



Conference Programme

Newcastle University, Lindisfarne Room

May 6 – 8, 2019



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Welcome to the Marine Biological Association's 16th Postgraduate Conference

Welcome Delegates,

On behalf of the entire Local Organising Committee, we welcome you all to Newcastle for this year's Marine Biological Association postgraduate conference! We are thrilled to be hosting the conference this year. Newcastle is a wonderful student city, accommodating two global impacting Universities, and located close to both the Northumberland coastline and North Sea, making it an ideal location for marine biology discussions and presentations. We hope you enjoy both this year's conference and our city!

The Local Organising Committee have been working hard to ensure that this year's conference follows in the footsteps of previous MBA postgraduate conferences, maintaining their reputation for high quality science, great networking opportunities and fun socials. However, this would not have been possible without the generous support from our sponsors. We are very thankful to all the local and global companies, organisations and journals that have supported this conference. They have allowed us to once again keep the three day conference fees low whilst not cutting back on the experience!

In this conference booklet we have tried to provide all the details you will need regarding all aspects of the conference. However, if you have any additional questions please email us at: mba2019@newcastle.ac.uk or speak to any of the committee members during the conference. We will be wearing blue committee t-shirts so that we are easy to spot for any help, advice or questions. Our committee is made up of nine friendly, bubbly people who are very enthusiastic about marine sciences and happy to help during both the conference days and social evenings.

We look forward to welcoming you to this year's conference!

Best wishes,

Izzy, Tina, Cassie, Georgina, Chloe, Johanna, Max, Mike and Danielle



Conference Mission - Sustainability and Inclusivity

The 16th Annual MBA Postgraduate Conference 2019 aims to bring together postgraduate students, newly graduated students, research assistants and post-doctoral research fellows to promote their research, whilst providing an opportunity to meet with senior academics and leaders in marine and maritime industries. With a touch of the famous northern hospitality at Newcastle University, we aim to create a diverse, inclusive and thought-provoking environment for budding marine scientists, to stimulate discussion about cutting edge research and generate ideas that may lead to future collaborations. By liaising with local businesses and industry leaders in the marine sector, we hope to encourage those who attend to think about future connections between industry science partners.

As marine scientists, we are all aware of the growing amount of plastic in the ocean. Conscience of this, we are minimizing the amount of waste generated at the conference by banning single-use plastics and excess paper. Please help us, and the ocean, by reducing your own waste, bringing your own water bottle, and using the conference mug provided in the delegate pack for tea and coffee.

We do the best science when all people have equal access to research and science. As a conference, we are here to support the entire community and be as inclusive as possible. This conference will have live captioning and international sign interpreters for our deaf delegates. To support them, we have requested presentation slides in advance. Thank you to those who have provided them!

About the Marine Biological Association

The Marine Biological Association is a Learned Society defined and recognised by Royal Charter. The objects of the Association are:

"to promote the investigation, and to disseminate knowledge, of the seas and marine life, including the use of marine and other organisms for basic biosciences for the benefit of the public (where biosciences means marine biology in its widest sense)".

The Marine Biological Association is one of the world's longest-running societies dedicated to promoting research into our oceans and the life they support. We were founded in 1884 and in 1888 opened the Plymouth Laboratory at Citadel Hill. Since 1884 we have been providing a unified, clear, independent voice on behalf of the marine biological community and currently have a growing membership in over 40 countries.

If you are not a member yet, we hope that you consider becoming one. Being a member of the MBA means you're part of a dynamic and dedicated community working to promote research into all aspects of life in the sea. As well as supporting our work, membership also gets you these benefits:

- Free subscription to The Marine Biologist magazine
- Access to the National Marine Biological Library
- Opportunities for career progression
- Exclusive post-nominal letters
- Steer the future of marine biology

Membership is available to all students registered in full time University education, including PhD studies. Student Membership is only £25.00 per year with a significantly discounted add-on option for online Journal subscription. For more information: <https://www.mba.ac.uk/student-membership>





Conference Timetable

Sunday 5th May – Northumberland coast trip

12:45 – Meet in Newcastle City Centre (parking bays on Claremont Road, opposite North Hancock Museum, NE2 4PT)

13.00 – Coach leaves Newcastle City Centre to Amble Village

13.45 – Amble Lobster Hatchery tour & lunch (fish & chips, café stop)

16.00 – Visit to St. Mary's Light House

16:45 – Arrive at Dove Marine Laboratory, Cullercoats

- Mingle and canapés in Evans Room (downstairs)
- Ice Breaker and form quiz teams

17.05 – Move to Buchannan Room (upstairs)

17.05 – Northumberland Inshore Fisheries Conservation Authority (NIFCA) talk

17.45 – Canapés and drinks

18.00 – Marine Themed Pub Quiz

20:00 – Coach to Newcastle City Centre (drop off same place as pick up)

Monday 6th May

8:30 – Registration

9:00 – Welcome Ceremony (Izzy Lake & Marine Biological Association)

9:15 – **Keynote talk: Professor Nicholas Polunin (Newcastle University)**

10:00 – **Session 1: Ecosystem Interactions (Chair: Christina Skinner)**

10:00 –10:20 – Lois Duff: Native and non-native basibionts as a habitat for native and non-native epibionts; differences between artificial and natural structures

10:20 – 10:40 – Ellie Vaughan: Determining the precision and cost-effectiveness of bioindicators to capture nutrient regimes on coral reefs around the Inner Seychelles Islands

10:40 –11.00 – Hannah Lampit: Northumbria Coast Focus Area Invasive Non-Native Species (INNS) Monitoring Partnership Project

11:00 – Coffee break

11:30 – **Session 2: Global Change and Anthropogenic Impacts I (Chair: Cassie Bakshani)**



11:30 – 11:50 – Paula Lightfoot: Not just a drop in the ocean! The value of Seasearch to the research community

11:50 – 12:10 – Katy Watson: Mapping anthropogenic threats to coral reef ecosystems in the Indo-Pacific; A tool for prioritising mitigation actions

12:10 – 12:30 – Jess Hudgins: Using Historic Print Resources to Recreate Baselines in the Family Pristidae

12:30 – Lunch

13:30 – **Keynote talk: Dr Amy Lusher (Norwegian Institute for Water Research)**

14:15 – **Session 3: Marine Pollution (Chair: Max Kelly)**

14:15 – 14:35 – Priscilla Carrillo-Barragán: Microplastics in Dove Time Series, Northumberland

14:35 – 14:55 – Alethea Mountford: Microplastics in Drake Passage

14:55 – 15:15 – Daniel Sadler: Context-dependent effects of nanoplastics on life history and immunity *Daphnia magna*

15:15 – Poster Session I & Break

16:30 – Workshop I: Science Communication (Duncan Yellowlees)

18:00 onwards – Town Wall Social

Tuesday 7th May

9:00 – **Keynote talk: Professor Claire Hellio (University of Western Brittany)**

9:45 – **Session 4: Biotechnology and Molecular Biology (Chair: Chloe Eastbrook)**

9:45 – 10:05 – Paul Whitworth: UV-C Light Emitting Diodes (LEDs) for marine biofouling control

10:05 – 10:25 – Pawel Palmowski: Coral proteomics – challenges and perspectives

10:25 – 10:45 – Rachel Hart: Securing Cyanobacteria

10:45 – 11:05 – Matt Walker: The utilisation of Definitive Screening Design as a more definitive contemporary solution toward principle factor identification in Marine Science

11:05 – Break

11:30 – **Session 5: Marine Megafauna I (Chair: Izzy Lake)**

11:30 – 11:50 – Melanie Smith: Stereotypic pacing and faecal corticosterone metabolites as non-invasive indicators of stress in rehabilitating green turtles

11:50 – 12:10 – Christian Daniell: Evidence of recovery of a reef-associated shark species in a Bahamian nearshore system



12:10 – 12:30 – Kayleigh Jones: Niche Segregation in the Largest Antarctic Fur Seal Colony: revealed by Stable Isotopes in Whiskers

12:30 – Lunch

13:30 – **Session 6: Oceans and Climate I (Chair: Georgina Hunt)**

13:30 – 13:50 – Ollie Thomas: Life as a Scientific Fisheries Observer in the Falklands

13:50 – 14:10 – Alex Khan: Understanding the connection between tuna pole-and-line landings and its fishing ground oceanographic characteristics in eastern Indonesia

14:10 – 14:30 – Matt Jankowski: Relationships among depth distributions, habitat specialisation and demography in coral reef fish communities

14:30 – 14:50 – Maarten De Brauwier: The forgotten ecosystem; soft sediment in the Coral Triangle

14:50 - 16:00 – Poster Session II & break

16:00 – 17:00 – Workshop II: Clear Writing (Dave Skinner)

19:00 onwards – Conference dinner at Assembly Rooms, Newcastle

Wednesday 8th May

9:00 – **Keynote talk (Dr Matt Frost, Marine Biological Association)**

9:45 – **Session 7: Marine Megafauna II (Chair: Mike Zhu)**

9:45 – 10:05 – Camille Ollier: The perception of a wide range species of sharks

10:05 – 10:25 – Prem Gill: Seals from Space; Identifying change in Antarctic ecosystems via the monitoring of ice-seals and sea ice habitats by very high-resolution satellite and UAV imagery

10:25 – 10:45 – Danielle Robinson: Socio-ecological Indicators for Sustainable Management of Global Marine Biodiversity Conservation using sharks as a model species

10:45 – 11:05 – TBC

11:05 – Break

11:30 – **Session 8: Oceans and Climate II (Chair: Danielle Robinson)**

11:30 – 11:50 – Katy Barrett & Catherine Scott: Northeast Natural England

11:50 – 12:10 – Christina Skinner: Prevalence of pelagic dependence among coral reef predators across an atoll seascape

12:10 – 12:30 – Mike Zhu: Multi-trophic roles of the sponge *Hyrtios erecta* revealed by different bio-tracers

12:30 – Lunch



13:30 – **Session 9: Global Change and Anthropogenic Impacts II (Chair: Georgina Hunt)**

13:30 – 13:50 – Jessica Duffill-Telsnig: Marine licensing – what is it and why is it necessary?

13:50 – 14:10 – Elizabeth Beauchamp: Hereditability of thermal tolerance in coral and its importance in juvenile growth and survivorship

14:10 – 14:30 – Coffee break

14:30 – 16:00 – Panel (Chair: Izzy Lake)

16:00 – 16:30 – Closing Ceremony and Awards

17:00 onwards – Farewell drinks at Pleased to Meet you



Thank You to Our Fabulous Sponsors!



Inshore Fisheries and
Conservation Authority



SOTEAG





Wireless Access

Wireless Access is provided and free through two options: **Eduroam** & **WiFi Guest**.

Sustainability Objectives: Coffees, Lunch, and Bring Your Own Water Bottle

What is a conference without the all-important coffee and tea fuel breaks?! To have a sustainable conference, we have provided each of you with your own mug! Bring it, use it, and love it at the coffee breaks. If you take milk, look for milk in jugs – no single-use milk packets here.

Lunch is provided for the entire conference. We have selected a catering company, Jasper's Catering Company, who is aligned with our sustainable vision. All of the food will be in bamboo bowls with bamboo cutlery. They will collect all of our platters when finished and recycle them so please don't throw them away!

During the whole conference, drinking water will be available at the meeting venue. To reduce our waste output, we encourage all participants to bring their own refillable drinking bottle.



Social Media

It's great to share your experiences at conferences and use social media to build connections! We can be found on Twitter, Facebook and Instagram. We encourage you to share your conference experience. We will be tweeting throughout the conference to keep everyone up to date. If a fellow delegate requests that photos of data to not be shared, please respect them.

@MBAconference19 @thembauk #MBA19 #marinescience





Keynotes & Workshops

Dr Matt Frost (Deputy Director, MBA)

Dr Frost has a degree and PhD in marine benthic ecology but has since focused on marine policy; providing science to policy training; lecturing on postgraduate courses; chairing science-policy committees; and representing the Association in marine policy advice including responding to government consultations and engaging with parliament and policy groups more widely. He has published over 60 journal papers, reports and book chapters as well as writing articles and giving talks aimed at a broader audience (and serves on the editorial board for a number of marine journals). Matt is President of the European Network of Marine Research Institutes and Stations (MARS).

Professor Nick Polunin (Newcastle University)

A Marine Conservation Ecologist researching and lecturing ecosystem connectivity at Newcastle University, including reef fish-habitats and sustainable fisheries. Professor Polunin is also an editor for the Cambridge University Press and hugely involved with the Northumberland Inshore Fisheries and Conservation Authority (NIFCA).

Dr Amy Lusher (Norwegian Institute for Water Research)

A researcher in the field of marine pollution at the Norwegian Institute for Water Research, focusing on the distribution, interactions and effects of microplastics in the marine environment. Dr Lusher has developed novel methods for sampling microplastics from water, sediment and biota. Dr Lusher sits on several international working groups and advisory boards related to marine litter. She advocates for efficient communication between scientists and the public. Dr Lusher has been focusing her research on arctic environments.

Professor Claire Hellio (University of Western Brittany)

Professor of Marine Biotechnology at the University of Bretagne Occidentale and Director of Biodimar, a technological core facility providing expert services in marine biomolecule extraction, purification and analysis. Professor Hellio is also a representative of the European Society for Marine Biotechnology.

Duncan Yellowlees

We are so pleased to host a fantastic communication workshop this year with the talented speaker, [Duncan Yellowlees](#). Helping us turn our ideas into engaging and interesting presentations, Duncan will train us in the art of communicating logically and emotionally, person to person. Forget boring presentations even existed! It's time we get inspired! This workshop will take place in the afternoon of Monday 6th May 2019 at 16:30.

Dave Skinner

Dave Skinner is a translator, editor and speechwriter. After years of wading through unnecessarily complicated technical and specialist material in several languages, he and colleagues started a Fight the Fog campaign consisting of guides and lectures on clear writing. On Tuesday 7th May, he will show you how to make your work easier to read and explain tips and techniques, backed up by exercises, to help you make your scientific documents more accessible to the general public.



Social Program

Coastal Field Trip – Sunday May 5th

The 5th May is a cracking opportunity for a day tour of the Northumberland Coast alongside a Northumberland Inshore Fisheries & Conservation Authority representative! 40 places are available on the coach, allowing delegates to see the beauty that the North East has to offer! We'll be taking you to the seaside town of Amble for a tour of Amble Lobster Hatchery, followed by a stop at a traditional chip shop. Then we're all off to St Mary's Lighthouse, a Grade II listed building and heritage site in Whitley Bay, and we'll end the day at Newcastle University's famous Dove Marine Laboratory. The evening will feature a presentation by our NIFCA representative, canapés and drinks, and a marine-themed pub quiz! Afterwards the coach will take us back to the city. It'll be a great way to get comfortable in the North East and meet the committee and other delegates!

Town Wall Social – Monday May 6th

Have you checked out where we'll be heading to wind down after our first day of talks and posters on Monday 6th May? The Town Wall (<https://www.thetownwall.com>) is a Grade-II listed building in the heart of the city. We've booked their private speakeasy style Secret Cinema room! We'll be welcomed with drinks and nibbles, and expect a free drinks token (or two) on us!

Assembly Rooms Conference Dinner – Tuesday May 7th

It's not a conference without a conference dinner! We're being treated at the gorgeous Assembly Rooms (www.assemblyrooms.co.uk) with a red carpet welcome, drinks on arrival and a four-course meal! All dietary requirements catered for.

Pleased to Meet You Farewell Drinks – Wednesday May 8th

Before you all return home packed with great experiences and new friendships, we would like to say goodbye. We will be saying goodbye at Pleased to Meet You (<https://www.ptmy-newcastle.co.uk/>).



Frequently Asked Questions

What is the closest metro stop to the Lindisfarne Room at Newcastle University?

Haymarket and then approximately a 5 minute walk through university campus to the Lindisfarne Room.

How do I reach the conference venue from Newcastle train station?

Walk approximately 20 minutes or take the metro northbound to Haymarket and walk approximately 5 minutes.

How do I reach the conference venue after flying into Newcastle International Airport?

There is a direct line from Newcastle International Airport to Haymarket which takes approximately 25 minutes. Alternatively, a taxi fare would cost around £15 and takes approximately 15 minutes.

Is there parking close to the conference venue?

Yes, there are two car parks close, either Claremont Road Car Park NE2 4AN which would cost £1.30 per hour and is approximately a 6 minute walk from the Lindisfarne Room, or Eldon Gardens Multi-storey NE1 7RT which costs £1.80 and is also a 6 minute walk.

How do I find the conference venue upon my arrival?

Lindisfarne Room is located on level 4 of the Hadrian Building at Newcastle University, which can be located on the website map or using campus maps all over the campus. The room can be reached by climbing the outdoor stairs which face the Bedson Building and Boiler House, where you will see our welcome banner. Committee members will be clearly identifiable, wearing blue committee t-shirts, so ask any of us for further directions if you see us around campus!

What is the best way to ask questions regarding my presentation?

Email, tweet or Facebook message us with any questions or queries before the conference, and we will happily reply as soon as possible! Our email address is: mba2019@newcastle.ac.uk and all our social media details are on this website!

How will I find the social event venues if I haven't been to Newcastle before?

The committee will be staying on campus after the days talks and workshops, so you're welcome to chill with us and walk straight down to the evening locations. You will be given a digital map upon arrival or ask anyone in a blue committee t-shirt throughout the day events. Newcastle is a very friendly city so asking the locals is never a bad idea either, they can point you in the right direction.

Where is the best place to stay for a student in Newcastle?

Newcastle is a relatively cheap city to visit, therefore there are plenty of options for student budgets! See our accommodation recommendations above, where we have quoted prices and walking distances. If you would like to discuss accommodation with us, just tweet or Facebook message us and we will happily help you decide where is best for you to stay.



Oral Presentation Abstracts

Microplastics in Drake Passage

Alethea Mountford, Miguel Angel Morales Maqueda
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Plastic pollution is ubiquitous within the marine environment, with both global models and extensive sampling confirming the presence of marine plastics at the sea surface, within sea ice and in the deepest reaches of the world oceans. However, there are still areas in which plastic pollution is undersampled, and as such, the full extent of its distribution is not entirely known. One such region is the Southern Ocean, in particular within the water column, where plastics may be present due to sinking, being drawn down in deeper waters through turbulent mixing, or brought into the area by water circulation.

We present the results from cruise JR17001 (December 2017), during which we sampled for microplastics throughout the water column (depths ranging from 5 m to 4200 m) along the SR1b repeat hydrography transect across Drake Passage. Bulk water samples (10 L per depth sampled) were collected via a CTD rosette and were filtered *in situ* prior to visual analysis back in the United Kingdom. Microplastics were present at all depths sampled, with concentrations ranging from 1 particle per litre to 13 particles per litre. The plastics were primarily microfibrils, which have been shown to be released in large quantities through the washing of synthetic clothing, from fishing gear, such as ropes and nets, and degradation of macroplastics present in the ocean. While the concentrations observed are significantly lower than in many other areas, the presence of microplastics throughout the water column suggests that plastic pollution may be capable of crossing the Polar Fronts and Antarctic Circumpolar Current and reaching the Antarctic continent, presumably, through deep water transport. Microplastics have already been observed in both surface waters and sediments around Antarctica, but the sources and transport mechanisms of these contaminants have not yet been fully identified. The results of the sampling conducted across Drake Passage may shed light on possible transport pathways of microplastics both through the water column and across the Antarctic Circumpolar Current.

Keywords: *microplastics, marine plastics, Drake Passage, marine pollution, Southern Ocean*

Understanding the connection between tuna pole-and-line landings and it's fishing ground oceanographic characteristic in eastern Indonesia

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Fish aggregating devices (FADs) deployed at fishing grounds for tuna pole-and-line fisheries in eastern Indonesia, and trends in landings, trips, and catch per unit effort (CPUE) at three locations were investigated. The FADs' locations, and mean sea surface temperature (SST) and chlorophyll-a (chl-a) concentration were examined using a geographic information system (GIS). Annual trends in landings, trips, CPUE, SST and chl-a concentrations were analysed using time series plots, and relationships of CPUE with SST and chl-a were analysed using generalised linear models (GLMs)



constructed from generalised additive models (GAMs). GAM plots indicated that positive association was observed between CPUE and SST from approximately 26.5-29.5°C in Sorong, <28.7°C and >30°C in Pulau Bacan and >29°C for Larantuka. Furthermore, positive effects between CPUE and chl-a from GAM plots occurred where chl-a <0.4 mg/m³ in Sorong, >0.22 mg/m³ in Pulau Bacan and <0.35 mg/m³ in Larantuka. The GAM models showed that SST explains up to 20% whereas chl-a explains up to 3.8 % of the deviances in skipjack CPUE, and the addition of predictor variables resulted in an increase in the deviance explained. A seasonality factor was added in by incorporating time of year as one of the variables to the model to explain the seasonality relationships between CPUE and the covariates. This research provides evidence that skipjack and yellowfin tuna CPUE have relationships with SST and chl-a.

Keywords: *Effort, fishing aggregating devices, Indonesia, oceanography, pole-and-line, tuna*

The perception of a wide range species of sharks

Camille Ollier

Oceanographic Research Institute, South Africa

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My fear of sharks, especially the great white sharks, has changed into respect for sharks due to my experiences as an intern in Marine Dynamics in South Africa last winter. It is well-known many people are scared of sharks, even though the shark attacks are statistically very low. Yet, they need to be protected as much as other marine species by studying and conserving them, as the sharks are subjected to a numerous threat like fisheries. Out of more 500 species of sharks inhabiting in every ocean and sea, there is one who always arouse both terror and fascination: the great white shark. Researches estimated that there are less than 5000 great white sharks left on the planet. Because of the diverse marine life in South Africa, one of the largest populations of these sharks is located nearby, and therefore, this country has numerous research centers focusing on conserving white sharks since 1991. One of the popular tourist activities is the shark cage diving and a way for commercial vessels to support and assist with shark research, conservation and education. And in that way, people will be aware why this specific predator is very important in the ecosystem.

But what about “forgotten” small sharks? These smaller home range species are equally important as the other species, as well as part of the diet of larger sharks. I studied four species of small sharks: *Haploblepharus pictus*, *Haploblepharus edwardsii*, *Poroderma pantherinum* and *Poroderma africanum*. The catch, tag and release process as part of ORI’s (Oceanographic Research Institute) cooperative Fish Tagging Project (ORI-CFTP) and the BRUVs (Baited Remote Underwater Videos) methods were used for population monitoring and conservation of South Africa’s marine life. By studying the small sharks, the conservation management of upper trophic sharks will be set up to conserve them and their habitats. It is not a matter of the size, but it is a matter of their places in different trophic levels of our marine ecosystem that need to be understand.

Keywords: *sharks, conservation management, population monitoring, South Africa.*



Evidence of recovery of a reef-associated shark species in a Bahamian nearshore system

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Globally, there are now very few marine ecosystems that have not seen a reduction and alteration of shark populations. Coral reefs, especially those in close proximity to populated coastlines, such as fringing reefs, have been particularly affected. The removal of sharks or the alteration of habitats they depend on can have wide ranging effects and lead to trophic cascades or alternate ecosystem states. In response to population declines, many nations have created protected areas, some specifically targeting sharks. The Bahamas have a history of shark conservation, and have historically enacted policy that has protected sharks. In 2011, the Bahamas established a "shark sanctuary", banning all types of shark exploitation. To understand the effects of these policies, we use historical (2009) and current (2017) Baited Remote Underwater Video Surveys (BRUVS) in three nearshore habitats in the Cape Eleuthera region. Overall, we found a significant increase in the abundance of the Caribbean reef shark (*Carcharhinus perezi*). While the increase in abundance cannot be directly attributed to the implementation of the shark sanctuary; the results suggest that a combination of conservation efforts and reduced fishery exploitation may have contributed to some level of recovery. These results also provide some justification that fishery regulation and sanctuaries can lead to positive impacts on shark populations.

Prevalence of pelagic dependence among coral reef predators across an atoll seascape

Christina Skinner¹, Steven P. Newman^{1,2}, Aileen C. Mill¹, Jason Newton³ and Nicholas V. C. Polunin¹

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² Banyan Tree Marine Lab, Vabbinfaru, Republic of the Maldives.

³ NERC Life Sciences Mass Spectrometry Facility, Scottish Universities Environmental Research Centre, Rankine Avenue, East Kilbride G75 0QF, UK.

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Coral reef food webs are complex, vary spatially and remain poorly understood. Particular large predators, notably sharks, are subsidised by pelagic production on outer reef slopes, but how widespread this dependence is across all teleost fishery target species and within atolls is unclear. North Malé Atoll (Maldives) includes oceanic barrier as well as lagoonal reefs. Nine fishery target predators constituting 57% of the local fishery target species biomass at trophic levels 3-5 were selected for analysis. Data were derived from carbon ($\delta^{13}\text{C}$), nitrogen ($\delta^{15}\text{N}$) and sulfur ($\delta^{34}\text{S}$) stable isotopes from predator white dorsal muscle samples, and primary consumer species representing production source end-members. Three-source Bayesian stable isotope mixing models showed that uptake of pelagic production extends throughout the atoll, with predatory fishes showing equal planktonic reliance between inner and outer edge reefs. Median plankton contribution was 65-81% for all groupers and 68-88% for an emperor, a jack and snappers. Lagoonal and atoll edge predators are equally at risk from anthropogenic and climate-induced changes which may impact the linkages they construct, highlighting the need for management plans that transcend the boundaries of this threatened ecosystem.

Keywords: *Stable isotopes, trophic ecology, connectivity, plankton.*



Context-dependent effects of nanoplastics on life history and immunity in *Daphnia magna*

Daniel E Sadler

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Nanoplastic (NP) pollution is having negative physiological effects on many aquatic organisms. But we currently know very little about how genetic and environmental variation alter the effects of NP pollution because most studies to date have been conducted on a single genotype in a single laboratory environment. Here, I assess how exposure to 500 nm polystyrene microspheres affects the growth, reproduction and immunity of different clones of the freshwater cladoceran *Daphnia magna* reared at two different temperatures (18°C and 24°C). Examining individual traits showed a limited effect of NPs on growth and reproduction. However, NP exposure shifted the multivariate phenotype especially at higher temperature (24°C). However, the effect that NP exposure had on multivariate phenotypes varied significantly between clones. NP exposure induced an immune response resulting in a greater haemocyte count under NP exposure. These results suggest that NP exposure has an influence on life history and immunity, however, these results are context-dependent, and environment and genotype should be considered to understand the full scope of the effects of NP in a population. It is also possible that an induced immune response, along with other factors such as decreased feeding rate causes a shift in resource allocation, resulting in a decrease in growth and reproduction.

Keywords: *Daphnia*, *nanoplastics*, *thermal stress*, *multivariate phenotype*, *immunity*, *clonal variation*.

Socio-ecological Indicators for Sustainable Management of Global Marine Biodiversity Conservation using sharks as a model species.

Danielle Robinson

School of Natural Environmental Sciences, Newcastle University

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Widespread exploitation of sharks has resulted in substantial declines in shark populations, with 30% of shark species globally at risk of extinction. Almost half of shark species are data deficient and subsequently the precautionary approach has resulted in shark fishing bans instigated over vast areas in 17 countries. However, evaluating the effectiveness of sanctuaries in supporting sustainable fisheries management has been impeded by a lack of robust socio-ecological data, access to alternative livelihoods for fishers and supportive participatory governance mechanisms fit for policy use. This interdisciplinary project utilized low cost techniques to quantify temporal and spatial change in Maldivian shark distributions and abundance. Historical data was ascertained using Local Ecological Knowledge (LEK) of former shark fishers while contemporary shark populations were assessed using baited remote underwater video (BRUV) and citizen science surveys. Local perceptions and depredation issues concerning fishers and resource users were investigated through remote and in-person interviews.

Sharks were detected on 58.1% of BRUVs averaging 0.65 ± 0.69 (S.D.) sharks per video, with a maximum of three sharks on a single BRUV. Sharks were ubiquitous across the sites surveyed in North Malé Atoll, however, species-specific habitat trends and hotspots were evident from kernel density mapping. Relative shark abundance estimates were greater than unprotected areas but



substantially lower than remote areas of the Pacific suggesting populations have not yet recovered from heavy fishing pressure. Mapping of LEK data identified historical trends in shark distribution, abundance and size, specifically increased shark abundance within and along atoll edges post sanctuary implementation. Reef fishers perceived increased rates of shark depredation (damage to gear and loss of catch) since they started fishing and attributed this to the 2010 shark sanctuary. On average fishers reported a daily loss of 48.5% of catch equating to an annual loss of \$32,643 ± \$27,693. This research provides valuable information on the status of Maldivian shark populations and the first assessment of the shark sanctuary efficacy.

Keywords: *Interdisciplinary, sharks, management, local-ecological-knowledge*

Heritability of thermal tolerance in coral and its importance in juvenile growth and survivorship

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Rising sea temperature is the main threat to coral reefs facing climate change. New, innovative active restoration techniques are being applied to assist coral adapt to this growing pressure. This study investigates the response of larvae with parents expressing different thermal tolerance phenotypes to a short-term thermal stress event and assesses longer-term impacts and potential growth trade-offs. Greater mortality of all larvae irrespective of heritage was seen immediately after the heat stress. The importance of heredity was more pronounced over a longer timescale where juveniles with low thermally tolerant parentage (LTP) saw a reduced survivorship after the larval heat stress for the entire 5-month monitoring period. Here a selective long-term impact to a short-term stress is demonstrated which lasts months after the initial stress. This is controlled by offspring genotype, supporting a genetic basis for thermal tolerance. Under control conditions, growth was significantly higher in LTP than High thermally tolerant parentage (HTP) recruits suggesting there is a trade-off associated with high thermal tolerance affecting growth. This study can be used in the application of active sexual reproduction and selective breeding techniques to promote higher proportion of thermally tolerant corals to restore damaged/unhealthy reefs and prevent future reef loss. It is suggested that more work into the associated trade-offs, genomic expression and heritability of phenotypic traits to the next generation (F2) is made. Understanding how phenotypes are passed from generations is central to discovering what assisted evolution techniques are viable and if they have enough power to be used on an ecosystem level, as well as providing information to produce more accurate stage-based population models for coral reefs under future climates.

Keywords: *Coral, Transgenerational, Heredity, Sea Surface Temperature, Thermal Stress, Climate Change, Active Restoration, Coral Assist*



Determining the precision and cost-effectiveness of bioindicators to capture nutrient regimes on coral reefs around the Inner Seychelles Islands

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The stable isotopic and elemental signatures of nitrogen and carbon in fleshy macroalgae are widely accepted as bioindicators of anthropogenic nutrient runoff and their subsequent impacts on coral reefs. However, these algae may not always be present in reefs in different ecological states where nutrient regimes need to be investigated, so a suite of bioindicators might be more informative over larger spatial scales. In the current study, the precision, congruency and cost-effectiveness of eight potential bioindicators (brown and green macroalgae, turf algae, cyanobacteria, soft corals, zoanthids, sponges, and sediment) were compared for capturing nutrient regimes both within and between 21 coral reefs that are all in one of two states (“recently-dead” (RD), n=12; “macroalgal-dominated” (MD), n=9) across the Inner Seychelles islands. The bioindicators were analysed for their stable isotopic and elemental signatures ($\delta^{15}\text{N}$, $\delta^{13}\text{C}$, %C, %N, and C:N Ratio), and compared using coefficient of variation (CoV) for precision, and principal component analyses (PCA) for congruency (comparative patterns). The cost-effectiveness of each bioindicator was also assessed in terms of cost (time taken, hours) and effectiveness (abundance, sample availability). $\delta^{15}\text{N}$ signatures in brown and green macroalgae showed the lowest average CoV values within and across sites (3.60 ± 0.50 , n=17; 4.07 ± 0.28 , n=11, respectively), and so could be considered to be the most precise, but zoanthids, the third most precise, were more abundant across reefs, and across both reef states (RD: n = 12; MD: n=7). However, congruency was low between these three indicators, as their different nutrient uptake mechanisms may have affected their signatures and show slightly varying spatial patterns. Sediment samples were available at all sites, but they are poor indicators of nutrient regimes as they contained very little nitrogen (0.04 ± 0.01 %N) which lowered their precision (CoV: 17.4 ± 8.77). Future research could involve selecting bioindicators from different trophic levels of the same food chain to increase congruency. Considering multiple criteria like those used in this study will aid efforts to cost-effectively capture any nutrient enrichment across reefs facing different kinds of disturbance, such as coral bleaching or regime shifts, and therefore help improve their recovery potential.

Keywords: *Coral reefs; pollution; stable isotopes; macroalgae; environmental monitoring; bioindicators; regime shifts*

Northumbria Coast Focus Area Invasive Non-Native Species (INNS) Monitoring Partnership Project.

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Marine Non-Indigenous Species (NIS) are a global problem, which by outcompeting native species can change the structure and function of marine communities, drastically affecting novel ecosystems. NIS travel on pathways of anthropogenic activities such as shipping, aquaculture, offshore renewables, and more recently on floating marine debris and with the changing climate.



Marine NIS are becoming a risk along the Northumberland coast after a recent study reported a 50% increase in NIS abundance in the North East (NE) over the last four years, with predictions to become more susceptible with global warming. Newcastle University, Natural England and Environmental Agency developed the 'The Northumbria Coast NIS Monitoring Partnership Project' in 2018 to develop a long-term marine NIS monitoring program for the NE and develop specific management strategies for the protected areas in the region.

This study continues the development of this long-term monitoring approach into its second year, testing adaptations to the SETL-methodology, whilst also investigating novel and innovative new methods for early detection of NIS. Early detection could allow for focus on prevention of NIS establishment and potential dispersal before negative effects on the local community, which could make management more efficient and less costly. Firstly, this study tests the use of Environmental DNA (eDNA). Environmental samples such as seawater contain traces of DNA left behind by eukaryotic organisms that live in that environment, which can be extracted and amplified using PCR target markers to identify species. This novel method can identify rare species or those at low densities, advantageous for the early detection of NIS. Secondly, if time allows this study will also investigate marine floating debris as a new high-risk pathway for NIS into the NE with the potential for debris composition to predict the associated invasive rafting fauna, another innovative method of early detection of NIS. Overall, this study will reveal the presence of NIS along the Northumberland Coast, assess new methods for early detection, and will inform decisions of marine management and biosecurity plans for use by statutory conservation organisations Natural England and Environment Agency.

Northumbria Area Team, Natural England

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Katy Barrett, a Newcastle University graduate, will be presenting about her MSc thesis and her current role within Natural England's Northumbria Area Team as a Coastal Lead Adviser. Katy and Dr Catherine Scott, Marine Lead Adviser, will then talk about some of the projects they are currently involved with and the importance of partnership working to MPA monitoring and management.

Using Historic Print Resources to Recreate Baselines in the Family Pristidae

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Populations of all species of sawfish have been depleted worldwide, and they are now absent from much of their historic range. Attempts to reconstruct the historic range of sawfishes has largely excluded reports which use the generic term 'sawfish', and much of historic sawfish capture and encounter data does not use identification at a species level. However, omitting historic public encounter data increases the risk of historic population and range assessments being biased due to shifting baselines. This study examines 200 historical newspaper articles from the Australian National Library's database 'Trove', that were found by searching for the generic term 'sawfish'. Articles were examined for information that could be relevant to sawfish conservation goals outlined in the IUCN's Sawfish Conservation Strategy, such as date, circumstance of capture, location,



animals' weight and length, and potential species identifiers. Additionally, a historic capture of one *Pristis pristis* specimen is presented, which extends the historic range of this species by over 800 km to the south. This evidence furthers the need for a global examination of historical print resources which use generic terminology to report sawfish encounters. Failure to utilize these resources may result in conservation goals falling short of what is required for sawfish populations to recover from exploitation.

Keywords: *Sawfish, Conservation, shifting baselines, Queensland*

Marine licensing – what is it and why is it necessary?

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The Marine Management Organisation (MMO) is the government regulator responsible for marine licensing around English waters. There are many activities which may require a marine licence such as: construction; dredging; deposition, incineration or removal of objects. These activities are underpinned in the Marine and Coastal Access Act 2009 which enables sustainable development whilst protecting the marine environment. If an activity requires a marine licence, a marine licence application must be submitted to the MMO detailing the activities and any potential impacts. As a regulator the MMO must assess any marine licence applications to protect the environment and human health and to prevent interference with other legitimate uses of the sea. This requires us to follow various legislation and policies and conduct assessments related to Habitat and Species Regulations, Marine Conservation Zones, Marine Plans and Marine Works (Environmental Impact Assessment) Regulations. We consult with a wide range of bodies related to habitats and species, water quality, fishing, navigation, tourism, heritage features, planning as well as technical specialists. In addition, we conduct public consultation to ensure all views from the general public and any additional bodies are considered. If a marine licence is granted then we place conditions on the licence. These conditions may relate to matters consultees raised to ensure the activities are sustainable. As the licence is a legal document we can also monitor activities post-consent and in areas of non-compliance we can undertake enforcement activities. Therefore marine licensing is integral in promoting economically and socially beneficial activities whilst minimising adverse effects on the environment, human health and other uses of the sea.

Keywords: *Environmental assessment, regulator, legislation, sustainable development*

Mapping anthropogenic threats to coral reef ecosystems in the Indo-Pacific: A tool for prioritising mitigation actions.

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Coral reef ecosystems are being degraded through concurrent direct and indirect anthropogenic disturbances. Understanding the spatial and temporal scale of anthropogenic threat events is crucial to determining ecosystem vulnerability, cumulative ecological impacts, and the potential recovery trajectories. However, the spatial extent and event history across the globe for many key stressors is unknown. Without this fundamental understanding, the likely effectiveness of reef management is



severely threatened. A database of key anthropogenic threat events and their severity was generated to produce detailed threat maps covering the Indo-Pacific, with events being categorised as either discrete or cumulative. Anthropogenic threats included: coral bleaching; diseases; predator outbreaks such as crown-of-thorns starfish, *Drupella* and urchins; destructive fishing; and land-based runoff and sedimentation. Threat maps highlighted degraded reefs which are under chronic stress and potentially reaching an ecological asymptote. Using information from the threat maps, and from pertinent reef management case studies, action maps were then created. The actions maps illustrated management prescriptions (e.g. monitoring, restoration, protected areas), likelihood of prescription success, timescale and cost. Mapping of anthropogenic threats events and quantifying stressor severity to coral reefs across the Indo-Pacific can serve as a useful tool to prioritise local-scale management areas, and highlights where management options can deliver the greatest ecosystem function gains.

Keywords: *anthropogenic, threat mapping, restoration, management, action mapping*

Niche Segregation in the Largest Antarctic Fur Seal Colony: revealed by Stable Isotopes in Whiskers

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The marine environment can be highly dynamic and marine predators may face intense competition for prey. Resource partitioning, through spatial or dietary segregation of sexes and age classes, can reduce competition and allow populations to thrive. We aimed to quantify resource partitioning throughout the lives of Antarctic fur seals breeding at the world's largest colony. Antarctic fur seal whiskers, which continuously grow and do not shed, were collected from 20 males and 20 females at Bird Island, South Georgia. Whisker samples were cut every 5mm along the length of each whisker and ran through an Isotope-Ratio Mass Spectrometer (IRMS), which measured stable isotope ratios in each sample. Nitrogen isotope ratios ($\delta^{15}\text{N}$) were used as proxies for trophic position, while carbon isotope ratios ($\delta^{13}\text{C}$) were used as broad indicators of foraging distribution. Synchronous oscillations in $\delta^{13}\text{C}$ values corresponded to annual migrations and revealed that on average male whiskers grew 1.5 x faster than female whiskers. Spatial segregation was evident between the sexes: $\delta^{13}\text{C}$ values were significantly lower in males than females, indicating that males generally foraged further south towards Antarctica. The $\delta^{13}\text{C}$ values in females revealed two main foraging strategies: 1/3 of females spent most time foraging north of the polar front and 2/3 of females south. Females mainly foraging north of the polar front had higher $\delta^{15}\text{N}$ values and likely fed on different prey species to the other seals. Antarctic fur seals in these distinct foraging groups likely face different degrees of inter-specific competition as well as environmental and anthropogenic stressors. We highlight the necessity to consider the variability between ecological niches of sex and age groups when formulating plans to conserve marine predators.

Keywords: *Antarctic fur seals, stable isotopes, niche partitioning, competition, foraging strategies*



Native and non-native basibionts as a habitat for native and non-native epibionts: differences between artificial and natural structures

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Artificial structures have proliferated in the marine environment and are known to be associated with facilitating the establishment and spread of non-native species (NNS). Surveys were carried out to compare the abundance of native (*Patella vulgata*, *Semibalanus balanoides*, *Chthamalus spp*) and non-native (*Magallana gigas*, *Austrominius modestus*) species on artificial and natural structures, and to determine the importance of native (*P. vulgata*) and non-native (*M. gigas*) basibionts as a habitat for native (*S. balanoides* and *Chthamalus spp*) and non-native (*A. modestus*) epibionts. Experimental work enabled us to examine the recruitment of *A. modestus* onto *M. gigas* and *P. vulgata* shells across artificial and natural habitats. We found that *M. gigas* was significantly more abundant on artificial structures ($p < 0.05$) whereas *P. vulgata* was significantly more abundant on natural rocky shore ($p < 0.05$). *M. gigas* and *P. vulgata* shells provided an important habitat for both native and non-native barnacle species. The ratio of native: non-native barnacle species varied significantly between the shells of *M. gigas* and *P. vulgata* and the adjacent rock, between species (*M. gigas* and *P. vulgata*) and across artificial and natural habitats. The predicted number of *A. modestus* varied according to overall barnacle density. *A. modestus* was significantly more abundant ($p < 0.05$) on the shells of *M. gigas* in natural habitats than artificial, suggesting that *M. gigas* has more of a facilitatory role for *A. modestus* in natural habitats. *A. Modestus* was the only species of barnacle found on the shells of *M. gigas* and *P. vulgata* at the end of the experiment, and *A. modestus* was significantly more abundant on *P. vulgata* shells in artificial habitats ($p < 0.05$) than *M. gigas* shells. Artificial structures are likely to continue to proliferate in the marine environment, providing more space for NNS species to colonise and supporting their expansion. In addition to patterns, it is also important that we understand the processes that occur on these structures.

Keywords: Artificial habitats, Coastal structures, Oyster, Barnacle, Epibiosis, Non-native species, Facilitation

The forgotten ecosystem: soft sediment in the Coral Triangle

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The Coral Triangle area in Southeast Asia is renowned for its marine biodiversity, the region has the highest globally recorded species richness for corals, fishes, and many invertebrates. Research and conservation activities in the Coral Triangle predominantly focus on coral reefs, mangroves, and seagrass beds. However, the most expansive habitat in the region has received far less attention. Soft sediment habitats make up more than half of the shallow coastal area in the Coral Triangle, but are frequently assumed to be of little interest.

In this talk I will discuss the combined results and implications of three recently published papers in which we investigated the ecology and socio-economic value of soft sediment habitats in Southeast Asia. Results showed that soft sediment habitats have a high economic value through scuba dive tourism, creating sustainable livelihoods for coastal communities. The high cryptobenthic fish biodiversity in these habitats exceeds that of many tropical reefs, though their abundance is very



low. The combined outcomes of this research contradict current views of tropical soft sediment habitats and highlight the many research gaps in this poorly studied ecosystem.

Keywords: *Ecology; Cryptobenthic fish; Economic value; Research gaps*

Relationships among depth distributions, habitat specialisation and demography in coral reef fish communities

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Patterns in the distribution and abundance of organisms in nature vary along environmental gradients, such as altitude, exposure and depth. These patterns can be determined by the degree of habitat specialisation and environmental constraints of demographic rates. On coral reefs, despite many studies identifying depth as a major source of variation, few studies have solely focused on the determinants of depth distributions and their relationships with the degree of habitat specialisation and key demographic parameters. Understanding these relationships is becoming critically important in assessing long-term responses to declining coral cover in shallow water and the potential for deep reefs to offer a refuge. The aim of this research was to investigate patterns in distribution, habitat use and specialisation with depth in coral reef fishes and to consider how these patterns might affect the depth refuge hypothesis. Diversity and species richness showed patterns with both depth and reef profile and there was a significant correlation between changes in the fish community and the benthic habitat. Communities had species with shallow water preferences as well as species with much broader depth distributions. Depth ranges of species were largest for those with mean depths of occurrence around the midpoint of the gradient studied and species at the extremes showed restricted depth ranges. Niche breadth decreased with depth, suggesting deeper species were more specialised. Unexpectedly, there was a higher association with branching corals in the deepest depth strata showing a great reliance on coral in patchy reef edge habitat. Surveying recruitment on patch reefs over 12 months showed depth and site had a strong effect on the communities present. Habitat still had a significant effect on the fish communities present, although weaker than depth or site. A transplant experiment showed no consistent depth-related patterns in mortality, however, overall body condition decreased with depth and growth was higher on the deepest reefs. This study shows the important direct effects of depth on reef fish and suggests depth needs consideration when looking at distribution patterns in reef fish communities. It also demonstrates that depth may only potentially provide a refuge for some species and not others.

Keywords: *Coral reef fish communities, Depth distribution, Habitat specialisation, Depth refuge hypothesis, Coral reef fish ecology*



The utilisation of Definitive Screening Design as a more definitive contemporary solution toward principle factor identification in Marine Science. A multifactorial, biocomposite development and optimisation example.

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Traditionally, experimental techniques have consisted of a 'one-at-a-time' approach, whereby varying a singular factor at each time of conducted experimentation. Whilst this technique may seem thorough due to the large time and resource requirements, important interactions can be missed which could be crucial for identification of the most optimal solution. Sequential experimentation allows effective use of resources by initial screening and further optimisation. Presently, fractional factorial screening designs are used to characterise non-linearity by introduction of centre points; however, in order to fully characterise curvature in multiple factors, resource requirements can be significant. Consequently, definitive screening design scan be used to characterise curvature and are substantially more efficient both in terms of time and resources. Furthermore, whilst fractional factorial screening designs can be useful when considering categorical factors with more than 2 levels, two-way interactions are unfortunately aliased; definitive screening designs do not completely alias two-way interactions. In addition to this, categorical factors should ideally be minimised in favour of continuous variables; consequently, increasing reproducibility and minimising nuisance factors. In this example, biocomposite development and cell retention has been optimised through definitive screening as an alternative to fractional factorial design. Biocomposite development is optimised through maximum cell loading, minimal cell death, and minimum release of cells from the substrate:binder complex. There are numerous factors which can be experimentally varied in biocomposite development, such as: percentage solid(of binder), percentage WCP(wet cell paste), drying time, and substrate composition ratio. As aforementioned, varying each factor individually would constitute a 'one-at-a-time' traditional experimental approach to identify the perceived optimal(Image 1 –A), whilst using DoE (Design of Experiments) computing, we can vary multiple factors in a fractional factorial design (Image 1 –B)or the significantly more useful definitive screening design(Image 1 –C). Overall definitive screening should be more highly utilised to fully characterise variability in multiple factors, thus saving time and resources, and consequently speed up the end optimisation process.

Stereotypic pacing and faecal corticosterone metabolites as non-invasive indicators of stress in rehabilitating green turtles (*Chelonia mydas*)

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Species of marine turtles are experiencing large population declines, and there are many conservation projects worldwide which aim to rehabilitate and release sick or injured turtles. Whilst in captivity, turtles will inevitably experience unnatural conditions and large amounts of human interaction, both of which may cause stress to the animal. Green turtles (*Chelonia mydas*) are believed to travel 5-10km per day, and animals with a similarly large range area have been shown to develop stereotypic behaviours such as pacing whilst held in a captive environment. However, there is both limited research of stress in marine turtles, and a lack of subjective method to quantify the locomotion of pacing. Here we trialled a new method of incorporating transition probability to identify repeated pathways. The results of which were correlated against a biological marker of



stress in the form of faecal corticosterone metabolites (FCM), as a non-invasive alternative to the classical use of blood sampling which can itself induce stress. Three of the four subjects displayed repeated pathways ($p = 0.03$, $p = 0.02$, $p = 0.04$). There was no correlation between repeated pathways and FCM concentration ($p = 0.17$), however as the study is the first to measure FCM in marine turtles there is an absence of comparative baseline for the results attained here. The aim of the study is to develop our ability to identify stress in real-time and non-invasively, in order to improve recognition and influence best practice for the welfare of captive marine turtles. This may reduce any chronic effects of stress such as immunosuppression, inappetence and impaired reproductive function, which could subsequently support the success of rehabilitation efforts and other conservation interventions. It is hoped the successful application of the methods will advocate their use within future research and captive care of green turtles

Keywords: *marine turtle, stress, rehabilitation, faecal corticosterone, stereotypic behaviour*

Multi-trophic role of the sponge *Hyrtios erecta* revealed by different bio-tracers

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Sponges are one of the most diverse marine animal phyla (Porifera), however, their trophic roles in coral-reef food-webs are scarcely looked at. In this study, we collected a non-cryptic high microbial abundance sponge *Hyrtios erecta* and both benthic and pelagic production sources in North Malé Atoll (the Maldives). As a mixotrophic species, the autotrophic role of *H. erecta* was analysed by comparing its bulk stable isotope data ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$) with those of other primary producers; the results suggest that *H. erecta* might be utilising the same ultimate nutrient sources as the benthic macroalgae for photosynthesis or largely feeding on the DOM produced by these macroalgae. We also analysed its heterotrophic role by tracing its essential amino acid (EAA) intake using the carbon stable isotope values of five EAAs and found that *H. erecta* tended to feed on pelagic plankton as a source of EAAs. Our results confirm the multi-trophic role of *H. erecta* and the nutrient preferences of this sponge suggest that it might prefer DOM for metabolism and plankton for body building. Yet whether such a source utilisation pattern exists among other reef sponges (e.g. cryptic species more prominent on Indo-Pacific reefs) remains unclear. The findings point to the need of future research on the function of sponges in linking pelagic production sources to coral-reef food-webs.

Keywords: *sponge, trophic ecology, stable isotope*

Life as a Scientific Fisheries Observer in the Falklands

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This talk focuses on the role that Scientific Fisheries Observers play within fisheries management in the Falkland Islands. The Falkland Islands Government currently generates a significant proportion of its annual income from sustainable offshore fishing. Fishing primarily targets finfish, squid, and to a lesser extent elasmobranchs. Most fishing is operated by benthic stern trawlers, however there is



also a longline fishery and a pelagic squid fishery. Observers play a vital role in the management of these fisheries, as they provide real time data all year-round on commercial and non-commercial species whilst actively stationed on-board these vessels. This is mostly biometric data, however observers also collect samples, otoliths and conduct marine mammal and seabird surveys when appropriate. This abundance of real time data allows for a reactionary management approach, restricting and allowing fishing effort based upon estimated stock levels at any given time. The cost of such data lies in the nature of the role. Observers can be stationed at sea for over six weeks, working seven days a week in often extremely challenging conditions. But despite any small adversity the job is utterly rewarding. As a marine scientist looking for something new or different, this job is certainly worth considering as a career stepping stone towards fisheries management.

Keywords: *Fisheries, Fisheries Management, Scientific Fisheries Observer, Falkland Islands*

UV-C Light Emitting Diodes (LEDs) for Marine Biofouling Control

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Marine fouling is the unwanted accumulation of animals, plants and microorganisms on surfaces submerged in marine waters. Marine vessels that accumulate fouling incur detrimental effects, such as increased hydrodynamic drag, which can impact on vessel efficiency, fuel consumption and gaseous emissions. Fouling can also contribute significantly to the translocation of non-indigenous species (NIS) globally. *Fouling control* technologies, primarily biocidal hull coatings, are therefore of great interest for commercial vessels, recreational cruise liners and naval platforms. Niche areas, such as sea chests, are hot-spots for NIS. They are challenging to access for coating and cleaning, and are currently treated with the hull's antifouling coating regardless of their unique hydrodynamic flow and operational regimes. In particular, non-biocidal fouling-release coatings fail to perform in niche areas. The consequence is often heavy fouling of intake grates, sea chests and internal pipework. Restricted flow and blockages result in operational downtime and/or costly repairs that require dry-docking or dive teams to clear niche areas of fouling, including NIS.

Ultraviolet-C (UV-C) (~265nm) exposure is commonly used in water sterilisation, killing or inactivating organisms by damaging nucleic acids and preventing proliferation or cellular functions. As a non-polluting technology, UV-C from light emitting diodes (LEDs) has the potential to disrupt the fouling control market. The current project aims to explore the applicability of a novel UV-C LED embedded coating system to vessel niche areas. The main focus is on the use of *UV-C tiles* to deter biofilm growth in laboratory-scale experiments. Future field testing for niche areas will focus on sea chests, but the findings of this study are likely to be more widely applicable.

Not just a drop in the ocean! The value of Seasearch to the research community

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Seasearch is a national project that trains SCUBA divers and snorkellers to record marine species and habitats, providing a cost-effective source of verified data to inform marine conservation and



management. Set up 30 years ago by the Marine Conservation Society and the Nature Conservancy Council to collect structured, policy-relevant data, today Seasearch's network of regional coordinators covers the entire coastline of the UK, the Republic of Ireland, the Isle of Man and the Channel Islands. All records are validated and verified at the point of data entry, and Seasearch offers a progressive training programme to teach and assess participants' skills in identification and recording. The training programme is backed up with a highly regarded series of photographic ID guides aimed at ensuring reliable identification skills, including awareness of taxa that cannot be identified to species level *in situ*, and of similar-looking species that can be confused. These guides will be available for purchase during the conference.

With a dataset of over 650,000 taxon records and over 68,000 habitat records, Seasearch is the second largest provider of marine species data to the NBN Atlas. Thanks to their efficiency at data mobilisation, Seasearch makes a particularly large contribution to data holdings for recent years, and is an important source of data on species which are rare, new arrivals or on the edge of their range. All records are available for use under a Creative Commons Attribution (CC-BY) Licence. This open policy towards data sharing led to Seasearch winning the NBN John Sawyer Open Data Award in 2017. Taxon records are also available via the Ocean Biogeographic Information System and the Global Biodiversity Information Facility, increasing their accessibility to international researchers. The Seasearch dataset is a valuable resource for the research community. It has been used in scientific publications on climate change, biodiversity conservation, non-native species, ecosystem services and modelling the impacts of development. The Marine Conservation Society recently recruited a Data Officer specifically to support research use of the Seasearch dataset, so if you would like to discuss collaboration please get in touch – we'd love to hear from you!

Keywords: *SCUBA diving; species data; habitat data; temperate seas; collaborative research*

Coral proteomics – challenges and perspectives

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Climate change is widely perceived as one of the most serious threats to corals and the coral reef ecosystems, leading to increased thermal stress which affects coral health and may induce mortality. Yet, corals have the capacity to accommodate considerable temperature changes (i.e. living in inherently hot or extremely variable environments). It is known, that this capacity to deal with thermal stress varies both across populations, as well as individuals within one population however, the causes underlying these differences and the molecular mechanisms involved in thermal resistance, still remain elusive. Understanding these mechanisms is a key to effective methods of reef conservation, i.e. assisted gene flow. In the last decade, advances in speed, accuracy and affordability of high throughput methodologies, i.e. so called "Omics", has made them a valuable and widely used tool for addressing complex biological questions. In coral research, particularly transcriptomics, shed some light on what we now consider to be the key pathways contributing to thermal stress response and tolerance. In contrast, proteomics-based studies in corals are sporadic even though, the observed phenotypes are in fact reflection of protein abundances and numerous studies show that there is no clear correlation between RNA and protein levels. Here we will discuss different proteomic approaches that can be used in coral research, their advantages, drawbacks and associated challenges specific to coral research. Using our own experimental data, we will present a typical workflow, from sample collection and processing, through data analysis, to examples of biological questions that proteomics is attempting to answer.



Keywords: *Proteomics, Mass spectrometry*

Seals from Space: Identifying change in Antarctic ecosystems via the monitoring of ice-seals and sea ice habitats by very high-resolution satellite and UAV imagery

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Antarctic pack-ice seals (APIS) are long-lived, upper trophic level predators and amongst the largest consumers of Antarctic krill. Therefore, the monitoring of APIS populations can indicate changes in the Antarctic ecosystem's status and health. However, seals inhabit the dynamic and inaccessible sea ice zone, making traditional surveys (plane/boat) logistically difficult. As a result of these challenges, reliable population estimates and habitat information for ice-seals are lacking. To overcome the limitations of traditional survey, very high-resolution (VHR) satellite and unmanned aerial vehicle (UAV) imagery will be used to: 1) detect/discriminate ice seal species for counts at local scales, 2) identify habitat hotspots at broad regional scales, and 3) investigate the impacts of climate change and resource overlap. This involves identifying species classification parameters; extracting sea ice characteristics; developing UAV survey protocols; constructing habitat models to explain population dynamics and predict responses to environmental change.

Satellite surveys have been conducted on breeding Weddell and crabeater seals to test various classification techniques, due to their abundance and increased haul-out duration. The accuracy of each technique will be assessed using thermal/optical data sourced from ground-truthing UAV surveys to exclude artefacts (i.e., rocks and shadows) and determine count variance. Resulting insights into the distribution and habitat preference of seal colonies will inform: (a) the automated detection of habitat hotspots for present and future sea-ice conditions under a range of climate scenarios, (b) the development of a penguin-seal-fisheries competition index and (c) the first robust pan-Antarctic ice-seal population estimates. Shifts in habitat extent and competition determined from these data will inform IUCN red list assessments. Given that sea ice volume is predicted to decline significantly by the end of the century, the monitoring of ice-seals and their habitat via VHR imagery is pivotal to polar marine conservation. Here, we present details of the satellite/aerial surveys conducted on breeding ice seals, and the on-going development of machine learning algorithms to provide the first VHR sea ice classification techniques. We will also discuss the capacity for dynamic conservation management provided by an automated system for near real-time seal counts and habitat mapping.

Microplastics analysis in the zooplankton Dove Time Series. Act 1.

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The ubiquitous presence of microplastics (MPs) throughout the marine environment has gained increased attention in recent years. However, much remains unknown about the prevalence and impacts of MPs in our waters. Being at the lower end of the food chain, zooplankton is a key indicator for health of the marine ecosystems, informing numerous conservation policies and



legislations as well as economic decisions in terms of the potential impacts of fish stocks and fisheries.

Our project, Plastic Plankton, aims to investigate MPs occurrence and prevalence over a significant time scale, using zooplankton samples from the Dove Time Series (DTS). DTS is a monitoring programme of plankton samples collected regularly off the coast of Northumberland for over 50 years. This will allow us to assess how the MPs prevalence within zooplankton has changed over time. To this end, the Dove Marine Laboratory has set up a Plastics Lab. This talk is a summary of the challenges and lessons to be considered when studying MPs in zooplankton samples, ranging from the laboratory environment, the type and processing of samples to the Analytical Chemistry techniques available for MPs characterisation. As a general conclusion, when working with all the small things, true care truth brings.

Securing cyanobacteria

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Centralised, large scale wastewater plants have been developed and used in many countries around the world for several years. Despite current policies, discharge from large scale wastewater treatment plants still causes significant loading of nitrates and phosphates at discharge points due to poor removal of total nitrogen and phosphorous, leading to eutrophic zones. “Off the grid” small scale septic tank systems also contribute to nutrient loading due to many systems being poorly maintained over many years. Cyanobacteria have been previously utilised for wastewater treatment, in raceway ponds and suspension photobioreactors. The commercial use of these has been hindered due to large space requirements and isolation of the cells from the effluent requires energy intensive processes. Immobilisation of cyanobacteria into biocomposites may be a disruptive alternative. Reducing footprint, overall cost, but increasing biomass may improve nutrient removal from wastewater.

Synechococcus elongatus (strains CCAP 1479/1A and PCC 7942) are model cyanobacterial organism. They are a planktonic species, capable of oxygenic photosynthesis, with good tolerance to a range salinities, temperature, and light intensity. Biocomposites containing strains CCAP 1479/1A or PCC 7942 have been developed using natural and artificial fabric substrates. Cells were immobilised using a range of binders derived from natural and artificial sources. Binders and substrates were screened for toxicity and adhesion. Experiments were conducted to determine the impact of drying times, percentage solid of the binder, and cellular loading. The most successful biocomposites, in terms of toxicity and adhesion, were then tested over a time series for CO₂ uptake and depletion of total nitrogen and phosphorous from media in closed systems. The data presented suggests that cyanobacteria immobilised onto solid substrate may offer an alternative to how we deal with domestic waste. Cells can survive in an environment very different to their natural conditions. Working with the H2020 Living Architecture project, a photobioreactor “wall” has been developed that enables recirculation of water within a home. Traditional suspension samples have been shown to limit the performance of the “wall”, thus increasing the need for effective biocomposites. If installed, a human dwelling would have its own wastewater treatment plant fully integrated.

Keywords: *cyanobacterial biotechnology, wastewater bioremediation, biocomposites*



Poster Abstracts

Can you spot the seals? Using a small unoccupied aircraft system (UAS) on grey seal (*Halichoerus grypus*) colonies across Northumberland, UK.

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Small unoccupied aerial systems (UAS), commonly referred to as drones, are vastly becoming used in a wide range of ecological and wildlife surveys for a wide range of objectives. Although UAS are somewhat limited by weather conditions, they are capable of providing photo-ID and measurements of individual marine mammals that previously could not have been obtained by large-scale aerial surveys or traditional visual counting techniques. Furthermore, UAS are providing new population monitoring methods that facilitate more accurate, cheaper, human-risk free aerial surveys in areas that have previously been difficult to sample. Although there have been many technological assessments for the use of drones for marine mammals, there is a significant data gap regarding behavioural and physiological impacts of UAS surveys as well as a lack of disturbance monitoring during operations. To address this, I conducted a series of quadcopter UAS flights over a grey seal (*Halichoerus grypus*) haul out colony across Lindisfarne National Nature Reserve (LNNR) in Northumberland, England. Various flights were undertaken across several months throughout a year, at various heights (120, 100, 80, 60m) using sequential image analysis with a 30% overlap at 3 known haul out locations around the LNNR. Group behaviour was videoed before, throughout and after the UAS in order to analyse each individuals change of behaviour and recovery time needed to return to baseline behaviours. The accuracy and efficiency of both traditional and various image-capture techniques were also compared. Disturbance events were observed throughout the study window at various points, however, highlighting these techniques is not always effective and therefore consideration is needed before embarking on UAS-based approaches as best practice for assessing grey seal colonies.

Keywords: *disturbance, marine mammals, grey seals, UAS, drones, abundance estimation, aerial surveys, unoccupied aircraft systems, unmanned aerial vehicle*

The mucus layer as a first line of defence in corals

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Corals are important ecosystem engineers in marine environments. Outbreaks of infectious disease on coral reefs can lead to rapid reef degradation, which is a global concern. However, the pathogenesis of many of the diseases affecting corals, remains poorly understood. In order to develop new strategies to combat infection in corals, it is critical to understand the mechanisms by which implicated pathogens cause disease. One way in which corals resist infection is by secreting a surface mucus layer (SML). The SML is a multi-functional hydrogel interface between the underlying epithelium and the external environment. It acts as a chemical and physical barrier and is considered a first line defence mechanism against colonisation by potential pathogens. This SML hosts a complex microbial community, known as the surface microbial community (SMC). The holobiont, which refers to the assemblages of corals and their complex symbiotic communities, is protected by the SML. Nevertheless, marine pathogens have evolved sophisticated virulence traits



which allow them to disrupt and degrade the SML, potentially leading to infection. In this study, the mechanisms of virulence of coral pathogens including 5 *Vibrio* spp. and a single species of *Photobacterium* were evaluated, using a range of physicochemical methods. Novel in vitromucus permeation assay was developed, using porcine small intestinal mucus (PSIM) as a model system. The assay was used to quantitatively assess the ability of the pathogens to penetrate through and degrade the mucus layer. Motility was also investigated to understand whether this was a factor influencing mucus penetration. Results obtained indicated that coral pathogens appeared to be able to penetrate the PSIM layer. These results provide important preliminary insights into the possible mechanism of disease pathogenesis of the species studied, which could be used to inform and develop innovative strategies to tackle infection.

Keywords: *Coral, Mucus, Coral Disease, Pathogens, Vibrio spp., Penetration, Motility*

Habitat preference of intertidal species on an ecologically enhanced rock armour revetment

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Efforts to protect densely populated coasts from increasingly frequent and severe storms has led to widespread hardening of the UK coastline. Hard coastal defences are known to support a diminished biodiversity compared to neighbouring rocky shores and as such, various methods have been developed to improve their ecological favourability through increasing the heterogeneity of habitats available. The present study aims to investigate the success of several enhancement measures on the establishment of species on a new granite rock armour revetment in Runswick Bay, North Yorkshire. The structure was modified during installation to incorporate water retaining features (horizontal grooves and drilled basins to act as pools) and include the addition of native boulders at the foot of the structure, in order to promote recolonization. Preliminary comparison has indicated that the presence of both native boulders, added pools and grooves improved the diversity of species supported by the structure. Native boulders supported a markedly higher mean total abundance of species compared to both added pools and control areas. Whereas, added pools supported both a higher total species richness and a larger abundance of mobile species (*Patella vulgata* and *Littorina littorea*) when compared to native boulders. Interestingly added pools also supported a marginally higher algal richness than native boulders. Artificial grooves exhibited both a higher species richness and total abundance compared to areas of bare rock without grooves, although data collection and monitoring remains on going. The application of ecological enhancement techniques has again showed promise in improving biodiversity on artificial coastal structures. Although long-term monitoring is required to assess the success of enhancement techniques over the lifetime of modified structures, the findings of this study add weight to the argument that hard coastal defence structures can provide sufficient habitat to support as varied and diverse an intertidal community, as their natural rocky shore counterparts.

Keywords: *Coastal protection, Ecological enhancement, Habitat heterogeneity, Biodiversity*



UV-Induced stress response of the marine copepod *Tisbe battagliai*: DNA damage and gene expression.

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Ultraviolet B (UV-B) radiation causes detrimental effects to the development and survival of aquatic invertebrates, including the crustacean copepods which are vital primary consumers in aquatic food-webs. Using the marine copepod *Tisbe battagliai*, we quantified acute exposure effects from UV-B by evaluating the formation of intracellular reactive oxygen species (ROS) and cyclobutane pyrimidine dimers (CPD) resulting from DNA damage, together with changes in the expression of key oxidative, DNA damage and apoptosis genes. *T. battagliai* inhabits the marine intertidal zone, often in shallow rock pools or on damp rocks and seaweeds. Consequently, they are subject to potentially high UV-exposure (particularly during tidal emersion) and, coupled with a semi-transparent body, they should in theory respond to UV associated stress. LC50 values were calculated for gravid females (14 ±1 day) using a mixed effects generalised linear model of survival during a modulated 14:10 hour diurnal cycle over 48 hours (24 hour LC50 = 1.85 wm^{-2} and 48 hour LC50 = 0.402 wm^{-2}). Additionally, gravid females were sampled after 24 hours of exposure to assess the developmental responses of their first (exposed to UV-B) and second (not UV-B exposed) clutches. Observations of mortality and developmental rates were made for 7 days (ending at the copepodid stage). The female and clutch 2 were monitored to determine whether the capacity for damage to clutch formation or clutch size was retained post exposure. Gene expression data were collected after 12 and 24 hours of exposure to assess for dose-rate and time dependent responses. CPD formation increased significantly with dose-rate, with a 9-fold increase at 0.8 wm^{-2} relative to controls. Significant upregulation ($p < 0.05$) occurred in the oxidative gene glutathione reductase (GR) and DNA damage gene RAD23, with dose-time interactions. This pathway-oriented mechanistic approach under simulated natural UV conditions provides new insights into the mechanistic response of marine copepods to UV-B exposure, and is, to the best of our knowledge, the first report for *T. battagliai*.

Analysis of microplastic content in the trophic levels of commercial fish and invertebrates in the East Aegean Sea, Greece.

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Microplastics have been well documented over the past decade, with much focus on the marine environment. Fibre's, fragments, sheets and beads have been found in beach sediments and water columns across the world. However, there has been much debate as to whether these microplastics can move through trophic levels. Here, this study analyses the type, colour and size of microplastics in three commercial species, collected from high and low human populations in the East Aegean Sea. In total, 86 individuals were sampled, including 36 *Paracentrotus lividus* (European Purple Sea urchin), 14 *Oblada melanura* (Saddled Sea Bream) and 36 *Scomber colias* (Atlantic Cub Mackerel), increasing in trophic levels respectively. 100% of the specimens contained microplastics in their gastrointestinal tract (GIT), totalling 2235 microplastics. Of this total, 85% represented fibre's, 13% fragments, 1.5% sheets and 0.1% beads. The average length of fibre's was 1.4[Symbol]0.03mm and the most common coloured microplastic was black. There was no significant difference in the



amount of microplastics between the different trophic levels. Providing the conclusion that microplastics may not accumulate through trophic levels, but rather certain species ingest more plastics than others. However, there was a significant difference in the amount of microplastics per 10g of each specimen between species. This highlights the risk of eating marine individual's whole, such as *P. lividus* and other invertebrates. Alongside this, the influence of high human population often returned significance, with more microplastics in the GIT of specimens collected from high human populations. This study highlights the need for research to focus on the impact of microplastics on human health.

Keywords: *Microplastic, Aegean Sea, Mediterranean, Oblada melanura, Paracentrotus lividus, Scomber colias, Filtration, Pollution, Trophic levels, Food web.*

Assessing the accumulation of microplastic within *Posidonia oceanica* epibionts.

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Posidonia oceanica seagrass meadows are some of the most productive ecosystems in the Mediterranean supporting an array of fish and invertebrates. The blades of *P. oceanica* hosts a good substrate and attachment for a diverse assemblage of epibiont communities made up of fauna and flora. Due to the reduction of water velocity over and within seagrass environments and the subsequent reduced ability for water to hold particles, *P. oceanica* ecosystems may be accumulating microplastics (<5mm). To assess this, samples of *P. oceanica* were taken from Samos, Greece and analysed under microscope for the presence of microplastics. Also tested was whether blade length or epibiont coverage influence the accumulation of microplastics on the blades. Overall, 21 microplastics were found: 19 microfibers, 1 microbead and 1 microfragment. Microfibers were found significantly more on the blades with 74% of microfibers found adhered within the epibiont communities. Despite there being no significant difference between epibiont coverage, blade length and microplastic accumulation, there were clear trends that shorter blades accumulated more microplastics and blades with <25% epibiont coverage accumulated fewer per blade. Adhering mechanisms onto the blades included entrapment by epibiont communities or attachment by microbial biofilms, with the conclusion that potentially the higher epibiont coverage the more species are available to catch and entrap microplastics onto the blade. As epibionts are heavily grazed upon, the presence of microplastics on lower trophic, primary producing epibiont communities is a worrying discovery and a clear and viable route into marine food webs. Future research into the adhering mechanisms of microplastics by epibiont and investigation into the relationship between seagrass water flow, and microplastic deposition will provide key evidence towards an important sink of microplastics in the benthic environment. This is the first study into the interactions between microplastics, seagrass epibiont and water flow and is vitally important subject for the health of *P. oceanica* fish and invertebrate species, epibiont communities and the seagrass ecosystems

Keywords: *Microplastics, Seagrass, Posidonia oceanica, Epibiont communities*



Genetic assessment of the number of breeders, breeding cycle and reproductive philopatry of the sicklefin lemon shark (*Negaprion acutidens*) in a tropical marine protected area

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The coastal shark, *Negaprion acutidensis* extirpated in India and Thailand, Endangered in South East Asia and Vulnerable to extinction across its Indo-West Pacific range. Like many species of shark, populations are declining due to overfishing and habitat degradation, but little information is available regarding specific local abundance. To effectively manage and conserve threatened species, a good understanding of breeding cycles, mating systems and philopatry are essential as they can influence a species' susceptibility to exploitation and ability to recover once protection is implemented. For *N. acutidens* available information on these aspects of the species' reproductive ecology are limited and ambiguous. In this study I will clarify the species' reproductive ecology and estimate local reproductive population size at a study site in Seychelles. I use microsatellite genetics and tissue samples collected from juvenile *N. acutidens* at a nurse site in the Curieuse Marine National Park (CMNP) to reconstruct the size of the parental population in four consecutive years (2014-2017), using two estimators (1) number of adults reconstructed through sibship assignment; (2) effective number of breeders (N_b). Additionally, I address the sibling relationships between years to determine the degree of adult reproductive philopatry and frequency of reproduction (breeding cycle). This project will provide valuable information to local managers at a time when Seychelles National Parks Authority is reviewing its management plan for the CMNP; Seychelles Fisheries Authority is intending to review the National Plan of Action for the Management and Conservation of Sharks; and the Seychelles government is undertaking an EEZ-wide marine spatial planning initiative which aims to increase coverage of marine protected areas by 2020. An improved understanding of reproductive ecology will be valuable to managers across the species range.

Keywords: *sicklefin lemon shark; sibship assignment; parentage construction; effective number of breeders; philopatry; breeding patterns*

The impacts of anthropogenic electromagnetic fields on the prey detection of the small-spotted catshark, *Scyliorhinus canicula*

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As humans increase their presence in the world's oceans and the need for renewable energy increases there is a growing amount electric and magnetic fields from anthropogenic sources. Electricity cables now span the world's oceans to connect offshore renewable energy sites to the coast and to connect the national grids of countries together. The European Commission's Projects of Common Interest include connecting the EU countries electricity grids together, this relies on a large number of marine cables especially to connect the UK to the rest of the continent. The North Sea and English Channel thus has a large number of new cables being laid to make this happen. Electricity passing through a cable causes an electric- and magnetic-field (EMF) to be created around cable. Although the electric field is shielded and remains inside the cable, the magnetic field leaks out into the surrounding environment; the movement of water or animals through this magnetic field causes a new electric field to be induced. Many marine species, especially the elasmobranchs, are sensitive to electric field through the use of



electroreception, utilising the specialised ampullae of Lorenzini. Electroreception is a key sense used to detect prey, predators or conspecifics and is very sensitive to the weak bioelectric signatures of other organisms. This study is designed to determine whether the additional induced electric fields from human structures affect the ability of elasmobranchs detecting prey solely using electroreception. Using an artificial bioelectric field stimulus three different prey types will be tested with varying strength electric fields to deduce if additional electric fields inhibit the detection of prey and to estimate a distance from standard cables that prey cannot be detected.

Keywords: *EMF, elasmobranchs, electroreception, behaviour*

Temporary adhesive secretory structures of acorn barnacles

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Adult acorn barnacles (suborder: Balanomorpha) are sessile crustaceans, thus they must locate a suitable settlement site during their motile cyprid larval stage. During this process, the cyprid larva will temporarily attach to the substratum and 'walk' and explore using its specialised paired antennules. Since many acorn barnacle species occupy highly dynamic intertidal regions, the cyprid secretes a proteinaceous temporary adhesive from the end of the antennules in order to facilitate its attachment and prevent removal by hydrodynamic forces. Previously, it was thought that the temporary adhesive glands were located in the second antennular segment, however recent evidence indicating the glands are located in the cyprid mantle from the stalked barnacle species *Octolasmis angulata* has cast doubt on this assumption. The aim of this study was to comprehensively map the route of the temporary adhesive ducts using transmission electron microscopy, and follow them to the location of the glands, in three acorn barnacle species: *Balanus amphitrite*, *Semibalanus balanoides*, and *Megabalanus coccopoma*. This poster will present high resolution images of the temporary adhesive secretory systems of these three species, and 3D models of their structure.

Keywords: *Structural biology / Transmission electron microscopy / Acorn barnacle / Cyprid larvae / Proteinaceous adhesive*

Gut microbial symbiosis in the world's deepest ocean trenches.

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There is growing appreciation of the role of microbial symbiosis within larger host organisms in discerning ecological function in global system processes. Research at extreme frontiers provides great leverage in disentangling taxon-specific, habitat-specific and local from global phenomena. This is critical in (1) establishing the key factors underpinning these relationships, (2) adaptations to environmental biogeochemical conditions and (3) the significance of microbial symbiosis for global nutrient cycling. Each trench has a unique biogeochemistry, geology and topography with nutrient input from varying sources (export from surface waters versus in situ chemosynthesis), making deep-ocean trenches ideal locations for examining microbe response to environmental factors. Amphipods dominate hadal trench environments, however, how they and their associated microbiomes respond and adjust to these surroundings remains unknown. Amphipods sampled across the hadal zone of the Mariana, Izu-Bonin



and Kermadec Trenches in the western Pacific Ocean were chosen as a model taxon for this study. 16S rRNA amplicon sequencing was used to determine the gut bacterial communities associated with hadal amphipods and functional metabolic pathway analysis was conducted using Tax4Fun software. This has allowed for the exploration of how deep-sea trench biogeography affects and drives organism-microbe interactions and how microbes in extreme frontiers are driving the ecological function of the hosts in which they reside.

Keywords: *Microbial symbiosis, nutrient cycling, biogeographic patterns, hadal trenches, amphipods, metagenomics*

The validation of the biological data collected by the novel *Planktag* sensors in the *North Sea* and *English Channel*.

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Phytoplankton are fundamental in assessing physico-chemical processes, as well as the dynamics of the pelagic food web, within the marine environment. The study presented a validation of fluorescence-based chlorophyll-a measurements ($\text{chl-a}^{\text{Fluo}}$), as a proxy for *phytoplankton* biomass, obtained by the novel sensor known as the *Planktag* against the operational Ferrybox systems. Between February 2016 and November 2017, the *Planktag* was attached to the Continuous Plankton Recorder (CPR) and towed by ships across the western *English Channel* and southern *North Sea*. In the western *English Channel*, the *Planktag* provided $\text{chl-a}^{\text{Fluo}}$ estimates that were in good agreement with the Ferrybox data, as well as yielding pronounced underestimations. Low mean bias values of 1% and 2% were calculated from the data in July and August 2017 respectively, whereas in March 2017 the mean bias was -23%. In contrast, the *Planktag* consistently underestimated $\text{chl-a}^{\text{Fluo}}$ in the southern *North Sea*, and the monthly mean ratios between the two instruments presented a small range of 0.38 to 0.49, which highlighted a statistical adjustment could be applied to the *Planktag* estimates to produce a consistent dataset with the Ferrybox.

The temporal and spatial variations in the relationship between the *Planktag* and Ferrybox were attributed to changes in coloured dissolved organic matter (CDOM), turbidity, and temperature. In March 2017, for example, high CDOM concentrations at 5.35 ± 0.46 ppb appeared to bias the Ferrybox-based $\text{chl-a}^{\text{Fluo}}$ measurements in the western English Channel. *Non-photochemical quenching* (NPQ) of $\text{chl-a}^{\text{Fluo}}$ estimates obtained by the *Planktag* and Ferrybox was identified. The results demonstrated no distinct difference in the relationship between the *Planktag* and Ferrybox chl-a during quenched and non-quenched conditions. The ability to detect NPQ on in situ chl-a observations at varying light levels highlighted the benefits of integrating a light sensor onto monitoring instruments. The current study highlighted the drawbacks inherent in validating a novel sensor with a fluorometric-based method, in the absence of correcting for the interferences of ambient environmental conditions, as the ground-truth data. Hence, to gather accurate chl-a concentrations, and to correct for interferences, the *Planktag* should in future undergo a calibration procedure.



The utilisation of Definitive Screening Design as a more definitive contemporary solution toward principle factor identification in Marine Science. A multifactorial, biocomposite development and optimisation example.

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Traditionally, experimental techniques have consisted of a 'one-at-a-time' approach, whereby varying a singular factor at each time of conducted experimentation. Whilst this technique may seem thorough due to the large time and resource requirements, important interactions can be missed which could be crucial for identification of the most optimal solution. Sequential experimentation allows effective use of resources by initial screening and further optimisation. Presently, fractional factorial screening designs are used to characterise non-linearity by introduction of centre points; however, in order to fully characterise curvature in multiple factors, resource requirements can be significant. Consequently, definitive screening design scan be used to characterise curvature and are substantially more efficient both in terms of time and resources. Furthermore, whilst fractional factorial screening designs can be useful when considering categorical factors with more than 2 levels, two-way interactions are unfortunately aliased; definitive screening designs do not completely alias two-way interactions. In addition to this, categorical factors should ideally be minimised in favour of continuous variables; consequently, increasing reproducibility and minimising nuisance factors. In this example, biocomposite development and cell retention has been optimised through definitive screening as an alternative to fractional factorial design. Biocomposite development is optimised through maximum cell loading, minimal cell death, and minimum release of cells from the substrate:binder complex. There are numerous factors which can be experimentally varied in biocomposite development, such as: percentage solid(of binder), percentage WCP(wet cell paste), drying time, and substrate composition ratio. As aforementioned, varying each factor individually would constitute a 'one-at-a-time' traditional experimental approach to identify the perceived optimal(Image 1 –A), whilst using DoE (Design of Experiments) computing, we can vary multiple factors in a fractional factorial design (Image 1 –B)or the significantly more useful definitive screening design(Image 1 –C). Overall definitive screening should be more highly utilised to fully characterise variability in multiple factors, thus saving time and resources, and consequently speed up the end optimisation process.

Functional diversity and trait composition of marine molluscs changes over subtropical reefs

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Climate change is causing range shifts of marine species at a global scale, threatening the structure and functioning of ecological communities and human populations that rely on them. The largest changes are seen in areas that sit between ecoregions, such as the subtropical biogeographic transition zones. Subtropical reefs could provide crucial refuge for migrating tropical species in the future but are threatened by significant functional loss. Despite this, the patterns of functional processes in communities over subtropical latitudes are elusive for many taxa. To address this, I build a trait database of 88 mollusc species from 31 coral reef communities along the Pacific coast of Japan. I examine the trait composition, functional diversity, and functional redundancy of these communities. The results show that trait composition changes continuously over subtropical latitudes and there is a distinction between tropical and subtropical regions. Also, the functional



diversity of communities decreases with increasing latitude, a change that is driven mostly by loss in functional dispersion. There is also evidence for functional redundancy in species rich communities. The study reveals that the roles molluscs play in ecosystems likely change with latitude and subtropical and tropical trait composition is different. The data also suggest that like species diversity, functional diversity decreases with increasing latitude. The redundancy of some sites provides potential functional resistance to species loss. This study provides the first consideration of the functioning of marine mollusc communities over the subtropics and builds a trait database to facilitate further study of these communities. Ultimately, I provide a baseline understanding of the trait compositional changes and functional changes in mollusc communities over the subtropics, allowing the advancement of our understanding of these rapidly changing ecosystems.

Keywords: *Ecosystem functioning, subtropical reefs, marine molluscs, range shifts*

Applying Neutral Models to Complex Microbial Systems

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Microbiome formation is something of an enigma in science, with many scientists wondering how they form. These complex systems often harbour thousands of different species and can vary in space and time depending on several factors. There are different principles and theories about what may be going on to determine the structure at any one time. The first is genetic drift which has generally been discarded for more complex systems because it can only account for a small amount of variability. The second is neutrality which is the theory that the formation of a microbiome is stochastic and depends on factors such as time of arrival, and multiplication and settlement speed. Next is functional redundancy which is the theory that there are substitute bacteria for certain metabolic processes that can jump in very quickly to carry out a specific role if the original bacterium is lost for whichever reason. Finally, is the Anna Karenina principle which is the theory that all healthy biomes are similar in alpha and beta diversity, but unhealthy microbiomes will all be dysbiotic in their own way and will display more β -diversity. By using two very different systems, each of these will be modelled and tested to determine how a microbiome is formed, and under what conditions. For the first system; an aerobic rocky shore habitat, the research was split into 3 parts. The first was the fieldwork, collecting samples of sponge, seaweed, and seawater from two different locations, one 'clean' and one 'polluted'. The second was the DNA extraction followed by 16S next generation sequencing, and the third is the data analysis and modelling. At this stage, the first two steps are complete, and so some expected results will be displayed alongside data collected the previous year. The second system is an anaerobic digester which was sequenced as part of a SeaGas project to produce biogas from macroalgae. The microbiome of this system was sampled at regular intervals over 23 months alongside detailed metadata. This therefore provides an important insight into how these microbiomes form, and what may alter the formation or cause dysbiosis.

Keywords: *Pollution, microbiome, dysbiosis, Halichondria panicea, bioinformatics*



The role of meiobenthos in the functioning of two types of earthen shrimp ponds: benthic assemblages and food webs

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Shrimp farming in earthen pond is by far one of the largest aquaculture industries among coastal mariculture, but has faced environmental issues in recent years, e.g. overloading of supplementary feed cause deterioration of pond environments. In order to assess the impact of pond shrimp farming on the benthic environment, we investigated meiobenthic community structure before aquaculture as well as in the early and late rearing stages in two types of earthen ponds - *Marsupenaeus japonicus* ponds and *Litopenaeus vannamei* ponds. We found meiobenthic community structure to change over the different rearing stages due to an increase in nematode densities, which were closely associated with shrimp farming activity in both types of ponds. We found nematode densities to be closely associated with shrimp culture in both ponds, which led to different meiobenthic community structure through time. We also investigated the functional roles of natural productivity (i.e. microalgae and meiobenthos) and supplementary feed by studying the benthic food webs in both types of shrimp ponds in the early and late rearing stages, with special emphasis on meiobenthos. Natural productivity contributed abundantly to *M. japonicus* and *L. vannamei*' diets in different forms between stages. Meiobenthos in the early stage, shared similar diets with shrimps (with both feeding on primary organic sources), potentially competing for resources. Due to the ontogenetic diet shift in shrimp diet, at late rearing stages, meiobenthos represented however constituted a functional link between primary producers and shrimps, serving as nutritional food source providing high amounts of polyunsaturated fatty acids (PUFA) to shrimps. Supplementary feed was not consumed abundantly by both shrimp species, but instead might fuel the benthic food web through other pathways and consequently promoted secondary productivity.

Keywords: *shrimp farming, meiobenthos assemblages, benthic food web, natural productivity, supplementary feed*

New insights into the health of wild seabirds using hematologic analysis

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Seabirds rarely show external signs of compromised health, but hematologic data from blood smears can provide valuable information about animal health, including presence of parasites, anaemia and immune system responses. While commonly used in domestic veterinary practice, blood samples are rarely taken from wild birds, despite the potential benefits for understanding species ecology and informing conservation. This study used blood samples from breeding gannets, *Morus bassanus*, tracked from Great Saltee Island, southeast Ireland, to assess bird health and investigate links with foraging strategy and diet. High levels of regenerative anaemia (characterised by high proportions of immature red blood cells) were noted in sampled birds, with anaemia particularly prevalent among females. Signs of immune response in white blood cells were also noted in a small number of individuals. However, there was no relationship between the health status of individuals and foraging trip metrics or diet. Healthy and compromised birds showed no difference in distance travelled on foraging trips, and spent similar times resting, foraging and travelling. Furthermore,



stable isotope analysis did not highlight any dietary differences between healthy or compromised birds, with birds consuming prey across a range of trophic levels and coastal to offshore habitats irrespective of health status. While there was no direct link between health and foraging ecology, hematologic analysis can be a useful tool in the diagnosis of sub-lethal conditions and identified potential widespread health issues in a seabird population. Health-compromised birds may still experience carry-over effects leading to longer-term reduced breeding success or survival.