2], Mr. Mahaboob Khan[2], Ms. Mahima Jaini[2], Dr. Naveen Namboothri[1]

[1]Dakshin Foundation, [2]Dakshin Foundation, Bengaluru, Karnataka

Fishing is one of the major factors modifying marine ecosystems worldwide. While marine science can play a major role in informing sustainable fisheries management, conventional methods of doing science are generally exclusive and restricted to academia, reaching out occasionally only to policy makers. Fishing communities, the primary drivers of marine resource utilization, are usually left out as well. Consequently, such science often fails to translate to on-ground change.To bridge this disconnect, we initiated a community-based fisheries monitoring programme in the Lakshadweep Islands, India. The pole and line tuna fishery practised here is inherently sustainable and supports many livelihoods, but faces management challenges due to resource crises, market dynamics and a data-poor environment. By involving fishers in voluntary, regular and long-term monitoring of pole and line fishery dynamics, our work aims to fill data gaps to address local fishery issues. Since 2014, 18% of active fishing boats have participated in this on-going programme. Through protocols co-created with the community, the programme generates high-value data on crucial fishery aspects such as trends in catch, baitfish utilization, fuel consumption, FAD use and limitations to fishing. Interactions with participants reveal that detailed records help them manage fishing operations better. Our work facilitates data generation on large spatio-temporal scales and enables fishers to see fishery patterns over time, empowering them to take actions based on science. It makes marine science matter by attempting to link fishers, scientists and managers through science and is an important first step towards building a framework for fisheries co-management.

Meeting in the Middle-finding common ground for successful marine science communication

Dr. Kristen Weiss[1]

[1]University of California, Santa Barbara

From Twitter trolls to science skeptics, engaging in effective marine science communication requires confronting a number of social, cognitive, and ideological challenges. The knowledge deficit model has long proven insufficient for motivating behavioral change. To engage groups with different perspectives and world views, science communicators must frame conservation messages so that they better reflect the concerns of the groups they hope to reach. Fortunately, many tools and methods exist to bridge the divide between different audiences and find common ground. We present five key considerations for scientists aiming to engage disparate audiences - Resonate, Empathize, Ask, Consider, and Honor (REACH) - and share examples of each based on our personal experiences in the field of science communication and outreach, drawing from in-person and virtual interactions. We show how tailoring marine conservation messages to resonate with the values and concerns of target audiences does not reduce the efficacy of these messages; rather, it makes conservation more relevant and less controversial. Key values that help frame the importance of conservation include concern for the health and well-being of oneself or one's family, community safety, and freedom of choice. Effective messaging combined with a sense of individual empowerment can lead to positive shifts toward conservation action while simultaneously breaking down barriers between conservation science and wider society.

Multi-stream Capacity Building for Marine Conservation

Ms. Jennifer Koss[1], Mr. Scot Frew[2], Mr. Jason Philibotte[2], Dr. Gabrielle L. Johnson[3]

[1]NOAA's Coral Reef Conservation Program, [2]NOAA Coral Reef Conservation Program, [3]Coral Reef Conservation Program

As part of the 2009 inception of the Coral Triangle Initiative, through two Participating Agency Program Agreement (PAPA) between USAID and NOAA, NOAA has partnered with four USAID missions and government agencies in Indonesia, Philippines, and Timor-Leste to support national and regional initiatives to promote fisheries governance and enforcement, as well as, to foster coastal community and ecosystem resilience. To support these initiatives, the partnership focuses on a variety of technical assistance workstreams. For example, NOAA bring expertise to the region to help combat illegal, unreported, and unregulated (IUU) fishing including Port State Measures, Catch Documentation and Traceability programs, and use of technologies such as VIIRS to monitor boat traffic in regulated areas; encourage Sustainable Fisheries; manage Marine Protected Areas; promote Sustainable Tourism, and implement Climate Adaptation Strategies. These workstreams are designed to address capacity building in these countries with the ultimate goal of institutionalizing tool and/or programs within the partner governments. Components such as curriculum development, training of trainers, peer-exchanges, mentor programs, and small grants initiatives have played key roles in this process. We will share our lessons learned from this multi-stream scope of capacity building with regards to partnership building, implementation, and the processes of institutionalization.

Next-generation genomics for marine management and conservation

Mr. Agostinho Antunes[1]

[1](1) CIIMAR, Interdisciplinary Centre of Marine and Environmental Research, University of Porto, Portugal (2) Department of Biology, Faculty of Sciences, University of Porto, Portugal

Whole genome sequencing projects can have a major relevance in understanding health, genetic disease, species adaptive evolution, diversification and conservation. Currently multiple species are having their genomes completely sequenced, from simple organisms, such as bacteria (e.g. microbiomes), to more complex taxa, such as birds and mammals. Such voluminous sequencing data generated across multiple organisms provides also the framework to better understand the genetic uniqueness of the studied species, allowing the assessment of its evolutionary histories and patterns of genetic diversity, which can be highly valuable for managing marine species conservation effectively, tracking invasive species and saving wildlife with forensic genetics (e.g. coral trade). Recent advances in next-generation genomics retrieved by our research group highlighting metazoan adaptive features, proto-eukaryotic symbiotic associations and its relevance in the conservation of marine biodiversity will be discussed, with emphasis on case studies comprehending neglected invertebrates (including deep-sea inhabitants), namely sponges, cnidarians, cephalopods, as well as more charismatic vertebrate marine species.

Northern Peru becomes the new aggregation area for whale sharks

Ms. Alejandra Mendoza[1], Ms. Rossana Maguiño[1], Dr. Shaleyla Kelez[1], Dr. Ximena Velez[2], Dr. Dení Ramírez-Macías[3]

[1]ecOceanica, [2]Smithsonian Conservation Biology Institute, [3]Tiburón Ballena México de Conciencia México

The whale shark is worldwide categorized as endangered due to its large population decline. Even though it is a giant, information on its natural history is still scarce. In the Eastern Pacific, the only well known aggregations are the Gulf of California (Mexico) and the Galapagos Islands (Ecuador). Moreover, most of the known aggregations are composed mainly by juvenile males. Our previous studies identified northern Peru as an area used by sharks seasonally. From October 2014 to January 2018, we conducted 62 whale shark boat surveys and collected data on size, gender, behavior, location and took pictures for photo-identification. We also obtained data from non-dedicated surveys and collaborators. Our photos were compared with the database from Mexico to find matches. We encountered a total of 203 sharks, and obtained photos from 195 of them which resulted in 95 unique sharks. The identified sharks were composed by 77% males and 23% females. Males were on average 6m long (range 3-9, n=48) and females 7m (range 3-10, n=14). The highest observations of sharks were in December and November and most of them were observed feeding. No matches were found with the Mexican database. Our findings highlight northern Peru as an important aggregation area in this region, with a new population that, so far, has no connectivity with Mexico and that is composed by both juvenile and adult males and females making it unique and important to study and conserve. This research was essential for issuing the national legislation that now protects them.

Online Spatial Database to Improve MPA for Fisheries management in Sunda Banda Seascape Area

Ms. Christian Novia Handayani[1], Ms. Desita Anggraeni[2], Mr. Nurkholis Fauzi[2], Ms. Amkieltiela Amkieltiela[1]

[1]WWF Indonesia, [2]WWF-Indonesia

Sunda Banda Seascape (SBS) is an area in the center of Coral Triangle which have more than 151 million hectares of waters areas, with more than 16 million population were depend their live on coastal area. This has led to pressure to the coastal and marine environment become much more higher. To compensate the pressure, the development of MPAs in SBS become increasingly important. Recently, MPA in Indonesia has masively developed. However, the monitoring system to monitor the management effectiveness were not in place yet. The extensive area of SBS waters and the various stakeholder involved in MPA management has caused the information about MPAs in this area were spread among several organization and institutions. To holistically overview the MPA effectiveness in SBS, an online monitoring system is needed which can be access easily by multiple stakeholders. SBS Atlas is an online spatial database that can be used to monitor the development of MPAs as well as the biodiversity and socio economic condition in SBS area. Sbs Atlas is expected to be a reference to the MPA managers in set a strategy to increase the MPA effectiveness.

Outreach and Engagement for the Makah Tribe's Climate Adaptation Plan

Ms. Haley Kennard[1], Ms. Katie Wrubel[1], Mr. Michael Chang[1], Ms. Laura Nelson[1], Mrs. Seraphina Gagnon[1], Mr. Forrest Howk[1]

[1]Makah Tribe

The Makah Tribe views climate change as one of the biggest threats to their natural resources and the rich and unique biodiversity of their coastal lands and waters, their livelihoods, economy, and culture. As part of climate adaptation and planning work to effectively manage these resources, the Makah Tribal Council and tribal natural resource managers prioritized early community outreach and engagement efforts in order to accomplish three goals: continually update and inform the tribal community about the Tribe's climate adaptation efforts; gather community input and priorities to inform the Makah Climate Adaptation Plan; and provide a series of educational events to engage the tribal community about projected climate change impacts to our resources. At our first community climate event, we provided an overview of the Makah Tribe's Climate Vulnerability Assessment and administered an initial climate survey that gathered information regarding community members' observed environmental changes, knowledge about climate change and impacts, and concerns and priorities to include in the Tribe's adaptation plan. The existence and well-being of the Makah people have always been closely tied to our relationship with the environment, especially the ocean, which provides bountiful natural resources and holds spiritual significance. Preliminary results of the community priorities survey prioritized concerns about a changing ocean and impacts of climate change on marine resources. This presentation presents our framework for incorporating community engagement in climate adaptation planning, the preliminary results of our community survey, and lays out the next steps that the Makah Tribe is pursuing towards climate adaptation planning.

Paradise Found: Discovering Diversity in the Sharks and Rays of Sri Lanka

Mr. Akshay Tanna[1], Ms. Rosalind Bown[1], Mr. Gobiraj Ramajeyam[1], Ms. Anusha Bishop[2], Ms. Thimali Dharmakeerthi[1], Dr. Janine Caira[3], Dr. Kirsten Jensen[4], Dr. Elizabeth Jockusch[3], Ms. Hannah Rakicki[3], Mr. Daniel Fernando[1]

[1]Blue Resources Trust, [2]Blue Resources Trust, Yale University, [3]University of Connecticut, [4]University of Kansas

The 28 year civil war in Sri Lanka had hindered fishery data collection in Sri Lanka's eastern and northern coast. Fishery surveys are ongoing since August 2017 and to date, we have surveyed 80 days in Valaichchenai (east), 22 days in Jaffna (north), 6 days in Negombo (west) and 22 days in Tangalle (south) to fill in this data void and to update the current list of Sri Lankan elasmobranch species. All elasmobranchs recorded are identified to the lowest possible taxonomic

level (n=1666). In addition, opportunistic morphometric and maturity data (n=296 sharks; 413 rays) and, tissue samples are being collected (n=118 sharks; 76 rays). Fishers are interviewed about catch details including location and fishing gear used. The most abundant species of sharks were Rhizopriodon oligolinx, Carcharhinus brevipinna and Carcharhinus falciformis. While 95% of all males of Carcharhinus brevipinna are mature, only 20% of males of Rhizopriodon oligolinx are mature. Thus far, we have recorded mobulid rays only at Negombo and Valaichchenai. The most frequent species is Mobula japanica (59%) which is consistent with our previous study conducted at Negombo and other southern markets from 2010 to 2014. It is noteworthy that 80% of all non-mobulid rays landed belong to two ray species viz Neotrygon indica and Brevitrygon cf. imbricata, which are classified as not evaluated and data deficient respectively by The IUCN Red List. We intend to begin catch per unit effort computations and stock assessments to better understand the sustainability of this fishery in Sri Lanka.

Participatory and multi-disciplinary strategies for marine conservation in Peru

Ms. Kerstin Forsberg[1]
[1]*Planeta Oceano*

Peru hosts one of the world's most productive marine systems in the world. However, these are exposed to challenges including unsustainable fisheries, pollution and climate change. Community engagement and ownership are vital to ensure effective conservation efforts. Since 2007, Planeta Océano works to empower coastal communities in marine conservation in Peru. This includes promoting citizen science, management and policy, as well as transformative marine education and sustainable development efforts. Thousands of people have been engaged, including children, youth, fishermen, teachers, government and the corporate sector; and local community members are incorporated as primary actors throughout project development.Initiatives have included engaging students and fishermen in sea turtle conservation, researching shark and ray fisheries, involving youth in MPA monitoring, integrating schools in a 'Marine Educator's Network' and pioneering manta ray conservation in Peru, among others. For example, manta conservation efforts have included working with fishermen, teachers and youth in research, education and ecotourism focused on giant manta rays, as well as achieving national legislation to protect this species in Peru.This presentation will discuss a variety of community-based and multi-disciplinary strategies, such as creating local networks, working with the formal educational system, identifying and empowering local ambassadors, fostering locally-lead initiatives, integrating and connecting multiple stakeholders in multi-disciplinary efforts, and bridging science and management. We will review key factors and challenges within these, and describe how these actions contribute to global frameworks and strategies.This work therefore provides a case study that can be adapted for marine conservation in other geographical areas.

Patterns of genetic population structure in commercially exploited Brazilian marine fishes

Ms. Julia Verba[1], Prof. Adam Stow[2], Dr. Maria Grazia Pennino[3], Prof. Priscila Lopes[1], Dr. Frederico Henning[4], Prof. Antonio Sole-cava[4], Prof. Sergio Lima[1]
[1]*Universidade Federal do Rio Grande do Norte,* [2]*Macquarie University,* [3]*Instituto Español de Oceanografía,* [4]*Universidade Federal do Rio de Janeiro*

Over 60% of all fish stocks are overexploited, requiring urgent and effective conservation and management planning. Designing management strategies requires knowing the geographic limits of stocks (populations). Populations can represent units with independent demographic, adaptive and genetic characteristics, and these factors can affect their response to exploitation. Currently there are no genetic data describing population structure for multiple, co-distributed marine fish species in Brazil. Here, we aim to determine major patterns of genetic population structuring of commercial marine fishes for the entire Brazilian coast. We are using Arlequin software to analyse mitochondrial (COI, CytB) and nuclear (Rhodopsin) DNA sequences to identify population structure of 60 economically important species. We expect to find different patterns among species that relate to their habits and reproductive type: species with pelagic juveniles and adults will probably show no structure along the coast, while species with pelagic juveniles and sedentary adults are likely to be structured according to environmental variables, as sea surface temperature, oceanic currents, and barriers (e.g. mouth of big rivers). Identifying general patterns is crucial for sustainable practice, especially for countries like Brazil, and most developing countries, where most fishery operators do not target individual species.

Perception of Fishers and Workers on the Impact of Closed Fishing Season Policy for Sardines in theZamboanga Peninsula

Dr. Merlyne Paunlagui[1]
[1]*University of the Philippines Los BaÃśos*

The main objective of this study was to assess the attitude of the communities on the implementation of the closed fishing season policy in Zamboanga City and Zamboanga del Norte. Overall more workers than fishers are knowledgeable about the policy. This is primarily due to the fact that workers more than fishers are affected by the closed fishing season policy. Workers, except for those providing maintenance to the sardine factories, stopped working from December until February each year since 2011 when the policy was enforced while fishers can continue to catch fish throughout the year.The study found that majority of fishers and workers knew the closed fishing season policy. However, less than half and about two-thirds of the factory workers understood the details regarding the months covered, prohibited gears, and the penalty for the violations. Majority of the fishers and workers believed that the closed fishing season policy is the best way to increase the fish stock. However, there is a need to provide employment opportunities during the closed season. There were reports that livelihood assistance can be availed, however, the fishers and workers were unable to prepare project proposals which are required for the livelihood assistance.

Perspectives of red list in Vietnam

Dr. Nguyen Van Quan[1]
[1]*Institute of marine environment and resources, Vietnam Academy of Science and Technology*

The Vietnam red data book (VRDB) contains a list of animals and plants were ranked as the rare/endangered species, ongoing to decline of individual accounts or under to be extinction. It assists to contribute crucial science based for the government to issue the decree and direction/guidelines in relation with management, protection and proposition of the emerging solutions to conserve and sustainable development of the wild life flora and fauna in Vietnam. The Vietnam Academy of Science and Technology (VAST) played as the facilitator to carry out the assessment processes of species to involve in the red list of the VRDB. All the criteria and categories used in the assessment were strictly followed the protocol guided by the IUCN. Through time, the red list of rare/endangered species have been issued in 4 version of the VRDB (1992, 1994, 2004, 2007). The latest version of VRDB in 2007consists of 882 species: 418 spec. of animals and 464 spec. of plants living in terrestrial, freshwater, brackish

and marine waters environment. For the marine fishes, 53 species were recorded in the VRDB and the major categories ranked at EN, CR and VU. In the vision of the intensive fishing practices and abnormal climate changes, a number of species can keep rising if the national strategic plan on protection of biodiversity will not be able to effectively put on action.

Possible Effects of Temporary Closure of Fishing Fleets on Resources Recovery: Case of Trawl Fleets in the Gulf of Cadiz (Southern Spain)

Dr. Ignacio Sobrino[1], Dr. Francesc Ordines[1]

[1]*Spanish Oceanographic Institute*

Important trawling fisheries are undertaken in the Gulf of Cadiz (Southwest Spain), affecting a large number of species of fishing interest (more than 50) and discarded species (more than 150). This fishery activity is regulated by several technical measures, such as the prohibition of fishing between the coastline and six miles off the coast, the use of 50 mm mesh size, in addition to establishing minimum sizes of some species and since 2005, the closure of the entire fleet between 15th September and 30th October. From the research and monitoring point of view, since 1997, demersal resource assessment surveys have been carried out on board oceanographic vessels in November and March. In the present study, we made a comparison (abundance; biodiversity; mean size) variations based on data obtained in the campaigns between November (just when the closure ends) and March of the following year. Two periods were considered: 1997 to 2004, when there were no closures; and 2005 to 2017, when the biological closures took place. In addition, the results of these analyses were compared with the evolution of fishing yields obtained by the trawl fleets during those periods. The implementation of the biological rest has had a positive effect in relation to the different indices of diversity that we have studied. In relation to commercial activity, we observe a positive effect just after the cessation of fishing with highest yields of the year. We also observe a trend of growing yield since the implementation of the biological rest

---

Potential impacts of climate change on the marine life of Chilean Patagonia

Mr. Günter Försterra[1], Dr. Verena Häussermann[1]

[1]*Pontificia Universidad Catolica de Valparaiso, Huinay Scientific Field Station*

With elevated C02 concentrations and rising temperatures due to climate change, species ranges may shift to suitable areas if the process is slow enough. The Patagonian Fjord Region however with its lacerated labyrinth of fjords, channels and islands includes two major, climate-independent latitudinal barriers for species migration. In addition, the entire region is characterized by the overlap of many different abiotic parameters and gradients on a local and regional scale creating highly complex interference patterns. These patterns are responsible for the exceptionally high diversity of Chilean Patagonia hosting unique and highly fragile ecosystems. When these local gradients are altered due to climate change, the possibilities of species shifting along gradients are very restricted and soon lead to local dead ends so that many species might not have the option to move to areas with suitable conditions for their survival. Ocean acidification will pose an additional stress to calcifying organisms, especially in Patagonian fjords with already low pH. Since the aragonite saturation horizon in these fjords is very shallow, the zone for suitable habitats for some calcifying organisms may disappear. For the last decade we could document a dramatic decline in species diversity in the Comau fjord, but without highly protected marine areas as a reference it is difficult to distinguish between natural fluctuations and direct and indirect anthropogenic impacts. MPAs are important as refugia for species in decline but shifting distribution patterns require reliable predictive models and/or precautionary approaches to ensure efficient MPA networks even in a changing climate.

Preliminary study on floating microplastics in Indonesian water

Mr. Muhammad Reza Cordova[1], Mr. Dede Falahudin[1]

[1]*Research Center for Oceanography, Indonesian Institute of Sciences*

Plastics marine debris are an emerging issue in the oceans and need to tackling through global action framework. As one of the countries with the largest plastic inputs in the marine environment, Indonesia come up with an enormous challenge. The risk and effect of microplastics have been well-documented in the various ecosystem around the world. However, due to limited information regarding microplastics research in Indonesia, this paper critically evaluate the preliminary research trend of microplastics in surface water in different location in Indonesia, the action of Indonesian government to tackling marine plastics pollution, and where appropriate, also adopting several recommendation for future research on and microplastics from different sources that possible to conduct in Indonesia.

Resolving Conflicts Between Industrial And Traditional Fishers Towards Equitable Access Rights In Madagascar

Mr. Rindra Rasoloniriana[1], Mr. Adrian Levrel[1]

[1]*Blue Ventures*

Madagascar's small-scale fisheries land 72% of the total national catch, and are the primary source of food security and income for most of the country's 84,536 fishers, the majority of whom live below the poverty threshold. Contrary to international guidelines, Madagascar's small-scale fishers have no formal rights to the marine resources upon which they depend, and no means to protect them from outside threats. Legislation regulating industrial fishing within inshore waters is incoherent, and trawlers fish the same waters as small-scale fleets. A collapse in production of Madagascar's industrial shrimp fishery since 2004 led to increased conflict between small-scale and industrial fishers, jeopardising economic, social and cultural rights.Conflict resolution initiatives in recent decades resulted in little progress. A multi-stakeholder agreement in 2017 saw the creation of a pilot 500 km2 inshore no-trawling zone to safeguard traditional livelihoods and rebuild stocks for the industrial fishery; this closure was discontinued after only one year, following pressure from the trawling industry. New hopes for recognition of fishers' rights are emerging through increasing awareness of the vulnerability of traditional coastal livelihoods. In 2017, representatives from 173 coastal communities approved a motion appealing the Government to recognize exclusive fishing zones for the small-scale sector. Reforms of national policy for marine management rights are under discussion, offering an important opportunity to further secure marine tenure for fishers. The plight of Madagascar's small-scale fishing communities highlights the critical need to adopt a human rights-based approach to marine spatial planning, and the resolution of cross-sector conflicts.

Restoring coastal sand dunes in Taean-haean National Park

Mr. Shin Daeseob[1], Mr. Lee Sukjoo[1]
[1]*Korea National Park Service*

Twenty four Coastal sand dunes, located in Taean-haean National Park, have played an important role as an natural break water protecting coastal area.

However, radical erosion process has incresed for decades has caused by artificial retaining wall, decreased sediment supply reduction and indiscriminated gathering of sea sand.

KNPS(Korea National Park Service) has been working on a project restoring coastal sand dunes in Taean-haean National Park since 2002. The project is not only installation of sand trap which can make sand sedimentation well but also elimination of artificial retaining wall which can cause changing wave energy. Moreover, monitoring and restoring of vegetation cover has undertaken on a regular basis.

Since drone technology applied to park management recently, coastal sand dunes can be observed topographic changes quickly and precisely.

Obtained overlapped aerial pictures have been analysed with DEM(Degital Elevation Model) with a resolution of 2cm by using photo measurement method. Also we have been monitoring changes in vegetation cover applied orthophotograph by drone.

Thus, Time series analysis has been made by using drone in order to study effectively and scientifically.

Restoring habitats for Convex Crab (Chasmagnathus convexus) endangered species level II

Ms. Kim Hyeon Seon[1], Mr. Lee Seoung Chan[1], Mr. Kim Jong Seop[1], Mr. Kim Han Jin[1]
[1]*Korea National Park Service*

There are many kinds of inhabited environments such as tidal flats (8 places), uninhabited islands (23 places) in the Namhae Sacheon district of Hallyeohaesang National Park. The Wolcha tidal flat is especially the largest habitats for Convex Crab(Chasmagnathus convexus) listed as endangered species level II.However, as the sedimentary environment of the habitats has been simplified through coastal development and road construction, the habitats for the endangered species tend to decrease. Especially the agricultural chemical use by the local farmers greatly threats the inhabited environments and causes mass death of crabs and sea grass.Restoring habitats for Convex Crab (Chasmagnathus convexus), the Korea National Park Service(KNPS) removed concreted roads as well as wasted tire retaining walls and increased the sand influx by creating habitats with natural stones and Seaside lawn grass (Zoysia sinica Hance) communities.In addition, KNPS has contributed to prevention for mass death by agricultural chemical use and improvement for inhabited environments for Convex Crab (Chasmagnathus convexus) by making the agreement called "Chemical-free Agriculture Park Protection Agreement" with local residents, which supports eco-friendly fertilizers and prohibits the agricultural chemical

---

Restoring habitats for Milky Fidder Crab (Uca lactea) endangered species level II

Ms. Hyeonseon kim[1], Dr. Lee Sang-kyu[1], Mr. Lee Seoung Chan[1], Mr. Lee Seoungchan[1], Mr. Kim Jong Seop[1], Mr. Kim Han Jin[1]
[1]*Korea National Park Service*

There are many kinds of inhabited environments such as tidal flats (8 places), uninhabited islands (23 places) in the Namhae-Sacheon district of Hallyeohaesang National Park. Especially the Leeraksa tidal flat is excellent habitats that 5 endangered species inhabit. However, as the sedimentary environment of the habitats has been simplified through coastal development and road construction, habitats for endangered species have been decreasing. The Korean National Park Services (KNPS) designated National Park Special Protection Area for the first time in Korea to protect the habitats for Milky Fidder Crab (Uca lactea) which is particularly vulnerable to environmental change. The KNPS monitored inhabited environments as well as changes in the habitats and made seawater flow smoothly by removing the artificial structure which had been neglected for 30 years. Analyzing sediments for three years, the KNPS realized the need for the Sand Capture Machine to prevent sand runoff. The KNPS benchmarked "Lahnung", the reclamation method in the German tidal flat and installed the Sand Capture Machine, which is on test operation.

Science and Policy Making within the BBNJ Process: Discussion of the Institutional Arrangements

Dr. Eka Higuchi[1]
[1]*Tohoku University of Community Service and Science*

Four sessions of the Preparatory Committee (PrepCom) developing the framework of an international, legally binding instrument - on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction (BBNJ) - were held from 2016 to 2017. The process advanced according to four key themes of negotiation: (1) Marine genetic resources (MGRs); (2) Area-based management tools (ABMTs); (3) Environmental impact assessment (EIA); and (4) Capacity building and transfer of marine technology (CB-TMT). This contribution examines the institutional arrangements within each of these themes, from the perspective of the science / policy-making relationships. Scientific bodies are suggested for the following functions: (1) MGRs: Recommending thresholds of material scope which are allowed to be extracted, and for elaborating guidelines on access and benefit-sharing; (2) ABMTs: Developing criteria for identifying areas, examining proposals, and monitoring / reviewing ABMTs; (3) EIAs: Elaborating activity criteria, making recommendations to decision-making bodies concerning EIA submissions, and reviewing EIA processes; (4) CB-TMT: Scientific advisory bodies are suggested for follow-up. More careful handling is required in upcoming BBNJ negotiation regarding the relationship decision-making body and scientific bodies involved in evaluating or reviewing processes. It should be necessary to clarify the location of responsibility for policy decision when the scientific body involved in.This issue should be solved by the careful discussion on mechanism-creation in upcoming negotiation process. When the negotiator adopts an evaluating or reviewing scientific body in new BBNJ agreement, they should work out to avoid putting the responsibility for decision making on scientists.

Seaweed restoration of whitening event area

Ms. Ryu Jeongeun[1]
[1]*Korea Nationa Park Service*

Albinism is the whitening event in coastal ecosystems that coralline algae cover the rock where seaweeds live, marking it seem white. To restore the seaweed forest, KNPS (Korea National Park Service) attempted restoration of seaweed that diappeared due to the albinism in areas of Hallyeohaesang national park, Korea. We restored 3 species of seaweeds, 1 species of Fucales and 2 species of Laminariales, of

underwater longline, sporebag and rocky cleaning methods at Songdo, Geoje in 2015-2016(restoration size: 2,400m2). Also, KNPS restored Sargassum horneri which is gathered around the coast by using direct transplantation method with environment-friendly prompt cement at Manji-do, Tongyeong in 2016.(restoration size: 1,000m2) As a result, Fucales transplantation in the barren ground was successful in terms of recovery of marine ecosystem.

Small-scale seagrass fisheries can reduce social vulnerability: a comparative case study

Dr. T E Angela Quiros[1], Dr. Mike Beck[2], Ms. Alexis Araw[3], Dr. Donald Croll[1], Dr. Bernie Tershy[1]

[1]University of California Santa Cruz, [2]The Nature Conservancy, [3]University of Hawaii at Manoa

Small-scale fisheries are declining, reducing food and employment for coastal communities. We assess how biological and socioeconomic conditions influence vulnerability, or a community's susceptibility to loss and ability to adapt. We characterized two Philippine fishing communities, Gulod and Buagsong with similar seagrass and fish species composition, and compared their social vulnerability, or pre-existing conditions likely to influence their response to changes in the fishing resource. We used household, fisher, landing and underwater surveys to compare their sensitivity and adaptive capacity. Depending on the scale assessed, each community and group within the community differed in their social vulnerability. The Buagsong community was less socially vulnerable, or less sensitive to pertubations to the seagrass resource because it was closer to a major urban center that provided salaried income. When we assessed seagrass fishers as a group within each community, we found that Gulod fishers had greater adaptive capacity than Buagsong fishers because they diversified their catch, gear types, and income sources. We found catch that comprised the greatest landing biomass did not have the highest market value, and fishers continued to capture high value items at low biomass levels. A third of intertidal gleaners were women, and they enhanced household adaptive capacity by providing additional food and income, in an otherwise male-dominated fishery. Community context is not the only determinant of social vulnerability, because groups within the community may decrease their sensitivity, enhance their adaptive capabilities, and reduce social vulnerability by diversifying income sources, seagrass-based catches, and include women in the fishery.

Society for Conservation Biology: Participatory and Citizen Science Working Group

Dr. John Cigliano[1], Dr. Monica Awasthy[2], Dr. Eva Lewandowski[3], Dr. Courtney Hughes[4], Dr. Tina Phillips[5], Dr. Sally Sims[6]

[1]Cedar Crest College, [2]BirdLife Australia, [3]Wisconsin Department of Natural Resources, [4]Government of Alberta, [5]Cornell Lab of Ornithology, [6]Independent Conservation Consultant

Citizen science is a powerful tool for tackling many of the challenges faced in the field of conservation biology, from natural resource management to policy and public action. The Society for Conservation Biology (SCB) is an international professional organization dedicated to promoting the scientific study of the phenomena that affect the maintenance, loss, and restoration of biological diversity. Initiated in 2016, the Participatory and Citizen Science Working Group (PaCS) seeks to facilitate research and practice that aids the SCB in achieving its mission of preserving the Earth's biodiversity. The PaCS working group aims to increase awareness of, support knowledge exchange for, and promote citizen science as an effective method in advancing biodiversity conservation among practitioners, researchers, and managers. Surveying global conservation practitioners' awareness and engagement with citizen science is assisting with identifying the priorities and future actions for the PaCS working group. PaCS will be working to serve as an international knowledge and networking hub for innovations in citizen science for conservation, elevate the role of citizen science within the national/international policy realm, link practitioners and citizen scientists working towards common goals, and help develop best practice management for citizen science in conservation. We welcome all who are interested the role of citizen science in conservation and invite you to chat with us!

Spatial variations in the Opisthobranch fauna in the Gulf of Kachchh- Western India

Dr. Dishant Parasharya[1], Dr. Bhavik Patel[1], Dr. Vishal Bhave[1], Dr. Deepak Apte[1]

[1]Bombay Natural History Scoiety

Opisthobranchs are the least studied molluscan group in India and the work done on this group is very limited. Having 8000 km long coastline with diverse habitats such as coral reefs, mangroves, sandy shores, rocky patches and large mudflats, records of Indian Opisthobranchs are very scarce. This study is a result of surveys carried out between 2004 to 2017 in the coral reef areas of the Gulf of Kachchh in western India. During the survey 80 species of opisthobranchs were recorded out of which, 36 are first records from India and some species still need validation / identification. The paper gives an overview of the work done between 2004 to 2017. The paper also describes the spatial variations in the occurrence of the selected group.

Spatio-temporal predictions of mobulid occurrence to help combat illegal manta ray fishing in Lamakera, Indonesia

Mr. Mochamad Iqbal Herwata Putra[1], Ms. sarah lewis[2]

[1]Marine Megafauna Research Group - Misool Foundation, Savu Sea Program, [2]Marine Megafauna Research Group - Misool Foundation, Savu Sea Program; Manta Trust - Catemwood House Corscombe Dorchester Dorset DT2 0NT, United Kingdom; Sea Sanctuaries Trust - London, UK, United Kingdom

Increased demand for mobulid gill plates in Chinese medicine has driven mobulids towards extinction. Indonesia is one of the world's biggest mobulid fisheries, and population extirpations and significant declines in CPUE are apparent. Lamakera, a small village on Solor Island, is Indonesia's largest manta fishery and has been targeting mobulids for generations, historically for subsistence but turning commercial in recent decades to supply the international gill plate trade. In 2014 the Indonesian government declared full protection for mantas, creating the world's largest manta sanctuary. Since then the government and stakeholders have been enforcing the regulation through various methods including applied marine surveillance. This study presents a modeling approach for predicting mobulid occurrence, used to improve the effectiveness of marine surveillance in Solor. We applied both Maximum Entropy and generalized adaptive model to build a spatio-temporal predictive model of mobulid occurrence in Solor waters. GAM output of moon illumination was most strongly related to mobulid temporal sightings (45%) ($\pm$0.05). Furthermore, the MaxEnt output performed well to characterize mobulid habitat with the AUC_{Test}> ~0.9. Since 2016, we have provided daily predictions to guide marine surveillance in Lamakera increasing the effectiveness of enforcement, resulting in a decrease in manta fishing effort and catch.

Species Composition, Abundance and Estimated Total Biomass of Reef Fishes at Sugud Islands Marine Conservation Area (SIMCA), Sabah, Malaysia

Mr. Davies Austin Spiji[1], Dr. Fung Chen Chung[1]
[1]*Reef Guardian*

Sugud Islands Marine Conservation Area (SIMCA) is a privately managed no-take marine conservation area in Sabah, Malaysia. The aim of the study was to document population structure of reef fishes within SIMCA in terms of species composition, reef abundance and estimated total biomass. Modified Reef Check's belt-transect survey was used to record fish abundance, while reef fishes were identified to the lowest possible taxonomic level, and the sizes were estimated to the nearest 5cm. The surveys were conducted at 34 sites over 3 years (2015-2017). A total of 101 species of fishes belonging to 37 genera were identified and recorded. An average of 8,484.3 individuals (or 249.5 individuals/500m2) were recorded in the 3-year surveys. The family Pomacanthidae showed significant difference in abundance (X2(2, N=102) = 6.079, p~0.05) and estimated total biomass (X2(2, N=102) = 8.151, p~0.05) over the years, while Scaridae showed significant difference in estimated total biomass across the years, X2(2, N=102) = 15.258, p~0.05. Amongst the commercially-important reef fish families, Caesionidae held as the highest abundance, with an average of 173.6 individuals/500m2, SD = 304.62, followed by Lutjanidae (38.5 indviduals/500m2, SD = 61.99) and Serranidae (7.3 individuals/500m2, SD = 5.64). As for the estimated total biomass, the family Caesionidae topped the list with an average of 9.1kg/500m2, SD = 15.21, followed by Lutjanidae (3.2kg/500m2, SD = 4.68), and Serranidae (2.4kg/500m2, SD = 2.65). Continuous monitoring effort is necessary in clarifying reef fish population dynamics, and assessing how SIMCA is performing in the conservation of the reef fish population.

Stranded online: utilizing social media to monitor marine mammal stranding in Vietnam

Mr. Long Vu[1], Dr. Louisa Ponnapalam[2], Ms. Anh Tho Truong[1]
[1]*University of Sciences Ho Chi Minh city,* [2]*MareCet*

There is an enormous information gap on marine mammal stranding in Vietnam. With a coastline of 3,260 kilometers excluding islands, monitoring marine mammal stranding is particularly challenging in this country. Due to the popularity of social media and widespread use of smartphone in Vietnam, information on many of stranding incidents are available on the internet, thus creating a potential data source for monitoring the stranding of marine mammals. To understand this potential, we conducted a systematic searching for marine mammals stranding along Vietnamese coast, targeting the time period from January 2006 to April 2018, on Facebook, Youtube and online newspapers. We found total 116 cases of marine mammal stranding along the Vietnamese coast that have been reported on social media. Stranding incident appear to distribute evenly along the Vietnamese coast. The average stranding case per month were 0.79. There were 17 marine mammal taxa were identified from acquired data. The most commonly stranded species was the Indo-Pacific finless porpoise (Neophocaena phocaenoides), accounted for 12% number of records. Compared to stranding response teams or inquiring reports from local stakeholders, using social media is a quicker and low-cost way to get information on stranded species, locations, and time of the incident. But in most cases, the cause of stranded (and mortality) could not be determined from provided information of social media. In combination with citizen science programs and public outreaches, social media can become a more useful tool for monitoring marine mammal stranding in the country.

The Status Of Sea Turtle Populations And Conservation Activities In Vietnam

Mrs. Hien Bui Thi Thu[1]
[1]*International Union for Conservation of Nature*

Five species of foraging and breeding sea turtles have been identified in Vietnam, they are Green turtle (Chelonia mydas), Loggerhead turtle (Caretta caretta), Olive ridley turtle (Lepidochelys olivacea), Hawksbill turtle (Eretmochelys imbricata) and Leatherback turtle (Dermochelys coriacea). Among them, with the exception of Loggerhead turtle (Caretta caretta), four species have been being lay eggs on the beaches along the country. However, these populations have been strongly suffered by human activities for decades. The number of foraging and breeding Hawksbill and Leatherback sea turtles have dramatically decreased, and Olive Ridley turtle has almost disappeared on their traditional nesting beaches. Beside the reason of harvesting eggs and nesting turtles by catch or by purpose, the developments in coastal areas where sea turtles laying eggs such as in shrimp aquaculture, tourist resort and residential area developments etc., also contributed to this decline of sea turtles. Despite the fact that the recent raising awareness programs on protection and conservation of the sea turtle were very well done with the participation of many organizations and provinces, these important creatures still face the risk of extinction in Vietnam.

The blue whales of the Savu and Banda Seas, Indonesia: Conservation planning for a highly migratory species.

Mr. Benjamin Kahn[1], Ms. Rili Djohani[2]
[1]*APEX Environmental,* [2]*The Coral Triangle Center*

The Savu and Banda Seas are positioned in eastern Indonesia, at the nexus of two oceans, and are a central part of the Coral Triangle - the region with the world's highest coral reef biodiversity. These waters inhabit at least 23 species of marine mammals and include critical habitats for a population of 'pygmy' blue whales (Balaenoptera musculus brevicauda) that migrate from the Southern Ocean to Banda, via the migratory bottlenecks of the Savu Sea (Ombai-Wetar Straits) and Timor Leste.

In 2016 and 2017, two 10-day Rapid Ecological Assessments (REAs) for Marine Mammals were conducted in this remote region, with a combined survey effort of 2039 kilometers of track-line and 206.5 daytime survey hours. A total of 17 marine mammal species were positively identified during 95 group sightings, with a minimal animal count of 3019 individuals. Pygmy blue whales were relatively abundant with the second highest species-specific sighting frequency in both years. The surveys included ecological tracking of individual blue whales and obtained crucial insights on fine-scale habitat use.

Survey outcomes have: a) confirmed the important ecological role of the Banda Sea as a migratory end-point or "destination" for endangered blue whales; b) expanded this critical habitat towards the Ceram Sea; c) identified important habitats for other oceanic cetaceans (i.e. West Ceram and Manipa Strait); d) provided an initial threat assessment including marine debris, fisheries interactions, oil and gas and shipping activities and e) contributed to the current development of Marine Protected Area (MPA) Networks in Indonesia and Timor Leste.

The effect of reef health on the abundance, impact and biological control of corallivores species in Kenya

Ms. Sophie de Reus[1]
[1]*Wageningen University*

Coral reefs are one of the most complex and fragile ecosystems on our planet. Coral reefs have multiple threats, both natural and human-made. One natural threat is consumption by corallivorous species. Corallivores are a wide group of organisms, represented by five invertebrate phyla and twelve fish families. Corallivorous species can have minor to lethal impact on the coral reef. A direct effect is the negative impact on coral growth and survival. In extreme outbreaks of the invertebrates species Acanthaster planci or Drupella spp., a coral reef could degrade so much that the reef could shift to a macro-alga dominated reef. Indirect impacts are bio-erosion and disease transfer. In almost every region in the world, corallivorous species are present, also in Kenya. In the South of Kenya, three types of experiments are being conducted on three different locations; Wasini Channel, Kisite Marine National Park and Mpunguti Reserve. The three types of experiments consist of surveys and predator experiments. The aim of this research is to gain more knowledge about the presence, identification and abundance of the corallivorous species, and about their dependency on the health of a coral reef. This will help with the conservation and managment of tropical marine ecosystems. One of the hypothesis is that there is a positive correlation between coral reef health and corallivorous species.

The habitat use and behavior of Indo-Pacific humpback dolphins (Sousa chinensis) and Indo-Pacific finless porpoise (Neophocaena phocaenoides) in Hong Kong SAR waters

Dr. Lindsay Porter[1], Mr. Arthur Lee[1], Dr. Matt Pine[2]
[1]*The University of St. Andrews,* [2]*Institute of Hydrobiology, Chinese Academy of Sciences*

Both Indo-Pacific humpback dolphins (Sousa chinensis) and Indo-Pacific finless porpoise (Neophocaena phocaenoides) occur regularly in Hong Kong Special Administrative Region (SAR) waters. The range of each species overlaps and each are exposed, to differing degrees, to the same anthropogenic activities, such as noise, ship strike, bycatch in fisheries, and contamination of their habitat and prey resources. So as to better understand fine scale habitat use and the factors which influence distribution patterns, acoustic tools were used to study selected areas within Hong Kong. Acoustic loggers were deployed between July 2015 and November 2018. As dolphins prey on soniferous fishes, acoustic detectors were also able to provide information on the overlap of both fish and marine mammal detections. A General Additive Model (GAM) which included a number of environmental parameters (e.g. tidal height and state, temperature, and rainfall) was used to assess the factors which could contribute to marine mammal occurrence. The results indicate that both scies of marine mammals were present year round in the areas of study, although there were both seasonal and diurnal patterns of occurrence. Feeding dominated during certain tidal periods and the occurrence of small fishing vessels also appeared to increase during these periods. Acoustic tools are easy to use, economical to deploy and can provide continuous data sets thus making them ideal fr such studies. the information provided on long term habitat use and key behaviours provide critical information for managers.

The restoration of Swinhoe's strom petrel on Chilbal-do (island), IUCN category I

Ms. Jihee Lee[1], Mr. Song Dojin[1], Dr. Lee Sang-kyu[1]
[1]*Korea National Park Service*

The project was started when unusual birds was found dead in Chilbal-do (island), was incorporated into Dadohaehaesang National Park in 2011. Goals of the project are removing noxious plant and vegetation restoration for reducing the mortality rate of birds. Chilbal-do (island) is the place, designated as a natural monument and raised to IUCN category Ia in 2016, that is managed as Korea national park spacially protected area. And there is middle stopover of unusual birds, so east asian-australasian flyway partnership (EAAFP) certificated Chilbal-do (island) as important habitate for migratory birds networking. There has been an outbreak of ecological disturbance by past manned lighthouse and residents. As a result, noxious plant, for example japanese chaff-flower, increased rapidly and more than 400 birds died each year because bird's wing hangs on its hook shape plant seeds. Accordingly, Korea national park service(KNPS) carried forward forming a consultative group with Shinan-gun (district), Koguryeo college etc,. and the project for removing noxious plants, japanese chaff-flower, and replacing native plants, Coastal rock sedge, was started from 2014 to 2017. As a result, KNPS removed noxious plan, japanese chaff-flower, 34,100m2, and replace native plant, coastal rock sedge 20,500m2. So the monitering data in 2017 showed that rate of dead birds, specially swinhoe's storm petrel, decreased 97 percent(%).

The role of marine protected areas in enhancing biodiversity and ocean sustainability

Ms. Naomi Townsend[1]
[1]*Bournemouth University*

Human activities are hugely affecting the marine environment, reducing biodiversity and diminishing fauna and flora at an unsustainable rate. Marine protected areas (MPAs) are a tool to help reduce the effects of these pressures.

Several aspects of an MPA affect its success in achieving its ecological goals. For example: age, size, no-take zone (NTZ) status, tourism level, isolation and enforcement all contribute to the success of the MPA. All MPAs vary massively in these factors.

This paper will examine the effectiveness of a range of MPAs across the world, and attempt to predict their ecological effectiveness in the face of potentially conflicting socio-economic and legal pressures. We used a Bayesian belief network to predict likely ecological success (enhancing stock sizes or increasing biodiversity) of 27 MPAs, both in the absence and presence of conflicting pressures. Understanding the conflicts that affect ecological success are an important first stage to begin examining the effectiveness of policy and legislation that has been applied to these 27 case studies.

Tracking green sea turtle (Chelonia mydas) nesting along Bangladesh coast

Mr. Mohammad Ehsan[1], Mr. Mohammad Islam[1], Mr. Rafat Adnan[1]
[1]*Marinelife Alliance*

In Bangladesh, currently Olive ridley and green turtle nest at suitable beaches along the coast. Olive ridley, green turtle and hawksbill turtle sub adult recorded along coast of Cox Bazar including St. Martin Island, Sonadia Island trapped in beach seine and abandoned fishing gears (ghost net) while foraging along shore line in recent years (Islam, 2016). Olive ridley and green turtle subadult also recorded inside intertidal lagoons of the southern end of Cheradia, St. Martin Island. To understand Green turtle movement and migration routes Marinelife Alliance started satellite tracking on nesting sea turtles.

We attached, Platform Terminal Transmitter (PTT) of Wildlife Computer, USA, Model # SPOT5-293A, The adult green turtle moved through the coast of Bangladesh south central zone, Sundarban and later spent 16 days along the shallow habitat of Vitarkanika National Park of India, within the tributaries of AbulKalam Island, and Kanika Island (Lat20.78147N, Lon87.03532E). This green turtle later traveled to Myanmar location at very coast of the northern shallow water of Myengu Island east of Savage Island, south of Sittwe (Lat 20.084350N, Lon 92.924996E). The clear sign of foraging that turtle spent moving around in a very small area for more than one month.

Traditional Ecological Knowledge for the Management and Conservation of Coastal-Marine Areas and Resources

Mr. Caiua Mani Peres[1], Dr. Fernanda Stori[1], Prof. Alexander Turra[1]
[1] *University of São Paulo*

Traditional Ecological Knowledge (TEK) of small-scale fisheries communities may combine environmental information such as marine species behaviour and taxonomy, physical-oceanographic processes, and traditional techniques of natural resources management. However, many conventional management and conservation policies for coastal-marine areas tend to ignore TEK, even when they directly affect these communities. Based on an ethno-oceanographic approach, we investigated the TEK of the Araçá Bay small-scale fishery community (São Sebastião, São Paulo, Brazil) through interviewing and ethno-mapping methods, aiming to analyse its application for marine management and conservation strategies. A total of 18 fisheries specialists were interviewed in-depth. We identified TEK on 57 marine ethno-species: 41 fishes, 10 crustaceans, 5 molluscs, and 1 turtle. Based on biophysical characteristics of the environment and species behaviour preferences, we scientifically classified the TEK on marine habitats: four habitats for fishes ("shallow/intertidal waters", "deeper/sub-tidal waters", "rocky shores surroundings", "deep rocky-bottom areas") and four habitats for invertebrates ("rocky shores", "unconsolidated-bottom inter-tidal zone", "sandbar zone" and "subtidal zone"). In addition, TEK also provided a detailed description of local currents, which tend to alternate between southwest and northeast directions from outside the bay (depending on tides, winds and other drivers). These physical-oceanographic processes affect fisheries strategies. Southwest currents tend to favour the occurrence of a higher diversity and abundance of fishes). Results demonstrates that TEK can be useful for the management of fish stocks, protection of threatened species and recovery of coastal habitats. TEK should be considered in management and conservation policies for coastal-marine areas and resources.

Traditional Resources Management Practices SASI In Raja Ampat, West Papua Indonesia

Mr. Awaludinnoer Ahmad[1], Mr. Purwanto Purwanto[2], Mr. Lukas Rumetna[1], Mr. Yohanes Martubongs[1], Ms. Salomina Tjoe[1], Mr. Nugroho Arif Prabowo[1], Ms. Junita Manuputty[3]
[1] *The Nature Conservancy,* [2] *University of Papua (UNIPA),* [3] *Starling Resources*

Sasi is a traditional resource management practice used by local communities in mostof the eastern part of Indonesia to open and close areas for fishing single or multiple fisheries species in certain period. Since 2012, local community in Folley village, Raja Ampat has declared 297 hectares of their coastal areas as a sasi for sea cucumbers as important resources for their communities. They protect the sasi areas by conducting regular patrol and harvested the sea cucumbers only for 1 or 2 weeks per year. Supported by the local government and religion leader, the local community set a harvest strategy, including size limitation before opening it for harvest. The Nature Conservancy's scientist provided scientific consideration to ensure the harvest strategy match with sustainable use principles. The trained monitoring team, consist of local community, local government and other partners collected data of number, size and species of sea cucumbers during the harvesting period. The annual data show increased number of sea cucumber species in sasi areas from 6 species in 2013 to 11 species in 2016 and increasing average total harvest from 191 individuals per day on 2013 to 681 individuals per day on 2016. The Income of local community from open the sasi area also increased approximately 3 times from 2013 to 2016. Revenue from harvest used to support interests of villagers that mutually agreed upon. This positive result indicating that the sasi is effective natural resource management to improve both species biodiversity and income for local communities in Raja Ampat.

Traditional culture-based public awareness and conservation actions for horseshoe crab at Kinmen Island, Taiwan

Mr. Te-shun Hung[1], Dr. Ming-Che Yang[2]
[1] *Kinmen Horseshoe Crab Conservation Association,* [2] *IUCN SSC horseshoe crab specialist group*

During the Marital Law era in 1949-1990s, Kinmen was brought under tight military control and kept people away from the coastal beaches filled with mines and enabled the marine animal, horseshoe crabs to thrive. However, most of residents lost their awareness to close to the sea during the long military period- not to mention to care about marine life and environment. During the decade of the 2000s, the construction of the 2.2 million m2 port had destroyed fishing grounds and devastated the ecosystem at Kinmen. Meanwhile, the horseshoe crab population has disappeared along with the traditional way of life for the island's fishermen. The homeless horseshoe crab and fisherman were made their first awarded documentary as "The Lost Sea".

To seek for conservation support from the locals and public, traditional culture-based public awareness and conservation actions were conducted. Traditional fishery skills were demonstrated by old fisherman with concept of sustainable fishery. DIY course of horseshoe crab model's sticky rice cake and origami enriched participants' knowledge and interests of horseshoe crab. Field tour around intertidal zone were guided for firsthand experience with horseshoe crab juveniles and their habitat. All the efforts contributed to the citizen science and urge government's conservation actions on coast biodiversity and environment.

Understanding the links between fishing frequency and food security in the Sunda Banda Seascape, Indonesia

Ms. Ignatia Dyahapsari[1], Mr. Matheus De Nardo[2], Mr. Nara Wisesa[3], Ms. Louise Glew[2], Ms. Estradivari Estradivari[1]
[1] *WWF-Indonesia,* [2] *WWF-US,* [3] *WWF-*

With two-thirds of its territory is seawater fulfilled by mega-diversity biota, Indonesia depends heavily on marine resources to support nation's protein food security. Some scientists argued that fishermen have higher potential to improve food security and nutrition through direct consumption or indirectly through income. To better understand these pathways, this study aims to examine if fishing households that fished more often and ate more fish would have higher food security level than non-fishing households in five areas in the Sunda Banda Seascape, Indonesia. We sampled various parameters related to fishing capacity and food security at household level, and

collected data from 1948 households in 109 settlements, from 2014-17. A statistical analysis was used to see the correlation between fishing behaviour and protein consumption. We also tested whether there are differences in fishing frequency and food security between sampled areas. Our results provide understanding on the extent of fishing behaviour as factors in influencing the household food security, and therefore can be useful to formulate future strategies on marine management to support sustainable fisheries and improve food security.

Understanding the public perception of sharks

Ms. Mareike Dornhege[1], Mr. Ioannis Giovos[2], Ms. Carlotta Mazoldi[3]

[1]*Sophia University Tokyo,* [2]*iSea,* [3]*University of Padova*

The image of sharks as obtuse ferocious predators of the oceans has been well shaped throughout human history by various myths, stories and contemporary movies. Nowadays, almost one third of the shark species are threatened due to human-based activities. Thus,there is an increasing need for conservation measures able to effectively preserve the threatened populations. Public perception towards wildlife is a key factor for the implementation of conservation planning, since the public can direct management priorities through its support and engagement. Our study aims at understanding the public perception towards sharks at a global scale, unravel potential factors and drivers shaping public opinion and highlighting paradigms. For this, an online questionnaire was used, consisting of three parts. The first part collects demographic and general information; the second part is a closed formed Likert scale matrix investigating the attitude, based on the attitudinal scale of Kellert (1985); the third part evaluates the knowledge of the responder on sharks. The questionnaire is translated in 19 languages and, in 16 months, got more than 13,000 answers from over 130 countries. Our results reveal interesting facts about the public attitude towards sharks and the relation between attitudes, knowledge and preferences with cultural and demographic parameters.

Using multi-disciplinary conservation strategies to recover sea turtles on Tioman Island, Malaysia.

Mr. Alberto Garcia[1], Ms. Nur Izzati Roslan[1]

[1]*Juara Turtle Project*

Sea turtle populations have decreased all over the world for the past 50-60 years, mainly from human causes. The Juara Turtle Project started on 2006 protecting sea turtles on Tioman Island, Malaysia. More than 1000 nests have been collected since then, and more than 80000 hatchlings have been released into the sea. The first two years, the eggs were bought directly to unknown local egg-collectors, trying to get as many eggs as possible. As a consequence, the hatching success rate (HSR) was far from the values obtained the last few years, being 56.16% in 2006 and 69.30% on average. After 2009, local egg collectors were taught and restricted to collect the eggs only around Tioman and, although the number of nests collected has decreased, the HSR has been increasing throughout the years, being 82.49% in 2017 and 81.70% on average since 2010. Thus, the number of hatchlings released into the sea has increased significantly. Specifically, the hawksbill population has improved notably, going through 2 to 5 nests between 2007 and 2009 to 20 nests in 2017. Local communities are a cornerstone for the sea turtle conservation in areas where sea turtles use to nest. Then, giving them proper handling techniques, the results can improve visibly in few years. We present on this document how the management techniques have changed to develop a successful conservation project, working together with Juara's community. A purpose for the next few years is to involve the whole Tioman Island in the conservation of sea turtles.

Validation of a novel satellite-transmitted data product to monitor long-term activity in free-ranging elasmobranchs

Ms. Rachel Skubel[1], Ms. Kenady Wildon[2], Mr. Isaac Heizer[2], Dr. James Sulikowski[3], Ms. Hannah Verkamp[3], Dr. Daniel Benetti[1], Dr. Yannis Papastamatiou[4], Dr. Neil Hammerschlag[1]

[1]*University of Miami,* [2]*Wildlife Computers,* [3]*University of New England,* [4]*Florida International University*

While satellite-transmitted measurements of fish depth, temperature, and location are possible over timescales of months to years, whole-animal activity levels are generally measured over much shorter time periods. Remote transmission of activity data, derived from accelerometer records, is limited by satellite-tag data storage, sufficient battery for transmitting data, and restricted satellite bandwidth for receiving transmitted data. As such, studies of whole-animal activity are generally limited to relatively short deployments where logged data can be feasibly retrieved, or opportunistic retrievals of longer-term logged data. Here, we validate a new satellite-transmitted data product for remote measurement of fish activity levels, movement, and temperature, over a period of months, without requiring recovery of the tag. Accelerometer sensors from pop-off satellite archival tags (PSATs) measure fish activity, which is transmitted as an 'activity time series' (ATS) along with depth, temperature, and irradiance data for geolocation, to the Argos satellite system. We tested these new PSATs which generated ATS data on captive cobia (Rachycentron canadum) and dogfish (Squalus acanthias), each over a period of 5 days. Deployments were paired with video monitoring to compare archived tag data, the transmitted ATS data product, and visually observed fish behavior including tail beat frequency (TBF). We used these data sources to validate ATS behavioral state classification using a supervised Hidden Markov Model (HMM). For highly mobile species whose behavior precludes the retrieval of long-term archival records, the ATS product may present an alternative for field-based studies of activity level under variable environmental conditions, and across broad spatiotemporal scales.

Vanishing sirens: an account of the dugong population of the Andaman and Nicobar archipelago, India

Dr. Elrika DSouza[1], Dr. Teresa Alcoverro[2], Dr. Vardhan Patankar[3], Dr. Núria Marbà[4], Mr. Nachiket Kelkar[5], Dr. Rohan Arthur[1]

[1]*Nature Conservation Foundation,* [2]*Centre d'Estudis AvanÃğats de Blanes (CSIC),* [3]*Centre for Wildlife Studies and National Centre for Biological Sciences,* [4]*Institut Mediterrani d'Estudis Avançats,* [5]*Ashoka Trust for Research in Ecology and the Environment*

Research and monitoring over the last decade has shown that the present dugong population of the Andaman and Nicobar archipelago in India occur in small, almost isolated pockets across the island chain. Fewer than fifty individuals are present in these waters and whenever sighted, have been solitary individuals; rarely in pairs. These animals persistently use a few seagrass meadows and this further exposes them to threats prevailing at the sites. Entanglement in fishing nets, high-speed boats and hunting by aboriginal tribes continue to affect the animal and its habitat. By assessing threats to the animal and habitat and the suitability of the habitat, we identify ways in which management authorities can conserve the remnant dugong population of the archipelago.

Vertical distribution of microplastic particles in the Eastern Indian Ocean off the Northern Sumatra Island

Mr. Dede Falahudin[1], Mr. Muhammad Cordova[1]
[1]*Research Center for Oceanography, Indonesian Institute of Sciences*

The first investigation of microplastics in the Eastern Indian Ocean off the Northern Sumatra Island was conducted during research cruise with RV Baruna Jaya VIII, we investigate the vertical distribution of microplastics (MPs) at 13 sampling site. The water samples (10L) were collected using Rosette Water Sampler on the surface (5m), thermocline (140-150m) and near the seafloor (350-1500m). MPs were extracted through close-system directly attached to the Rosette Water Sampler and then the suspension water was filtered under vacuum onto cellulose filter paper (Whatman 047 mm; pore size 0.45μm). MPs characteristics (shape, size, and number) were analysis under a stereomicroscope. The results showed that the average of MPs concentration was between 0.4-0.5 MPs/L and there was no significant difference between the MPs concentration collected from the surface, thermocline and near the seafloor. The most common shape was fibers (68%) and the range of MPs size was between 26 to 2480 um. From this study, further investigation is needed to see the distribution of microplastics on benthic-pelagic system and the scale effect of MPs on the organism in the water column and seafloor.

Whale sharks Rhincodon typus occurrence and bycatch record in Bangladesh marine territory.

Mr. Rafat Adnan[1], Mr. Mohammad Foysal Ehsan[1], Mr. Abdul Wahab Akonda[1]
[1]*Marinelife Alliance*

This huge pelagic filter feeder first came in Bangladesh scientific report during late nineties. Incidental capture and offshore records by fishermen predict the presence of whaleshark in Bangladesh marine territory. According to offshore fishermen during winter October to February every year whaleshark occur at southwest offshore from St. Martin Island and along Swatch of no ground (SONG). Our bycatch monitoring fishermen observed whaleshark at Swatch of No Ground and further down within continental self where water is deeper. Our marine megafuana and bycatch survey recorded whaleshark 50-60 kms west of St. Marin Island, and at 30 kms south of the island during winter. Fishermen claimed to have been sighted solitary and several individuals. We recorded 34 individuals incidental capture of size ranges 9 - 23 ft (n=34) during 1996-2017 along the coast of Cox's Bazar, Chittagong and South central to southwest coast. Although this is not a target species they are accidentally caught in large drifting gill net of strong filament. Like other sharks if captured whalesharks also consumed only by tribal people and fins are exported like other sharks. Marinelife Alliance marine meagafauna program coordinating with scientists working in Indian ocean state about whaleshark movement and occurance. It is highly likely whaleshark of the Indian Ocean sharing Bay of Bengal and Bangladesh marine waters. We are starting satellite tracking in near future for better understanding of their movement pattern and seasonality. The major occurrence of the whale shark is assumed to be in winter period ding to our observation.

Wildbook AI: Using Computer Vision and Machine Learning to Discover Whale Shark Encounters on YouTube

, Mr. Jason Holmberg[1], Mr. Jason Parham[2]
[1]*Wild Me,* [2]*Rensselaer Polytechnic Institute*

The proliferation of mobile phones and GoPros has created a wealth of video and photographic material ripe for mining scientific data. At Wild Me, we have extended our open-source wildlife conservation software, Wildbook, to take advantage of this by autonomously searching social platforms for animal sightings.Our pilot project runs on Wildbook for Whale Sharks (whaleshark.org), using YouTube as a source. Nightly, our automated process, "Wildbook AI", uses YouTube's API to search for videos, then uses custom computer vision software to detect the presence of whale sharks in the video frames. Next, we use natural language processing to derive a date and location of the sighting. We then use our pattern matching algorithm to match the individual against our database of nearly 9000 whale sharks. Finally, the software follows up by notifying the creator of the video of these results by leaving a comment on the source YouTube video.This initial trial has already surpassed the next most prolific (human) researcher in number of sightings collected by a factor of 3-to-1, discovering upward of 150 encounters each month. We are testing extending this method to other social platforms, as well as other species.

IMCC5 Day 5 (28/6)

Dr. Ransom A Myers Memorial Plenary: Philip Levin, Ph.D.

8:30 - 9:30, Ranyai Ballroom

Conservation at the edge: interdisciplinary science for nature and people

Phillip Levin is the lead scientist of The Nature Conservancy, Washington and a Professor-of-Practice in the School of Environmental and Forest Sciences at the University of Washington. Dr. Levin is a conservation scientist who is interested in bridging the gaps between theory and practice in conservation, and developing modeling and statistical approaches to inform conservation and management of ecosystems. The main focus of his current work is developing interdisciplinary tools to inform conservation of marine, aquatic and terrestrial ecosystems and the communities that depend on them. Prior to joining the Nature Conservancy and University of Washington, he was the Director of Conservation Biology and a Senior Scientist at NOAA Fisheries' Northwest Fisheries Science Center in Seattle, WA, USA. Levin served as the scientific lead of NOAA's Integrated Ecosystem Assessment efforts in the California Current Large Marine Ecosystem and Puget Sound. In the course of this work, he has led the development of new analytical tools for characterizing ecosystem health and forecasting the cumulative effects of coastal zone management and climate change on ecosystems. Dr. Levin received the Department of Commerce Silver Award and NOAA's Bronze Medal for his work on marine ecosystems, and the Seattle Aquarium's Conservation Research Award for his work in Puget Sound. He has published over 150 scientific papers in peer-reviewed journals, book chapters and technical reports, and edited the recently published book, "Conservation of the Anthropocene Ocean: interdisciplinary approaches for nature and people". His work has been featured in such news outlets as NPR, PBS, the BBC, MSBNC, The Economist, among others. Levin recently served as President of the Western Society of Naturalists, and has served on numerous editorial boards and scientific advisory panels. Levin received his Ph.D. in zoology from the University of New Hampshire in 1993 and was a postdoctoral fellow at the University of North Carolina.

OS-10A: Marine Policy 1 (10:00 - 12:00, FJ Auditorium)

10:00 - In search of silent seas

Dr. Rob Williams[1], Dr. Erin Ashe[1], Dr. Christopher Clark[2], Prof. Christine Erbe[3], Dr. Alan Friedlander[4], Dr. Adam Frankel[5], Prof. Val Veirs[6], Dr. Scott Veirs[7]

[1]Oceans Initiative, [2]Cornell, [3]Curtin University, [4]University of HawaiÊži at MÄĄnoa, [5]Hawai'i Marine Mammal Consortium, [6]Colorado College, [7]Beam Reach Marine Science

Ocean noise degrades the "ancient ambient" acoustic conditions under which marine animals evolved. Critical habitats of endangered southern resident killer whales and North Atlantic right whales are sufficiently altered that whales lose more than 90% of opportunities to communicate over biologically meaningful ranges. Much of the world's ocean remains unsampled. In partnership with National Geographic's Pristine Seas program, we used a rapid-assessment, "acoustic prospecting" approach to capture recordings with minimal anthropogenic contribution. Spot recordings from Palau, Rapa Nui, and Bali allowed us to generate ambient noise spectra and compare these to Wenz's minimum noise levels. Across the full 0-48 kHz frequency range, we found that 95th percentile noise levels off Bali were approximately 10 dB higher, Palau 3-6 dB higher, and Rapa Nui 2-3 dB re 1 μPa lower than Wenz's minimum curve. Across an "anthropogenic band" between 10 and 1,000 Hz, Palau was 108 dB//μPa, Rapa 119 dB//μPa, and Bali was 95 dB//μPa, the lower theoretical limit. Given increases in global shipping, we risk losing opportunities to study ecological effects of ocean noise due to lack of control sites and times. Spatially, we urge action to identify candidate sites for quieter MPAs, not only sites that need mitigation. Temporally, we recommend taking advantage of holidays, such as Bali's Nyepi (Day of Silence), where we observed a 6 dB drop in the noisiest percentile of low-frequency levels. Now, our focus is shifting toward practical solutions to reduce ship noise through simple changes in shipping practices in important whale habitats.

10:15 - Tracking shifting baselines on known marine and coastal habitat extents globally

Ms. Juliette Martin[1], Ms. Lauren Weatherdon[1], Ms. Mariane Deguignet[1], Ms. Hazel Thornton[1], Mr. Christopher Mcowen[1], Mrs. Corinne Martin[1]

[1]UN Environment World Conservation Monitoring Centre (UNEP-WCMC)

Reliable data on marine and coastal ecosystems lie at the heart of informed decision-making that sustains marine biodiversity, yet these data are often fragmented and difficult to access, with ever-shifting baselines of knowledge. In 2011, the UN Environment World Conservation Monitoring Centre's (UNEP-WCMC's) release of the Ocean Data Viewer marked a significant step forward by offering an easy-to-use interface hosting more than 2.5 million remotely sensed, in situ, and modelled biodiversity records, including known seagrass, coral, and mangrove distributions.

Now, UNEP-WCMC is seeking "smart" approaches to tracking the known extent and condition of marine and coastal habitats globally by establishing an international network of national focal points, and thereby contributing to a step-change in global access to and use of spatial data. Here, we review the evolution and application of these datasets, highlighting key statistics from recent analyses. We also describe improvements undertaken (e.g. standardised attributes, validation, and quality metrics), our engagement with national focal points

and our vision for the coming years, illustrating how these efforts will help move the conservation agenda forward by tracking progress towards global targets, such as the Aichi Biodiversity Targets and Sustainable Development Goals, and helping to prioritise areas for capacity development and management.

10:30 - Designing effective marine protected areas in biodiversity and fisheries conservation hotspots

Dr. Nils Krueck[1]
[1]*The University of Queensland*

Overfishing is commonplace, threatening the sustainability of coastal marine ecosystems and associated services worldwide. About 200 governments have therefore committed to protecting 10-20% of national coastal marine waters by 2020. However, the planning and enforcement of marine protected areas (MPAs) remains challenging, given that millions of people in the most heavily impacted regions depend on fishing for food and income. In my presentation, I will introduce a set of guidelines and software programs developed to support decisions on total MPA coverage, placement and local size in known biodiversity and fisheries conservation hotspots. The research behind these MPA design "tools" shows that informed decision making can help reconcile potentially conflicting biodiversity conservation and fisheries objectives of MPAs. Freely available policy briefs and software programs make this research accessible for application by conservation planners, fisheries managers, industry stakeholders and communities. Drawing on multiple case studies in Indonesia, I will specify the likely magnitude of associated benefits in MPA effectiveness.

10:45 - Application of Bayesian belief networks to marine ecosystem services assessment to support MPA management

Dr. Olivia Langmead[1], Mr. Andy Cameron[1], Prof. Martin Attrill[1]
[1]*University of Plymouth*

Marine protected areas (MPAs) are a key management tool to halt the global decline in marine biodiversity and fish stocks. Evidence is mounting on the societal benefits they can support through enhanced ecosystem service provision. In the UK almost all MPAs allow some activities to occur - protection is seldom complete. Here we explore how the level of management of MPAs can influence the delivery of marine ecosystem services using a geospatial Bayesian belief network (BBN) approach. Spatial pattern of seabed habitat potential to supply ecosystem services (ES) of four types was modelled: nursery habitat for commercial fish species; carbon burial; waste processing and primary production. Across the case study area, Lyme Bay, SW England, ES provision was highly heterogeneous and varied by ES type. Results also revealed that the current network of MPAs support higher flows of ecosystem services compared with surrounding waters, and MPAs with mobile demersal fishing restrictions had the greatest ES provision. Practical applications for this approach were tested: 1) mapping high risk areas to prioritise management interventions and ensure the most important areas were targeted; 2) applying scenarios for future management; 3) identifying trade-offs between ES provision with different management interventions /developments; and 4) focusing engagement and communication with managers and stakeholders. The BBN modelling approach provided a framework to build up understanding of how complex marine ecological systems respond to changes resulting from management and has considerable application as a practical tool to enable the consideration of marine ES in marine management.

11:00 - Resolving conflict due to negative environmental externalities from marine renewable energy developments to marine protected areas using cooperative game theoretic allocation rules

Dr. Zacharoula Kyriazi[1], Prof. Raul Lejano[2], Prof. Frank Maes[1], Prof. Steven Degraer[3]
[1]*University of Gent,* [2]*New York University College of Arts & Science,* [3]*Royal Belgian Institute of Natural Sciences*

The increasing demand for marine space makes conflict avoidance through single use zoning of incompatible uses or multi-use zoning of strictly compatible uses increasingly impossible. Because of this, coexistence of (partially) incompatible uses has already become an option giving rise to conflicts that cannot be avoided and need to be resolved. Here a case of co-locating marine renewable energy (MRE) developments with marine protected areas (MPAs) is examined, where the negative environmental externalities caused by the first to the second can be addressed through environmental or monetary compensation as a conflict resolution mechanism. Such mechanism should ensure fair, win-win coexistence guaranteeing that both current and future potential losses of conservation benefits are covered. This assumption is better captured by the Net Gain goal of mitigation strategies in contrast to the No Net Loss one which has prevailed so far. Considering the above, a hypothetical example is used where it is demonstrated how cooperative game theoretic allocation rules can be used to adequately estimate the type and size of such compensation. An important conclusion is that the effectiveness of such a mechanism requires among other the best knowledge of the changes in the current and future MPA value in order to accurately calculate possible losses due to coexistence. Such a finding is also highlighting the prevalence of the importance of marine science in addressing complex multidisciplinary research questions, such as the ones examined in the present study.

11:15 - Challenges of managing migratory megafauna in a large marine jurisdiction: Lessons for the Coral Triangle

Ms. Rachel Miller[1], Prof. Helene Marsh[1], Dr. Claudia Benham[1], Dr. Mark Hamann[1]
[1]*James Cook University*

Managing the threats to marine migratory species is difficult, even within the same country, as animal movements often span large areas and are unconstrained by jurisdictional boundaries. In Australia, a country with an Economic Exclusion Zone comprised of approximately 10 million square kilometres of ocean, marine governance is encompassed by federal and state governments. However, such multi-government systems require complementary legislation, particularly when managing large marine migratory species. We conducted an analysis of Australian policy and management plans protecting six species of marine turtles, dugongs, humpback whales, and 27 species of non-threatened migratory shorebirds. Our analysis identified biases towards larger, charismatic megafauna, such as marine turtles and dugongs, in statutory policy instruments. Smaller species, such as migratory shorebirds, were often protected by non-statutory environmental management plans. Further, our analysis highlighted a disconnect between policy instruments operating at different governance levels. Species-specific biases combined with the disconnect of policy instruments between governance levels emphasises the need for coordinated and cooperative governance to protect marine migratory megafauna in Australia. We propose the introduction of an overarching conceptual framework for managing marine migratory species as one solution for promoting cooperative governance and remedying the communication gap in Australia. These findings have broader

global application to other large marine governance systems, such as the Coral Triangle (a marine system comprised of approximately six million square kilometres of ocean), which is home to threatened marine migratory species and is a region governed by multiple national and state level governments.

OS-10B: Conservation and Management 7 (10:00 - 12:00, FJ Event Hall)

10:00 - Tracing Coral Reefs: A Citizen Science Approach in Mapping Coral Reefs to Enhance Marine Park Management Strategies.

Mr. Chai Ming Lau[1], Mr. Kee Alfian Abdul Adzis[2], Mr. Affendi Yang Amri[3], Mr. Julian Hyde[1], Mr. Alvin Chelliah[1], Ms. Yun Sing Leong[1], Ms. Putri Asma Megat Yusop[4], Mr. Yin Lee Low[1], Mr. Ven Thye Leong[1], Mr. Mohd Halimi Amar[5], Dr. Mohd Sahir Yaman[5], Mr. Ramdhan Razak[6]

[1]Reef Check Malaysia, [2]SEAlutions Sdn. Bhd, [3]Institute of Ocean and Earth Sciences, University of Malaya, [4]Institute of Oceanography and Environment, Universiti Malaysia Terengganu, [5]Tioman Marine Conservation Group, Reef Check Malaysia, [6]B&J Diving Centre

Effective marine park management and protection of its coral reef can only happen if managers have adequate knowledge of its present health status, extent and area. However, obtaining such information is labour intensive and difficult with limited funding and time. Reef Check Malaysia was engaged by Department of Marine Park Malaysia in a collaborative effort to map the coral reefs area surrounding Tioman Island Marine Park and document an overview of its health status and site specific threats. To achieve this, we utilize Reef Check survey method, a simple, rapid and holistic standardized reef monitoring procedure based on scientific principles. This method is suitable where funds and time are limited. A total of 95 sites surrounding Tioman Island were surveyed with the assistance of certified Reef Check EcoDiver volunteers and members from local stakeholders. This citizen science approach proved successful and resulted in a baseline map revealing a difference in the health of coral reefs between the west and east side of Tioman Island, where the West had ~25% live coral cover as compared to ~50% on the East. Combined with the data of indicator fish and invertebrates as well as human and natural impacts, the results suggest that Tioman Island should be separated into three distinctive conservation priorities zones to enhance management strategies of this marine park. This is an example of an innovative way to engage and involve local stakeholders in planning conservation and management strategies, addressing question number 48 for the advancement of marine conservation.

10:30 - Geographic priorities for Marine Biodiversity Conservation in the Coral Triangle

Mr. Irawan Asaad[1], Dr. Carolyn Lundquist[2], Dr. Mark Erdmann[3], Dr. Ruben Van Hooidonk[4], Dr. Mark Costello[5]

[1]University of Auckland and Ministry of Environment and Forestry of Indonesia, [2]National Institute of Water and Atmospheric Research, and University of Auckland, [3]Conservation International, [4]University of Miami, [5]University of Auckland

We evaluated the performance of an existing marine protected area (MPA) network in protecting representative ranges of biodiversity features and developed a prioritization scenario for expansion of this MPA network. This study is focused on the Coral Triangle (CT) region, a marine region located between Indian and Pacific Oceans, widely recognized as the global epicenter of shallow marine biodiversity, though current MPAs protect less than 2% of its marine area. We utilized the systematic conservation planning software Zonation as a decision-support tool to ensure representation of biodiversity features while minimizing costs associated with threats. Our results indicated that the average representation of biodiversity features within the existing MPA network is currently about 5%. By systematically increasing MPA coverage to 10%, the average representation of biodiversity features within the MPA network would increase to over 37%. Marine areas in the Halmahera Sea, the outer island arc of the Banda Sea, the Sulu Archipelago, the Bismarck Archipelago, and the Malaita Islands were identified as priority areas for the designation of new MPAs. Moreover, we recommended that several existing MPAs be expanded to cover additional biodiversity features within their adjacent areas. An MPA network that covered 30% of the CT would include 65% of the biodiversity features. This assessment provides a blueprint for efficient gains in marine conservation through the extension of the current MPA network in the Coral Triangle region.

10:45 - Using Public Participation GIS to inform the human dimension for large marine parks: lessons for marine spatial planning

Dr. Halina Kobryn[1], Dr. Jennifer Munro[2], Prof. Greg Brown[3], Prof. Susan Moore[1]

[1]Murdoch University/Environment and Conservation, [2]Department of Parks and Wildlife, [3]California Polytechnic State University

Marine spatial planning (MSP) is an approach to manage different human uses and conservation goals. Most conservation planning, including MSP, relies heavily on biophysical data and suffers from the lack of social data, hence our aim was to fill the gap and collect spatially explicit data on social values and management preferences for the marine and coastal areas of the Kimberley, Western Australia. This region is renowned for its rich Aboriginal culture and heritage, biodiversity and wilderness, with low population and dispersed economic development including agriculture, mining, fishing, and more recently oil and gas exploration. Interviews (N=170) involving participatory mapping were held with stakeholders who either visited or lived in the Kimberley. Seventeen values were elucidated from the interviews, spanning consumptive, non-consumptive, direct and indirect uses. Biodiversity, the physical landscape and Aboriginal culture were most valued. The entire study area was mapped with one or more values. Management preferences were dominated by the desire for more conservation and exclusion of oil and gas development and commercial fishing. The diversity of values suggests high potential for conflict over management and activities in the region.PPGIS based on interviews provides social data for the 'missing layer' in MSP. Such data are needed if the social concerns of stakeholders are to be recognized and included in spatial planning. PPGIS complemented by extensive field interviews is a powerful method of evaluating existing human values over large marine spaces and provides quantitative inputs into modeling of conflict potential in marine spatial planning.

11:00 - A first attempt of incorporating coral restoration by a hotel industry following a beach and lagoon rehabilitation work in Mauritius

Mr. Nadeem Nazurally[1]

[1]University of Mauritius

Mauritius is a famous touristic destination and is currently facing a serious decline in coral reefs and overall marine biodiversity. In response to the ongoing damage to coral reefs and the consequences on sand erosion, hotel industries have started to engage on beach and lagoonal rehabilitation works as well as coral farming as being a major part of conservation strategies. The project consisted of two parts. First, corals and marine organisms were removed along three (10 m by 10 m) area labelled Reef 1, Reef 2 and Reef 3 to accommodate Permeable Submerged Breakwaters (PSBs) made of basaltic rocks inside the lagoon to act as a barrier for sand erosion. Line intercept transect (LIT) method was used to assess the percentage coral cover prior to removal process. They were placed on special designed table nurseries and were carefully monitored for 1 month before transplantation. The second part involved the transplantation of corals on special artificial reef structures placed next to the PSBs as well as assessment of natural recruits on the basaltic rocks and the artificial reef structures post construction phase. The overall percentage survivorship so far has been 95% with very few bleaching. The natural recruits were observed only on the natural basaltic rocks as compared to the artificial cement-made artificial reef structures. One of the major aspect of this project has been to demonstrate the sustainable approach towards placement of artificial structures to prevent sand erosion while incorporating the ecological criteria.

11:15 - Impact evaluation generates novel insights into MPA effectiveness

Dr. Dominic Andradi-Brown[1], Dr. Jill Harris[1], Ms. Louise Glew[1], Mr. Purwanto Purwanto[2], Mr. Nur Ismu Hidayat[3], Dr. Helen Fox[4], Dr. Megan Barnes[5], Dr. Gabby Ahmadia[1]

[1]World Wildlife Fund, [2]University of Papua (UNIPA), [3]Conservation International, [4]National Geographic, [5]University of Hawaii at Manoa

Establishing effective MPAs are a major goal of many marine conservation programs, with MPAs often expected to provide both fisheries and biodiversity benefits. Yet despite the rapid global expansion of MPAs, MPA effectiveness evaluation is often limited by a lack of appropriate monitoring designs and a disconnect between MPA objectives and the monitored outcomes. Here we use state-of-the-art impact evaluation techniques to assess a recently established MPA network in the Bird's Head Seascape (BHS), West Papua, Indonesia. Coral reef ecological and fisheries data were collected approximately every 3 years since 2010 at ~200 monitoring locations within and at control sites outside seven BHS MPAs. By using impact evaluation, it is possible to explicitly estimate MPA outcomes in comparison to the counterfactual (the outcome based on no MPA implementation). Matching techniques were used to pair sites within MPAs to outside control sites based on ten biophysical and anthropogenic variables (e.g. reef type and exposure, distance to deep water, distance to nearest human settlement and market etc.) previously reported to affect fish biomass and coral cover. We assessed the effectiveness of the MPA network for herbivorous and commercially valuable fish biomass and coral cover. Interestingly, when comparing using counterfactuals to assess effectiveness of the MPA network to traditional non-matched controls we found that some MPA impacts would have been underestimated, while others have been overestimated with traditional MPA monitoring designs. Using impact evaluation techniques such as these allows for causal inference of MPA effects, which subsequently can inform better-designed MPAs.

11:30 - Mapping Indigenous ecological knowledge of the marine environment to inform marine conservation planning

Ms. Harriet Davies[1], Dr. Jackie Gould[2], Dr. Ben Radford[3]

[1]University of Western Australia/ Australian Institute of Marine Science, [2]Charles Darwin University, [3]Australian Institute of Marine Science

In regions where the majority of land is under Indigenous ownership or where Indigenous people retain a connection to their marine estates, respect for and an ability to include the rich knowledge base of Indigenous people in conservation policy decisions is essential. Particularly for marine management, drawing together the knowledge of Indigenous communities and marine scientists can result in improved conservation outcomes. Maps of benthic habitats are considered some of the best surrogates for biodiversity in the marine environment and are an essential foundation for effective conservation planning. Indigenous ecological knowledge (IEK) can be an excellent source of information for mapping the marine environment and this contribution is especially valuable when other data is scarce. This study developed a methodology which combines elements of expert elicitation and participatory mapping techniques to assemble the IEK of the Anindilyakwa people of the Groote Eylandt Archipelago off Australia's poorly surveyed Northern coast. Representatives from 14 Anindilyakwa clan groups participated (n=40), resulting in 21 individual maps. Nine broad-scale habitat classifications, predominately in the intertidal and nearshore marine environment, were described in both Anindilyakwa and English. The information gathered was then used to develop benthic habitat maps covering a combined area of 1800km2, identify conservation priority areas and ascertain distributions of vulnerable species. The methodology developed provides a cost effective and replicable technique to characterise large areas of the marine environment from IEK and facilitates ongoing information exchange and respectful knowledge sharing between western scientists and Indigenous communities.

11:45 - Macroalgae may be a misleading indicator of coral reef health

Ms. Sara Cannon[1], Dr. Simon Donner[1], Dr. Douglas Fenner[2], Dr. Maria Berger[3]

[1]University of British Columbia, [2]Consultant, [3]University of Leeds

Climate change and human disturbance threatens coral reefs across the Pacific, yet even within the field of marine conservation, there is little consensus on what characterizes a "healthy" reef. Benthic cover, particularly low coral cover and high macroalgae cover, are often used as an indicator of reef degradation, despite uncertainty about the typical algal community compositions associated with either near-pristine or damaged reefs. In this study, we assess taxa-level response to human disturbance, past heat stress and exposure by contrasting 25 sites along a gradient of human disturbance in Majuro and Arno Atolls of the Republic of the Marshall Islands. The results show that total macroalgae cover indicators of reef degradation may mask the influence of local human disturbance. Instead, identifying macroalgae to a lower taxonomic level (e.g. the genus level) would provide a more accurate measure of Pacific coral reef health, which is critical for the effective conservation of coral reefs.

S-207: Making Livelihoods Projects Work: Appraising Fisheries-Based Livelihood Enhancement Strategies For Marine Conservation (10:00 - 12:00, Tubau 1)

10:00 - Diversified livelihoods and alternative responses to dilemmas of poverty and environmental degradation in coastal fisheries and marine conservation

Dr. Martin van Brakel[1], Dr. Md. Nahiduzzaman[1], Dr. A.B.M. Mahfuzul Haque[1], Dr. Md. Abdul Wahab[1]
[1]*WorldFish*

Integrated coastal management and marine conservation programs in developing countries nowadays explicitly recognize the value of livelihood support to tackle poverty and environmental degradation. Successful livelihood interventions can improve the outcomes of such programs and therefore governments and donors make considerable investments in diversifying the livelihoods of small-scale fishing communities. The effectiveness of such interventions in terms of improving incomes and food security, while reducing environmental degradation, remains however a matter of unresolved debate. Our research places dimensions of human well-being, food security and social equity within the wider debate on societal and cultural considerations of coastal and marine conservation. Outcomes and lessons learned over three years of livelihood interventions through the USAID-funded Enhanced Coastal Fisheries in Bangladesh (ECOFISH) activity challenge common assumptions about linkages between alternative livelihoods and income generation, and potential outcomes for management and conservation of coastal and marine biodiversity.

Our results demonstrate that livelihood diversification has contributed to enhanced resilience of coastal hilsa shad fishing communities, but not primarily through 'conventional' pathways of creating alternative employment and income generation. Economic and social empowerment of women in hilsa fishing communities has led to enhanced fisheries-based livelihoods through a diversified livelihood portfolio and reduced debts, while motivating their male community members to refrain from illegal and destructive fishing practices. This confirms the notion that the real value of livelihood interventions from a conservation perspective may lie in alternative responses that improve local attitudes towards conservation through increased cooperation and improved community relations.

10:15 - Nearshore, artisanal fish Aggregating Devices (FADs) strengthen fisher livelihoods and alleviate pressure on reef resources in Timor-Leste

Dr. Alex Tilley[1], Mr. Mario Pereira[2], Ms. Agustinha Duarte[2], Mr. Joctan Dos Reis Lopes[2], Mr. Acasio Guterres[3], Dr. David Mills[4]
[1]*WorldFish,* [2]*WorldFish Timor-Leste,* [3]*Ministry of Agriculture & Fisheries, Government of Timor-Leste,* [4]*WorldFish; Australian Research Council Centre of Excellence in Coral Reef Studies, James Cook University*

Convincing examples of coastal interventions that have successfully improved livelihoods and reduced threats to biodiversity are rare. In coastal Timor-Leste, some of the world's most diverse coral reefs are juxtaposed with one of the poorest and most malnourished populations. Fishing effort is low, but is largely restricted to nearshore habitats by limited capacity (boats, engines, fishing gear, and knowledge) to access pelagic resources. Yet, fish is an underutilized source of animal protein for food security, with the capacity to substantially increase availability of micronutrients and beneficial fats vital to brain development, motor function and growth. We tested the utility of deploying nearshore FADs to increase access to resilient and highly productive small pelagic stocks by artisanal fishers. Using landings data from FAD and non-FAD sites, we tested the effects of FAD presence on catch rates and species assemblages, using an index of relative importance to highlight changes in exploitation patterns. Semi-structured interviews of community fishers and stakeholders were then undertaken to discuss and explore social-ecological aspects of behavioural change. Our results show significant increases in catch rates at FAD sites compared to control sites, and significant decreases in species diversity scores as catch shifted from reef to pelagic assemblages. Fisher effort (time spent fishing) remained constant, or decreased in response to FAD deployment, as desired catch volume was reached faster, allowing fishers to commit time to alternative livelihood strategies such as livestock farming and horticulture. These results suggest nearshore FADs are effective in providing short term livelihood and conservation benefits.

10:30 - #FISBISNIS: Livelihood Enhancement And Resource Management In Langalanga Lagoon, Solomon Islands

Mr. Meshach Sukulu[1], Dr. Hampus Eriksson[1], Dr. Jan Van Der Ploeg[1]
[1]*WorldFish*

Young people in Solomon Islands have to negotiate an uncertain future impacted by rapid social and environmental change. The degradation of coastal ecosystems is undermining the resource base on which rural communities depend for nutrition and livelihoods. Urbanization, education and globalization are fundamentally altering production and consumption patterns, and expectations of life. However, most young people have very limited opportunities to fulfill these dreams. High drop-out rates, high youth unemployment levels, and the erosion of traditional support and governance systems lead to a variety of social problems, including alcoholism, drug abuse, sexual violence and petty crime. To be effective in the long term, community-based resource management efforts have to address this 'poverty of opportunity'. Here we describe the on-going efforts in Langalanga Lagoon to test and evaluate methods to actively engage youth in fisheries management and develop livelihood enhancement activities. Initial results show that vocational training and mentoring can strengthen collective action, reduce social frictions, and empower young people to set realistic goals and take concrete steps to improve their lives.

S-210: Seafood Ethics: Moving Beyond Sustainable Management to Ethical Governance (10:00 - 12:00, Tubau 2-3)

10:00 - An ethical approach to fisheries through Ecosystem-based Management Strategy Evaluation and value assessment

Prof. Tony Pitcher[1], Mr. Szymon Surma[2], Dr. Mimi Lam[3]
[1]*The University of British Columbia,* [2]*University of British Columbia,* [3]*University of Bergen*

Management Strategy Evaluation (MSE) for fisheries relies on a formal process of numerical simulations to explore the risks of alternative management protocols, but at the same time MSE is mandated

to include the preferences, attitudes and values of stakeholders, often determined in participatory community meetings that advise on fishing regulations. These two features, encompassing both ecological uncertainty and societal approval, render MSE well suited for ethical seafood governance. First, quantitative models used to explore scenarios are usually based on single species, while a stronger ethical footprint results from credible ecosystem-based MSE protocols. Second, there is a lack of methods designed to evaluate objectively the values and social factors to be included in any ethical consensus concerning the management of a fishery. A case study from a conflicted herring fishery in Haida Gwaii, Canada, has attempted to address both of these issues using a novel Value and Ecosystem-based Management Approach (VEBMA). A dynamic ecosystem model, fitted to data and simulating the food web of herring prey and predators, was employed in an MSE analysis of the impacts of alternative herring fishery management scenarios on important species in the ecosystem, such as marine mammals, seabirds and salmon. Interviews of stakeholders and citizens affected by the fishery, including local and indigenous communities, and herring fishers, revealed their preferences for alternative fishery management scenarios and evaluated the fundamental values underlying their choices. VEBMA is making marine science matter by broadening the focus of sustainable fisheries management to encompass ethical governance

---

10:15 - Values and ethics of multicultural fishing communities in the Andaman and Nicobar Islands, India

Mr. Sahir Advani[1], Prof. Tony J. Pitcher[1], Dr. Mimi Lam[2]

[1]University of British Columbia, [2]University of Bergen

Fishing communities, through their interactions with marine ecosystems, can play an integral role in marine conservation. An understanding of the diversity of values and ethics of fishing communities is therefore important to promote fisheries sustainability and marine conservation. Values and ethics can vary across fishing communities, reflecting socio-cultural factors such as gender, ethnicity, history, resource dependence, and market interactions. The multicultural and historically complex nature of fisheries and fishing communities in the Andaman and Nicobar Islands (ANI), India, provide a unique opportunity to study the interplay between values, ethics, and fisheries sustainability. Diverse communities from mainland India and South Asia migrated and settled in these islands and are now involved in fisheries and the seafood industry. I conducted in-depth, semi-structured interviews with 72 individuals from four cultural groups across eight communities. Locally-contextualised values, socio-cultural histories, and marine resource use were thematically coded using qualitative software. Additionally, fisheries sustainability was investigated quantitatively with a modified scoring matrix from Rapfish, a rapid appraisal technique, to examine both ecological and human dimensions. Communities involved in subsistence fisheries with longer histories of settlement on the islands share common values for marine conservation, despite differences in ethnicity and spatial separation. Meanwhile, unethical trade practices, poor price transmission, unfair deals and wages, and inequitable access to food security, are rampant in the islands' seafood sector. For effective marine governance, scientists and conservationists should frame their messages contextualized to the local values and ethics of the fishing communities who should adopt and implement marine action plans.

10:30 - Why marginality persists in a governable fishery

Dr. Andrew Song[1], Dr. Hekia Bodwitch[2], Dr. Joeri Scholtens[3]

[1]Australian Research Council Centre of Excellence in Coral Reef Studies, James Cook University; WorldFish, [2]McGill University, [3]University of Amsterdam

This paper examines the issue of reproduction of marginality widespread in fisheries: why does inequality and social exclusion persist? Using governability as an overarching basis for interpreting this issue, the purpose of this paper is to demonstrate the possibility that marginalization, not only a feature of ungovernability, might also occur in a governable system, as both the product and the cause of governability. For this, we engage an expanded notion of governability that draws on relational dynamics between main governance actors and applies it to the case of small-scale fisher exclusion brought on by the implementation of individual transferable quota in New Zealand's commercial fishery. Analysis using theoretical tools of political ecology help reveal the changing social and economic relations that give rise to an accentuated capitalist structure whereby the quota-owning sector of the population (e.g. processing companies and Maori tribal organizations) has control over the ways in which fishers access economic benefits from their labor. As an asset primarily managed for capital gain rather than as a right to fish, quota has gained acceptance as a resource management strategy, an intervention that is now ideologically hard to break away. The result is the reproduction of fisher exclusion which contributes to a governable fishery, rather than an ungovernable one. This understanding casts a critical note on what we mean by governability, directing our attention to the ethical questions regarding how we govern and how successful we are in doing so as well as a risk that comes with its pursuit.

10:45 - Ethical Reflections on the Food from the Oceans Report

Prof. Matthias Kaiser[1]

[1]University of Bergen

There is a global narrative that the world population is growing and that the only way to feed the global population by, say, 2050, is to increase the production of seafood, given the physical limits of agriculture and climate impact of livestock. At the end of 2016, the EU Commissioner Bella therefore requested scientific advice on the following question: "How can more food and biomass be obtained from the oceans in a way that does not deprive future generations of their benefits?" An international group of appointed experts - the current presenter among them - submitted its answer November 2017. This presentation shall focus on the societal and ethical challenges that were identified in the official report. Indeed, while some biological potential for increased harvesting from the oceans was identified, the report also states the societal, cultural and ethical challenges as the greatest bottlenecks for further growth. So-called licences-to-operate are in many countries of the industrialized world hard to come by. Kaiser sees the reasons for this in the neglect of holistic and social science perspectives in still dominating discourses on seafood, in the ideological focus on what is believed to be value-free and objective science, and he promotes a post-normal view on scientific knowledge production. The paper is meant to be thought provoking rather than reporting on specific research.

11:00 - Seafood Ethics

Dr. Mimi Lam[1]
[1]*University of Bergen*

Seafood ethics is a nascent transdisciplinary field at the science-society-policy nexus that aims to enhance marine resource sustainability by embedding considerations of values and ethics into marine management frameworks. Values govern all human activities and their explication in management can aid decision-makers in resolving resource conflicts and policy trade-offs. Ethics, the moral principles that govern individual and group behaviours, can affect responses to regulatory measures and influence resource sustainability. Seafood ethics thus encompasses the descriptive and normative study of the values and pro-social attitudes, value-based trade-offs, and ethical dilemmas of diverse stakeholders and citizens along seafood value chains, from producers to consumers. Increasingly, ethical consumerism or 'dollar voting' is demanding criteria-based ethical standards to foster environmental sustainability and corporate social responsibility in the global seafood industry. In response, boundary organizations have emerged, such as Seafish, whose mission is "to support a profitable, sustainable and socially responsible future for the seafood industry." It is uncertain, however, whether companies with commitments to emerging seafood ethics are leading to more sustainable and just value chains or if they are simply enhancing their market competitiveness and purchasing moral satisfaction for their consumers. In this talk, I will present emerging trends in seafood ethics, potential indicators for the ethical assessment of seafood value chains, and illustrative examples from fisheries and aquaculture of new regulatory and market-based approaches to ethical seafood. I conclude by arguing that moving beyond sustainable management to ethical governance can foster both sustainable and equitable marine resource allocation, use, and conservation.

S-56: Human Impacts in the Deep Sea (10:00 - 12:00, Kabu)

10:00 - Deep-sea fish characterization on Necker Island, Papahãnaumokuãkea Marine National Monument

Mrs. Beatriz Mejia-Mercado[1], Mrs. Nicole B. Morgan[1], Dr. Brendan Roark[2], Ms. Allison Metcalf[1], Ms. Kelly Klein[1], Dr. Amy R. Baco[1]
[1]*Florida State University,* [2]*Texas A&M University*

Some seamounts harbor a high abundance and diversity of fishes. However, evidence is emerging that within any given seamount, these attributes may vary strongly depending on variability in the physical, chemical or geological conditions. Necker Island, the second smallest island in the Papahãnaumokuãkea Marine National Monument (PMNM), includes a diversity of deep-sea habitats. Unlike seamounts further west in the PMNM, it has not been subject to commercial trawl fisheries. The relatively pristine nature of this site allows for baseline studies of deep-sea fish communities that can improve our understanding of the distributions of fishes on seamounts as well as inform management of sites throughout the Hawaiian Archipelago. Using 52,098 AUV photos we identified 18,515 fishes from three sides of Necker Island at depths of 200-700 m. The dominant fish orders identified were Stomiiformes, Aulopiformes, Gadiformes, Myctophiformes and Perciformes. Species richness showed significant differences among depths, sides of the seamount, and their interaction. Relative abundance was significantly different among sides, whereas Shannon diversity and Simpson dominance showed differences among depths and their interaction with sides. The highest richness was found at 500 m, in which diversity was also very high with low dominance. The highest values of dominance were observed at 250 and 700 m. Community structure was different among depths, sides, and their interaction, with a variation along a depth gradient. At deeper depths pelagic fishes were dominant, whereas shallower depths were dominated by benthic fishes. Based on DISTLM, fish community structure was most strongly correlated with depth and POC.

10:15 - The effect of research effort on global biodiversity and anthropogenic risk at deep-sea hydrothermal vents

Dr. Andrew Thaler[1]
[1]*Blackbeard Biologic: Scientific and Environmental Advisors*

Seafloor mining is emerging as one of the leading anthropogenic threats to deep-sea hydrothermal vent ecosystems, yet international regulation of seabed mining is in its infancy. Deep-sea hydrothermal vents represent a collection of ecosystems that vary extensively in species composition, abundance, and biodiversity. This presents a challenge in anticipating the potential short- and long-term impacts of deep-sea mining on vent ecosystems.The impact of that biodiversity loss to regional and global vent systems depends on the resilience of surrounding vent communities, the degree of connectivity between vent systems, and the biodiversity of these ecosystems. Global assessment of biodiversity at deep-sea hydrothermal vents is confounded by uneven sampling effort. Some vent systems have been visited hundreds of times by research vessels from multiple nations, while others have been visited by fewer than ten research expeditions. This broad disparity in sampling effort makes it difficult to directly compare biodiversity between different vent systems, and, in some cases, entire biogeographic provinces. Consequently, a biodiversity-based model for prioritizing deep-sea mining sites will favor well-studied vent systems.How is the known biodiversity and species richness of hydrothermal impacted by sampling effort? What inferences can be made about the relative resilience of hydrothermal vent ecosystems based on biodiversity and species richness? Can biodiversity be used to inform the potential impact of deep-sea mining at relatively understudied vent systems?An accurate assessment of global deep-sea hydrothermal vent biodiversity normalized against research effort is critical in informing long term, multi-stakeholder approaches to managing the nascent deep-sea mining industry.

10:30 - Science diplomacy for stewardship: advancing science-based policy through the Deep Ocean Stewardship Initiative (DOSI)

Ms. Harriet Harden-Davies[1], Dr. Maria Baker[2]
[1]*University of Wollongong,* [2]*Deep Ocean Stewardship Initiative, University of Southampton*

Acceleration of human activities in the deep ocean ranging from resource extraction (minerals, oil and gas, fisheries, genetic resources) to pollution, disposal, and climate change threaten biodiversity and the resilience of ecosystems that sustain life on this planet. This confluence of challenges and opportunities is embodied in the historic intergovernmental negotiations for the conservation and sustainable use of marine biodiversity in the 60% of the ocean that lies in areas beyond national jurisdiction (BBNJ), due to commence at the United Nations in September 2018. Gaps in deep-ocean governance, lack of knowledge, and fragmentation in national and international legal frameworks require new global, multi-sectoral and cross-disciplinary approaches to conserve and sustainably use deep-sea biodiversity. Collaboration and technological innovation is critical to develop capacity to identify and address knowledge gaps, guide and integrate future scientific research endeavours, and articulate scientific knowledge to inform environmental policy development and

decision making. Science, technology and innovation are critical to overcome obstacles facing the BBNJ agreement and could be a unifying focus for the negotiations. The Deep Ocean Stewardship Initiative (DOSI) provides an international and integrated network of more than 1000 members combining deep-sea scientific expertise with natural science, social science, economics, policy, industrial application and innovation. DOSI enables science-policy engagement for the development of an effective and enforceable new instrument including conservation tools such as marine protected areas, strategic environmental assessments and the deployment of new technologies.

10:45 - Deep Sea and Environmental Policy

Mr. Angelo Villagomez[1], Dr. Stacy Baez[1]
[1]*The Pew Charitable Trusts*

Marine ecosystems currently face an increasing array of threats, from overfishing, habitat degradation, and the impacts of carbon pollution including warming temperatures, and ocean acidification. While observations of these impacts throughout surface waters are clear, the unseen waters of the deep sea are also affected. Until recently much of the marine life in deep waters, within the Mariana Trench for example, were unknown to science. However, recent discoveries find that even in these deep waters the marine debris and other impacts can be seen. To combat these threats, a growing number of large marine protected areas are being created to safeguard vulnerable habitats. The Mariana Trench Marine National Monument protects the waters and submerged lands around three isolated islands in the Marianas Archipelago, and the submerged lands of the Mariana Trench. The underwater geology of this region is unique, encompassing submerged volcanoes and hydrothermal vents.

S-71: Raising the Bar on Marine Protected Areas (10:00 - 12:00, Kerangas)

10:00 - History tells us that marine protected area goals should be more ambitious

Prof. Callum Roberts[1]
[1]*University of York*

When faced with competing views on marine protection, politicians often try to keep their constituents happy by creating protected areas but not restricting any ongoing activities, including obviously harmful ones. Agencies charged with delivering protection are often complicit in this fictional protection, establishing 'conservation' objectives that have little basis in science or reason, and claiming they will lead to healthier seas. 90% of conservation goals for Marine Conservation Zones around England, for example, are to maintain habitats as they are, rather than effect any recovery. Such an approach makes 'conservation' simple; the present state of a habitat is logically compatible with existing activities. But it will not improve the state of the ocean. History tells us that this approach to conservation is not only cynical but deeply unambitious. In almost every sea on the planet intensifying human uses have, over decades to hundreds of years, led to loss of megafauna, biodiversity, habitat complexity and ecosystem function. The Dogger Bank, for example, lies in the middle of the North Sea. In the 1840s a sailing boat could catch one ton of halibut in a day. Today, the entire modern fishing fleet catches two tonnes per year! Other megafauna, like skates, have disappeared, while trawls scraped the bottom clean more than a century ago. To make a difference, MPAs must be highly protected from extractive uses. Countless examples attest to the benefits of full protection. We cannot rewind history, but history tells us that greater ambition in protection will be amply rewarded.

10:15 - Revealing a "Global Scientific Consensus Map" on Areas for Marine Protection

Dr. Natasha Gownaris[1], Dr. Ellen Pikitch[2], Ms. Christine Santora[2]
[1]*University of Washington,* [2]*Institute for Ocean Conservation Science at Stony Brook University*

The United Nations Sustainable Development Goal 14 sets a target of conserving and protecting at least 10% of the ocean by 2020 based on "the best available science". Numerous UN entities and nongovernmental organizations have developed maps identifying marine conservation priorities based on criteria such as ecosystem uniqueness, productivity, and/or importance for threatened species. Because these initiatives rely on different sets of criteria, they do not always identify the same regions. We aimed to understand the level of consensus among regions identified by these initiatives and to determine current gaps in marine protection through an overlay analysis conducted in GIS. This analysis relied on spatial data from six United Nations initiatives and four nongovernmental organization initiatives and from the World Database on Protected Areas. To elucidate opportunities for increasing MPA coverage, we identified areas that several initiatives identified as important (i.e. consensus regions) but that are not currently protected. We considered our findings in the context of protection level and biogeographic representativeness. Recognizing that protection often occurs at the national level, we also conducted local case studies to demonstrate how our results could be applied at smaller scales. The maps used in this meta-analysis each result from substantial scientific effort by the experts that created them, so revealing consensus among these efforts is a powerful and immediate tool for directing future MPA development.

10:30 - Negotiating a quality MPA network in a complex multi-sectoral ocean space- the South African story

Dr. Jean Harris[1], Dr. Kerry Sink[2]
[1]*WILDOCEANS,* [2]*South African National Biodiversity Institute*

Protection of the oceans in the African region lags behind most parts of the world in terms of meeting global targets for Marine Protected Areas (MPAs). South Africa has only 0.4% of its continental waters within MPAs. Africa is also currently facing escalating offshore mining pressure, which come on the heels of industrial and small-scale over-fishing challenges that threaten food security and resilience. South Africa has committed to at least 10% of its Exclusive Economic Zone (EEZ) by 2020 in formal MPAs and this target is formalised in a National Protected Area Expansion Plan. In 2014, the South African government initiated an official process to meet this pledge, by including MPA expansion as a fast-tracked priority in "Operation Phakisa" which seeks to fast-track delivery on the 2030 National Development Plan through "unlocking the potential of the ocean economy". This resulted in 22 proposed new/expanded MPAs being identified in 2014, to achieve an interim target of 5% protection, and endorsed a process to meet the 10% by 2020. In this paper we outline the criteria, products and methodology for identification of the initial 5% to achieve a MPA network that delivers quality (in terms of biodiversity and resilience), while minimising conflict with other ocean space users.

10:45 - Marine Protected Areas in China

Dr. Julia Xue[1]

[1]*Shanghai Jiao Tong University*

The coastal and marine ecosystems in China are of high bio geographic and socio-economic importance, and the country hosts an exceptional abundant marine biodiversity. The rich coastal and marine resources in turn support important industries such as fishing, maritime shipping, and oil and gas explorations, which jointly contribute to over 10% of China's overall GDP. However, as the main arena for China's economic rise, attracting large volumes of labor and capital investments, the coastal regions, particularly the coastal and marine ecosystems in China have been facing increasing threats along with the rapid economic development, urbanization in the coastal regions, and the population growth (1.3 billion account for 20% of world total). Indeed, the pressures on China's ecosystems and natural resources are unprecedented, which have led to the disappearance of 50% of the area of coastal wetlands, 70% of mangroves, and 80% of coral reefs since the 1950s.

Against this background, this presentation examines the establishment four types of MPAs in China and assesses the protection effort of such an MPA system with specific reference to China's operational experiences regarding the designation, monitoring, and evaluation procedure of the MPA management. It will highlight the key characteristics of the four types of MPAs, comparing the protection afforded by each and how the expected benefits and outcomes might differ, while considering current challenges to implementation.

11:00 - MPA costs and funding needs - a comparison against Terrestrial PAs to guide advancements in MPA finance

Mr. John Bohorquez[1], Dr. Anthony Dvarskas[2], Dr. Ellen Pikitch[1]

[1]*Institute for Ocean Conservation Science at Stony Brook University,* [2]*Stony Brook University*

Marine Protected Areas (MPAs) are frequently challenged by a lack of sufficient and sustainable financial resources to conduct enforcement, management, and monitoring activities. Some have suggested that marine conservationists examine past success in terrestrial protected areas (TPAs) to help guide future MPA management, including financial strategies. However, differences in funding needs for MPAs versus TPAs have not been directly compared, and need to be better understood to help identify and apply traditionally TPA financial strategies for a marine context. This presentation includes summary of a recent literature review that investigates the distribution of costs incurred by MPAs vs. TPAs across three main categories; establishment, operational, and opportunity costs. Available literature and data is not sufficient to report formal statistical results comparing cost distributions. However, the research does allow for a snapshot quantitative comparison, that is complemented with theoretical support to provide initial insights on the different funding requirements between MPAs and TPAs. Discussion includes policy influences such as property rights, as well as logistical differences of conducting PA operations between marine and terrestrial mediums. In addition, the research and presentation points towards significant knowledge gaps and necessary future steps to further research in MPA sustainable finance.

11:15 - MPAs are like retirement accounts: Leakages undermine them

Dr. Rashid Sumaila[1]

[1]*University of British Columbia*

Well-implemented, well-functioning MPAs provide numerous economic benefits. Here I begin by presenting some of these benefits, which include fisheries, insurance, recreational, option, carbon and equity benefits of implementing well-functioning MPAs. Next, I use retirement accounts to illustrate the need to raise the bar for marine protection. The key argument is that MPAs are like retirement accounts, if one keeps raiding his or her retirement account it will not be there when it is most needed, i.e., during retirement. Similarly, an MPA which is only on paper or which is not well-implemented or not adequately monitored to ensure that it is not 'raided' by illegal fishers would not serve its purpose. I wrap up my presentation by discussing the new emerging challenge of 'deMPAing', and suggesting strategies for implementing MPAs that have the potential to serve their purpose.

11:30 - Ensuring quality marine protected areas in the pursuit of meeting global targets

Dr. Ellen Pikitch[1], Ms. Christine Santora[1]

[1]*Institute for Ocean Conservation Science at Stony Brook University*

Marine protected areas (MPAs), and no-take marine reserves in particular, are one of the strongest conservation tools that can be utilized in the current era of ocean decline. For decades, progress on protecting key areas of the ocean stagnated. However, within the past few years, commitments to establish new MPAs have significantly increased and the rate of MPA formation has accelerated, in great measure by new and renewed global commitments of member states. Both the Convention on Biological Diversity and Sustainable Development Goals specify a global target of protecting and conserving at least 10 percent of ocean area by the year 2020. As the world collectively experiences an upward trend in establishing new MPAs, it is essential that greater focus be given to the quality of protected areas. Achieving positive conservation outcomes, and implementing effective MPA management measures, should be kept in mind in the design and set-up of new MPAs to ensure they are successful. The goals of increasing both quality and quantity can and should be met in tandem. There is enough information on what constitutes an effective MPA to act, both in creating new MPAs and in strengthening existing ones. This presentation will review various efforts to date that have issued recommendations and standards for MPAs, and outline the characteristics and mechanisms needed for effective MPA implementation. It will also discuss next steps for ocean conservation post-2020, and how global platforms can be utilized to inform policymakers and shape positive action for the ocean into the future.

Speed Networking Event: Conservation Conversations - Beyond Business Cards

12:00 - 13:30, Ranyai Ballroom

Focus Group: Bridging the gap of local scientific and management needs in marine biodiversity (12:00 - 13:30, Kerangas

Mr. Chai Ming Lau[1], Mr Julian Hyde[1], Mr. Alvin Chelliah[1]

[1]*Reef Check Malaysia*

Making Marine Science Matters is to bridge the gap between differing needs of science and management of marine resources. Often this gap causes impractical solutions which lead to unsuccessful conservation efforts. Hence, we are proposing a focus group to discuss on where we draw the line between management priorities and scientific curiosity. This is so that we can manage marine resources effectively without compromising ecological understanding while simultaneously conducting researches that are of local management priorities. Our goal is to explore the best possible ways to incorporate limited localised scientific knowledge and data into local level management to address marine conservation issues at a specific site. Despite having abundant studies of coral reefs in various topics from around the world that addressed some conservation issues, there is no one model that fits all. Most of the 71 important questions for the conservation of marine biodiversity will not only be addressed but can be applied into management strategy as well. We expect to publish an advocacy report that draws upon recommendations to how to prioritise localised research that provide value to practical management solutions in which will assist us in applying these recommendations at our project sites. We are proposing a one and a half hour town hall forum format with Reef Check Malaysia being the moderator. We expect 20 participants from various background including active conservationists, academic researchers from biologists to social scientists, marine resource managers and various stakeholders.

Focus Group: Seabirds in Southeast Asia: need for collaboration programme (13:30 - 15:30, Tubau 1

Dr. Abdulmula Hamza[1], Dr. Simba Chan[2], Mr. Yat-tung Yu[3]

[1]University Malaysia Terengganu/ and Malaysian Nature Society, [2]Birdlife International - Asia Office-Tokyo, [3]Hong Kong Bird Watching Society

Southeast Asia lies between NE Asia and Australasia: many seabird species breeding in the north, for example the Critically Endangered Chinese Crested Tern and the elusive Aleutian Tern, winter in this region but very little information is currently available. Other seabird species are breeding in Southeast Asia, and historic egg collection in several countries in addition to changes in land use shaped the size and diversity of today's populations. Both countries along the East Asian Australasian flyway (later the flyway) such as the USA, Russia, Japan and South Korea in the north and Australia, New Zealand in the south have longer histories in seabird study and conservation, while both data and interest in SE Asia are still relatively low. This symposium aims to present current initiatives in seabird conservation, needs in SE Asia and to discuss the possibility of a new collaborative project on seabird research and conservation via policies, training and management guidelines of seabird sites for SE Asia. We aim to promote sharing and develop international cooperation in research and conservation along the flyway. This project also will complement the efforts to conserve migratory seabird populations along the flyway. Other important aspect for the symposium is to present current efforts of ringing and tracking schemes in the flyway region and how we can establish a common ringing/tracking scheme database for the Southeast Asian region, to better understand movements of breeding seabirds in the region using scientific standards, and share information and knowledge across the flyway region.

Focus Group: Citizen Science for science: charting a path forward for collaborative efforts (13:30 - 15:30, Kabu

Dr. Christine Ward-Paige[1], Dr. John Cigliano[2]

[1]eOceans, [2]Cedar Crest College

The number of scientists and organizations leading marine citizen science projects has increased in recent years. These projects require various types of people - fishers, divers, tourists, captains, etc. - to participate. for many would-be-participants, the request is often similar, if not the same, as previous requests for data, observations, opinions, etc. from other citizen science programs. Thus, well-intentioned participants are often redundantly reporting the same information to multiple projects, and some have questioned why the leaders in the field cannot find a way to collaborate? In this focus group, we aim to synthesize the field of marine citizen science, looking for broad-scale trends of similarities in the way these data are collected, analyzed and treated, including outcomes. As well, we will be looking for themes that are unique. We will do this by bringing together researchers and practitioners who utilize citizen science or who are interested in developing citizen science programs, and citizen scientists. following from this exercise, the goal will be to develop a path forward that could increase collaborative efforts among citizen science organizations that would reduce participant dilution and fatigue and increase overall contributor efficiencies and impact.

OS-11A: Marine Policy 2 (13:30 - 15:30, FJ Auditorium)

13:30 - Assessing the value of the coast for human well-being: a case study from Plymouth (Devon, UK)

Ms. Rebecca Shellock[1], Dr. Tobias Börger[2], Dr. Caroline Hattam[3], Dr. Mathew White[4], Dr. Lewis Elliott[4]

[1]Plymouth Marine Laboratory and the University of Exeter, [2]University of St Andrews, [3]Plymouth Marine Laboratory, [4]University of Exeter

Human well-being is becoming an integral part of international, regional and national policies to better protect marine and coastal environments and their benefits. Despite this, there is still a limited understanding of how to evaluate the impact of marine and coastal interventions (e.g. physical coastal improvements and marine conservation) on well-being. The current research assesses the impact of a coastal renovation project (Teat's Hill, Plymouth, UK) on the well-being of local residents. The Teat's Hill renovation is a collaborative project which brings together local government and a range of stakeholders, to improve access, facilities and environmental quality of the coastal site. Well-being was assessed before and after the renovation using two non-market valuation methods: (i) a novel approach which relies on psychological states and 'ex-post' experiences, the Life Satisfaction Approach and (ii) a more traditional and frequently used preference-based ('ex-ante') method, the Contingent Valuation Method. First, the talk will present the findings of the Contingent Valuation study (n=314), which explored the well-being that individuals anticipate they will receive from the coastal renovation. Second, it will provide an overview of the Life Satisfaction Approach, and how together the approaches may help to provide more accurate and robust estimates of marine goods and services. This research: (1) advances our understanding of the well-being benefits of marine and coastal environments, (2) provides evidence for local government, aiding policy-making and planning for coastal spaces and (3) makes steps towards developing an approach upon which to base future policy evaluations.

13:45 - Understanding the drivers of genetic diversity in marine top predators and its impact on effective conservation management - a case study of Mediterranean Bottlenose Dolphins.

Mr. Daniel Moore[1], Dr. Per Berggen[2], Prof. Oscar Gaggiotti[3], Prof. Rus Hoelzel[1]

[1]Durham University, [2]Newcastle University, [3]University of St Andrews

By harnessing the power of modern genetic techniques, it is now possible to examine population connectivity in marine species to a much greater resolution than ever before. In this study we have combined this application with examination of stable isotope and oceanographic data to delve deeper into the drivers of genetic diversity in the Bottlenose Dolphin, Tursiops truncatus, in Mediterranean waters with surprising results. With the much greater resolving power of modern genetics we have shown a previously revealed population division is geographically shifted by over 400 miles in some locations. This shift has profound impacts for conservation management, not least as the new boundary lies within the jurisdiction of a previously non-boundary bordering country. Furthermore, knowledge of Bottlenose Dolphin social structure and behaviour combined with stable isotope data from this study reveals differential traits between populations which suggests applying differing conservation strategies may be more effective than treating Mediterranean Bottlenose Dolphins as a single management unit. Drawing from this study this presentation will then argue that the power of modern genetic techniques can provide a valuable starting block for identification of effective marine conservation pathways and should be more widely applied to marine systems and species, even if they have previously been examined using older methodologies.

14:00 - Marine no net loss: the challenges of policy development and implementation

Ms. Holly Niner[1], Dr. Craig A. Styan[1], Dr. Ben Milligan[1], Dr. Peter J. S. Jones[1]

[1]University College London (UCL)

Biodiversity offsetting seeks to improve the ecological link between impact and compensation, commonly under an aim of no net loss (NNL). Little is known about how this approach, which has been developed for terrestrial application, is being used in marine contexts. Australia has offsetting policies at a federal and state level and is an ideal case study to explore the complexities and practicalities of applying the mitigation hierarchy and biodiversity offsetting in marine environments. Using a mixed method approach I have explored how offsets have been used in marine development consenting processes. This analysis presents a range of views and experiences across jurisdictions and sectors, and suggests that current practice in Australia is unlikely to realise an aim of NNL. Factors influencing this outcome relate to issues common to terrestrial offsets but also those specific to marine environments. These include the challenges posed by: (1) quantifying impact pathways to manageable levels of certainty in highly variable and dynamic marine environments; (2) the lack of proven and cost effective marine restoration strategies; and, (3) the frequently complex governance systems in place to support the implementation of offset activity. I discuss how compensation strategies in marine environments require special consideration and explore what is required to ensure that the rigour of impact assessment is not reduced by the use of offsets. I conclude with an assessment of how the mitigation hierarchy and requirements for compensation arising through EIA and other frameworks can be applied to leverage improved outcomes for marine biodiversity.

14:15 - Understanding recreational fishers and their attitudes to conservation

Ms. Asha McNeill[1], Dr. Julian Clifton[1], Prof. Euan Harvey[2]

[1]University of Western Australia, [2]Curtin University

To address declining marine ecosystem health and biodiversity, governing bodies must employ policy to prevent harmful activities while maintaining a sustainable level of access for communities. Consequently, users who may have previously had access to marine resources may find restrictions on their activities, including individuals who fish for recreation. Recreational fishers are a key stakeholder group to consider when planning conservation policy as they can hold considerable influence on governments, particularly on divisive issues such as marine protected areas, and stakeholder support for regulations is key to achieving success. In Western Australia, more than one in four people fish recreationally, therefore account for a large proportion of the voting public. An internet survey of 588 fishers across WA was employed to collect information on avidity, catch orientation and motivations in addition to attitudes towards marine protected areas, fisheries management tools and managing institutions. Results show overall support for conservation measures is extremely high amongst surveyed fishers despite distrust of managing institutions. Some groups of fishers have lower support for sanctuary zones than others, and support is higher amongst all fishers when no fishing zones protect a unique or fragile place, or specific event. Recreational fishers are a diverse stakeholder group who hold different attitudes to regulatory tools, and are therefore likely to be impacted in a variety of ways by marine policy. Together these results demonstrate the need to bridge the gap between the community and the management institutions and outlines opportunities to engage with recreational fishers in the future.

14:30 - Exploring for conservation: opportunistic crowd-sourced observations and insights matter

Dr. Christine Ward-Paige[1]

[1]eOceans

Around the world, ocean explorers are increasingly making their personal observations and insights available to researchers and organizations with the intention of contributing to science and conservation. The opportunities for these data are immense. For example, individual observations from daily experiences (opportunistic rather than from standardized sampling), can inform on various natural, social, and political science questions because the data reflect human use patterns in addition to ecological patterns. Here, I present a summary of some of the most significant findings revealed, so far, by the 1.9 million opportunistic dives reported to the eOceans databases from 90 regions of the world. These findings include the global distribution and human use patterns of manta rays and sharks, evaluations of various marine conservation policies, the temporal and spatial distribution of sharks, rays, and turtles in Thailand and Fiji, and other snapshots of marine animals, and human explorers. These findings have already had important outcomes for regional and international policies. Given the value of these data, I finish by outlining my vision of how we can move towards a more efficient platform where ocean explorers log and track what they see, while seamlessly contributing to various researchers and organizations.

OS-11B: Conservation and Management 8 (13:30 - 15:30, FJ Event Hall)

13:30 - Baited Remote Underwater Video Reveals Low Abundances Of Sharks Across The Philippines But Marine Protected Areas Offer Respite

Mr. Ryan Murray[1], Ms. Georgina Roberts[1], Mr. Segundo Conales Jr.[2], Mr. Gonzalo Araujo[1], Mr. Josh Rambahiniarison[1], Mrs. Angelique Songco[2], Ms. Marivel Dygico[3], Dr. Alessandro Ponzo[1]

[1]Large Marine Vertebrates Research Institute Philippines, [2]Tubbataha Management Office, [3]World Wildlife Fund

Exploitive and unsustainable fishing practises are having deleterious effects on marine resources worldwide. Members of the order Chondrichthyes are particularly susceptible to overharvesting as a result of k-selected life history traits rendering slow population recovery. The Philippines is a biodiversity hotspot for sharks and rays yet the country remains a data-poor region for many species. To address this urgent knowledge gap, we investigated the abundance, biodiversity and distribution of elasmobranchs in nine locations using Baited Remote Underwater Video (BRUV), a non-invasive and increasingly popular monitoring tool in marine ecosystems. We also evaluated the performance of two Marine Protected Areas (MPAs), Apo Reef Natural Park and Tubbataha Reefs Natural Park against Open Fishing Zones (OFZ) in sustaining populations of Reef Associated Sharks (RAS). The surveys recorded 301 sharks and rays from 18 species across all study locations. Our results demonstrate that MPAs support significantly higher abundances of RAS when compared with OFZ, where sharks were either absent or occurred only in low abundances. We hypothesize that RAS populations are highly exploited in the Philippines and these results further highlight the crucial role of MPAs for their conservation.

13:45 - Understanding The Movements Of Grey Reef Sharks In Tubbataha Reefs Natural Park Using Acoustic Telemetry.

Mr. Ryan Murray[1], Mr. Segundo Conales Jr.[2], Mr. Gonzalo Araujo[1], Prof. Philip Dearden[3], Dr. Simon Pierce[4], Prof. Colin Simpfendorfer[5], Dr. Michelle Heupel[6], Ms. Sally Snow[7], Mr. Josh Rambahiniarison[1], Dr. Alessandro Ponzo[1]

[1]Large Marine Vertebrates Research Institute Philippines, [2]Tubbataha Management Office, [3]University of Victoria, [4]Marine Meg, [5]James Cook University, [6]Australian Institute of Marine Science, [7]Large

Gaining knowledge on the movement and dispersal rates of highly exploited shark species in Marine Protected Areas (MPA) can help to guide and improve their management. Grey reef shark Carcharhinus amblyrhynchos are a meso-predatory reef associated species whose ecology is poorly understood within the coral triangle. Acoustic telemetry is a valuable tool for conservation managers as it can quantify the spatial movements and residencies of highly mobile species. Here we used acoustic telemetry to assess the site fidelity and inter-reef connectivity of C. amblyrhynchos in Tubbataha Reefs Natural Park (TRNP), the largest no-take MPA in the Philippines. Seven acoustic receivers were deployed throughout the park between June 2016 and June 2017. Fourteen mature grey reef sharks, seven male and seven female, with total lengths ranging 138-170 cm (x = 153.86 cm, sd = 12.76 cm), were surgically implanted with Vemco acoustic tags over two years. Preliminary data reports residency indexes ranging between 0.14 - 0.69 (x = 0.37 , sd = 0.28) whilst also confirming the movements of C. amblyrhynchos between unconnected reef atolls separated by deep water channels exceeding 1000 m in depth. This study underlines the importance of MPA for shark conservation in the Philippines.

14:00 - Population structure and site fidelity of photographically identified reef manta rays (Mobula alfredi) in Raja Ampat, Indonesia

Mr. Edy Setyawan[1], Ms. Sarah Lewis[1], Mr. Rafid Shidqi[1], Dr. Mark Erdmann[2], Mr. Calvin Beale[3], Mr. Ronald Mambrasar[2], Mr. Abraham Sianipar[2], Mr. Abdi Hasan[2]

[1]Manta Trust; Sea Sanctuaries Trust, [2]Conservation International, [3]Misool Manta Project

The reef manta ray (Mobula alfredi) aggregates at numerous sites in Raja Ampat-one of the top manta tourism destinations globally. The population structure and site fidelity of reef mantas were examined using photographic identification. A total of 525 different individuals were identified between Dec 2007 and Feb 2018 from 19 locations in 7 regions within the Raja Ampat Marine Protected Area (MPA) network. The first sightings of these individuals mainly occurred in the Dampier Strait (DS) (46%) and Misool (31%), located in central and southern Raja Ampat, respectively. The sex ratio was biased towards females, with a female to male ratio of 1.8:1. Manta coloration was predominantly chevron, though fully one third of the individuals showed melanistic coloration. The females were slightly larger than males, with an average estimated disc width of 3.1 m ($\pm$0.03) vs. 2.9 m ($\pm$0.04), respectively. One third of all individuals were re-sighted at least once during the study period. The longest period between re-sighting events was 3,708 days (10.2 years). Of 479 re-sighting events, 70% of these occurred at Manta Sandy - a cleaning station in DS that is a very popular dive site. One individual manta was sighted 24 times at Manta Sandy over the 10-year monitoring period. Re-sightings occurring over multiple years strongly suggest high site fidelity of many individuals to particular feeding and cleaning aggregation sites, which requires urgent efforts to better manage and ensure the long-term sustainability of manta tourism in the region.

14:15 - Conservation of marine sponges in the Mascarene archipelago

Mr. Olivier Pasnin[1], Prof. Sophie Von Der Heyden[1], Dr. Nicole De Voogd[2]

[1]Stellenbosch University, [2]Naturalis Biodiversity Center

Sponges are ecosystems engineers that play important roles in marine ecosystems. Currently about 8, 000 species are recognised, but it is thought that because of their lack of obvious morphological characteristics, their global biodiversity is vastly underestimated with knock-on effects for including sponge biodiversity in conservation efforts. The situation regarding a lack of knowledge of sponge biodiversity is no different in the Indian Ocean than it is globally, with no studies on sponge biodiversity in the Mascarene region. Consequently, the three islands (Mauritius, Rodrigues and Reunion islands) forming the Mascarene archipelago were surveyed for sponges at depths ranging from 0 to 30m. A total 413 specimens were sampled and identified morphologically using spicule and skeletal analyses. Molecular analyses were carried out using CO1 and 28S markers at the Stellenbosch University. Preliminary results show three islands of different sponge faunas with numerous previously undescribed species observed. With information on sponge biodiversity coupled with phylogenetic and phylogeographical analyses, this study will provide the first baseline information on sponge biodiversity in the Mascarene region. The overall aim is to use data and information generated in this study to strengthen integrated conservation planning for marine

sponges and to use the findings as an example for integrating genetic information into conservation planning.

14:30 - Movement patterns of acoustically tagged reef manta rays (Mobula alfredi) in Raja Ampat MPA network, West Papua

Mr. Edy Setyawan[1], Mr. Abdi Hasan[2], Mr. Abraham Sianipar[2], Mr. Calvin Beale[3], Dr. Mark Erdmann[2], Mr. Rafid Shidqi[1], Mr. Ronald Mambrasa[2], Ms. Sarah Lewis[1]

[1]Manta Trust; Sea Sanctuaries Trust, [2]Conservation International, [3]Misool Manta Project

Little is known about the movements and habitat range of reef mantas within the 5 million hectare marine protected area (MPA) network in Raja Ampat, West Papua. Here we report on the movement patterns of reef mantas among their known feeding and cleaning aggregation sites across the region. Twenty-four VR2W acoustic receivers were deployed in known aggregation sites across the Raja Ampat region, distributed within all seven MPAs. A total of 44 mantas were acoustically tagged in six locations with Vemco V16 transmitters. They consisted of 31 females, 12 males, and 1 individual of unknown sex. The ratio of chevron to melanistic mantas tagged was 1:1.9. In the two-year period of monitoring (1 Jan 2016 - 31 Dec 2017), the cumulative number of visitations recorded by individual mantas ranged from 1 to 156 days (25Âś5). Of the 15 receivers detecting mantas, Kofiau was the most frequently visited site, with 301 days of visitations. Visitation of melanistic mantas (average of 39 days) was significantly different from that of chevron mantas (average of 17 days), while visitation rates between males and females were not statistically different. The furthest distance between two receivers visited by an individual manta was approximately 270 km, which was between Magic Mountain (Misool) and Sepatu (Waigeo). This provides the first evidence of reef manta movement between the northern and southern region. Overall, results indicate strong site fidelity and very little crossover between the several isolated reef areas in Raja Ampat, including Misool, Kofiau, and Waigeo island groups.

14:45 - Plastics on the menu: Microplastics Present in Indonesian Manta Ray Feeding Habitats

Ms. Elitza Germanov[1], Dr. Andrea Marshall[2], Dr. I Gede Hendrawan[3], Prof. Neil Loneragan[4]

[1]Murdoch University/ Marine Megafauna Foundation, [2]Marine Megafauna Foundation, [3]University of Udayana, [4]Murdoch University

Microplastics have emerged as a major threat to the marine environment. Recent research advances have shed light on global microplastics estimates, threats to biodiversity, and key focal regions for intervention. Yet there are few reports assessing the potential for microplastic ingestion by threatened large filter feeders, such as mobulid rays, in regions heavily impacted by plastic pollution like Indonesia. Here, we evaluate the microplastic concentrations found in critical feeding habitats for manta rays (Mobula alfredi) in two areas fraught with marine plastic pollution, Nusa Penida and Komodo National Park, Indonesia. Using a 200-micron plankton net, we assessed microplastics found in the top 0.5m of the water column during the predominantly wet and dry months over two years (2016-2018). Microplastic abundance in manta rays feeding grounds appears to be seasonally influenced in Nusa Penida, with higher concentrations of microplastics during the wet as compared to the dry season (0.48 pieces/m3 Vs 0.03 pieces/m3, respectively). Conversely, microplastic abundance did not change significantly with season in the manta ray feeding grounds in the Komodo National Park. Given the large quantities of water manta rays must filter to meet their daily energy demands, feeding activity in these locations will likely result in microplastic ingestion that over time may expose these vulnerable animals to associated treats, including toxins. A seasonality trend in the microplastic abundance in Nusa Penida points to an ideal time for concentrating marine debris intervention and prevention efforts from land based sources such as rivers.

15:00 - The Illegal Trade in Live Corals to the United States

Dr. Gohar Petrossian[1], Ms. Monique Sosnowski[2], Dr. Judith Weis[3]

[1]John Jay College, City University of New York, [2]University of Bristol, [3]Rutgers University

Coral reefs are the fundamental building blocks of tropical marine ecosystems. They are also one of the most endangered ecosystems on the planet suffering from myriads of environmental, fishing, and trade threats. While the trade in live corals for home aquariums has been growing, little research has been done to better understand the process and consequences of illegal coral collection, as well as trends in illegal imports of corals into the United States. Using crime script analysis, a strategy rooted in the theoretical foundation of environmental criminology, we detail the stages of illegal wild coral harvest and trade and suggest interventions that could be performed at different stages, with examples from Indonesia and Fiji. We examine the major patterns of illegal imports of live corals into the United States by analyzing the U.S. Fish and Wildlife Service Law Enforcement Management Information Systems database for 2003-2012. Results indicate that coral harvesting is a carefully planned activity, which involves specific decisions starting from the 'planning' and ending at the 'aftermath' stages. Import patterns of illegally harvested corals into the United States indicate that: (1) 10 times more corals were seized in 2012 than in 2003, (2) three genera (Euphyllia, Acropora, and Favites) accounted for 27% of all seizures; (3) imports from four countries (Indonesia, Tonga, Australia, and Fiji) accounted for 92% of all seizures; and (c) over 90% of the seizures occurred in five ports of entry.

15:15 - Industry partnerships can contribute to marine conservation and sustainable development outcomes

Dr. Denise McCorry[1]

[1]Woodside

Scientific research outcomes that support marine conservation and sustainability can be achieved through industry partnerships. Woodside is Australia's largest oil and gas company and our environmental risk evaluations and management are underpinned by robust scientific research. The key to partnership success is to identify the collaboration 'sweet spot' whereby science outcomes contribute to both conservation management needs and influences industry activities to improve environmental performance and sustainability. Two case studies are described to demonstrate the mutually beneficial outcomes achieved through the approach Woodside has developed in partnering with research institutes and science-based conservation organizations. The first example is from the marine environment of Western Australia where Woodside have supported humpback whale research including satellite tagging to map seasonal migratory pathways. Scientific research outcomes have shaped the current humpback whale conservation and offshore industry management and governance. The second case study is from Myanmar where collaboration with Fauna & Flora International is building marine science capability to collect baseline marine biodiversity data that will be used to shape marine conservation planning and can be applied to future oil and gas developments.

S-134: Integrating Cultural Values in Dugong Conservation (13:30 - 15:30, Kerangas)

13:30 - Integrating Cultural Values In Dugong Conservation: The Case of Mozambique Coast

Mrs. Alima Taju[1], Dr. Almeida Guissamulo[2], Dr. Vic Cockcroft[2]

[1]Nelson Mandela Metropolitan University, [2]Associaçäo para Conservação e Protecçäo dos Dugongos

Historical information suggests that in the past dugongs (Dugong dugon) were plentiful and widely distributed along the Mozambique coast, with known hotspots at Cabo Delgado province (Pemba and Quirimbas archipelago), Nampula (Angoche, Mozambique Island and Nacala), Inhambane (Bazaruto archipelago, Pomene, Chidenguele and Inhambane Bay) and Maputo bay (Inhaca Island). However, before any status of protection was given to this species in the country, dugongs were deliberately hunted for their meat, mainly over the 70's - 80's, causing most of these populations to dwindle over the years. Today, the largest and possibly the last viable population of dugongs in Mozambique coast and East Africa is found in Bazaruto archipelago (from Save river mouth to Cabo São Sebastião) with approximately 250 individuals. Although many coastal communities don't understand the conservation status of this protected species and in most of the past hotspots dugongs are hardly seen, the local perceptions and traditional knowledge about the ecosystem functioning and importance of the habitats they depend on for fisheries, specially the seagrasses, are very important for developing a conservation strategy that will effectively protect dugongs and its foraging habitat. A scoping study of cultural values, conducted under the Dugong & Seagrass Conservation Project, aimed at proving an overview of the historical and recent interactions of local communities with the dugongs in the main past and current dugong hotspots in Mozambique coast, including their perceptions about the dugong conservation status, local traditions, stories and beliefs related to dugongs and seagrasses.

13:45 - Socio-cultural significance of Dugong dugon in Comoros and north-west Madagascar and the influence of taboos and religion on conservation status

Ms. Patricia Davis[1], Mr. Chris Poonian[1], Ms. Lalarisoa Rakotoarimino[2], Ms. Mihary Ramiandrisoa[2]

[1]Community Centred Conservation (C3), [2]C3 Madagascar

We interviewed 256 fishers between the ages of 19 and 100 across the Union of Comoros (Moheli, Grande Comore, Anjouan) regarding knowledge about the sea cow or Dugong dugon; its distribution, behaviour, exploitation and historic information including cultural significance. We interviewed a further 580 fishers in Madagascar at 15 distinct localities. Historic human migrations between these islands were the basis of common customs and traditions relating to the hunt, slaughter and consumption of this endangered species which is now rarely encountered given high historic exploitation rates. Taboos and religion played a historical role in some localities in banning or limiting the hunt and consumption of the species. The anthropomorphic nature of the dugong was well-recognized by many of the fishers interviewed, including lacrimation and human-like genitalia, leading to a number of associated rituals and legends demonstrating respect and sacredness for the species. Given the huge decline in the dugong populations across Comoros and Madagascar in the 20th century, primarily due to hunting and secondarily through accidental entanglement in gillnets, the majority of younger fishers had never seen/heard of the species and traditional and historical knowledge was only held by older fishers. These studies emphasize the urgent need for documentation of traditional knowledge before it is lost forever, its value in providing a historical baseline for endangered species and its potential application in species conservation programmes. The cultural scoping study launched by the Dugong and Seagrass Conservation Project provides a framework with which to capture this knowledge from further localities worldwide.

14:00 - The Dugong dugon in Ancient Sri Lanka

Mr. Ranil Nanayakkara[1], Ms. Thamara Spitzner[1], Mr. Dilan Ranaweera[2], Mr. Mathisa Karunaratne[3]

[1]Bioiversity Education And Research (BEAR), [2]University of Peradeniya, [3]Bio

Dugongs (Dugong dugon) play a pivotal role in Sri Lankas history and mythology. Once thought to be the lady of the sea by ancient seafarers, who visited Sri Lanka. Archaeological excavation in the northern part of Sri Lanka has unearthed microliths, mostly stone implements together with dugong bones, this suggest that ancient aborigines of Sri Lanka viz., Yaks, Nagas, Rakus and the Asuras were used to eating dugong, as most bones bore cut marks from the said microliths. To understand better the historical grounds of the relationship between dugongs and coastal communities of Sri Lanka, we have conducted a scoping study, covering representative sites in North and Northwest of Sri Lanka. The scoping study covered dugongs and their seagrass habitats, without which dugongs cannot survive. The results from the study will feed decision making and ensure better integration of communities' culture and concerns in dugong and seagrass conservation across coastal Sri Lanka.

14:15 - Cultural significance of dugongs and their seagrass habitats to local communities and its relevance to conservation in Malaysia

Dr. Leela Rajamani[1], Mr. Nazirul Amin Azmi[2]

[1]Universiti Sains Malaysia, [2]Reefcheck Malaysia

Dugongs are culturally significant in many parts of its range. Dugong related seagrass habitats have been important for securing livelihoods to local communities. A scoping study of the cultural significance of dugongs and their seagrass habitats in Malaysia was conducted to understand better the links between communities and dugongs, communities and seagrasses and to apply this information to the conservation of the dugong and seagrass habitats. Information was gathered in Sabah and Johor, two states in Malaysia where the dugong is found. Mythologically, the local Ubian and Bajau are able to relate to the dugong emphasising that the dugong is like a human. Locally known as 'duyung' in Sabah, it was found that dugongs are traditionally used as a delicacy in feasts and weddings. It is traditionally eaten by local Ubian and Bajau in North Sabah (Banggi and Kudat). Dugong products such as the tusks and bones are being used in the treatment of various ailments such as asthma, back pains and shock. The Chinese in Kudat, Sabah are known to fashion dugong tusks into pipes for smoking claiming that they have medicinal and therapeutic values. Dugong tears are also known be used in love potions. Little is known about seagrasses and how they have been perceived or used by local communities. The scoping survey will give insights on the importance of seagrasses to local communities. This information will help conservation planners understand the mindset of the local community when involving them in conservation practices.

14:30 - Why Timor-Leste communities excel in marine protection

Mrs. Trudiann Dale[1], Mr. Anselmo Lopes Amaral[1], Mr. Rui Pires[2]

[1]Conservation International, [2]National Directorate for Biodiversity Protection, Ministry of Development and Institutional Reform, Timor-Leste

Integrating tradition into modern day life can be hard at the best of times, but in Timor-Leste the people have developed a model where tradition and contemporary world go hand in hand.Tradition and culture in Timor-Leste has not been easy to maintain, especially through the years of struggle for independence. However, one part of the culture was kept strong, and that is the traditional law of tara bandu. The tara bandu ceremony is a culmination of the entire community's decision to close an area for protection. This long held tradition has seen many primary forests and marine areas protected from any form of harvesting or interference. It is marked as prohibited by chefe, upon request from the community. Another aspect of the Timorese culture which survived throughout the turmoil, was the protection of the spiritually significant animals such as the dugong and crocodile. The dugong population in Timor-Leste is small but significant to the people, who view them with a great deal of respect. Some families conduct rituals ceremonies to call on the ancestor's spirit who live in the marine mammals, including the dugong, to protect the family for the coming time, while others hold similar ceremonies for the crocodile. This is one community's story of how culture and tradition secured protection of their environment, the marine biodiversity, improved livelihoods, and obtained food security. To capture this knowledge, a scoping study of the cultural significance of the dugong and their seagrass habitats was conducted at selected sites in Timor-Leste.

14:45 - Using Art As A Tool To Mobilize Support For Dugong Conservation In Solomon Islands

Ms. Chelcia Gomese[1], Dr. Jan Van Ded Ploeg[1]

[1]WorldFish

The dugong (Dugong dugon) is a cultural keystone species in many parts of the Solomon Islands. Dugongs feature prominently in oral history and kastom. Various people trace their ancestry to the marine mammal, and therefore refrain from killing and eating the species. Clearly, these cultural values and taboos have not been sufficient to conserve dugongs in a rapidly changing society: hunting and by-catch has depleted dugong populations throughout the archipelago. Nevertheless, it is essential to embed conservation action in local realities, knowledge and values. We used artwork to revive cultural values and mobilize broad public support for dugong conservation in Lau Lagoon on Malaita. Such a biocultural approach has the potential to strengthen community-based natural resource management and conserve an iconic species.

S-161: Prioritising marine conservation in the South Asia region (13:30 - 15:30, Tubau 2-3)

13:30 - Reducing plastic pollution to safeguard Sri Lanka's marine mega fauna

Dr. Lalith Ekanayake[1], Mrs. Yamuna Kumari Karunarathna[1]

[1]Bio Conservation Society (BCSL)

Sri Lanka is an island nation surrounded by the Indian Ocean and as such has outstanding marine biodiversity. Marine mega-fauna such as sea turtles, sharks and cetaceans inhabit coastal and offshore waters. Of the seven species of extant sea turtle, five species nest on Sri Lankan shores and feed and migrate in Sri Lankan waters. About 30 species of marine mammals inhabit Sri Lankan waters including blue whales, spinner dolphin and even occasional orca. Coral reefs, sea grass meadows and mangroves provide important habitat for thousands of species of fauna and flora. Sri Lanka also has a plastic pollution problem. According to Science magazine (2015) Sri Lanka ranked fifth place in the world among countries that release "Plastic waste input from the land to the ocean", releasing 1.59m mt/year. This is high, especially when one considers that if considered collectively, the 23 coastal European Union countries (including the UK) would rank only 18th on the list. The main pollution items are plastic bags, plastic bottles, tin cans and abandoned fishing nets. In September 2017 Sri Lanka banned plastic bags and other disposable items. However, this legislation was rapidly introduced and has led to widespread confusion and non-compliance, without a carefully considered implementation plan. So Bio Conservation Society conducting programmes and distributing cotton bags to increase local community awareness of plastic pollution, and encourage local people to minimize the use of plastic items and promote to use alternative products. This abstract will be discussed the progress of the awareness programme.

13:45 - Incorporating climate change resilience into MPA planning in Sri Lanka

Mr. Nishan Perera[1]

[1]Blue Resources Trust

The impacts of coral bleaching and patterns of recovery in Sri Lanka after the major bleaching events of 1998 and 2016 were assessed through primary and secondary data sources. Past and current condition of coral reefs, and biophysical parameters affecting resilience were considered in order to identify key conservation areas. The resilience potential of reefs within existing MPA's was assessed using globally accepted resistance and resilience factors. Of the four major coral reef MPA's in Sri Lanka, Bar Reef Marine Sanctuary, Hikkaduwa National Park and Rumassala Marine Sanctuary on the west and south coast are currently in a degraded condition while Pigeon Island National Park on the east coast remains in good condition. Overall, coral reefs on the western and southern coasts have suffered high bleaching related mortality and show signs of poor recovery with the exception of Bar Reef Marine Sanctuary. In comparison coral reefs on the east coast had lower mortality, and high potential for recovery. Coral species diversity, the presence of bleaching resistant coral species, fish assemblage structure, natural recruitment patterns, geographical location, wind exposure, natural fluctuations in water temperature, and level of anthropogenic impacts appear to affect the resilience of coral reefs in Sri Lanka. Developing a framework to apply country specific resistance and resilience factors identified through applied research into MPA declaration and management is essential in ensuring management success and conserving reefs in light of predicted climate change impacts in the future.

14:00 - Destruction of Marine habitats in Gulf of Mannar: Thinking behind Trans-boundaries and national fishing economy

Dr. Marirajan Thiruppathi[1], Mr. Velmurugan Thangarasu[1]

[1]DMI ST.Eugene University

The Gulf of Mannar (GoM) sea of both India and Srilanka side has biodiversity-rich ecosystems that are providing valuable eco system services. Small scale fishing is the backbone of people living around the GOM. The coral reefs and other marine ecosystems are very important to the lives and livelihoods of these coastal ecosystem dependent communities. However, human interference and management shortcomings have put this ecosystem under tremendous pressure. Bottom trawling is one of worse method caused heavily to the ecosystem health of GOM as perceived by local people of both side. This paper draws on socioeconomic assessments and monitoring carried out at selected sites in Tamilnadu and Srilanka in 2015. The tools used include a combination of participatory appraisal methods, interviews and surveys of 450 households and 850 individuals to understand the peoples dependence on marine ecosystem, and also compares the attitudes of artisan and trawler fishers towards conservation and management.There were solution echoed by fishing community which emphasized total ban on bottom traveling in both sides of GoM and also to increased the size of the mess. The management of the marine habitat also needs to be rethinked from present state centric management system. The marine habitat and reef areas needs to be managed under community Controlled conservation reserve (CCCR) based on their traditional governance system which recognizing more explicitly the interdependence between human well-being and ecosystem health and the need to maintain ecosystems productivity for present and future generations.

Make for the Planet: final conservation solution pitches (13:30 - 18:00, Ranyai Ballroom)

Dr. Barbara Martinez[1]

[1]*Conservation X Labs*

Come hear the final presentations of the Make for the Planet teams competing for prizes and recognition for their innovations. Make for the Planet teams worked in a pop-up makerspace to develop prototypes and models of conservation solutions in response to one of five conservation challenges presented on the first day of IMCC5. This is an event at IMCC5 to create real solutions. The teams worked with mentors at IMCC5 and were inspired by the presentations, discussions, and interactions with the delegates and other teams at the conference. In this session, teams will present their ideas to a panel of reviewers. Reviewers will rank and recommend the finalists, who will be eligible for monetary prizes. All delegates are welcome to attend. You might hear ideas that inspire your own research and conservation actions, or perhaps you are a potential investor, donor, or partner that can help move the ideas from early designs to on-the-ground conservation actions, and eventually to scalable solutions.

Focus Group: Prioritising marine conservation in the South Asia region (16:00 - 18:00, Tubau 2-3

Dr. Naveen Namboothri[1], Dr. Vardhan Patankar[2], Dr. Vineeta Hoon[3]

[1]*Dakshin Foundation,* [2]*The Wildlife Conservation Society,* [3]*Centre for Action Research on Environment, Science and Society*

South Asia (SA) covers 3.4% of the world's land area and more than 25% of the world's population is packed into the region, making it one of the most densely populous regions in the world with consequent pressures on natural resources. five countries in SA viz. Bangladesh, India, Maldives, Pakistan and Sri Lanka have a maritime boundary where 7-8 million people who are directly dependent on fisheries as a source of livelihood. SA also houses the world's largest mangrove ecosystem (the Sunderbans), contributes to about 7% of the global mangrove and coral reef cover and support marine ecosystems and populations that are of global significance and conservation value. Despite the huge economic, social and ecological values of these ecosystems, the SA region has always received scant attention at a global scale. Even within the region, the coastal and marine systems are low in terms of conservation priority. Local capacities for conservation, scientific and technological support, funding sources and government interests are generally lacking. As a result, these systems and the people dependent on them are in an extremely vulnerable state. The idea of the proposed workshop is to bring together various government and non-government institutions, organisations and individuals from SA to brainstorm and

- build a consortium of partners working on coastal and marine conservation issues
- identify shared as well as specific issues and challenges
- identify opportunities to complement each other's efforts
- develop a framework and strategy for regional collaboration

---

OS-12A: Marine Policy 3 (16:00 - 18:00, FJ Auditorium)

16:00 - Unpacking the theory and practice of multiscale marine conservation planning

Ms. Jessica Cheok[1], Dr. Rebecca Weeks[1], Prof. Robert Pressey[1], Prof. Tiffany Morrison[1]

[1]*Australian Research Council Centre of Excellence in Coral Reef Studies, James Cook University*

Problems of scale abound in the science and governance of marine environments and are pervasive in conservation planning. Despite frequent calls to integrate planning across scales, it remains unclear whether multiscale planning occurs in practice, or how it should be approached. First, to understand the strengths and weaknesses of conservation plans developed at different scales, we applied a social-ecological systems (SES) framework to assess the ability of plans developed at different levels (from patch to international) to consider SES components that exist at different scales, using the Coral Triangle as a case study. We found that no plans were able to adequately consider SES components across all scales, and thus there is no ideal scale at which to plan for conservation. On this basis, we identify a need for and develop an explicit definition of multiscale conservation planning: where planning processes undertaken at different scales effectively inform one another and consequently result in improved outcomes. To examine the extent to which multiscale planning occurs in practice and identify factors that may impede or facilitate multiscale planning, we analysed planning processes from Papua New Guinea and the Solomon Islands. We found that plans at different scales inform one another through flows of planning resources (e.g. data, knowledge, expertise, funding) and that, rather than occurring unidirectionally (i.e. 'scaling down' or 'scaling up'), real-world instances involve multidirectional scaling. We demonstrate that scalar capital is critical to effective multiscale planning and describe how this can intentionally be fostered in planning processes to improve outcomes.

16:15 - The role of Buffer zones in MPA design

Ms. Madeline Davey[1]
[1] *University of Queensland*

With conservation focused on meeting globally set conservation targets for effective marine protection, it is critical to understand how additional forms of spatial management are used to enhance and add to marine protected areas conservation goals. One often overlooked management tool for marine conservation buffer zones. Buffer zones are widely utilised in World Heritage Sites and other protected areas, yet the concept is ill-defined and scarcely assessed within marine literature.Buffer zones originate from terrestrial conservation, and the question remains if they can serve as an effective management tool in marine areas. This depends largely on their intent and application. We lack comprehensive assessment of marine buffer zones, leaving a gap in the understanding of their effectiveness or functional role; or an analysis for data-driven guidance on the size, shape and regulatory framework. While there are some papers discussing buffer zones, many of the conclusions are limited to case studies rather then conservation broadly.This study examines the role of buffer zones in conserving tropical marine ecosystems, and explores their application in protected area management in an attempt to clarify their conservation effectiveness. By reviewing the literature surrounding buffer zones, this study aims to enhance our understanding of buffer zones to better utilize a potentially valuable tool to enhance the global effectiveness and relevance of marine reserves for both humans and ecosystems. Without understanding of the complementary role buffer zones may play to a marine reserve, they could detract from the conservation objectives they are intended to enhance.

16:30 - Identifying marine priorities for biodiversity conservation: a case study along Brazil's marine ecoregions

Dr. Rafael Magris[1]
[1] *Chico Mendes Institute for Biodiversity Conservation*

Marine conservation in Brazil has long lagged far behind protection efforts for terrestrial realms. As an attempt to meet global conservation targets (e.g. Aichi Target 11), two large Marine Protected Areas (MPAs) were recently established in the open ocean. However, the MPAs were placed in areas with limited potential for extractive uses, rather than where they would be most useful to conservation. As a step towards providing support for a more ecological approach to strengthening MPAs and meeting policy targets, this study combines cumulative impact assessment and conservation planning methodologies to undertake a large-scale spatial prioritisation. Spatial data on marine ecosystems at all ecoregions, threatened species, anthropogenic drivers of disturbance, and seascape connectivity were integrated into a conservation planning tool (i.e. Marxan with Zones) to identify conservation priorities that meet several conservation objectives intended to make a positive difference for biodiversity (i.e. represent all ecosystems and species, maximise seascape connectivity, and mitigate impacts of disturbances). When identifying priorities for conservation, two scenarios were considered, distinguishing how existing MPAs were accounted for in the prioritisation: (i) only no-take MPAs were considered as contributing to the achievement of objectives; and (ii) all MPAs contributed to conservation objectives with varying ecological effectiveness according to their management categories. The study provides a comprehensive assessment of how to embrace a more ecological approach when chasing policy targets with ecoregion-scale conservation plans. I advocate these data be used to inform biodiversity conservation at scale and to assess current conservation efforts in the Brazilian waters.

16:45 - How does decentralisation of government affect conservation implementation?

Dr. Vera Horigue[1]
[1] *University of the Philippines Diliman*

Many countries have signed various international treatises and agreements that aim for environmental protection and sustainable development. However, these goals are still somewhat unattainable, particularly for developing countries that continue to struggle to balance people's demands for development, and the need for and reliance on healthy ecosystems. Moreover, despite the great support for conservation in developing countries, success of protected areas still largely depend on governance and the supporting structures underpinning effective implementation. And although integrated approaches and more inclusive institutional arrangements have been recommended for governing protected areas, certain shifts in policies, decision-making processes and network organisation can also influence conservation implementation. Hence in this talk, we present how protected areas evolved in a developing country context that changed from a centralised to decentralised government system. Using the municipality of El Nido in the Philippines as a case study, we describe how conservation and resource management efforts have evolved, and how donor driven initiatives and structural reforms in the country's governance system have catalysed or impeded conservation initiatives. We hope that the lessons and proposed mechanisms in this study be considered to facilitate better alignment and integration of existing policies, and structural reforms in order to properly implement conservation initiatives in El Nido, the Philippines, and other countries who have shifted to a decentralised policy.

17:00 - What is the global status of sharks and rays?

Ms. Janice Law[1]
[1] *Imperial College London*

Declines in top predator fish populations, such as sharks, have significant implications in marine ecosystems, with decreases in diversity and productivity, loss of ecosystem services and, in some instances, ecosystem collapse. Previous studies suggest that up to 90% of large predatory fishes have been lost since the 1950s and 16% of all shark species are threatened with extinction. There are 21 pelagic sharks and rays species and 75% classified as Threatened or Near Threatened in 2008. Conservation and management efforts for these species are complex - their vast ranges expose them not only to over-exploitation and being bycaught in high seas fisheries but also result in a lack of protective legislation due to insufficient coordination across national jurisdictions. Furthermore, their slow intrinsic rates of population growth and slow rate to maturity make them particularly vulnerable to exploitation.

Populations must be monitored and well-managed given their ecological significance as top predators. Regional Fisheries Management Organisations are primarily responsible for serving this role, although their ability to undertake full stock assessments is limited due to data deficiencies. To identify species at risk of extinction, we assess the current global status of pelagic sharks and rays by analyzing population time-series literature, with a particular focus on regional variations within species. The analysis utilizes the Living Planet Index approach, applying the generalized additive modelling framework to identify underlying trends within each population time-series. The findings will provide insight into the current regional and national conservation needs for pelagic sharks and rays.

17:15 - Policy Needs for Shark and Ray Conservation in the Philippines

Ms. Jean Asuncion Utzurrum[1], Dr. Aa Yaptinchay[2], Ms. Anna Oposa[3], Ms. Mo Maguyon[2], Mr. Vince Cinches[4]

[1]*Institute of Environmental and Marine Sciences, Silliman University,* [2]*Marine Wildlife Watch of the Philippines,* [3]*Save Philippine Seas,* [4]*Greenpeace Southeast Asia*

The Philippines is one of the most biodiverse areas in the world in terms of sharks and rays with possibly over 200 species in its waters. Artisanal, and to a lesser extent commercial, shark and ray fisheries are characterized by directed, opportunistic, or incidental takes. Management is minimal because sharks and rays are not considered commercially important species. A management program is contained within the NPOA-Sharks but a policy framework for sufficient conservation does not exist. To date, only twenty-one shark and rays are protected nationally, all of which are listed in the CITES Appendices. A few provincial and municipal governments have addressed this gap by passing local laws resulting to blanket bans on takes and protection of some species such as those in the Threatened IUCN Redlist categories or those that are locally important. However, implementation and enforcement of these laws are a challenge, aggravated by a low level of awareness. Through the development of a three-year roadmap for shark and ray conservation, a comprehensive national law is proposed to address the inconsistencies and gaps in policy. It is envisioned that when this is passed and implemented, the policy will provide a model for sustainable and ecosystem-based management of shark and ray fisheries in the Philippines.

OS-12B: Conservation and Management 9 (16:00 - 18:00, FJ Event Hall)

16:00 - Mitigating the growing risks of marine invasive species in the Easter Tropical Pacific Region: an action plan for the future

Dr. Inti Keith[1]

[1]*Charles Darwin Foundation*

The marine ecosystems of the Galapagos Islands harbor unique biological communities with a high incidence of endemic species. Galapagos is a UNESCO world heritage site, renowned for its high biodiversity and extraordinary oceanographic features that provide a great variety of habitats in a unique environmental setting. Marine biological invasions have increased due to global trade, transport and tourism. The Galapagos Islands are under threat from marine non-native arrivals, given the connectivity that exists across the Eastern Tropical Pacific (ETP), the increase in marine traffic and the effect of extreme climatic events such as the El Niño. The management strategies to tackle marine invasive species in Marine Protected Areas (MPAs) in the Pacific region have to be addressed in order to protect the marine biodiversity of the region. The number and impact of marine invasions are accelerating worldwide yet, most regions lack the rigorous data required to understand status and trends of invasions, how these are changing through time, and the effectiveness of management strategies to prevent new invasions and their associated impacts. The risk posed by non-native marine species already established in the GMR and the region, should not be underunderestimated, nor should the amount of crucial research needed to mitigate this risk. This paper starts to quantify that risks present in the ETP region by describing the species that have been found in the Galapagos Islands (Ecuador) and Cocos Island (Costa Rica) using different methodologies.

16:15 - Implementation of ecosystem-based management in the Bay of Bengal Large Marine Ecosystem

Ms. Sandya Gunasekara[1]

[1]*Queensland University of Technology*

This study deals with the possibilities of implementing an ecosystem-based marine management in the Bay of Bengal Large Marine Ecosystem, which lacks a collective system of ocean management and also an integrated framework (legal and institutional) to ensure cooperation at the scale of the Large Marine Ecosystem level. In order to implement ecosystem-based marine management, it requires to know in advance to what extent the Bay of Bengal States accept the legitimacy of the collective solutions to deal with ocean governance issues while feeling more ownership over their decisions. This idea is compatible with the notion of 'subsidiarity', which recognises that regional ocean issues can be better solved among regional States than global ones. At the centre of the current discourse around ecosystem-based marine management in the world the application of subsidiarity have yet to be explicated. Therefore, the aim of this study is to discuss Large Marine Ecosystem level commitment as a necessary precondition for ocean management in general, and ecosystem-based marine management in particular. In order to provide an account and an overview of the cooperation among Bay of Bengal regional States, an analysis of key documents published during 2005-2016 will be undertaken.

16:30 - Developing a marine spatial plan for a 30% conservation goal in Seychelles

Dr. Joanna Smith[1], Mr. Didier Dogley[2], Mr. Alain De Comarmond[2], Mr. Wills Agricole[2], Mr. Matthew Brown[3], Ms. Helena Sims[3], Mr. Richard Tingey[4]

[1]*TNC Canada,* [2]*Ministry Environment, Energy and Climate Change,* [3]*The Nature Conservancy,* [4]*Spatial Support Systems Ltd*

The Seychelles is an archipelagic nation in the rich, tropical marine waters of the Western Indian Ocean. Encompassing 1.37 million square kilometres and 115 islands, biodiversity is Seychelles' most important natural asset supporting a luxury tourism industry and over 10 different fisheries. In recent years, public concerns about fisheries sustainability, tourism development and climate change impacts have increased. Conservation and sustainable use of marine resources are very important to Seychelles' way of life and in 2010 the government made a bold commitment to increase marine protections from 0.03% to 30% using a debt-for-conservation deal. The Seychelles Marine Spatial Plan (SMSP) process began in 2014 and is a public and transparent process to achieve the 30% marine conservation goal and meet other conditions of the debt swap. The SMSP is government-led process, facilitated by The Nature Conservancy, and includes input from at least 11 marine sectors including fishing, tourism, conservation, oil & gas, recreation, maritime safety, ports, and renewable energy. By developing robust stakeholder engagement processes, a simple zoning framework to match planning goals, building an adaptive spatial database at multiple scales, and using a planning unit approach with decision-support tools like Marxan with Zones, the first SMSP milestone was achieved in 2018 after more than 100 consultations. This approach resulted in over 210,000 square kilometres or 16% of Seychelles' waters in marine protection and sustainable use areas. This presentation will show how marine conservation goals and resilient ocean economies can be achieved using a transparent marine spatial planning process.

16:45 - Quantifying Threats to Seahorses and Sea Turtles in Cambodia and Designing By-catch Mitigation Measures

Ms. Rylida Vong[1], Mrs. Kate West[1]
[1]*Fauna & Flora International*

Endangered species such as sea turtles and seahorses are often caught as bycatch in both large- and small-scale fishing gear in Cambodia. Recently, the Royal Government of Cambodia has created Marine Fisheries Management Areas (MFMAs âĂŞ multiple use protected areas) to conserve marine fishery resources and biodiversity. However, bycatch is still a significant threat to seahorses and sea turtles in Cambodia's waters and additional measures are required to tackle this threat both inside and outside protected areas. So far, there have been few studies conducted to understand threats to seahorse and sea turtles in Cambodia. To fill this gap, FFI researchers have been interviewing fishermen across coastal provinces in Cambodia to understand the scale and drivers of endangered species catch and trade, in order to design locally-appropriate conservation measures. Here, we share results from these surveys and expose the scale of the threat from trawl fisheries to both sea turtles and seahorses in Cambodia. In addition, we report on results from in-water assessments of seahorse populations within a permanent monitoring site in the Koh Rong Archipelago MFMA, where fishing restrictions have been in place since 2016. Through feeding data and recommendations into site-level and national Technical Working Groups and management plans for marine conservation, this primary research will guide both MPA management and fisheries policy development in Cambodia.

S-138: Management of Sustainable Coral Reef Tourism under the Climate Change Crisis (16:00 - 18:00, Tubau 1)

16:00 - A management of coral reef refuge in off-shore Gulf of Thailand

Dr. Mathinee Yucharoen[1], Ms. Anchalee Chankong[2], Mr. Santi Ninwat[2]
[1]*Marine and Coastal Institute, Prince of Songkla University, Hat Yai, Songkhla,* [2]*Department of Marine and Coastal Resources (DMCR), Ministry of Natural Resources and Environment*

The large-scale impacts on coral bleaching due to high seawater temperature have increased dramatically. A widespread of coral mortalities resulted from the severe coral bleaching events was occurred along the Andaman Sea and Gulf of Thailand causing the decrease of coral reef fertility as well as their ecosystem services. However, some off-shore reefs, for example the Losin pinnacle, were still alive after the coral bleaching events due to the water temperature in the location was not much changed. This is recognized as a 'thermal refugia' for corals. Therefore, the collaboration between the Department of Marine and Coastal Resources and universities was built in order to establish those thermal refugia as the Marine Protected Area (MPA). This study was a part of MPA proposal resulted from the surveys of coral reef ecosystem at Losin. A checklist of reef building corals was produced during August 2017 showing a total of fifty-nine coral species, mainly covered by Acropora spp., for examples, A. intermedia, A. grandis, A. muricata, A. cytherea, A. cytherea, followed by Porites spp. and Montipora spp. This area should be reserved as a refugia to maintain an abundance of coral population. The Losin pinnacle should be considered as a restricted area through appropriate conservation strategies. The outputs obtained from this study actively supports Thailand coral reef management plan under the crisis situation.

16:15 - Lessons learned from carrying capacity assessment of dive sites in the Gulf of Thailand and the Andaman Sea

Dr. Thamasak Yeemin[1], Dr. Makamas Sutthacheep[1], Mr. Wichin Suebpala[1], Mr. Sittiporn Pengsakun[1], Mr. Watchara Samsuvan[1], Ms. Wanlaya Klinthong[1]
[1]*Marine Biodiversity Research Group, Department of Biology, Faculty of Science, Ramkhamhaeng University, Huamark, Bangkok*

Diving tourism sector provides the great benefits to local and national economy as well as supports local employment and livelihoods. However some tourism activities can generate negative impacts on coral reefs. Hence, the concept of tourism carrying capacity has been applied in many dive sites globally. The carrying capacity gives the maximum number of tourists at a certain tourism site can accommodate sustainably. In this study, we assessed the tourism carrying capacity at several dive sites i.e. Mu Ko Samed and Mu Ko Chang in the Eastern Gulf of Thailand, Mu Ko Chumphon in the Western Gulf of Thailand, Mu Ko Surin, Mu Ko Similan, and Ao Phang-nga in the Andaman Sea. We found that some areas, for examples some dive sites at Mu Ko Similan, exceeded the carrying capacity while some were still below the carrying capacity. Some obstacles were found in controlling the number of tourists not to exceed the carrying capacity due to a growing tourism demand resulted from the national policy on tourism development and promotion. High conflict with tourism business operator is always occurred when the marine national parks regulate the number of tourists. To overcome those obstacles, we should focus on controlling tourist's behavior on how to dive without having impacts on coral reefs, educating dive leaders, providing artificial reefs for recreational diving to reduce pressures on natural reefs.

16:30 - Recreational fish feeding: Understanding impacts for tourism management

Mr. Felipe Monteiro Gomes de Mattos[1], Dr. Thamasak Yeemin[1]
[1]*Marine Biodiversity Research Group, Department of Biology, Faculty of Science, Ramkhamhaeng University, Huamark, Bangkok*

Fish feeding is one of the most seeked activities among coastal tourism in coral reef areas. The easy interaction on water surface makes it one of the preferred ways for most tourists. This worldwide spread action affects specially developing countries in tropical zones such as Brazil and Thailand. We try to compare the fish feeding activities on the coral reefs of those two countries using a literature background. Studies performed on both countries identified around 20 reef fish species aggregating on usual feeding locals or during the feeding itself, although the richness of this group is 3x higher in Thailand. Records indicate bread is a common feed used both in Brazil and Thailand, though in the first, other food remnants and dog food were also detected. The damselfish genus Abudefduf is the most representative in all studies about this topic, being A. saxatilis and A. vaigiensis the dominant species in Brazil and Thailand respectively. Similarly communities on both countries were composed mainly by omnivorous, followed by herbivores and mobile invertebrate feeders. Although some local differences might be regarded in both cases, the reef fish communities seem to react in similar ways to tourism feeding, both in composition and behavior. This kind of activity has few and local studies, though its impact can reach poorly understood levels on reef fish ecology, behavior and even physiology, due to malnutrition. More in deep studies are needed, specially in ethology, since changes in behavior can be subtle are yet not clear.

16:45 - Analyzing marine ecotourism potential of Chumphon Province, Thailand, to support coral reef conservation

Mr. Wichin Suebpala[1], Dr. Thamasak Yeemin[2], Dr. Makamas Sutthacheep[2], Mr. Sittiporn Pengsakun[2], Mr. Watchara Samsuvan[2], Ms. Supawadee Hamanee[3], Mr. Chinarong Ruangthong[4]

[1]Interdisciplinary Program of Environmental Science, Graduate School, Chulalongkorn University, [2]Marine Biodiversity Research Group, Department of Biology, Faculty of Science, Ramkhamhaeng University, Huamark, Bangkok, [3]Faculty of Economics, Sripatum University, [4]Chumphon Marine National Park Operation Center 1, Department of National Parks, Wildlife and Plant Conservation, Chumphon

The growth of marine and coastal tourism boots up the blue economy of coastal and island countries globally. The degradation of coral reefs has been reported due to natural and anthropogenic disturbances such as coral bleaching, coastal development and urbanization etc while the mass tourism itself also generates negative impacts and delays natural recovery process of degraded coral reefs. In this study, we applied a transdisciplinary approach to analyze marine ecotourism potential of Chumphon Province, located in the western Gulf of Thailand, to support coral reef conservation. The ecological, socio-economic, and tourism surveys were conducted to gather relevant information i.e. ecological data, socio-economic, and tourism development. The preliminary results revealed some possibilities that some coral communities and pinnacles in Chumphon Province can be developed and promoted as alternative ecotourism sites to attract tourists from the main dive sites such as Ko Samui, Ko Phangan, Mu Ko Ang Thong in Surat Thani Province, Pattaya in Chonburi Province, Phuket etc. Since the popularity of marine tourism in Chumphon Province is relatively low, tourism promotion and marketing as well as tourism infrastructure development should be heavily emphasized. Also, we suggest that ecotourism concept with local participation should be applied to ensure the sustainability of ecological integrity and social-economic viability. This study provides an integrated baseline information to support sustainable ecotourism management along with coral reef conservation in Thailand.

17:00 - Influence of human activities on coral diseases at tourist hotspots in the Gulf of Thailand

Mr. Watchara Samsuvan[1], Dr. Thamasak Yeemin[1], Dr. Makamas Sutthacheep[1]

[1]Marine Biodiversity Research Group, Department of Biology, Faculty of Science, Ramkhamhaeng University, Huamark, Bangkok

The quality of ecosystem services of coral reefs depends on coral reef health which has been impacted by human activities and natural stressors. This study aims to analyze the influence of human activities on coral health by conducting the field surveys at fourteen study sites in the Gulf of Thailand during 2016. The main patterns of coral diseases at the study sites consisted of pigmentation responses, white syndromes, growth anomalies, and unusual bleaching patterns. Twelve species of corals with the diseases and signs of compromised health included Acropora muricata, Astreopora mileopora, Plerogyra sinuosa, Pavona decussata, Fungia fungites, Platygyra sinensis, Favia speciosa, Favites halicora, Goniastrea aspera, Porites lutea and Goniopora lobata. The highest prevalence of the diseases and signs of compromised health was found with P. lutea (83%). Of which, more than 50% was pigmentation response, followed by white syndromes accounting for 23%. The results showed that the highest prevalence was found at the study sites located close to big cities and influenced by the tourism activities. The prevalence of coral diseases may associate with poor water quality. This study emphasizes the need of impact mitigation of human activities, particularly from mass tourism and infrastructure development, on coral communities in the Gulf of Thailand.

17:15 - Should underwater pinnacles be used as thermal refugia or dive site?

Dr. Makamas Sutthacheep[1], Mr. Sittiporn Pengsakun[1], Mr. Watchara Samsuvan[1], Ms. Juthamart Putthayakool[1], Dr. Thamasak Yeemin[2]

[1]Marine Biodiversity Research Group, Department of Biology, Faculty of Science, Ramkhamhaeng University, Huamark, Bangkok, [2]Marine Science Association of Thailand

Underwater pinnacles play similar roles as coral reefs such as nursery and feeding grounds, tourism sites etc. Many underwater pinnacles are found in the Gulf of Thailand and they have faced with coral bleaching, recorded in 1998 and 2010, resulting in coral reef degradation. In this study, we surveyed many underwater pinnacles in the Gulf of Thailand to assess their status and potential use for tourism. We found that some underwater pinnacles are thermal refugia for corals during the coral bleaching crisis. For example, the underwater pinnacles at Hin Phoeng which are located about 25 km offshore from Rayong Province, the Eastern Gulf of Thailand, and harbored high diversity of scleractinian corals, especially the susceptible corals to bleaching such as Pocillopora spp. and Acropora spp. Three morphs of Pocillopora spp. were recorded at the study sites. The most dominant type was Type B which had high population density (about 50 colonies.m-2) in some areas. The surveys on coral communities at Ko Samet (about 27 km from Hin Phoeng) and Trat Province (about 90 km from Hin Phoeng) revealed that no colonies of Pocillopora spp. were observed during the study period. Therefore, the underwater pinnacles at Hin Phoeng should be reserved as a refugia for corals under the climate change crisis. However, many underwater pinnacles with less coral cover but having beautiful soft corals and sea fans may be promoted to be dive sites.

S-139: Social, economic, and governance tools and incentives to combat Illegal, Unregulated and Unreported (IUU) trade of marine fauna (16:00 - 18:00, Kerangas)

16:00 - Socio-economic incentives for harvesters and supply chain to meet seafood sustainability standards

Dr. Catherine Longo[1], Dr. Amber Himes-cornell[2], Dr. Cristina Pita[3], Prof. Christopher Anderson[4]

[1]Marine Stewardship Council, [2]UN World Food and Agriculture Organization, [3]University of Aveiro, [4]School of Aquatic and Fishery Sciences, University of Washington

Seafood traceability is a key strategy for combating marine illegal trade, unethical practices and ensuring transparent and sustainable seafood sourcing. However, it is no simple feat to transparently document and track the journey of marine harvest from sea to market, especially in complex, border-crossing and geographically far-reaching supply chains.Voluntary Sustainability Standards, such as the Marine Stewardship Council (MSC), incentivize harvesters to adopt sustainable practices, and supply chain actors to selectively source and track their products, in exchange for public recognition through an ecolabel. Reasons to join a certification program may include access to new markets, improved reputation, and risk-avoidance of mislabeling and fraud. With potential for being a strong driver of positive

change, but also risks of negative impacts, for example certified harvesters outcompeting small-scale producers that cannot afford necessary improvements, it is important to understand and monitor socio-economic mechanisms involved in seafood certification. Yet, to date, most published studies rely on anecdotal knowledge and isolated case studies. The MSC, with 13% of global wild-capture fisheries' harvest certified, and nearly 3500 Chain of Custody certificates, works with a global network of stakeholders in the harvest and post-harvest sectors, thus being well-placed for systematically investigating these questions. Here we present early results of a new large-scale data collection program on socio-economic impacts of MSC certification in three pilot studies. Interviews with harvesters and processors show a complex landscape of costs and rewards. We discuss implications for effectiveness of market-driven sustainability interventions, emerging research questions, and MSC's plans for future developments.

16:15 - Challenges in seafood traceability & sustainability in the South China Sea

Ms. Shen Yan Liow[1], Dr. Jaco Barendse[1]
[1]*Marine Stewardship Council*

The South China Sea is home to some of the most diverse marine life. With 12% of global wild catch and 88% of global aquaculture production, it plays a vital role for nutrition, income and livelihoods of millions of people in the region, but it is often exploited at the expense of vulnerable communities and marine environments. Overfishing of resources and poor working conditions, due to unregulated or illegal harvest, are enabled by lack of monitoring. An incentive to increase legal practices is foreign market pull for traceable products from sustainable fisheries. Voluntary ecolabelling initiatives, such as the Marine Stewardship Council (MSC) and the Aquaculture Stewardship Council (ASC), setting standards for sustainable wild and aquaculture harvest, respectively, require that every actor in the supply chain is certified according to MSC Chain of Custody Standard. This lays out a framework for businesses to effectively segregate and trace products from harvest to final consumer. Here, we present lessons learned from use of MSC traceability framework in 99 countries, about key challenges in enforcing verifiable sustainability claims throughout the supply chain. We discuss the case of certified Vietnamese shrimp aquaculture, where risks of mislabelling, volume and origin substitution were identified. We then propose how recent technologies for product authentication and digital traceability may provide new solutions to address traceability issues at local and global levels, improve industry practices, and achieve greater transparency, thus driving much needed change towards more sustainable use of marine resources.

16:30 - Improving global trade data to enhance fisheries traceability and the detection of illicit harvests and trade

Dr. Donna-Maree Cawthorn[1], Prof. Stefano Mariani[1]
[1]*University of Salford*

In an era of rising seafood demand and declining ocean health, the ongoing prevalence of illegal, unreported and unregulated (IUU) fishing represents a major global concern, threatening vulnerable species and ecosystems, fleecing the economy, jeopardising human livelihoods and having frequent links to highly-organised transnational crime. As seafood trade routes become longer and more complex, there is an ever-increasing need to trace seafood from source to consumption, as well as to understand where IUU fishing occurs and how and where illegal products infiltrate the market. Theoretically, the analysis of trade data should offer a tangible avenue for elucidating the external market forces driving fisheries harvest, as well as discrepancies that point to illegal activities. Yet, by collating and comparing existing production, import and export records for various valuable fisheries commodities - including 'snappers' (family: Lutjanidae), 'seabreams' (family: Sparidae) and 'groupers' (subfamily: Epinephelinae) - we demonstrate that official trade data severely lack the level of detail required to track trade flows and inform sustainable management of many heavily-exploited fish species. Moreover, our analysis highlights current constraints of the widely used international 'Harmonized Commodity Description and Coding System' (HS system) that give rise to trade data discrepancies and ultimately offer opportunities for products from illegal sources to enter global marketplaces. Considering these results, we contend that the lack of taxonomic granularity and use of vague generic names in official trade records represent one of the most insidious impediments to seafood traceability and suggest that the HS system should evolve to address these gaps.

16:45 - Global Fishing Watch & Detection of Illegal Fishing Activity

Ms. Samantha Emmert[1], Dr. Nate Miller[1], Mr. Ahmad Baihaki[1]
[1]*Global Fishing Watch*

Historically, fishing activity at sea and beyond the horizon has been poorly monitored. This poor monitoring, combined with patchy regulation and little enforcement, has allowed illegal and unreported fishing to reach significant levels where best estimates suggest that 1 in 5 fish could be caught illegally. This places the sustainability of our ocean at risk. Thanks to recent advances in machine learning, computing power, and satellite technology, Global Fishing Watch, an independent non-profit organization, is bringing an unprecedented level of transparency to global fishing activity and, with our research partners, new and informative research. The vast quantity of data, collected by a growing satellite constellation, can be quickly analyzed to turn AIS and VMS signals transmitted from vessels at sea into global fishing activity data in near real-time. Global Fishing Watch strives to bring sustainability to the fishing industry through increased transparency in fishing on a global scale, and in unparalleled detail. Through three case studies, we will demonstrate the power of this technology to illuminate illegal activity at sea. We will discuss how we were able to identify illegal fishing within a no-take Marine Protected Area and transshipment activity that allowed a vessel to illegally carry thousands of sharks and shark fins. In addition, we will highlight our current work on detecting human rights violations at sea. Through these and similar cases, we are identifying patterns to help detect suspicious activity, strengthen transparency, and advance responsible fisheries management.

17:00 - Combining law enforcement and livelihood-based incentives to deliver measurable conservation outcomes in the world's largest targeted manta ray fishery

Ms. Hollie Booth[1]
[1]*The Wildlife Conservation Society*

Overexploitation represents a significant threat to wildlife, with the severest impacts felt by slow growing, economically valuable species. Manta rays have been increasingly targeted in recent decades to meet emerging demand for their gills in traditional Chinese medicine markets. In an attempt to improve their conservation status, manta rays were listed on Appendix II of the Convention on the International Trade of Endangered Species (CITES) in 2013 and declared a fully protected species in Indonesia in 2014. Indonesia is a global priority for manta ray conservation, as it's the world's largest elasmobranch fishing nation, a major supplier of manta ray gill plates to consumer countries, and home to one of the largest known targeted

manta ray fisheries in the world - Lamakera in Solor, East Nusa Tenggara. The Wildlife Conservation Society (WCS) has been working in partnership with Misool Foundation and local government authorities in Lamakera since 2015 in order to implement Indonesia's manta ray regulation on the ground. We adopted an integrated approach, including aspects of strict site-based law enforcement and livelihood-based incentives, and collected comprehensive monitoring data to measure our impact. Despite initial challenges due to strong socioeconomic drivers for continued manta hunting, our monitoring data shows that our approach has now successfully reduced illegal exploitation of manta rays in Lamakera by more than 90%. The results provide a case study of how a local-level intervention has reduced illegal hunting and trade of protected marine megafauna, and showcases techniques for conducting robust impact assessments for conservation interventions.

17:15 - Making marine science matter to seafood consumers

Ms. Lucy Erickson[1]
[1]*Marine Stewardship Council*

For many of the world's citizens, the closest they come to marine conservation, or even the ocean, is by eating fish. Globally, fish provides nearly 7% of all protein consumed. There's a need for greater stewardship of these resources under pressure, and seafood consumers could play a key role in promoting sustainability through purchasing power and supporting eNGOs. If we understand what motivates consumers, we can tailor marine science messages to resonate with different segments of this audience and engage more effectively. Certification and rating schemes have been identified as one tool to incentivise harvesters and retailers to shift towards sustainability. The Marine Stewardship Council ecolabel program is designed to incentivise improved fishing practices by working with retailers to leverage consumer power at scale. We want to understand how to engage seafood consumers who might not typically pay attention to ocean health issues so they can leverage further change. In 2016 independent research and insights company GlobeScan carried out the largest ever global analysis of attitudes to seafood consumption, finding that sustainability is a key driver for purchase. This talk will present new results from the 2018 survey, providing insights into the values and perceptions of seafood consumers around the world. It will explore how receptive seafood consumers are to sustainability, marine science messages and associated behavioural change in the context of ecolabeling, and will address the growing focus on traceability and the eradication of illegal, unreported and unregulated (IUU) fishing from consumers and retailers.

Closing Ceremony & Student Awards Presentation (18:00 - 18:30, Ranyai Ballroom)

Oceans Online

Oceans Online Welcome (8:30 - 9:00, Ranyai Ballroom)

Opening Plenary: Danielle Brigida

9:00 - 10:00, Ranyai Ballroom

Using social media to educate, inspire, and sea change

Danielle Brigida leads the national social media strategy at the U.S. Fish & Wildlife Service. With over 10 years experience communicating about wildlife on social channels, she's got a passion for connecting people with wildlife and uses online communities and technology to do so.

As an early adopter of social media with creative, engaging campaigns, Danielle has been recognized as one of the 10 Most Generous Social Media Mavens by Fast Company; one of the 75 Environmentalists to follow by Mashable; one of 10 People to Follow Who are Saving the World by Mother Nature Network and was named a Social Media MVP by PRnews in 2014. Danielle has been interviewed about her social media experience by USA Today, The New York Times, The Nonprofit Times, Fast Company, Washington Post, and Mashable.

Connecting youth and teachers across borders: using online technology as a platform to integrate classrooms and strengthen marine conservation (10:30 - 11:30, Kabu)

Ms. Kerstin Forsberg[1]

[1]*Planeta Oceano*

Increased accessibility of online technology provides opportunities for schools, teachers and students worldwide to connect around marine conservation. Online conversations with peers from distinct geographical locations could catalyze knowledge exchange and mobilize local community action, while consolidating a sense of 'global citizenship'. for example, students from different sides of the same sea can discuss common issues and propose regional solutions or joint projects, or students from different seas can discuss global issues, and highlight how these are impacted by local actions. This discussion will focus on key issues including:

- What strategies have been implemented to connect schools in marine conservation through online technology? What results have been achieved and what have been the main obstacles?
- What else needs to be done around this approach? Based on individual experiences and feedback, participants will be encouraged to collaborate on joint efforts, propose commitments and develop collaborations related to this topic.

Make Your Science Matter to the Average Mortal: Pitching to the Media (10:30 - 11:30, Kerangas)

Ms. Adrienne Mason[1], Mrs. Isabella Jude[1], Mr. Josh Silberg[2]

[1]*Hakai Magazine,* [2]*Hakai Institute*

Independent media-newspapers, magazines, radio, podcasts, documentary films-are an important part of public education. Many adults never take another science course after high school and the way they make sense of scientific breakthroughs is through the popular press. Like it or not, the press, rather than scientific journals, is the conduit for making your science matter and can help effect public perceptions, actions, and even policy. Often though, the stories that get told are the ones typically the easiest to sell. How can scientists interest journalists in the nuanced, multi-dimensional, long-term research that goes on in the field and lab without resorting to clickbait and sensationalism? What do journalists want to know? How do scientists find the right journalist to tell the world about their hard-won research? In this session, the three journalists will spell out what creates a winning story for the popular press. Through examples and discussion, scientists will learn what works, what doesn't, and how they can create winning pitches. Scientists can also discuss their media experiences (for better or worse) and brainstorm how their research or issue may be framed in a manner that will attract media attention to reach their intended audience.

Marine Planning 201 - Tackling Questions that have no Answers (10:30 - 11:30, Tubau 3)

Ms. Allison Besch[1]

[1]*Nicholas School of the Environment, Duke University*

Leaders in the marine science community are tasked with addressing regional conservation challenges that do not have straightforward answers. Join Allison Besch of Duke University to explore how and when you might utilize professional workshops and trainings to help a team or region move decisionmakers and stakeholders forward together. Session leaders will share some educational workshop techniques that can be used for regional teambuilding, and will also lead a focus-group style group discussion on the value of "Marine Planning 201" topics such as network analysis, identifying group values, writing for diverse audiences, and how to convey data with trust. While we cannot provide the answers, we can provide guidance for finding a structure or approach that might help move your particular region or project one step closer to doing so yourself.

Can we raise awareness and understanding of interdisciplinary marine conservation through online action? (10:30 - 11:30, Tubau 1

Dr. Emma McKinley[1], Dr. Edward Hind-Ozan[2]
[1]*Cardiff,* [2]*SCB Marine*

Over recent years, there has been a growing effort to bridge the gap between social and natural sciences, with increasing calls for disciplines such as marine social science to supplement and complement traditional marine biology in marine conservation efforts. However, this transition seems to being hampered by the often silo-ed structures of academic and government institutions. While a move to interdisciplinarity is underway, the existing research landscape can be frustratingly slow. Consequently, there are doubts as to whether the necessary integration of the social and natural sciences can happen in time to address some of the most pressing socioecological issues impacting are coasts and oceans (e.g. climate change, plastic pollution, overfishing). With this in mind, we ask if the less structured, but rapidly growing, online community of marine researchers, stakeholders, and policy-makers can become active in the transition towards greater interdisciplinarity in marine conservation. Recent conversations on Twitter around the hashtag #MarSocSci (i.e. 'marine social science'), for instance, have initiated the growth of a virtual research community, bringing international social and natural scientists together in discussions on interdisciplinary issues. Can this be built on to accelerate progress toward true interdisciplinarity in marine conservation? In this facilitated discussion we will identify and discuss current and potential online networks, tools, and resources, examining a range of opportunities that can and should be part of this progress. We will start this discussion through highlighting how a soon to be established Marine Social Sciences Network aims to foster greater interdisciplinarity, on and offline.

Tapping into the Global Iconographic Lexicon: Making Ocean Emoji (11:30 - 12:30, Tubau 3)

Dr. Andrew Thaler[1]
[1]*Blackbeard Biologic: ScientiiňAc and Environmental Advisors*

"Why isn't there an emoji for X?" is a question often asked by science and conservation outreach professionals but rarely answered. There is an answer. The reason that there are so few ocean-themed emoji is because they haven't been proposed to the Unicode Consortium. Emoji is a iconographic language. It is the only language that is global in both its scope and interpretation. Every device operating in every language display the same standardized emoji. Over 3 billion devices have native support for emoji while platforms like facebook, Tencent, Sina Weibo, and Twitter extend emoji to over 4 billion active users. Adopting new emoji is a complex process but the impact on social consciousness by building new concepts into a global lexicon cannot be underestimated. During this session, we will brainstorm potential candidates for ocean and conservation themed emoji and then triage them in accordance with the Unicode Consortium's standards for new emoji. Once equipped with a targeted list of potential candidates we will draft a formal proposal such that, by the end of the conference, we will be ready to solicit artwork and formally submit a new emoji request for the candidates we've identified.

A model for promoting coral reef data sharing, accessibility and improved application for conservation outcomes (11:30 - 12:30, Tubau 1)

Mr. Warren Lee Long[1], Ms. Akiko Hamada-Ano[1]
[1]*Secretariat of the Pacific Regional Environment Programme*

This facilitated discussion will present and discuss a model for mobilising data and stimulating greater data sharing by coral reef monitoring programmes. The model brings together existing global coral reef monitoring network (GCRMN) experts, scientists, training providers, organisations, recipient countries into a single capacity building event that promotes a new culture of open data sharing. It also stimulates the application of coral reef research and monitoring data for addressing the needs of small island states in the Pacific. This model arose in the Pacific island region in response to interest from multiple training providers wishing to deliver capacity building events, but each proposed event came with a poor funding base. With the need to optimise delivery cost effectiveness of training to small island developing states, combining the various training events into one event presented some interesting new benefits and opportunities for data collection and sharing amongst the experts and stakeholders. These benefits include greater sharing across the different monitoring methods, improved understanding of countries' needs in the application of coral reef data, and standardisations of tools and methods to meet the needs of target groups. The discussion will draw out audience suggestions on how this model could be improved or adapted to further enhance data mobilisation, accessibility and sharing for coral reef conservation outcomes.

Do it for the 'gram: How Scientists can Utilize the best of Instagram (12:30 - 14:00, Kerangas)

Ms. Melissa Marquez[1]
[1]*The Fins United Initiative*

Instagram can be a powerful tool for researchers and students involved in the sciences. The photo-sharing application is up to 800 million monthly active users, making it one of the most popular social media platforms and a medium more scientists should take advantage of to discuss science with large audiences. Used effectively, Instagram offers a unique opportunity for virtual science outreach through pictures, videos, and live "stories." Unfortunately, many don't know how to use the app for professional purposes. At the end of this workshop you will have an account, learn the basics, how to best share your scientific experiences, and a plan to further your outreach goals.

The Dugong and Seagrass Research Toolkit (12:30 - 14:00, Kerangas

Dr. Donna Kwan[1], Dr. Richard Unsworth[2], Mr. Len McKenzie[3], Mrs. Samantha Matthews[4], Dr. Himansu Das[5]
[1]*CMS Dugong MOU Secretariat,* [2]*Swansea University and Project Seagrass,* [3]*Seagrass-Watch HQ,* [4]*CMS Dugong MOU,* [5]*Environment Agency - Abu Dhabi*

The Dugong and Seagrass Research Toolkit (www.conservation.tools) is a free, web-based resource for marine natural resource managers, decision-makers (government and non-government) and researchers. The conservation and management of dugongs and their seagrass habitats should be evidence-based and informed by research. The Dugong and Seagrass Research Toolkit works to support this by helping users to refine their research question and taking them through a decision tree that ultimately identifies the most appropriate tools or techniques to answer their research question. The Toolkit also provides information on the constraints of each tool or technique, including the resources required, expertise needed and the spatial scales at which the technique is most suitable. Technical Guidelines are available for each identified tool or technique. In addition to helping users to identify the most appropriate tool or technique to answer their research question, the Toolkit also encourages the collection of standardised and comparable data which supports global dugong and seagrass conservation efforts. The Toolkit includes three streams of

research: dugongs, seagrasses and the associated human communities - an important dimension for conservation, especially in coastal communities. The Toolkit was developed by the Convention on Migratory Species (CMS) Dugong MOU's Dugong Technical Group, a group of international experts (see www.conservation.tools/meet-the-experts/) and represents a partnership between TOTAL, Total Abu Al Bukhoosh, Environment Agency - Abu Dhabi and CMS Dugong MOU.

Science Communication. New ways to reach citizens and policy makers in the post fact world. Case: Marine/Ocean stories. (12:30 - 14:00, Tubau 3)

Mr. Jorge Aguado Sánchez[1]

[1] *By The Ocean We Unite*

Science communication is the key for the future of science and the world. Citizens are a piece of the puzzle of science; the effectiveness and the engagement of our research in maritime's future will be crucial these days. The scientific community is taking a step towards the creation of new connection models and tools to reach policy-makers and citizens. These current methods are moving towards the path of storytelling and data visualisation. Emotions and visuals are becoming more popular in the XXI century. Learning how to work with it will make the role of science essential again. Therefore, we will provide a tool box with new ideas on how to develop the competences and skills of professionals. Examples include: how to create a message box and infographics, how to debunk myths and how to engage with media and other stakeholders. This workshop will focus in the case of Marine and Ocean stories. We will give help to communicate and make your research able to reach new frontiers and people.

Marine Monitor - An Online Tool for MPA Vessel Monitoring and Activity Analysis (12:30 - 14:00, Tubau 1)

Mrs. Jennifer Sletten[1], Mr. Virgil Zetterlind[2]

[1] *ProtectedSeas*

Marine Monitor (M2) is a low-cost, easy to use, technology platform designed specifically for marine resource managers and enforcement agencies to more effectively manage nearshore Marine Protected Areas (MPAs). By providing a persistent monitoring technology that integrates and displays radar, video, and AIS via M2's custom built software, the M2 system can dramatically increase the effectiveness of anti-poaching efforts and provide critical use data for better fisheries and MPA management. To enhance the utility of M2 systems and promote inter-organization collaboration on MPA management, M2 uses a fully web-based, cloud application for data viewing and analysis with organization and user based permissions for viewing specific, active systems. Our workshop will focus on features and use cases for the M2 Cloud Viewer in the MPA monitoring context. This includes display of real time vessel activity and automatic vessel photo capture, review and playback of recorded vessel tracks and photos, use of alert zones and rules to filter vessel tracks, and generation of various vessel activity reports. Use cases and examples will be drawn from long term monitoring of multiple California MPAs by M2 systems and we look forward to audience feedback on additional features and capabilities that would enhance MPA monitoring and effectiveness.

Oceans Online Tools Demonstrations (14:30 - 16:00, Tubau 1)

14:30 - Ocean Literacy Online

Ms. Rachael Bell-Irving[1]

[1] *Ocean Wise*

Ocean Wise Education has dived into the digital world. The Ocean Literacy Course is an online, interactive course available to K to 12 students. Students can explore the seven ocean literacy principles while completing various engaging activities and quizzes to earn badges. In this demonstration, Ocean Wise Educators will provide a walk-through of the course, and highlight the various resources and lesson plans, which are available to teachers and students. This session will demonstrate the various ways the Ocean Literacy Course can be used in classrooms, communities and individual environments.

15:00 - Integrating diverse data to effectively manage Marine Protected Areas

Prof. Rick Stafford[1]

[1] *Bournemouth University*

Successful marine protected areas (MPAs) need to fulfill a wide range of functions, from protecting ecological indicators such as fish stocks or biodiversity through to maintaining stakeholder engagement and ensuring sufficient economic benefit can be obtained from the MPA and surrounding area. These functions are multidisciplinary, and in many cases can be antagonistic in nature. Data to support scientific and management decisions come in a wide variety of formats, from conclusive outcomes of rigorous meta-analysis at one end of the scale, to anecdotal stories from local fishers at the other. Integrating multiple data sources to provide interdisciplinary information in a manner transparent manner to stakeholders may therefore seem an impossible challenge, yet through the proposed demonstration, I will present a series of online tools and tutorials which will allow these outcomes to be achieved. The core of the data processing comes from a downloadable Microsoft Excel Template, with VBA coding to produce a powerful Bayesian belief network suitable for understanding complex socio-ecological systems. The demonstration will explain how the model works, how models can be constructed and how results can be interpreted and understood. This brief overview will provide awareness of what the model can achieve, however, the online resources (available at MPAmanagement.net) also provide a full and comprehensive set of tutorials related to topics such as finding relevant data, assigning confidence of data, constructing the models, and communicating the results to stakeholders - all of which is freely available to use.

15:30 - ProtectedSeas Marine Managed Area Map - A comprehensive, standardized, and interactive map and dataset marine protected and marine managed areas

Mrs. Jennifer Sletten[1], Mr. Timothé Vincent[1]

[1] *ProtectedSeas*

The ProtectedSeas marine managed area map project collects global MPA data, supplements it with detailed information for each MPA as well as data for managed areas, such as fishery management and idle speed zones, and distributes the data for free via an interactive public map and GIS file downloads. Users of the map have easy access to detailed, easily digestible, and up-to-date information that applies within each area, as well as links to outside resources and additional tools for research and analysis. This presentation will demonstrate how to access and use the map and explain the featured information detailing activity restrictions, exceptions, purpose, and additional informational resources, as well as the levels of protection ProtectedSeas has assigned to over 25 categories. We will explore the different layers of information on the map and the possibilities of using the attribute information and the assigned protection levels, which include categories such as extraction, entry, speed, anchoring, certain types of fishing gear, commercial, and recreational fishing, for research and analysis.

Oceans Online Tools Demonstrations (14:30 - 16:00, Tubau 3)

14:30 - Marine Monitor - An Online Tool for MPA Vessel Monitoring and Activity Analysis

Mrs. Jennifer Sletten[1], Mr. Virgil Zetterlind[2]
[1]*ProtectedSeas*

Marine Monitor (M2) is a low-cost, easy to use, technology platform designed specifically for marine resource managers and enforcement agencies to more effectively manage nearshore Marine Protected Areas (MPAs). By providing a persistent monitoring technology that integrates and displays radar, video, and AIS via M2's custom built software, the M2 system can dramatically increase the effectiveness of anti-poaching efforts and provide critical use data for better fisheries and MPA management. To enhance the utility of M2 systems and promote inter-organization collaboration on MPA management, M2 uses a fully web-based, cloud application for data viewing and analysis with organization and user based permissions for viewing specific, active systems. Our workshop will focus on features and use cases for the M2 Cloud Viewer in the MPA monitoring context. This includes display of real time vessel activity and automatic vessel photo capture, review and playback of recorded vessel tracks and photos, use of alert zones and rules to filter vessel tracks, and generation of various vessel activity reports. Use cases and examples will be drawn from long term monitoring of multiple California MPAs by M2 systems and we look forward to audience feedback on additional features and capabilities that would enhance MPA monitoring and effectiveness.

15:00 - Whale Alert Alaska - an Online Approach to Whale Awareness and Protection for Southeastern Alaska

Mr. Virgil Zetterlind[1], Ms. Louise Taylor-Thomas[2], Ms. Christine Gabriele[2]
[1]*Conserve.IO Inc,* [2]*National Park Service*

Southeastern Alaska is home to a large number of cetaceans and is a favorite destination for cruise ships and other tourism related traffic. In 2016, GBNP in partnership with NOAA fisheries and Conserve.IO, launched a pilot program to provide near real-time whale sighting information derived from the Whale Alert App and other sources to vetted ship captains operating in park waters via a password-protected interactive web map and automated email alerts.

Captains can also download GPX files of recent sightings for use in shipboard

navigation systems. The interactive, online map also supports administrative functions so that park personnel can easily add, edit, and moderate sightings. The program was continued for 2017 and has logged a total of hundreds of sightings so far. In 2018, new capability is being added to include dynamic speed management areas and sightings of seals on ice, both of which are of concern to the cruise industry. We welcome feedback on how our application might help other parks or organizations with similar information outreach needs.

15:30 - Mapping Ocean Wealth: A Tool for Exploring Ecosystem Services of Coastal and Marine Environments

Ms. Kate Longley-Wood[1], Dr. Mark Spalding1, Dr. Rob Brumbaugh[1], Mr. Zach Fendana[1], Ms. Laura Flessner[1], Dr. Mike Beck[1], Dr. Spencer Wood[2], Ms. Lauretta Burke[3], Dr. Alastair Harborne[4]
[1]*The Nature Conservancy,* [2]*University of Washington,* [3]*World Resources Institute,* [4]*Florida International University*

Mapping Ocean Wealth (MOW) represents a major synthesis of innovative science to model and map ecosystem services at multiple scales in coastal and marine environments. This project began in 2014, led by The Nature Conservancy, in collaboration with multiple partners. MOW convenes scientists to review current knowledge, and to consult with experts to develop models that quantify the value of ecosystem services (e.g., financial, risk reduction, seafood harvest, blue carbon) under varying conditions. Model results are mapped to provide spatially-explicit data products that can be used to inform marine planning and protection. The MOW website and map viewer (maps.oceanwealth.org) enables exploration of data derived from global and local scales studies around four key services: recreation and tourism; natural coastal protection; coral reef fisheries, and carbon storage and sequestration. Upcoming map services will be added for filtration. Interactive "apps" enable more detailed interrogation of the datasets and the generation of summary statistics that can also be used to create downloadable images or reports. for example, coral reefs globally have an annual expected protection benefit for more than 257,000 people and $5.9 billion in capital. In the Philippines specifically, reefs protect 73,163 people and $970 M in capital. This demonstration will include an overview of Mapping Ocean Wealth and its key functionalities, features, existing and upcoming apps. We will also describe how the data and tools can be applied to marine spatial planning, MPA designations, restoration, and investment in nature initiatives.

Oceans Online Tools Demonstrations (14:30 - 16:00, Kabu)

14:30 - How To Use Podcasting To Protect The Ocean OceansOnline Tools Demonstration

Mr. Andrew Lewin[1], Ms. Melissa Marquez[4]
[1]*Speak Up for Blue,* [2]*The Fins United Initiative*

Online communication technologies are making it easier to communicate messages to thousands, and potentially millions of people around the world in one attempt. Brands are using this technology successfully to grow their businesses by selling their products and services over numerous online platforms. Marine science and conservation messaging can also benefit from the use of online platforms.

Twitter, facebook, Instagram, and Youtube are used to spread "ocean-positive" messages to millions of followers; however, the podcasting platform is underused. Using podcasts as an outreach tool, marine science and conservation organizations can build a segmented audience that is interested in listening to the intricacies of the marine conservation field. Using The Speak Up for Blue podcast as an example, we aim to show how a podcast in this field can build a loyal audience that is searching for marine science and conservation information as well as actions they could take to live for a better ocean.

15:00 - iNaturalist: A potentially powerful but overlooked tool in marine conservation

Mrs. Claudia Rocha[1], Dr. Luiz Rocha[1], Dr. Scott Loarie[1]

[1] *California Academy of Sciences*

iNaturalist started as an online social network for sharing biodiversity information to help each other learn about nature. However, it grew so large (more than 8,000,000 observations were added by both citizen and career scientists since its creation in 2008) that it now has the potential to be a major data source for projects involving biodiversity science and conservation. It is extremely easy to make and automatically upload observations with mobile phones, but the extra uploading step required for underwater photos has kept the number of marine observations very low when compared to terrestrial ones. Here we will use Trindade Island off Brazil as a case study, an area that has just recently gained protection, and will create upload in real time several observations made on the island. We will also encourage participants to bring and upload their own underwater photos. With this hands on demonstration, we hope to show that the uploading step has become much easier over the past few months, and that iNaturalist can be an excellent tool for monitoring marine protected areas, engaging the public in marine conservation, and monitoring coral reef health.

15:30 - Crowdsourcing Marine Conservation Solutions: the Digital Makerspace

Ms. Cassie Hoffman[1]

[1] *Conservation X Labs*

The Digital Makerspace is a platform where science, entrepreneurship, and technology communities come together to start projects and co-create tech-enabled solutions to marine conservation problems. In this demonstration, we show how crowdsourcing ideas and digital collaboration can change what is possible in the marine conservation space. The Digital Makerspace is a workshop, collaboration space, and project pipeline where ideas can be born, tested, and developed. The platform has supported late stage companies through a digital ocean conservation accelerator program, called Oceans X Labs, run in collaboration between Conservation X Labs and the World Wildlife fund. As well as been the genesis of new tech-ideas and projects through prize competitions and ocean challenge competitions. Open innovation, collaboration across disciplines, and community engagement are key to generating world-changing ideas. The tool is designed to support projects that are born on the Digital Makerspace and help transform them into financially sustainable viable products that will address the drivers of extinction.

Unmanned Aerial Systems: A Tool for Conservation and Social Innovation (14:30 - 16:00, Kerangas)

Ms. Alicia Amerson[1]

[1] *Alimosphere*

Unmanned aerial systems (UAS or Drones) are important tools for conservation research. Drones create new perspectives in photogrammetry and survey-based research that assist marine conservation managers in important decision-making processes that provide protection to wildlife and resources. Drones are more cost effective than manned aircraft currently used to survey marine habitats, and drones provide more timely, accurate, and higher quality data. Although without proper training, a drone pilot can unintentionally stress the wildlife they encounter. With the flight protocols to reduce wildlife stress, flight mission can be accomplished with minimal disturbance to wildlife. As a drone pilot that knows how to work safely around wildlife, you will be far more valuable to an employer since this improves business ethics dramatically. Alimosphere a small women owned business tailored a workshop specifically for research biologists to integrate the UAS technology safely and responsibly. This workshop is designed to provide an overview of wildlife disturbance reduction protocols and greening the drone footprint in the field. The workshop will give participants the ability to design a flight plan for their field operations and grow their knowledge in safety management. The wildlife and drone seminar has been developed using scientific research to address disturbance and the seminar has been used to teach researchers in California on the various applications for research and flight skills necessary for safe and responsible flights.

Closing Plenary: Diva Amon, Ph.D.

16:15 - 17:15, Ranyai Ballroom

Title: Shining the spotlight on the darkest depths of our oceans through science communication

Diva Amon is a Trinidadian deep-sea biologist who studies chemosynthetic habitats and anthropogenic impacts in the deep ocean including from deep-sea mining and oil and gas extraction. She is currently undertaking a two-year Marie Skłodowska-Curie fellowship at the Natural History Museum in London, UK. In 2013, she completed her PhD at the University of Southampton, UK, after which, she spent three years at the University of Hawai'i researching the largely unknown abyssal megafauna of the Clarion-Clipperton Zone, an area targeted for deep-sea mining in the Pacific Ocean.

Throughout her career, Diva has participated in deep-sea expeditions around the world, including many which have utilized telepresence. Telepresence uses satellite technology to transmit live images and real-time data from ships at sea, providing a portal into the excitement of deep-sea exploration and research for scientists, stakeholders, and members of the public onshore. Her work has been featured

on CNN International, National Geographic, BBC World, ABC Australia, NHK, Los Angeles Times and more.

"We drink and we know things" - a live recording of the Marine Conservation Happy Hour podcast with audience participation (18:00 - 19:00, Kerangas)

Prof. Chris Parsons[1], Dr. Andrew Wright[2], Dr. Ashley Sitar Soller[1], Mr. Andrew Lewin[3]

[1]George Mason University, [2]University of Caterbury, [3]Speak Up for Blue

The Marine Conservation Happy Hour is a popular podcast produced as part of Speak Up for Blue podcast network, in which a panel of marine conservationists discuss hot topics in the marine conservation field. This panel discussion will be a live recording of a special episode of the podcast,involving some podcast regulars as well as guest panelists and audience participation. The panelists will each discuss their favorite presentations at the 5th International Marine Conservation Congress (IMCC5) as well as the big topics that arose at IMCC5. As in all of the episodes of the Marine Conservation Happy Hour, the panelists will be celebrating the day with drinks "during Happy Hour", and drinks will be available for the audience so that they can relax and kick back after several days of busy conferencing, and enjoy the discussions.

Author Index

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

X

Y

Z