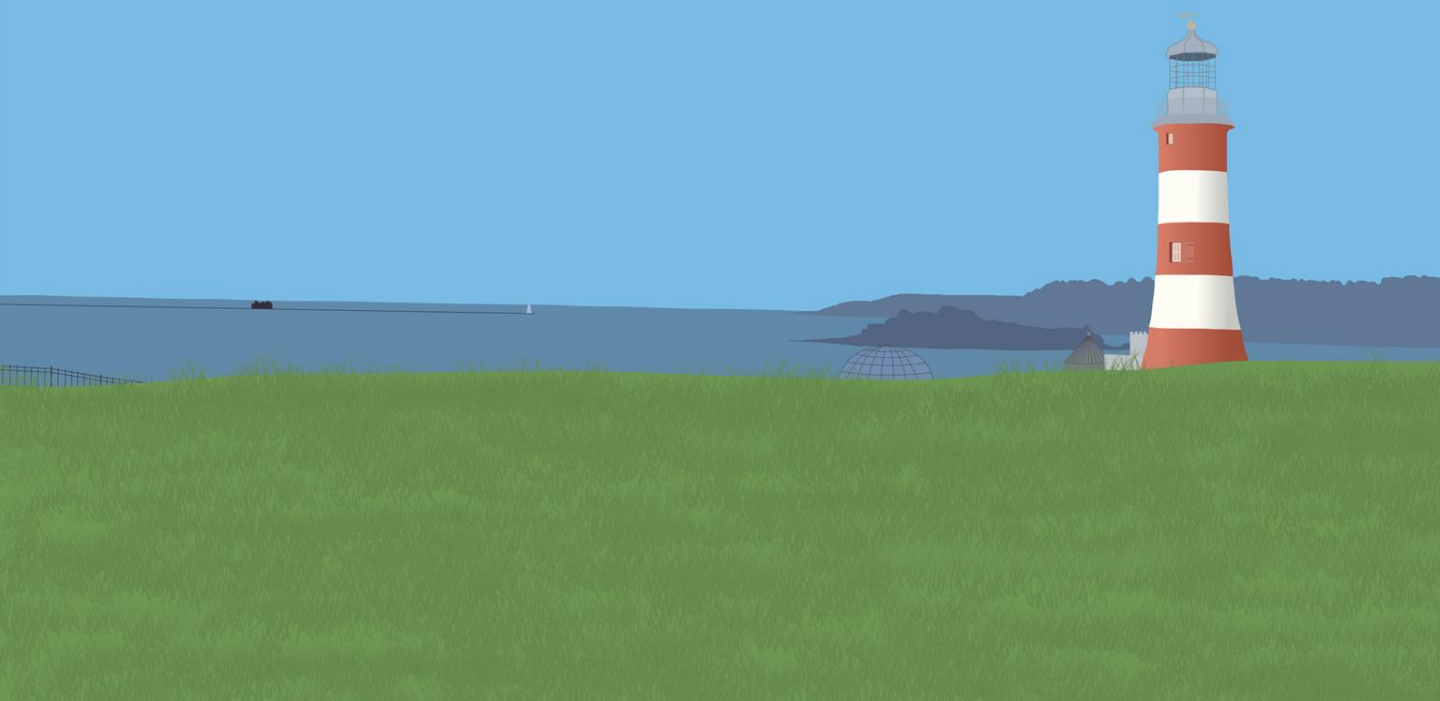
PLYMOUTH 2024

20th MBA POSTGRADUATE CONFERENCE

The Marine Biological Association Post-Graduate Conference 2024

23rd - 25th of April



The committee would like to thank our sponsors – without which this conference would not be possible!

To attendee,

Welcome to the Marine Biological Association (MBA) Post-Graduate Conference 2024!

We are very excited to welcome you to Plymouth on the conference's 20th celebration of the excellent scientific work that post-graduates accomplish. To those who have travelled far to be here, we are grateful to you for spending your valuable time to attend this conference and to more local researchers we thank you for demonstrating some of the amazing science done in the South-West of England.

We hope you enjoy the conference and please feel free to spread the science on display at this event using the hashtag #MBAPG2024

If you have any questions, just ask the committee or email using MBAPG2024@outlook.com

Enjoy the conference!

The #MBAPG2024 committee.

Day 1: PlyMSEF

Tuesday 23rd April

Venue(s): Plymouth Marine Laboratory | Marine Biological Association

Time

08:30 – 09:00 **Arrival and refreshments**

09:15 – 09:30 **Welcome Talk**
Professor Icarus Allen | Plymouth Marine Laboratory

09:30 – 10:10 **Keynote**
Dr Glen Wheeler | Marine Biological Association

10:10 – 11:10 **Presentations**

10:10 – 10:25 **Challenges in Life Cycle Assessment for Composites: LCI data quality assessment**
Badr Moutik | University of Plymouth

10:25 – 10:40 **Assessing Local Adaptation in Macroalgal Microbiomes**
Shauna Corr | Plymouth Marine Laboratory

10:40 – 10:55 **Controls of NH3 air-sea flux in southwest UK: Seasonal trends and drivers of sources and sinks**
Simone Louw | Plymouth Marine Laboratory

10:55 – 11:10 **Purified Brewers' Yeast – Derived functional feed additives alleviate soybean meal-induced enteritis in Atlantic salmon parr**
Taofik Adeiza Momoh | University of Plymouth

11:10 – 11:30 **Tea break**

11:30 – 12:30 **Presentations**

11:30 – 11:45 **Growth in the margins: field measured protein metabolism rates in the keystone, intertidal limpet, *Patella vulgata***
Ignacio Alvarez-Cienfuegos | University of Plymouth

11:45 – 12:00 **Ocean Acidification and the UK**
Lily Anna Stokes | Plymouth Marine Laboratory, University of Plymouth

Day 1: PlyMSEF

Tuesday 23rd April

Venue(s): Plymouth Marine Laboratory | Marine Biological Association

Time

12:00 – 12:15 **Investigating the potential impacts of Direct Ocean Capture on blue mussels**
Guy Hooper | Plymouth Marine Laboratory

12:15 – 12:30 **A Density Mystery: The Interplay of Cell Density and Stress Signalling Responses in Marine Diatoms**
Ellie Murphy | Marine Biological Association

12:30 – 13:30 **Lunch**

13:30 – 14:15 **Poster flash talks**

Ocean Eyes: Developing novel optical proxies of particulate iron in the ocean
Tess Ashen | University of Plymouth

Wave Attenuation by Natural Habitats
Jack Duffy | Newcastle University

A comparative study on the ultrastructure of Cnidarian sensory apical organs
Sophie den Hartog | University of Exeter

Abundance and distribution of cetaceans in the western English Channel, and their exposure to key threats
Bethany Jo Harvey | University of Plymouth

Larval Connectivity Modelling for Porifera Populations Beneath an Antarctic Ice Shelf
Andrew James Hoggett | Newcastle University

Seagrass Recovery and Restoration in a Bay of International Conservation Importance
Charlotte Jennings | Newcastle University

Day 1: PlyMSEF

Tuesday 23rd April

Venue(s): Plymouth Marine Laboratory | Marine Biological Association

Time

13:30 – 14:15 **Poster flash talks**

Dissecting the Gene Regulatory Networks Downstream of the BMP and Activin/Nodal pathways in the Spiralians *Owenia fusiformis* and *Platynereis dumerilii*
Imran Luqman | Marine Biological Association, University of Exeter

The Use Of Heart Rate Monitors To Determine The Effects Of Environmental Stressors In The Common Shore Crab (*Carcinus Maenas*)
Emily Price | University of Portsmouth

14:15 – 14:30 **Coffee break**

14:30 – 15:00 **Poster flash talks**

Shipwrecks: Rusty Relics to Carbon Capital
Rachael Priest | Newcastle University

Quantifying ecological impacts and changes to ecosystem services as a result of seaweed aquaculture
Jasmine Ramshaw | Marine Biological Association

Combining local fisheries knowledge with ecological methods to identify critical elasmobranch habitats
Chloe Renn | University of Plymouth

A New Reference Genome of Ctenophore, *Pleurobrachia pileus*
DaeNia La Rodé | University of Leicester

Day 1: PlyMSEF

Tuesday 23rd April

Venue(s): Plymouth Marine Laboratory | Marine Biological Association

Time

14:30 – 15:00 **Poster flash talks**

Spatiotemporal variability in population structure and associated assemblages of the warm-temperate kelp *S. polyschides*
Nora Salland | Marine Biological Association

The biodiversity value of South Cornwall's seagrass beds
Emily Sissons | University of Exeter

Middens to Markets: Exploring Historical Global Distribution of Limpet Consumption
Thalia Stinton | University of Plymouth

The many faces of functional traits: the case of benthic ecosystems
Irene Susini | University of Plymouth

To kill or not to kill: deciphering the mechanism behind a facultative algicidal marine bacterium
Courtney Swink | Marine Biological Association, University of Exeter

Characterising the expression and function of myoinhibitory peptide in the pre-settlement pediveliger stage of the Pacific oyster, *Crassostrea gigas*
Callum Teeling | University of Exeter

15:00 – 15:30 **Walk over to the Marine Biological Association**

15:30 – 16:30 **Poster Session**

16:30 – 17:00 **Prizes PlyMSEF judges**

17:00 – 19:00 **Social Event**

Day 2: MBA PGR

Wednesday 24th April

Venue: University of Plymouth | Rolle Building Room 605

Time

08:30 – 09:00 **Arrival and breakfast**

09:10 – 09:50 **Keynote**
Dr Nicola Foster | University of Plymouth

09:50 – 10:35 **Ecology Theme Presentations**

09:50 – 10:05 **The ecological and evolutionary consequences of tropicalisation: a case study from intertidal gastropods**
Karolina Zarzyczny

10:05 – 10:20 **Venomous Insights: Understanding Ecological Dynamics of Sea Anemone (*Bunodosoma goanense*) through Tissue-Specific Venom Correlation**
Cecelia Menezes | CSIR-National Institute of Oceanography

10:20 – 10:35 **Quantifying Rates of Growth, Erosion and Dislodgment of Cultivated Kelp in the UK**
Maxine Cavin | Marine Biological Association

10:35 – 11:00 **Tea break**

11:00 – 11:45 **Presentations**

11:00 – 11:15 **Quantifying blue carbon storage in Plymouth Sound seagrass beds to support development of a Carbon Code**
Jessica Cramp | University of Plymouth

11:15 – 11:30 **Expansion of temperate intertidal seagrass meadows without intervention: what are the blue carbon ramifications?**
Oliver Thomas | University of Plymouth

11:30 – 11:45 **Developing approaches for UK kelp restoration**
Cat Wilding | Marine Biological Association

11:45 – 12:30 **Panel discussion**

Day 2: MBA PGR

Wednesday 24th April

Venue: University of Plymouth | Rolle Building Room 605

Time

12:30 – 13:30 **Lunch**

13:30 – 14:10 **Keynote**
Dr Abigail McQuatters-Gollop | University of Plymouth

14:10 – 14:55 **Applied Theme Presentations**

14:10 – 14:25 **How can fisheries' operations contribute to the global nature positive goal?**
Stefanía Ásta Karlsdóttir | University of Oxford

14:25 – 14:40 **Sharks on the Menu: An assessment of the Consumption of Elasmobranchs in Sri Lanka**
Shathuki Perera | University of Oxford

14:40 – 14:55 **The potential of plankton as indicators of changes to marine natural capital assets**
Matthew Faith | University of Plymouth

14:55 – 15:30 **Tea break**

15:30 – 16:00 Presentations

15:30 – 15:45 **Assessing the ecological effects of an experimental scallop ranch in Torbay**
Amy Cartwright | University of Plymouth

15:45 – 16:00 **An investigation into stakeholders' perceptions of eco-engineered structures and their value**
Jessica Allen | University of Plymouth

16:00 – 17:00 **Panel discussion**

18:30 – 23:00 **Conference Dinner | National Marine Aquarium**

Day 3: MBA PGR

Thursday 25th April

Venue: University of Plymouth | Rolle Building Room 605

Time

08:30 – 09:00 **Arrival and refreshments**

09:10 – 09:50 **Connectivity Keynote**
Dr Lilian Lieber | Marine Biological Association

09:50 – 10:20 **Presentations**

- **09:50 – 10:05** **Environmental and biological drivers are good predictors of long-term variability in NE Atlantic plankton communities**
  Matthew Holland | University of Plymouth
- **10:05 – 10:20** **How does surface topography determine abundance and spatial distribution of key benthic species?**
  Franz Bauer, University of Plymouth

10:20 – 11:00 **Tea break**

11:00 – 11:45 **Presentations**

- **11:00 – 11:15** **Exploring ocean warming impacts on Northeast Atlantic kelp forests: a comprehensive investigation using field studies and experimental approaches**
  Nora Salland | Marine Biological Association
- **11:15 – 11:30** **Connecting the dots in Anthropocene seascapes: Assessing the role of connectivity in community assembly along the southern UK coastline**
  Laura Bachmaier | University of Plymouth

11:30 – 12:30 **Panel discussion**

12:30 – 13:30 **Lunch**

Day 3: MBA PGR

Thursday 25th April

Venue: University of Plymouth | Rolle Building Room 605

Time

13:30 – 15:30	**Workshop | Designing Story Board** Hannah Whitman
15:30 – 16:00	**Tea break**
16:00 – 16:30	**Prizes**
16:30 – 17:00	**Closing remarks** Maya Plass | Marine Biological Association
17:00	**Conferences Closes**

PlyMSEF Abstracts

Presentation Abstracts

Challenges in Life Cycle Assessment for Composites: LCI data quality assessment

Badr Moutik | University of Plymouth

The assessment of environmental impacts of composite materials through Life Cycle Assessment (LCA) is increasingly crucial for sustainable development. Central to this is the integrity of Life Cycle Inventory (LCI) data. This presentation addresses the challenges in ensuring data quality within LCI, a key factor affecting the validity and the overall reliability of LCA studies for composites. The presentation delves into the assessment of data quality for major composite materials, drawing from principal sources in the field. The discussion extends to practical approaches aimed at refining data accuracy and enhancing the integrity of environmental impact evaluations for composites.

Assessing Local Adaptation in Macroalgal Microbiomes

Shauna Corr | Plymouth Marine Laboratory

Macroalgae are host to a wide variety of bacteria with which they form chemically mediated relationships, operating as a unified holobiont. Host fitness is often reliant on this symbiosis, with interactions from epiphytic bacteria necessary for the correct physiological functioning, health, development, and resilience of the seaweed. As macroalgae provide a plethora of ecosystem services and commercial benefits, understanding these interactions and how they affect host condition and viability is important. To enhance fitness, seaweeds exert a strong selective pressure over the settlement of their microbial community through their chemical structure and metabolites, possibly creating species-specific ecological niches. However, whilst many studies have investigated how algal-bacterial associations shift between species and location, it is not yet known whether microbial communities are locally adapted. Local adaptation occurs when environmental perturbations cause divergent selection, initiating the evolution of beneficial traits granting a fitness advantage under local conditions. To resolve this question, reciprocal transplants via a novel isolation strategy were conducted to test whether a sympatric or allopatric host environment conferred a greater fitness advantage to host associated epibacteria. Transplants were performed on two seaweed species native to the North-East Atlantic, Palmaria palmata and Fucus serratus. Results depicted higher fitness for both species' isolates in sympatric over allopatric environments. Results confirm that macroalgae may structure their epibacterial community through chemical selection causing epibacteria to become locally adapted. Nevertheless, this ability is variable between species and may be a consequence of differences in epibacterial diversity, chemical structure, and exuded metabolites.

PlyMSEF Abstracts

Presentation Abstracts

Controls of NH3 air-sea flux in southwest UK: Seasonal trends and drivers of sources and sinks

Simone Louw | Plymouth Marine Laboratory

NH_3 is the most abundant base gas in the atmosphere and has an important neutralising role in new particle formation, which affects aerosol radiative forcing. Within the marine boundary layer (MBL), NH_3 impacts the climate by contributing to the nitrogen cycle and impacting the air-sea exchange of greenhouse gasses. Once in the surface ocean, NH_3 assumes a vital role in nutrient recycling and redistribution. However, our understanding of the mechanistic processes governing NH_3 air-sea exchange in the MBL is limited by sparse atmospheric observations. Penlee Point Atmospheric Observatory is situated along the Cornwall coast (South West United Kingdom), and presents a unique opportunity to study NH_3 sources and sinks in the coastal MBL. Since January 2022, atmospheric NH_3, aerosol ammonium (NH_4^+), and seawater NH_4^+ were measured. The magnitude and direction of NH_3 air-sea flux were estimated and potential sources and processes contributing to its seasonal variability were identified. The NH_3 flux was mostly negative, indicative of NH_3 transfer from the air to water, likely driven by gradients between atmospheric and seawater concentrations. A distinct source of atmospheric NH_3 were identified as agricultureactivities. Observations of NH_3 in coastal MBL provided valuable insights into how NH_3 affects both regional atmospheric chemistry and surface ocean biogeochemistry, helping us better understand and manage these important marine ecosystem.

Purified Brewers' Yeast – Derived functional feed additives alleviate soybean meal-induced enteritis in Atlantic salmon parr

Taofik Adeiza Momoh | University of Plymouth

The inclusion of high levels of soybean meal and other plant ingredients have been shown to trigger inflammatory response and induce dysbiosis in the distal intestine of Atlantic salmon. Functional feed additives (FFAs) such as brewers' yeast (Saccharomyces cerevisiae) may confer immunomodulatory effects in fish. In this experiment, we investigated the ability of two brewers' yeast FFAs from Leiber GmBH to modulate the known pathological effects of high SBM in Atlantic salmon parr. Product A (β-glucan) contains cell wall extracts rich in β-1,3 and -1,6-glucans while product B (yeast extract) is made of soluble dried cell extracts rich in amino acids, glutamic acids, nucleotides and peptides. A total of 450 salmon parr (ca. 24 g) were randomly assigned into 15 experimental units and fed one of 5 experimental diets: 1] Neg_ctrl (0% SBM), 2] Pos_ctrl (30% SBM), PβG (30% SBM + 0.02% β-glucan), SDYE_1 (30% SBM + 1% yeast extract) and SDYE_2.5 (30 % SBM + 2.5% yeast extract), with each treatment replicated three times. Fish were fed between 1% - 2% of body weight per day with feeding rate adjusted following periodic batch weighing. At the end of the experiment, samples of skin and distal intestine samples were collected for light microscopy, scanning and transmission electron microscope, gene expression, and microbiome analysis following relevant protocols. The results from this experiment showed that the high SBM treatment (Pos_ctrl) induced extensive signs of enteritis with significantly wider lamina propria and higher density of goblet cells in the epithelium than the Neg_ctrl diet.

PlyMSEF Abstracts

Presentation Abstracts

Growth in the margins: field measured protein metabolism rates in the keystone, intertidal limpet, *Patella vulgata*

Ignacio Alvarez-Cienfuegos | University of Plymouth

Seasonality in both shell and soft tissue growth has been reported in intertidal molluscs since early rocky shore studies. Reproductive cycle, shore height and annual changes in food availability and temperature, among other factors, have an effect on growth in these species. Protein metabolism, a key biological process responsible for tissue growth, has also proven to be aligned with seasonal changes in temperature and food availability in other species. However, to date no studies have measured protein metabolism in the field in any organism. The common limpet Patella vulgata is ubiquitous to North-Eastern Atlantic intertidal rocky shores. Their growth is reduced in summer, during gametogenesis, and in winter compared to autumn and spring. Low shore populations, formed by younger individuals, show faster growth compared to their higher shore conspecifics. No studies had previously examined protein metabolism in P. vulgata, and it was unclear whether growth patterns would extrapolate to protein synthesis (ks), degradation (kd) and growth (kg) rates. Here, we measured growth, protein metabolism and oxidative stress in P. vulgata in the field over a year, at three different shore heights. Shore height had a significant effect on ks and mass growth and there were significant seasonal variations in protein metabolism, mass growth and oxidative stress. ks was highest in spring, whereas kg peaked in summer and decreased in spring due to increased kd. Total mass growth rates were higher in winter, especially in low shore animals. Tissue mass growth rates were higher in spring/summer compared to winter/autumn. This study demonstrates that reproductive cycle appears to drive seasonal variations in protein metabolism and tissue growth in P. vulgata.

Ocean Acidification and the UK

Lily Anna Stokes | Plymouth Marine Laboratory, University of Plymouth

Exceeding 414 ppm, atmospheric carbon dioxide (CO2) is currently 50% greater than it was prior to the industrial revolution. An estimated 25-30% is absorbed by the ocean providing a buffer for the atmosphere at the cost of increasing the acidity of the seas. Here we are reviewing the current status of the UK marine environment in relation to Ocean Acidification (OA) and assessing the vulnerability of key habitats and biota as part of a PhD project to Build Evidence for Action. Starting in the South West of England we are collecting near-shore water samples and recording the biota present. Dissolved inorganic Carbon (DIC) and Total Alkalinity (TA) will be measured from these samples to assess the current state of the carbonate chemistry at each sample site. Results will be validated against model outputs to ascertain the effectiveness of offshore measurements and predictions in representing the nearshore environment. Species composition and abundance at each site will be compared with relevant literature and the measured carbonate chemistry to build a risk-register specific to the UK marine environment. The outputs of this project aim to provide an understanding of the relationship between OA and the UK.

PlyMSEF Abstracts

Presentation Abstracts

Investigating the potential impacts of Direct Ocean Capture on blue mussels

Guy Hooper | Plymouth Marine Laboratory

Marine-based Carbon Dioxide Removal (mCDR) is a rapidly evolving subject area. Electrochemical Direct Ocean Capture (eDOC) is a developing CDR technology that facilitates atmospheric CO2 removal by extracting Dissolved Inorganic Carbon (DIC) from seawater. Decarbonated seawater, that also has a high pH, is released into the marine environment, facilitating the drawdown of atmospheric CO¬2 into the surface ocean. Currently there is no research that investigates the impact of eDOC on marine ecosystems. This work presents results from laboratory experiments that examine the physiological response of keystone organisms to decarbonated and high pH seawater. Decarbonated high pH seawater released into the environment will be diluted by mixing with ambient seawater, such that the chemical perturbations become less extreme with distance from source. Intertidal mussels (Mytilus edulis) are a keystone species that utilize DIC for major cellular functions and have poor acid-base balance. Mussels were exposed to three different dilutions of decarbonated high pH seawater (generating pH values of approximately, 10, 9.2 and 8.7). Mortality, oxygen consumption rate and filtering rate were measured after short-term (48 hr) exposure and then 48 hrs after returning to ambient seawater. Initial experiments indicate that undiluted decarbonated high pH seawater has a significant short-term impact on the physiological response of Mytilus edulis, but the species shows signs of recovery following 48 hours in ambient seawater. Data from these and other experiments will be used to generate a risk gradient that illustrates how physiological response(s) change with dilution of low carbon, high pH seawater discharge.

A Density Mystery: The Interplay of Cell Density and Stress Signalling Responses in Marine Diatoms

Ellie Murphy | Marine Biological Association

Diatoms are important primary producers in marine and freshwater environments. However, very little is currently known about the mechanisms that marine diatoms use to detect and respond to stress conditions in their surrounding environment. Calcium signalling is used by all eukaryotic organisms to perceive and respond to environmental stimuli. With the rapid improvement of imaging techniques, we are now able to discern the involvement of calcium signalling in specific diatom stress responses. We investigated how cell density affects calcium-mediated stress signalling in the model diatom *Phaeodactylum tricornutum*. It is apparent that the cell density of a diatom culture plays an important role in cell physiology and signalling. Our results suggest that cells in lower density cultures show a higher responsiveness to certain stress signals compared to cells in higher density cultures. We are in the process of investigating the molecular mechanisms behind this density-dependent change in cell status. Enhanced understanding of these signalling processes will support ongoing research into how a changing marine environment will impact diatoms over coming years.

PlyMSEF Abstracts

Poster Abstracts

Ocean Eyes: Developing novel optical proxies of particulate iron in the ocean

Tess Ashen | University of Plymouth

Iron (Fe) is an essential micronutrient and its availability relative to other nutrients impacts phytoplankton growth in the ocean. Phytoplankton are the primary producers in marine food web and drive significant atmospheric CO_2 uptake by the ocean. Extensive research has been devoted to better understanding the Fe cycle and accurately determining and monitoring the most bioavailable dissolved phase (dFe, <0.2 µm). There remains a gap in knowledge as to how particulate Fe (pFe, >0.2 µm) contributes to the 'Fe pool', despite results indicating that pFe is significant and can exceed dFe concentrations. Fe is readily cycled between dissolved and particulate phases, but little is known of the oceanic pFe composition and distribution relative to dFe. A lack of marine pFe data is due to the lengthy processing time and intensive analysis required for discrete samples. Optical sensors on autonomous marine monitoring systems potentially offer a tractable alternative proxy method for assessing pFe, giving promise of greater temporal resolution, access to remote environments and unveiling pFe information from archival datasets. The aim of this study is to develop methods to estimate pFe concentrations using optical techniques (scattering, absorbance and fluorescence) that work in conjunction with existing and emergent sensing technologies. In this presentation we review the current techniques used in marine particulate trace metal research and evaluate potential analytical techniques, with preliminary data, to develop optical proxies. Successful in-situ application will facilitate a greater understanding of the spatial-temporal oceanic distribution of pFe and improve estimations of the global ocean iron budget.

PlyMSEF Abstracts

Poster Abstracts

Ecological Implications of Climate-Driven Shifts in Kelp Species Distributions: A Focus on Stipe-Associated Secondary Foundation Species

Fraser Brough | Marine Biological Association

Kelp forests are distributed along around 25% of the global coastline and represent crucial marine ecosystems playing a pivotal role in supporting biodiversity and maintaining ecological processes. In both the subtidal and low intertidal environments, kelp serve as foundation species creating structurally complex habitats offering refuge and sustenance for diverse marine life, from invertebrates to commercially- important fish species, sea birds and mammals. These biogenic habitats are often colonised by epiphytes which in turn serve as a secondary foundation species further increasing biodiversity through a facilitation cascade. In the UK, the kelp Laminaria hyperborea supports numerous red algae epiphytes growing on its stipe and the highly diverse and abundant stipe- associated faunal communities are well documented across the region. L. hyperborea is a cold-water species and as ocean temperatures increase, warm-water adapted species such as Laminaria ochroleuca have become increasingly competitive and abundant. Although providing a seemingly similar primary habitat, L. ochroleuca does not support the same richness and biomass of secondary foundation species as L. hyperborea stipes. Previous work has highlighted the importance of different habitat architecture for the attraction of kelp fauna and with continued climate change leading to range shifts in kelp species it is vital to understand how faunal diversity and abundance may be impacted due to the breakdown of a facilitation cascade. Here we outline our aims to quantify and compare the structure (i.e. community composition) and functioning (i.e. net primary production) of stipe assemblages associated with both warm-adapted and cold-adapted kelp species, through a series of field surveys and ex situ incubation experiments.

Wave Attenuation by Natural Habitats

Jack Duffy | Newcastle University

The use of natural habitats for coastal protection, so called Nature Based Solutions (NBS), whether by themselves or as part of an integrated shore defence network of manmade and natural structures, is seeing increasing prevalence around the world. Foundational species, and the complex three-dimensional habitats they form, such as kelp forests, oyster reefs and seagrass meadows are the most promising candidates for this function. However, the results of studies investigating these species' roles in wave energy attenuation and coastal defence, whether in situ or in laboratory trials, have been conflicting. There remains a lack of understanding about how these habitats affect wave energy attenuation, their performance under different environmental conditions and the relationship between habitat density and wave attenuation.

PlyMSEF Abstracts

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Further, given the global trends in sea-level rise, storm frequency and storm intensity, a robust future-proofed shore defence plan based on these habitats must consider their expected performances under predicted IPCC climate change scenarios. This project aims to understand the wave attenuation effects of seagrass, kelp and oysters, using scaled mimics of these habitats in flume tank laboratory trials. Using the results of these flume trials, combined with numerical modelling, this project will determine the optimal habitat restoration density, such that cost is minimised relative to wave attenuation, and evaluate the wave attenuation performance of these habitats under potential IPCC climate change scenarios.

A comparative study on the ultrastructure of Cnidarian sensory apical organs

Sophie den Hartog | University of Exeter

Suitable substrate selection, subsequent settlement and metamorphosis are key processes in the marine invertebrate life cycle. These processes influence an organism's development as well as shaping marine benthic communities and are driven by the detection of environmental cues. Apical organs are sensory structures present in numerous marine invertebrate larvae across taxa. Though studies on this organ are limited, it is widely accepted that it plays a critical role in the detection of larval settlement cues. Primarily because the organ tends to disappear after the larval stage. Despite the importance of the apical organ, studies on this structure have only been undertaken in a few select species, and as such its function and evolution are yet to be fully understood. Here, we explore the differences and similarities in both external morphology and internal structure of the apical organ between Cnidarian and Bilaterian species, using scanning and transmission electron microscopy. We are generating high-resolution spatial maps of cell types within apical organs of Bilaterian larvae Platynereis dumerilii, and Anthozoan Cnidarian larvae Acropora Millepora (Scleractinia), Nematostella vectensis and Aiptasia spp. (Actiniaria). These morphological insights will allow us to generate hypotheses on the function of various of cell types, as well as the apical organ as a whole. Our comparative resource of apical organ cell-type composition and morphology between sister groups Cnidaria and Bilateria will provide insight into the evolutionary history and origins of this elusive sensory organ.

PlyMSEF Abstracts

Poster Abstracts

Abundance and distribution of cetaceans in the western English Channel, and their exposure to key threats

Bethany Jo Harvey | University of Plymouth

The English Channel, one of the world's busiest shipping lanes, is heavily impacted by industries including fisheries, offshore wind and recreational boating. These waters are also habitat for multiple cetacean species. Despite this, cetacean abundance and distribution in the western English Channel are poorly understood. Data from the University of Plymouth's ongoing visual and passive acoustic surveys (conducted in the summer months of 2017-23 over 47 days), provides novel insights into the distributions of cetaceans in the coastal region (<6nm from shore) from Plymouth to the Isles of Scilly. Common dolphins (Delphinus delphis) and harbour porpoises (Phocoena phocoena) were most abundant with an average of 0.79 and 0.43 seen per hour, respectively. Minke whales (Balaenoptera acutorostrata), bottlenose (Tursiops truncatus), Risso's (Grampus griseus) and white-beaked (Lagenorhynchus albirostris) dolphins were less common. The towed hydrophone doubled the detection rates of harbour porpoises compared to visual sightings alone. Distance sampling of P. phocoena acoustic data indicated higher densities in late summer compared to early summer and higher probability of presence in shallower near-coastal areas, and around the Isles of Scilly. Supplementary to boat surveys, continuous passive acoustic monitoring at the mouth of Plymouth Sound has highlighted the overlap of cetacean vocalisations with vessel noise. Winter detections of both harbour porpoises and common dolphins were higher than in summer, with increased echolocation rates at night. With anthropogenic pressures increasing, knowledge of distribution and exposure to key threats such as noise pollution and bycatch is vital for conservation efforts and policymakers.

Larval Connectivity Modelling for Porifera Populations Beneath an Antarctic Ice Shelf

Andrew James Hoggett | Newcastle University

The discovery of a small sponge assemblage on a boulder beneath the Filchner-Ronne Ice Shelf in the Weddell Sea was the first sessile life observed within an ice shelf cavity. This study utilises a hydrodynamic model operational within the WED025 domain – encompassing the Weddell Sea and surrounding ice shelves – to investigate whether pathways of larval connectivity exist between the sponge grounds of the Weddell Sea and the boulder assemblage observed beneath the Filchner-Ronne Ice Shelf. The developed model is an active sponge lifecycle model in which the dynamics of the planktonic larval stage and the mature, sessile stage are parameterised, and it is the first of its kind to be developed for sponges within the Weddell Sea.

PlyMSEF Abstracts

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Several dispersal simulations have been conducted – the first set being short-term simulations to assess the maximum and minimum extent of dispersal within one spawning cycle, and the second set being 25-year simulations to assess whether larval connectivity exists between sponge populations on Berkner Bank and the Eckström Shelf, and the boulder assemblage observed within the Filchner-Ronne Ice Shelf cavity. Our simulations show a clear dispersal pathway into the ice shelf cavity via the current inflow across Berkner Bank and conclude that there is clear connectivity potential between sponge populations under suitable environmental conditions. Further refinement of our sponge lifecycle model is necessary, and higher resolution bathymetric data is required to begin to implement habitat suitability mapping into our modelling approach.

Seagrass Recovery and Restoration in a Bay of International Conservation Importance

Charlotte Jennings | Newcastle University

Nuisance macroalgal blooms are on the rise globally, driven by anthropogenic drivers such as eutrophication and climate warming. Once established, macroalgal blooms can have significant negative impacts on biodiversity, ecosystem functioning and amenity value. As a consequence, there is increasing interest in identifying and reducing the impacts of these blooms and in developing sustainable methodologies to remove them. Lindisfarne National Nature Reserve in Northumberland is of significant conservation importance (SAC, SPA, underpinned by a SSSI, adjacent an MCZ), but is increasingly subjected to blooms of opportunistic algae driven by, for example, diffuse agricultural pollution. The resulting eutrophication is having a negative impact on one of the main conservation features of this site, intertidal Zostera seagrass meadows. We are currently undertaking research to determine the impacts of opportunistic macroalgae on seagrass morphology and productivity at the same time as investigating methods for the sustainable removal of nuisance macroalgae without harming seagrass. Finally, we are also trialling methods for seagrass restoration that have proven to be successful in other parts of the UK.

Dissecting the Gene Regulatory Networks Downstream of the BMP and Activin/Nodal pathways in the Spiralians *Owenia fusiformis* and *Platynereis dumerilii*

Imran Luqman | Marine Biological Association, University of Exeter

Investigating the molecular processes behind Bilaterian body axis formation and their conservation throughout animal evolution is crucial in understanding the foundation of Metazoan body plans. The TGF- β superfamily is one of the main pathways responsible for dorsoventral patterning in Bilaterians, but its developmental role is not well-known in spiralians. To help reach a consensus on DV patterning in Spiralians, we employ Owenia fusiformis, a potential sister group to all annelids, and Platynereis dumerilii, a member of a distant sister group to Owenia (Errantia) to dissect the gene regulatory networks triggered by the TGF- β superfamily.

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We used chemical treatments to promote or inhibit the BMP and Activin/Nodal pathways during early axial specification for RNA-seq analyses. Due to logistical constraints, experiments of Activin/Nodal on Platynereis was not viable. We then executed gene expression analyses (in-situ hybridisation) and immunostaining protocols to validate differentially expressed genes. Bioinformatic analyses conducted on Owenia showed that disrupting the TGF- β pathways impaired genes involved in morphogenesis, polarity, organ development, and RNA transcription. Furthermore, shortlisted gene candidates were strongly expressed either during or after the formation of the embryonic organiser; thus revealing spatial and temporal expression of gene candidates. Contrastingly, disrupting the BMP pathway in Platynereis did not seem to affect its DV axis, which was also evident in other major annelid groups. Therefore, this report provided evidence that the BMP pathway may have been lost throughout annelid evolution as it is currently seen in an ancient annelid member (Owenia), but not in more modern representatives.

Climate linked microbial interactions in green tide causing seaweed

Catherine Philip | Plymouth Marine Laboratory

Dimethyl sulfoniopropionate (DMSP) is one of Earth's most abundant organosulfur molecules and Ulva seaweeds, which cause green tides, are prolific DMSP producers. Ulva species produce DMSP as an anti-stress compound and can cleave DMSP to liberate the climate-cooling gas dimethylsulfide (DMS), but the precise role of DMSP in Ulva is unclear. Furthermore, DMSP released by Ulva into the environment has roles in signalling and recruiting beneficial bacteria, which use DMSP as a nutrient and facilitate further DMS production. Ulva seaweeds when exposed during low tide emersions prepares itself for desiccation in addition to the subsequent rehydration. The role of DMSP in this instance is unknown. The current study investigates the effects of desiccation on DMSP production in Ulva and analyses the bacterial population that metabolises Ulva produced DMSP. This is part of a larger study that addresses knowledge gaps on: how and why seaweeds produce DMSP and DMS; how environmental changes impact these processes; and which bacteria utilise Ulva-produced DMSP and how.

The Use Of Heart Rate Monitors To Determine The Effects Of Environmental Stressors In The Common Shore Crab (*Carcinus Maenas*)

Emily Price | University of Portsmouth

Wearable technologies have advanced substantially in the human fitness and health field and offer huge potential for the monitoring of wildlife. In this study, we aimed to determine the utility of wearable fitness watches as a non-invasive method to monitor the health of crabs. Traditional methods examining the physiology of decapod crustaceans have used wired approaches which are invasive and logically challenging for environmental toxicology. The objective of the study was to determine whether over-the-counter fitness watches could be utilised to monitor heart rate in a decapod crustacean (Common shore crab, Carcinus maenus).

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The accuracy and reliability of these devices are being explored through a series of ongoing experiments using temperature and cardio stimulants. Results so far indicate that fitness watches can detect crab heartbeats through the carapace at rates equivalent to former studies with some clear peaks through handling stress. While there is still considerable optimisation required and the determination of baseline data, these preliminary results point huge potential in this approach to in vivo studies in the laboratory or in situ monitoring in the environment.

Shipwrecks: Rusty Relics to Carbon Capital

Rachael Priest | Newcastle University

Deep oceans, seagrass beds, mudflats, and mangroves are examples of marine ecosystems that provide us with essential services. These services include carbon capture, coastal protection, and food provision, but with the growing human population, increasing demands are being placed on the marine environment and the services that it provides. As such, it is important that we are able to quantify and assess marine services to ensure sustainable management. One marine service that is often overlooked, is offered by shipwrecks. Over 37,000 of shipwrecks litter the English coast, providing sanctuary to marine species. This has implications for biodiversity and carbon storage on shipwreck sites, but it is unclear to what extent shipwrecks impact the distribution of benthic carbon stores. We investigate the potential distribution of benthic carbon stores across several shipwrecks, from the Tyne to Tees, England. Whilst shipwrecks are known to be biodiversity hotspots, there is a need for more in-depth understanding of the benthic seafloor surrounding them. This research broadens the services that shipwrecks offer and highlights the need to include them as carbon providing ecosystem services.

Quantifying ecological impacts and changes to ecosystem services as a result of seaweed aquaculture

Jasmine Ramshaw | Marine Biological Association

Seaweed aquaculture is a rapidly growing industry, currently accounting for 20% of global aquaculture biomass. It holds vast potential for innovation and sustainability within various sectors, including: pharmaceuticals, cosmetics, agriculture, and food production. In the UK, the industry is in its infancy. The primary challenge facing the expansion of UK seaweed aquaculture is a lack of understanding of its potential ecological and socioeconomic benefits and impacts. This project aims to address this lack of understanding by collecting data from multiple UK-based seaweed farms, employing diverse methodologies such as: 1) Deployment of remote sampling gear (e.g. underwater video) and undertaking of stakeholder surveys to assess the farms' impacts on local biodiversity, focusing on key fisheries species. 2) eDNA sequencing to assess how farm presence affects local microbial assemblages, with a focus on human health and fishery contamination. 3) Photorespirometry chamber experiments and sediment core collection to assess seaweed aquaculture's potential contribution to carbon capture and sequestration. Additionally, project data, existing literature, and stakeholder insights will be collated and synthesised to create an ecosystem services model. The project's overall aim is to generate information needed to inform policy and development decisions, facilitating the sustainable expansion of the seaweed industry in the UK.

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Combining local fisheries knowledge with ecological methods to identify critical elasmobranch habitats

Chloe Renn | University of Plymouth

Understanding elasmobranch (sharks and rays) critical habitats is crucial for effective conservation and management efforts. This research aims to merge social science approaches with ecological methodologies to identify and delineate vital habitats for elasmobranchs in the Southwest UK. By integrating traditional ecological surveys with insights gathered from local fishers, this PhD primarily endeavors to create a comprehensive map of elasmobranch habitats to inform spatial management. Collaborative efforts involving fishers' observations, combined with scientific methodologies such as underwater surveys and acoustic telemetry, will enable the identification of key areas utilized by elasmobranchs during essential stages of development and important behaviours. The PhD will be broadly divided into the following parts. Firstly, a literature review will be conducted to explore the opportunities presented at the interface between social science and spatial ecology methods. The second chapter will employ semi-structured interviews to summarise knowledge from commercial and recreational fishermen, this will be combined with a range of data sources, including catch and release angling data to create a comprehensive review of elasmobranch habitats (Southwest UK). The third chapter will explore thornback ray (Raja clavata) movement in South Devon in relation to protected areas and the UK's largest mussel farm. The final chapter will develop and validate ultrasonography as a method for assessing pregnancy in coastal sharks to identify pregnant female habitats. Ultimately, this research aims to facilitate the sustainable management of elasmobranch populations by pinpointing critical habitats in the Southwest UK, fostering a harmonious balance between conservation and local fisheries.

A New Reference Genome of Ctenophore, *Pleurobrachia pileus*

DaeNia La Rodé | University of Leicester

Ctenophores are a phylum of non-bilaterian marine species representing one of the earliest branching animal groups. Studying ctenophores creates opportunities to understand the early evolution of animals. We focused on Pleurobrachia pileus, a species native to the UK and Ireland considering the Darwin Tree of Life Project sequencing species found in the UK and Ireland, with only six of these organisms sequenced to date. This project will offer an opportunity for future comparative downstream phylogenetic analyses. We aim to generate the first high-quality reference genome for Pleurobrachia pileus, combining both long and short-read sequencing. Using a series of High Molecular weight DNA Extraction methods, we extracted DNA from slow-frozen Pleurobrachia pileus, which was then sequenced using Illumina Whole Genome Sequencing for short reads, and PacBio HiFi for long reads. This ongoing genome assembly uses an amalgamation of pipelines combining long and short-read assembly processes. The extracted DNA for sequencing yielded 11.1 ng/µl for long-read sequencing and 17.6 ng/µl with two combined samples for short-read sequencing. The sequencing done used PacBio's Sequel IIe and Illumina's NovaSeq 6000 S4 resulting in an ~89% confidence of correct base calling during sequencing.

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Spatiotemporal variability in population structure and associated assemblages of the warm-temperate kelp *S. polyschides*

Nora Salland | Marine Biological Association

The warm-temperate Lusitanian pseudo-kelp Saccorhiza polyschides, has proliferated markedly in the SW of England in recent decades. We investigated this species during two field surveys in Plymouth Sound: The primary survey focused on its population demography (over a duration of 15 months on intertidal populations, and three months of subtidal populations), and the secondary survey focused on its associated assemblages (three months during growth peak season, intertidal and subtidal populations). S. polyschides dominated shallow rocky habitats in summer, with consistently high density and standing stock values recorded across survey sites. The structure of associated faunal assemblages was quantified to assess the ecological role of this species as a biogenic habitat former. Different morpho-structural components (e.g., the blade, stipe, and holdfast) offered distinct living space, shelter, nursery and foraging grounds for associated fauna, including gastropod grazers and small coastal fishes. However, the short-lived sporophytes provided only temporary, highly seasonal habitats, with greatly reduced habitat availability in winter. With ongoing ocean warming, continued proliferation of S. polyschides is expected, with replacement of some cold-adapted kelp species likely to induce wider changes in kelp habitat structure and functioning. The results presented provide a robust baseline for further monitoring.

The biodiversity value of South Cornwall's seagrass beds

Emily Sissons | University of Exeter

Overview: Seagrass beds are crucial biodiversity hotspots, and nursery habitats for many marine species. They create beautiful green underwater meadows in sheltered UK coastline areas. They also sequester and store carbon, forming 'blue carbon' reserves. Protection of seagrass beds is, therefore, key to battling climate change and maintaining marine biodiversity and ecosystem function. Aims and hypotheses: There has been a significant decline in the health of UK seagrass beds over the past century. It is expected that South Cornwall's seagrass beds will exhibit signs of deterioration and altered properties. There is a lack of scientific information and public awareness on the vital role of seagrass in carbon sequestration and as a nursery for species including sharks, fish and crabs. Therefore, this research aims to measure the carbon sequestration capacity of Cornish seagrass beds, and identify the network of marine species they support. Methodology: Deployment of Baited Remote Underwater Video Systems (BRUVS) in seagrass beds will be used to collect data on the health of the seagrass beds and the species assemblages present within them. Sediment extraction and analysis will be used to measure the carbon content of the sea-floor sediment beneath the seagrass beds. This research is being performed for an MSc thesis. Results: At the time of the MBA conference, fieldwork and data collection will have taken place for 1 month. Results will not yet be available, however, data analysis will have begun and preliminary trends explored.

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Middens to Markets: Exploring Historical Global Distribution of Limpet Consumption

Thalia Stinton | University of Plymouth

Coastal environments harbor an abundance of ecosystem services, with provisioning services playing a pivotal role by continuously supplying humans with consumable resources, such as limpets. Limpets have been a dietary staple since the Pleistocene era, leaving traces in archaeological middens and modern fishery data. While localised studies have delved into historical limpet consumption, a comprehensive global analysis remains elusive. Moreover, the Azores lack an evaluation of limpet recovery following the population collapse of the 1980s, unlike surrounding archipelagos. Conducting a systematic review, we aimed to elucidate the global distribution of limpet consumption and its prevalent locations. Additionally, we assessed the extent of limpet recovery in the Azores using multifaceted criteria: (a) landing weight, (b) economic value (Madeira), and (c) the length of *Patella candei*. Statistical analyses, including chi-squared tests for global distribution and Spearman's rank correlation for recovery trends, provided robust evidence. Our findings revealed a global history of limpet consumption, albeit with notable regional disparities, with South Africa emerging as a prominent consumer. Moreover, our analysis indicated a substantial recovery of limpet populations in the Azores post-collapse. However, to fortify our conclusions, further research into the spatial and temporal presence of limpets in middens is warranted. Additionally, comprehensive analyses of fishery data from the Azores would enhance our understanding of limpet recovery dynamics.

The many faces of functional traits: the case of benthic ecosystems

Irene Susini | University of Plymouth

Functional trait-based approaches have revolutionised our understanding of key ecological processes such as species assembly and biodiversity loss. This focus on traits, rather than on taxonomy, promotes comparability across spatial and organisational scales, further enabling application of trait-based methodologies to systems where species identity is difficult to recognise. Lack of standardisation, however, is preventing trait-based approaches from unlocking their true potential. Here, 87 published research and review articles are reviewed to document inconsistencies in the understanding and use of trait terminology in the context of marine benthic ecosystems. Firstly, existence of four separate classification frameworks, one of which presenting further internal variation, was recorded. Secondly, discrepancies in the operationalisation of key terminology were identified, each term associated with two to seven separate definitions. Lastly, a total of 150 synonyms were noted with respect to 18 traits commonly implemented in benthic research. Considering the escalating societal demands placed on benthic ecosystems, there has never been such a pressing need to align our understanding of the relationship between the physical impact of anthropogenic activities and the function of benthic assemblages. However, it is only by standardising the reporting and storage of trait data that trait-based approaches will realise their full potential.

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To kill or not to kill: deciphering the mechanism behind a facultative algicidal marine bacterium

Courtney Swink | Marine Biological Association, University of Exeter

Diatoms are not only important primary producers in the ocean, but a potential sustainable source of biofuel and other natural products. In the environment diatoms do not live in isolation and interactions with other members of the microbial community can have significant impacts on their growth and productivity. A facultative algicidal bacterium, Ponticoccus alexandrii, has been recently isolated from the Western English Channel and kills diatoms in a species-specific manner. Growth experiments show that conditions promoting algicidal activity of P. alexandrii include exposure to diatom necromass, nutrient starvation and diatom cell senescence. This activity is also cell density dependent, meaning it could be related to bacterial quorum sensing. Initial findings from P. alexandrii genome exploration will also be presented. Further work to understand the mechanism and prevalence behind this microbial interaction is important for understanding the ecological role of opportunistic pathogenic bacteria in the marine environment.

Characterising the expression and function of myoinhibitory peptide in the pre-settlement pediveliger stage of the Pacific oyster, *Crassostrea gigas*

Callum Teeling | University of Exeter

Free-swimming larval stages are a common feature of marine invertebrate developmental cycles. As the larvae develop, they reach a point of competency for settlement out of the plankton and onto the seafloor where they begin their metamorphosis into a juvenile. The initiation of settlement and metamorphosis is likely controlled by the integration of environmental cue input and neural signalling pathways. However, the role of neuropeptide signalling during settlement and metamorphosis is not well known for marine invertebrate larvae. We aim to decipher the signalling pathway and function of a candidate neuropeptide, myoinhibitory peptide (MIP), that we believe to play a key role in this crucial life-stage transition. Here, we present the expression pattern and possible function of MIP in competent pediveliger larvae of the commercially important bivalve mollusc, Crassostrea gigas. MIP positive cells were detected within the cerebro-pleuro ganglia (CPG) and foot of the pediveliger larvae via fluorescent in-situ hybridisation chain reaction (HCR). Immunohistochemistry using a Platynereis dumerilii MIP antibody revealed the foot cells to have a sensory neuron morphology, and MIP cells in the CPG project axons into the velum. Exposing C. gigas pediveligers to different concentrations of MIP did not induce metamorphosis after 24 hours, however, MIP may have initiated the settlement process but without attachment. Future work will look to further characterise the MIP cell morphology and expression in earlier developmental stages of C. gigas and will also be extended to the larval stages of other molluscs, such as the European abalone, Haliotis tuberculata. Further characterisation of the function of MIP during settlement and metamorphosis in mollusc larvae is still required. By unravelling the expression and function of MIP across different marine invertebrates, we can better understand the evolution of neuropeptide signalling during larval settlement. We hope this work will be of interest to marine biologists, neuroscientists, and aquaculture.

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The ecological and evolutionary consequences of tropicalisation: a case study from intertidal gastropods

Karolina Zarzyczny

Tropicalisation is a marine phenomenon arising from contemporary climate change, characterised by the range expansion of tropical species and the retraction of temperate species. Tropicalisation has a multitude of ecological consequences for species, communities and whole ecosystems, but our understanding of its evolutionary consequences remains limited. Here we used distributional and genetic data to document the consequences of tropicalisation in rocky shore gastropods and assess the implications of tropicalisation on phylogeographic patterns. We conducted field surveys spanning over 3,000km along the eastern Pacific rocky coastline and conducted a comparative study genetic study using partial COI gene. We detected tropicalisation along the rocky shore coastline and showed that some range extending species can maintain high levels of genetic diversity. Conversely, tropicalisation may lead to genetic erosion of evolutionarily distinct lineages through range contraction. Species-specific barriers to dispersal are likely to influence patterns of tropicalisation and its consequences in the future.

Venomous Insights: Understanding Ecological Dynamics of Sea Anemone (*Bunodosoma goanense*) through Tissue-Specific Venom Correlation

Cecelia Menezes | CSIR-National Institute of Oceanography

This research investigates the multifaceted ecological interactions of Bunodosoma goanense, a sea anemone species found along the rocky shores of the West Coast of India. These interactions encompass spatial competition, involving encounters with soft corals, alongside predation on shore crabs, mussels, and a facultative mutualistic relationship with a sea snail and their eggs. Additionally, non-clonal intraspecific spatial competition among B. goanense was observed. A focal point of this study concerns the examination of sea anemone venom from three distinct tissues: tentacle, ectoderm, and acontial filaments. Interestingly, venom peptide chromatographic profiles differed significantly among these tissues, hinting at finely tuned adaptations tailored for specific ecological functions. To delineate the involvement of venom in these interactions, we explored the neurotoxic activity of venom fractions against specific voltage-gated ion channels. The findings unveiled selective modulation capabilities within the venom fractions. These correlations between tissue-specific venom and targeted ion channels highlight the role of venom in shaping the sea anemone's ecological interactions. The study provides insights into how the sea anemone's venom, particularly from different tissues, influences its adaptive strategies, contributing to its competitive edge and ecological relationships within the intertidal ecosystem.

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Quantifying Rates of Growth, Erosion and Dislodgment of Cultivated Kelp in the UK

Maxine Cavin | Marine Biological Association

Kelp-dominated habitats are not traditionally considered Blue Carbon ecosystems. However, due to high rates of primary production and carbon export, they may serve as important donors in natural carbon sequestration. While seaweeds, including kelp, have been historically hand-harvested in the UK, cultivation of seaweeds for various products (e.g. nutraceuticals and alginate) is an emerging industry. Kelp farming may also provide additional ecosystem benefits and services, such as enhancing fisheries habitat or elevating carbon sequestration, but the evidence base remains poor. As such, quantifying carbon dynamics in and around kelp farms is crucial to determining their viability as a Blue Carbon climate change mitigation strategy. Over the 6 month growing season, the growth and loss of cultivated Saccharina latissima biomass was monitored at an integrated multi-trophic kelp and mussel farm in Cornwall, UK, to quantify the accumulation of carbon as biomass and the release of particulate organic carbon (POC). A modified hole-punch method was used to monitor both meristematic growth and distal erosion of the blades, and individual plants were tagged to quantify dislodgement rates. Preliminary results demonstrate the pronounced seasonality in productivity and POC dynamics. Next steps include quantifying the release of dissolved organic carbon (DOC) by cultivated S. latissima and quantifying storage of kelp-derived carbon within sediments associated with the farm. This will provide a holistic overview of the carbon dynamics of kelp farms and the capacity for carbon sequestration in sediments below farms.

Quantifying blue carbon storage in Plymouth Sound seagrass beds to support development of a Carbon Code

Jessica Cramp | University of Plymouth

This study aimed to assess sediment carbon stocks and accumulation rates of UK Zostera marina seagrass beds to support the development of a UK Seagrass Carbon Code. For the first time, this study assessed seagrass sediment carbon stocks to great depth at high resolution, to gain detailed understanding of variability with depth and insight into historical patterns. Nine 3 metre cores were collected from 3 sites across Plymouth Sound, UK, using a vibrocorer in August 2022. High resolution analysis, every 1cm, was carried out for Organic Carbon content using Elemental Analysis. A subset of samples were analysed using Loss on Ignition to compare methodologies. 210Pb dating was used to estimate sediment accumulation rates. Initial results for the Drakes Island site displayed high variability in OC content between cores and with depth (average = 4.07% OC, range = 0.25-28% OC). 2 cores displayed distinct peaks in carbon, related to the presence of coal. 210Pb results provided an estimated sedimentation rate range of 0.23-0.33 cm/yr, indicating a 3 m core to date ~1200 years. This study has demonstrated the value of high resolution analysis and highlighted methodologies important for improving our understanding of seagrass carbon stocks and their role in carbon storage.

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Expansion of temperate intertidal seagrass meadows without intervention: what are the blue carbon ramifications?

Oliver Thomas | University of Plymouth

Intertidal seagrass is recovering across many parts of Europe, often without human intervention, including southwest England. Since 2015, we have documented colonisation of bare intertidal mudflat by the seagrass Zostera marina and establishment of two annually stable meadows (25 ha total) in Tamar Estuary locations with no historic records of seagrass. We examined spatiotemporal variability in organic carbon (OC) stocks of these newly-established beds, pre-existing Nanozostera noltei meadows and unvegetated mudflats. Between 2021 and 2023, 70 cores (50 cm depth) were collected across the habitats, and the OC profile of each core (5 cm intervals) was examined using a CHN analyser. OC stocks in the top 50 cm were higher in newly-established Z. marina meadows (Meadow1: 69.28 ± 5.32 MgCha-1; Meadow2: 74.63 ± 7.65 MgCha-1) than an older pre-existing Z. noltei meadow (53.46 ± 4.03 MgCha-1), but lower than adjacent unvegetated mudflats (76.83 ± 5.51 MgCha-1). We recorded significant seasonal variation in carbon stocks between sampled meadows. These findings show that, under favourable conditions, intertidal seagrass can successfully expand into unvegetated sediments without direct intervention, contributing to local OC storage. However, wider patterns and drivers of OC storage in temperate seagrass meadows and unvegetated mudflats require further investigation.

Developing approaches for UK kelp restoration

Cat Wilding | Marine Biological Association

I aim to develop restoration methods for UK kelp species as a precautionary approach. While widespread loss of kelp habitats has yet to be observed in the UK, local declines, species substitutions and range shifts have been widely documented, often impacting on ecological function. In other regions globally, loss of kelp habitats has been driven by anthropogenic stressors, most commonly ocean warming and declining water quality, leading to community-wide shifts to alternative states and loss of kelp-associated ecosystem services. As environmental stressors are predicted to intensify, development of restoration capacity is timely, to allow for fast intervention and promote recovery and resilience where needed. Restoration efforts have also been found to be more cost effective and more likely to succeed when implemented following partial declines, rather than after extensive or complete loss. The project will develop "green gravel" restoration techniques and test the influence of seeding substrate on the efficacy of the approach. Kelp spores will be seeded onto various substrates, including natural stone, fishing industry shell waste and 3D printed "reef" units, under controlled laboratory conditions.

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The influence of substrate type/size on a range of response variables, such as kelp settlement density, attachment strength and growth rate, will be quantified under different hydrodynamic conditions. Following this, substrates seeded with juvenile kelps will be deployed at sea and monitored for retention, attachment to the underlying bedrock, and kelp growth. Continued monitoring of growth rates and habitat structure of 'restored' kelp forests will be conducted and compared with reference habitats.

How can fisheries' operations contribute to the global nature positive goal?

Stefanía Ásta Karlsdóttir | University of Oxford

Amidst global efforts to address biodiversity loss, the concept of 'nature positive' has gained traction as a societal goal aligned with the Global Biodiversity Framework. While the goal is increasingly being embraced by businesses, governments and multilateral government organisations, there remains a gap in understanding how fisheries, a key sector in the global economy, could contribute to it. This study aims to start filling this gap by (1) drawing on literature on the mitigation hierarchy and higher-level transformative actions for businesses to offer a conceptual framework and worked examples outlining how fisheries direct operations could start contributing to the nature positive goal; and (2) gaining insight into the perspectives of a few stakeholders of the relevance of the nature positive goal for fisheries. Our findings indicate that (1) the path towards nature positive will differ considerably between fisheries and knowledge gaps need to be addressed before 'like-for-like' net positive outcomes can be achieved for all fisheries; and (2) based on preliminary impressions, stakeholders are cautiously optimistic regarding the nature positive goal for fisheries, recognising both its potential benefits and challenges for implementation. This study represents a first step towards nature positive fisheries, with implications for broader marine conservation initiatives.

Sharks on the Menu: An assessment of the Consumption of Elasmobranchs in Sri Lanka

Shathuki Perera | University of Oxford

Wildlife species are a cheap source of protein for many populations, especially in developing countries. One taxonomic group which is facing continued threats through exploitation for food are the elasmobranchs (sharks and rays). Understanding the drivers of the demand for elasmobranchs is pivotal in informing conservation strategies. This research aims to evaluate the patterns, trends, and drivers of consumption, as well as trying to measure the quantity of elasmobranchs moving through the local supply chain in Negombo, Sri Lanka.

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This will be an evaluation of the beginning of the supply chain through existing landing site data, the intermediaries through vendors selling elasmobranchs, and finally, of the consumers through an assessment of restaurants in Negombo. I will showcase elasmobranch landings data spanning from 2017 to the present, sourced from a local NGO, along with primary data obtained through semi-structured interviews conducted with traders and vendors in 2023. Preliminary results indicate that the demand for elasmobranchs is primarily fuelled by local domestic consumption in markets, while demand in restaurants is predominantly targeted towards foreigners. The most common species of ray and shark traded is the leopard whipray (Himantura leoparda) and the milk shark (Rhizoprionodon acutus) respectively. They are both listed as vulnerable by the IUCN Red List with inferred levels of decline and exploitation. My final findings will aim to illustrate the market dynamics of elasmobranchs and the magnitude of the influence exerted by local consumption, which can help target and design appropriate and effective conservation strategies.

The potential of plankton as indicators of changes to marine natural capital assets

Matthew Faith | University of Plymouth

Plankton monitoring surveys have been continuously pursued since the early 20th century, due to the ability of plankton to signal changes to marine ecosystems which could impact society, from changes to commercially important fish stocks to the sequestration of atmospheric carbon. More recently these monitoring surveys have contributed to the development of indicators of Good Environmental Status (GES) for pelagic habitats in European biodiversity assessments, but these indicators are yet to be used to directly assess the potential human impacts of not meeting GES. To understand the societal benefits of meeting GES and to better target management measures in the marine environment, it is first necessary to understand the potential impact to ecosystem service provision (and subsequently natural capital assets) resulting from ecological changes to plankton communities. Here we demonstrate the potential of plankton as indicators of both ecosystem services and hazards in the marine environment as a foundation to the development of plankton-informed natural capital accounting. We present a conceptual framework developed to help classify the different ways marine plankton can impact human wellbeing; this framework is then applied to the current literature, allowing us to identify a range of ecosystem services and hazards associated with marine plankton. Further, we identify the key mechanisms by which some key plankton taxa can both support and inhibit the provision of ecosystem services. Using this output, we explore the future role plankton monitoring surveys could play in assessing changes to marine natural capital.

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Assessing the ecological effects of an experimental scallop ranch in Torbay

Amy Cartwright | University of Plymouth

Scallop dredges are among the most destructive fishing techniques in relation to benthic habitats and species. In response, an experimental scallop ranch was developed in Torbay to determine whether a sustainable and commercially viable alternative to traditional scallop dredging can be created in the UK. Bivalve aquaculture is thought to be one of the most sustainable methods of farming seafood and has been found to have a positive effect on the surrounding ecosystem, improving water quality and enhancing biodiversity. However, there are potential negative effects as enhanced biodeposition on the seabed can alter energy transfer within systems and modify trophic interactions. Given the range of potential environmental impacts, this study aimed to test the effect of the scallop ranch on the epibenthic and pelagic species at the site over three years and develop a structured ecosystem-based monitoring approach, essential if such aquaculture ventures are brought to commercial scale in the future. To assess changes in the assemblage composition video data were collected using a Remoted Operated Vehicle (ROV) and Baited Remote Underwater Video Systems (BRUVS) to sample the epibenthic species and non-baited midwater video systems (PelagiCam) to analyse the pelagic species. Data were collected within the scallop ranch and at comparable reference areas. Results indicate that the diversity of epibenthic and pelagic species increased in the scallop ranch compared to control sites, with pelagic fish recorded in the scallop ranch only, which may indicate a FAD effect.

An investigation into stakeholders' perceptions of eco-engineered structures and their value

Jessica Allen | University of Plymouth

Ecological engineering initiatives are altering coastal infrastructure to make artificial structures better suited to the survivorship of taxa. Determining the perceptions of stakeholders allow us to identify factors that will prevent or increase successful implementation of greening of grey infrastructure (GGI) instillations in the future. The aims of this study were to identify stakeholders' perceptions and support of GGI, assess their willingness to pay for GGI instillations, and identify potential origins of differing views. Data was collected from questionnaires distributed to a range of stakeholders at a Living Seawall Workshop in Plymouth in July 2024. Relationships between demographic factors and general support of GGI were tested, as well as the relationship between a calculated GGI support score and participant's willingness to pay. All respondents supported the greening of existing seawalls and ranked the ecological benefits provided by GGI above other social and economic benefits. Demographic factors did not impact GGI support or willingness to pay but there was a positive association between GGI support score and respondents' direct willingness to pay. Conclusions were drawn that a more diverse group of people needed to be surveyed, as all respondents were highly educated (held an undergraduate or postgraduate degree) and were aware of GGI before the workshop, which does not reflect the general population.

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Environmental and biological drivers are good predictors of long-term variability in NE Atlantic plankton communities

Matthew Holland | University of Plymouth

Plankton are the primary energy resource in marine food webs, and they respond rapidly to environmental change, making them a useful indicator of important shifts in ecosystem structure or function. Categorising plankton into broad functional groups, or “lifeforms” (e.g. large and small copepods) can be useful for understanding macroecological patterns associated with environmental changes. Understanding how lifeforms respond to environmental variability can be useful for identifying which changes are likely to impact the plankton community. While the marine environment is changing rapidly, the relative influence of environmental variables across the plankton community remains uncertain. We analysed 29 years of Continuous Plankton Recorder data (1993-2021) from the North-East Atlantic shelf to examine how planktonic lifeforms covaried with temperature, nutrients, other lifeforms, and background environmental variability. We studied whether lifeforms had unique responses to predictors by examining partial dependency relationships, and assessed whether random forest models generated from these predictors could accurately predict trends in lifeform abundance. Models accurately predicted between 57 and 80% of variability in lifeform abundance. Variability was primarily explained by trends in other lifeforms, with positively correlated partial dependency consistently across lifeforms, indicating bottom-up control or shared response to environmental variability. Two immutable variables, bathymetry and longitude, emerged as the most important environmental predictors, indicating data were more variable spatially than temporally. Lifeforms had a range of partial dependency responses to environmental predictors, so directional environmental changes are associated with increase in some lifeforms and decrease in others.

How does surface topography determine abundance and spatial distribution of key benthic species?

Franz Bauer, University of Plymouth

In response to ongoing coastal urbanization, it is critical to develop effective methods to optimise the biodiversity and ecological sustainability of artificial shorelines. Enhancing the topographic complexity of coastal infrastructure through the mimicry of natural substrata may facilitate the establishment of ecosystem engineering species and associated biogenic habitat formation. However, interactions between ecosystem engineers and their substratum are likely determined by organismal size and resource needs, thus making responses to topography highly scale-dependent. Here, we assessed the topographic properties (rugosity, surface area, micro-surface orientations) that underpin the abundance and distribution of three ecosystem engineers (fucoids, limpets, barnacles) across six spatial scales (1-500 mm). Field surveys and 3D scanning, conducted across natural and artificial structures, showed major effects of rugosity and associated structural variables on assemblage composition and spatial occupancy, while abiotic and biotic covariates only had weak influences. Natural substrata exhibited ≤67% higher rugosity than artificial ones. Fucoids were predominantly associated with high-rugosity substrata and horizontal micro-surfaces, while limpets predominated on smoother substrata.

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Barnacle-driven rugosity homogenized substrata at scales ≤10 mm. Our findings suggest that scale-dependent rugosity is a key driver of fucoid establishment and limpet habitat use, with wider eco-engineering applications for mimicking ecologically impactful topography on coastal infrastructure. and horizontal micro-surfaces, while limpets predominated on smoother substrata.

Exploring ocean warming impacts on Northeast Atlantic kelp forests: a comprehensive investigation using field studies and experimental approaches

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Climate change has profound effects on habitat-forming species in marine ecosystems. This results in shifts in ecosystem composition and functioning, associated species diversity and provisioning of ecosystem services. Ocean warming, in particular, is driving a redistribution of species at a global scale. Biogeographic transition zones, such as the Boreal-Lusitanian mixing region (BLMR) in the northeast Atlantic, may be hotspots for species range shifts, as both warm and cold-adapted species may be found towards contrasting range edges. In temperate rocky reefs, kelps (large, brown seaweeds) are the dominant habitat-formers. Our studies investigate temporal changes in kelp forest composition by comparing historical field observations with contemporary survey data. Experimental approaches explored the physiological tolerance of kelps populations distributed along a latitudinal gradient within the NE Atlantic region. The ongoing trend of ocean warming is anticipated to induce further shifts in the distribution and abundance of canopy-forming species, with consequent changes to broader kelp forest composition. As ecological functions and traits differ between kelp species, in particular between the ocean warming 'winners' and 'losers', wider changes in ecosystem service provision and ecological resilience may ensue.

Connecting the dots in Anthropocene seascapes: Assessing the role of connectivity in community assembly along the southern UK coastline

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The Anthropocene is characterised by significant transformations and reconfigurations to both land and seascapes globally with unprecedented rates of biodiversity loss. Decelerating and even reversing this biodiversity loss is a key goal of international policies yet this requires increased knowledge on how global stressors are affecting the distribution and assembly of biotic communities. A key component within the assembly process is connectivity or dispersal – describing individuals' movement across space – which links local communities to the global species pool. Ensuring connectivity is also one direct solution to biodiversity loss, ensuring individuals can adapt to changing conditions. This PhD will explore the community assembly process within temperate benthic intertidal communities on rocky shores across the southern UK coast and aim to improve our theoretical understanding of the role of connectivity in this process. However, before we can determine how connectivity affects community assembly, it is essential that differences between communities can be adequately quantified. Therefore, the first aim has been to explore community composition and structure using data from online repositories and develop a community-based discrimination metric.

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This metric uses multivariate techniques and associated dissimilarity measures, popular within the community ecology field, to provide a more suitable option for quantifying community differences than traditional diversity indices. It does this by explicitly considering abundances making it especially suitable for quantifying turnover. This will provide the basis for assessing if and how connectivity is driving these differences.