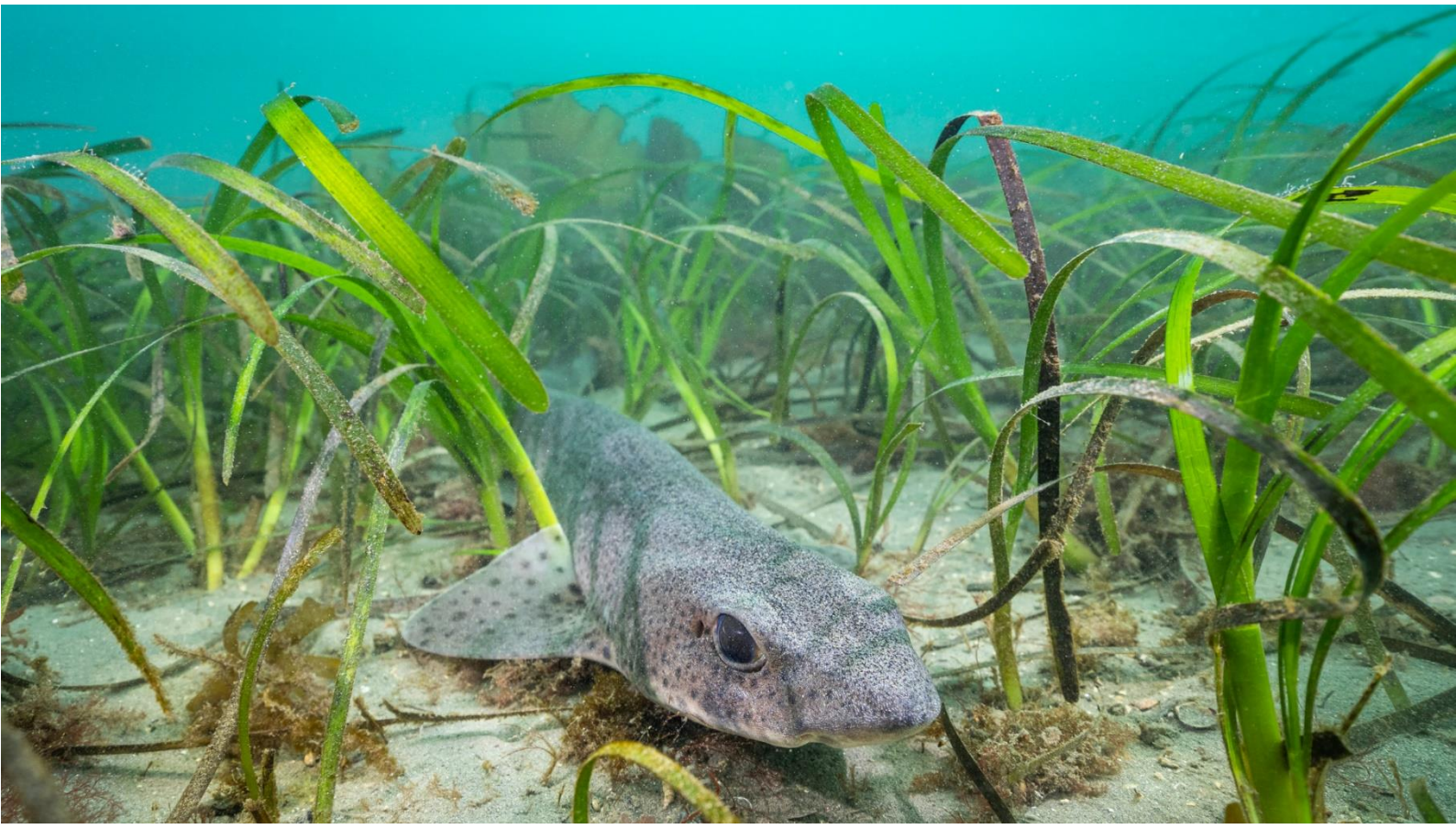
ECOLOGICAL CONNECTIVITY ACROSS TEMPERATE COASTAL HABITATS – MOVING TOWARDS SEASCAPE SCALE RESTORATION

22 – 23 NOVEMBER 2022



ZSL SYMPOSIUM

ZSL MEETING ROOMS, ZOOLOGICAL SOCIETY OF LONDON,
REGENT'S PARK, LONDON, NW1 4RY

THIS SYMPOSIUM IS HOSTED BY THE ZOOLOGICAL SOCIETY OF LONDON (ZSL), IN PARTNERSHIP WITH THE NATIVE OYSTER NETWORK, THE UNIVERSITY OF PORTSMOUTH, THE UNIVERSITY OF EDINBURGH, AND EU LIFE.

ORGANISERS:

Alison Debney, Conservation Lead, Wetland Ecosystem Restoration, Zoological Society of London
Celine Gamble, Native Oyster Network - UK & Ireland Coordinator and Wild Oyster Project Manager, Zoological Society of London
Dr Joanne Preston, Reader in Marine Ecology and Evolution, Biodiversity and Blue Carbon Lead, University of Portsmouth
Dr Philine zu Ermgassen, Marine Ecosystem Restoration Expert and Honorary Fellow, University of Edinburgh

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Cover image: *Seagrass bed beneath the Helford River SAC in Cornwall, providing crucial habitat to a small-spotted catshark © Lewis Michael Jefferies*

SYMPOSIUM OVERVIEW

THE CHALLENGE

Coastal and estuarine habitats in Europe have been decimated over the last 200 years. In England, we have lost 85% of our saltmarsh, extirpated seagrass from 50% of our coastal waterbodies and removed 95% of our oyster habitat. Yet these habitats are some of the most important for carbon-storing and other provisioning services such as fisheries, improving water quality, and coastal defences, which Nature based Solutions so depend on.

An increasing evidence base illustrates the critical value of these coastal habitats individually. In this UN Decade on Ecosystem Restoration, the number and scale of restoration efforts is increasing and now is the time to reflect on the potential of the seascape to deliver for nature and people at a large scale. The role of habitats as part of a dynamic and resilient system is beginning to be understood. With the recently proposed EU Nature Restoration Law presenting a legally binding requirement to restore 20% of the EU marine territory, and with the Decade on Ecological Restoration and the Ocean Decade both underway, now is the time to reflect on what seascape connectivity could mean and what can be achieved in the longer term. Symposium sessions will focus on ecological connectivity, climate mitigation, resilience, restoration potential and benefits of restoration of threatened coastal habitats.

THE SYMPOSIUM

This two-day symposium will provide a comprehensive review of the current state of science surrounding habitat connectivity in temperate coastal systems and provide a firm basis for discussion and networking relating to the policy and practical importance of this understanding. It will bring together a varied audience of scientists, policy makers, restoration practitioners and interested parties looking to provide evidence and delivery of seascape restoration. This symposium will be contributing to the aims of the ReMeMaRe Connectivity in Estuarine, Coastal and Transitional Ecosystem Restoration (ConnECTER) Special Interest Group (SIG).

DAY 1: TUESDAY 22 NOVEMBER 2022

08:50 DOORS OPEN – REGISTRATION

09:20 WELCOME
Matthew Gould, Director General, Zoological Society of London

09:30 SYMPOSIUM INTRODUCTION
Dr Joanne Preston, University of Portsmouth and UK Native Oyster Network

09:40 SESSION 1: INTERNATIONAL CONTEXT FOR SEASCAPE RESTORATION
Chair: Alison Debney, Zoological Society of London

09:45 Turning the tide on ocean decline: Large-scale marine restoration is key
Dr Tundi Agardy, Sound Seas

10:10 An overview of the EU Nature Restoration Law with respect to the coastal environment
Dr Jakub Wejchert, Directorate-General for Environment, European Commission

10:30 PANEL SESSION Q&A

10:50 MORNING BREAK

11:20 SESSION 2: HISTORICAL ECOLOGY AND CURRENT KNOWLEDGE OF TEMPERATE MARINE HABITATS
Chair: Dr Philine zu Ermgassen, University of Edinburgh

11:25 Evidencing Europe's lost native oyster (*Ostrea edulis*) habitats
Dr Ruth Thurstan, University of Exeter

11:45 The structure, function and blue carbon potential of UK kelp forests
Professor Pippa Moore, Newcastle University *(remote presentation)*

12:05 Connected seagrass restoration – a seascape of knowledge gaps
Dr Richard Unsworth, Project Seagrass

12:25 Saltmarsh ecology and processes
Angus Garbutt, UK Centre for Ecology & Hydrology (CEH)

12:45 PANEL SESSION Q&A

13:05 LUNCH BREAK

14:10 SESSION 3: INTEGRATED HABITAT RESTORATION & SEASCAPE CONNECTIVITY
Chair: Celine Gamble, Zoological Society of London

14:15 Seascape restoration: is it possible and what are the benefits?
Dr Philine zu Ermgassen, University of Edinburgh

14:35 Multi-habitat restoration: optimising reef restorations to recover multiple habitats

Dr Dominic McAfee, University of Adelaide, Australia *(remote presentation)*

14:55 Solent Restoration Project - building the evidence base for a seascape approach
Dr Joanne Preston, University of Portsmouth and UK Native Oyster Network

15:15 ARK's rewilding at sea approach
Gwenaël Hanon, ARK Nature

15:35 PANEL SESSION Q&A

15:55 AFTERNOON BREAK

16:25 SESSION 4: MECHANISMS AND EVIDENCE OF CONNECTIVITY
Chaired discussion; Chair: Dr Joanne Preston, University of Portsmouth and UK Native Oyster Network

17:25 CLOSING COMMENTS

17:30 POSTER SESSION & DRINKS RECEPTION

18:45 SYMPOSIUM DINNER *(Mappin Pavilion - additional ticket required)*

21:00 DAY 1 CLOSE

DAY 2: WEDNESDAY 23 NOVEMBER 2022

09:00 DOORS OPEN - REGISTRATION

09:30 WELCOME & INTRODUCTION
Dr Philine zu Ermgassen, University of Edinburgh

09:35 SESSION 5: SCIENCE OF CONNECTIVITY
Chair: Professor Graham Underwood, University of Essex

09:40 How can seascape ecology thinking and analytics help guide coastal restoration
Dr Simon J. Pittman, Oxford Seascape Ecology Lab, University of Oxford and Seascape Analytics

10:05 The multifaceted nature of connectivity and its implications for coastal restoration: a fishy perspective
Professor Ronald Baker, University of South Alabama, USA and Dauphin Island Sea Lab

10:30 Whose carbon is it anyway? Accounting for connectivity between blue carbon habitats
Dr Rachel Dunk, Manchester Metropolitan University

10:45 Marine habitat connectivity through the soundscape
Professor Steve Simpson, University of Bristol and University of Exeter

11:05 PANEL SESSION Q&A

11:20 MORNING BREAK

11:45 SESSION 6: DECISION MAKING IN HABITAT RESTORATION

Chair: Dr Boze Hancock, The Nature Conservancy

11:50 Towards a consistent approach for monitoring, evaluation and reporting of seascape restoration
Dr Simon Reeves, The Nature Conservancy, Australia

12:15 ReMeMaRe (Restoring Meadow Marsh and Reef) – the challenge of increasing confidence: how far have we come and where do we go next
Roger Proudfoot, Environment Agency, UK

12:30 The role of habitat condition in Nature-based Solutions in the Solent
Dr Stephen Watson, Plymouth Marine Laboratory

12:45 Habitat characteristics modulate fish recruitment enhancement in threatened coastal nursery habitats: a continental meta-analysis
Dr Juhyung Lee, Northeastern University, USA *(remote presentation)*

13:00 PANEL SESSION Q&A

13:20 LUNCH BREAK

14:20 SESSION 7: COASTAL RESTORATION AND THE FUTURE

Chair: Will Manning, Environment Agency, UK

14:25 Nature based solutions: opportunities and challenges
Dr Nathalie Pettorelli, Zoological Society of London

14:50 Mangrove restoration opportunities
Dr Thomas Worthington, University of Cambridge

15:05 Blue Carbon - an integrated, collaborative approach
Dan Crockett, Blue Marine Foundation

15:20 Coastal Restoration: Implications for human health and wellbeing
Professor Michael Depledge CBE, University of Exeter Medical School & Eden Project

15:45 PANEL SESSION Q&A

16:05 AFTERNOON BREAK

16:25 SESSION 8: OPERATIONALISING SEASCAPE RESTORATION

Chaired discussion; Chair: Caroline Price, The Crown Estate

17:25 CLOSING COMMENTS

17:30 DAY 2 CLOSE

END OF SYMPOSIUM

ABSTRACTS

DAY 1: TUESDAY 22 NOVEMBER 2022

08:50 DOORS OPEN – REGISTRATION

09:20 WELCOME
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09:30 SYMPOSIUM INTRODUCTION
Dr Joanne Preston, University of Portsmouth and UK Native Oyster Network

09:40 SESSION 1: INTERNATIONAL CONTEXT FOR SEASCAPE RESTORATION

Chair: Alison Debney, Zoological Society of London

09:45 **Turning the tide on ocean decline: Large-scale marine restoration is key**
Dr Tundi Agardy, Sound Seas

Marine ecosystems are vital to human and planetary health yet remain under assault from degradation. Conservation measures that hold the line on degradation haven't proved sufficient to maintain ocean health, nor to allow the continued delivery of ecosystem services. Similarly, marine restoration has been attempted only at small scales, creating an illusion that the inexorable decline of ocean health has halted. A radical transformation is thus required in the way we manage continued ocean development. Restoration needs to be scaled up, recognizing connections that underpin the functioning of linked ecosystems. These connections are ecological, with far-ranging marine species linking diverse biomes, and with benthic and water column coupling. The connectivity also pertains to the open nature of marine systems - pressures from afar must be addressed if ecosystem recovery is to be encouraged. While conservation throws a nod to ecosystem-based management, restoration truly requires it.

The current almost obsessive focus on 'nature-based solutions' is dangerous in that it can entice people to think that we can simply construct natural habitats to erase pressures and 'solve' our environmental problems. Nature is retreating for a reason, and until that reason is addressed, putting nature back into our environments will not succeed. It makes no sense to cement coral fragments on reefs degraded by pollution, just as it makes no sense to reconstruct seagrass meadows in waters suffering increased turbidity and contamination, just as it doesn't make sense to plant mangrove seedlings in places where hydrology has been altered. True restoration requires that we address underlying drivers of degradation before we begin to reconstruct habitat, reintroduce species, and allow passive recovery of stressed ecosystems. We have a great chance to get this right - if we strive to understand the problem we are trying to fix, and tailor conservation and restoration solutions accordingly.

10:10 **An overview of the EU Nature Restoration Law with respect to the coastal environment**
Dr Jakub Wejchert, Directorate-General for Environment, European Commission

Earlier in June this year the Commission made its proposal for a Nature Restoration Law. This law promises to be a milestone in European legislation - the first EU-wide, comprehensive restoration law of its kind. The law aims to counter biodiversity loss, ensure the good health of nature, and help mitigate climate change. It should play an important role in bringing back nature for a number of ecosystems across the EU. In the law, we are proposing a large set of specific targets covering a broad range of ecosystems in the EU. The targets proposed aim to ensure the good health of a range of ecosystems in the EU: forests, wetlands, peatlands, agro-ecosystems, coastal ecosystems, marine ecosystems and others.

10:30 PANEL SESSION Q&A

10:50 MORNING BREAK

11:20 SESSION 2: HISTORICAL ECOLOGY AND CURRENT KNOWLEDGE OF TEMPERATE MARINE HABITATS

Chair: Dr Philine zu Ermgassen, University of Edinburgh

11:25 Evidencing Europe's lost native oyster (*Ostrea edulis*) habitats

Dr Ruth Thurstan, University of Exeter

Authors: Ruth H. Thurstan, Philine S.E. zu Ermgassen, Hannah McCormick, Elizabeth Ashton, Floris Bennema, Ana Bratos Cetinic, Janet H Brown, Tom Cameron, Fiz da Costa, David Donnan, Christine Ewers-Saucedo, Tomaso Fortibuoni, Anamarija Frankic, Eve Galimany, Otello Giovanardi, Romain Grancher, Daniele Grech, Maria Hayden-Hughes, Luke Helmer, K. Thomas Jensen, José A. Juanes, Thomas Kerkhove, Janie Latchford, Alec Moore, Dimitrios K. Moutopoulos, Pernille Nielsen, Henning von Nordheim, Bárbara Ondiviela Eizaguirre, Corina Peter, Bernadette Pogoda, Bo Poulsen, Stéphane Pouvreau, Joanne Preston, Callum M. Roberts, Cordula Scherer, David Smyth, Ioannis A. Theodorou

Aggregations of European flat oyster (*Ostrea edulis*) form highly diverse biogenic habitat which was once common throughout the Northeast Atlantic, and historically was an important source of sustenance and livelihoods for coastal communities. Since the 19th Century, increased fishing pressure combined with disease and other problems led to wild fisheries for native oyster all but collapsing across Europe, with its habitat now heavily depleted throughout its range and largely functionally extinct. The early loss of many wild oyster habitats has led to a major gap in our understanding of these habitats: what they looked like, where they used to occur, their extent, and which species were associated with them. This presentation describes the efforts made by members of the Native Oyster Restoration Alliance Historical Ecology Working Group to identify relevant historical documentary sources from across Europe and extract information from these sources to uncover the past distribution, abundance, and characteristics of European flat oyster habitats prior to their decimation. Records spanning hundreds of years enabled us to map historical oyster habitats with varying degrees of confidence along the coastal margins of Europe, with some of these habitats described as spanning tens of miles in extent. Historical descriptions of oyster habitat also suggest that individuals routinely aggregated at higher densities compared to modern day definitions. This talk will demonstrate the utility of the historical record and longer-term perspectives for guiding restoration ambitions as well as helping to pinpoint areas where past oyster habitat thrived.

11:45 The structure, function and blue carbon potential of UK kelp forests

Professor Pippa Moore, Newcastle University *(remote presentation)*

Kelp forests are some of the most productive ecosystems on Earth and as true ecosystem engineers support high levels of biodiversity, including commercially important species. They also provide a wealth ecosystem services, including coastal protection, nutrient cycling and tourism. More recently, there has been interest in kelp as a blue carbon habitat and while it is likely that kelp forests do release carbon that is transported to storage environments there are still many knowledge gaps. At the same time, like many marine ecosystems, kelp forests are under threat from anthropogenic impacts. From a UK perspective, our understanding of the structure, function, goods and services provided by our kelp forests have lagged behind that of other advanced nations. This is despite a recent estimate suggesting kelp forests cover an aerial extent of >5,700 km^2, which is 6 times and 30 times greater than the aerial extent of UK saltmarsh and seagrass respectively. Here I will outline the last 10 years of research into the structure and function of UK kelp forests,

before exploring the ecosystem goods and services they provide, including their potential role as a blue carbon habitat. I will also outline the threats that UK kelp forests face now and into the future and what we need to do to protect these important ecosystems.

12:05 **Connected seagrass restoration – a seascape of knowledge gaps**
Dr Richard Unsworth, Project Seagrass

12:25 **Saltmarsh ecology and processes**
Angus Garbutt, UK Centre for Ecology & Hydrology (CEH)

Coastal ecosystems provide many benefits to humans such as flood protection, storage of carbon in sediments to help offset global warming and a rich source of inspiration for art and literature. Most of the major cities in the world are located on estuaries or near the coast, and many countries trade and transport links rely on coastal ports giving coastal margins significant economic importance. As a result, the coast and coastal habitats are placed high in the collective consciousness of many nations. Coastal ecosystems are however particularly vulnerable to change as they have been exposed to centuries of over-exploitation, habitat modification and pollution, which has led to estuarine and coastal zone degradation, biodiversity loss and a decline in ecological resilience. These changes can occur over extended time scales (e.g. as a gradual response to environmental change or management shifts) or as a result of one off, catastrophic events such as flooding or disturbance.

Salt marshes in particular have been impacted upon by a multitude of factors but none the less remain an important and valuable habitat that has been the focus of human activity and study over time. In Europe as the population grew, salt marshes were embanked and drained, where the fertile soils produced high quality agricultural land, particularly from the 17th century onwards. Through natural processes and engineering new salt marsh grew in front of the embankments which was in turn reclaimed for agriculture. And so, a system of fertile farmland and embankments closely tied coastal communities to their natural and hard-won constructed environment. Salt marshes continue to play an important part in the lives of coastal communities today through farming, buffering flood embankments from wave action and offering places for recreation and tourism. This talk will put the salt marshes of the UK in a global context, discuss their importance to people and wildlife, and how societal needs have driven research over the last century.

12:45 PANEL SESSION Q&A

13:05 LUNCH BREAK

14:10 SESSION 3: INTEGRATED HABITAT RESTORATION & SEASCAPE CONNECTIVITY

Chair: Celine Gamble, Zoological Society of London

14:15 **Seascape restoration: is it possible and what are the benefits?**
Dr Philine zu Ermgassen, University of Edinburgh

Coastal habitats have long been under threat and decline as a result of increased coastal development, extractive practices and pollution. However, in recent decades, there has been a growing recognition of the value of these threatened and declining habitats, which has spurred growing protection and restoration efforts. To date, many coastal habitat restoration efforts have focused on single habitats, but an understanding of the possible benefits of multi-habitat, large-scale (seascape!) restoration is growing fast. Here we will introduce some of the existing efforts to restore coastal systems across multiple habitats and seek to provide a starting point for exploring

questions such as: Just what is meant by seascape restoration? Can such efforts provide greater benefits, or are they simply more complicated to carry out?

14:35 Multi-habitat restoration: optimising reef restorations to recover multiple habitats

Dr Dominic McAfee, University of Adelaide, Australia *(remote presentation)*

Healthy seascapes are characterised by many interacting species and intermingled habitats (e.g., seagrass, kelp, bivalves, sedimentary) that co-create ecological functions of socio-ecological value. These co-created functions not only build stability and resilience to environmental change but may also combine to synergise the recovery of degraded ecosystems. Yet, single-species approaches still dominate marine restoration practice. In South Australia, we are examining the benefits of a multi-ecosystem approach to marine restoration by utilising the opportunities created by large-scale reef construction. Boulder reefs constructed to restore oysters also provide opportunities to restore lost kelp forests (provision of hard substrate) and seagrass meadows (hydrodynamic buffering and sediment stabilisation). Ecological synergies created by co-restoring these habitats were immediately evident. For example, transplanted kelp forests increased oyster recruitment to reef boulders by orders of magnitude, which produced mixed oyster-kelp habitat that can synergistically benefit kelp re-attachment (haptera growth) and oyster habitat formation. Furthermore, the oyster-kelp combination increased hydrodynamic buffering leeward of reefs where seagrass transplants (hessian bags) show early signs of recovery despite the high-energy environment where they have historically failed. We propose that restoration practice should prioritise a multi-habitat approach that not only stabilises but accelerates ecosystem recovery.

14:55 Solent Restoration Project - building the evidence base for a seascape approach

Dr Joanne Preston, University of Portsmouth and UK Native Oyster Network

Restoration of coastal biogenic habitat within an anthropogenically impacted and degraded system requires a multiplex approach to overcome significant barriers to success. Human impacts on temperate coastal ecosystems include, the introduction of invasive species, eutrophication, overfishing and degradative fishing practices, habitat loss and climate change which combined, can lead to ecological phase shifts. This creates a socio-ecological environment within temperate coastal seascapes that no longer supports self-recruiting native oyster populations and the complex biogenic habitat they create. A case study from the Solent Restoration Project demonstrates how a multiplex approach using ocean literacy, governance, active habitat restoration, site specific hatchery production and sustainable aquaculture for bioremediation can address these complex issues and create tipping points to successfully restore native oyster habitat, and start to link this restoration with that of seagrass, saltmarsh and bird habitat for a truly seascape approach. The Solent Seascape Restoration project has built in the assessment of connectivity into its monitoring plan. Beyond assessing progress, scientific monitoring of restored biogenic habitat is essential to define the ecological characteristics, associated biodiversity and quantification of ecosystem services and plays an essential role in the upscale of restoration at UK and European scales.

15:15 ARK's rewilding at sea approach

Gwenaël Hanon, ARK Nature

Authors: Gwenaël Hanon and Karel van den Wijngaard

The rewilding approach, as a relative new approach to nature conservation and restoration, is gaining momentum, also at sea. With marine nature in severe decline worldwide, mainly due to our way of using natural resources, rewilding is an ecologically and socio-economically viable approach to re-vitalise marine nature. ARK is a leader in this approach in the Netherlands, working on practical research and application of rewilding in the Dutch North Sea since 2016.

Rewilding (at sea), what and why? Natural processes are at the heart of rewilding. But perhaps first and foremost, rewilding is about awareness and perspective. Awareness that we all use something

from the sea in one way or another and thus impact the quality of the natural system. And the ability and willingness to look beyond one's own perspective. Secondly, rewilding is about the art of systems thinking, combined with taking action. If you are able to look beyond your own position and perspective, it is still difficult to understand the bigger picture, to understand how the system works. Without stepping in the pitfall of firstly wanting to understand the whole system, before making any changes. We get further by acting now and focusing our attention on the feedback loops between our actions and the state of the natural system. Thirdly, it is about interaction. Interaction of species and habitats, but perhaps more importantly human-nature interaction. Do we just 'take' or do we take care. Rewilding starts in the minds of people, before it leads to interventions in our seascapes. How can we ensure that more people and organisations no longer see nature as something you 'use', but something you are part of and feel responsible for. As humans and as organisations we should see nature as both a starting point (nature is at least as important as other values and interests) and an end point (without a resilient natural world, we cannot exist).

15:35 PANEL SESSION Q&A

15:55 AFTERNOON BREAK

16:25 SESSION 4: MECHANISMS AND EVIDENCE OF CONNECTIVITY

Chaired discussion; Chair: Dr Joanne Preston, University of Portsmouth and UK Native Oyster Network

17:25 CLOSING COMMENTS

17:30 POSTER SESSION & DRINKS RECEPTION

18:45 SYMPOSIUM DINNER *(Mappin Pavilion - additional ticket required)*

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DAY 2: WEDNESDAY 23 NOVEMBER 2022

09:00 DOORS OPEN - REGISTRATION

09:30 WELCOME & INTRODUCTION
Dr Philine zu Ermgassen, University of Edinburgh

09:35 SESSION 5: SCIENCE OF CONNECTIVITY
Chair: Professor Graham Underwood, University of Essex

09:40 **How can seascape ecology thinking and analytics help guide coastal restoration**
Dr Simon J. Pittman, Oxford Seascape Ecology Lab, University of Oxford and Seascape Analytics

Coastal seascapes are complex social-ecological systems, shaped by dynamic and interconnected spatial patterns and ecological processes operating across a range of spatial and temporal scales. Human activities have modified the web of interconnections across land and sea in ways that often remain unclear. Determining how best to restore the ecological integrity of coastal ecosystems is a worthy pursuit for biodiversity conservation and for the benefits to people that flow from healthy well-connected systems. Like landscape ecology, the emerging pattern-oriented science of seascape ecology places connectivity as one of its four core principles (the 4Cs), along with configuration, context and the consideration of scale. To design effective and resilient restoration strategies, it is necessary to consider all 4Cs. Seascape ecology is helping to advance the integration of ecological connectivity into decision support tools to inform actions that restore, rehabilitate, create and maintain healthy coastal ecosystems. This presentation will introduce seascape ecology and explain how seascape thinking and the associated tools are advancing our understanding of connectivity. With a focus on structural connectivity, examples from tropical coastal seascapes are presented to highlight practical and cost-effective ways that connectivity information can be integrated into the evidence-base for decision making in scaling up restoration science and practice.

10:05 **The multifaceted nature of connectivity and its implications for coastal restoration: a fishy perspective**
Professor Ronald Baker, University of South Alabama, USA and Dauphin Island Sea Lab

Coastal ecosystems provide a range of goods and services to people, and the maintenance of these benefits is a major motivation for the protection and restoration of coastal habitats. One of their key roles is providing critical habitat for a diversity of species, particularly serving as nurseries for culturally, ecologically, and economically important finfish and shellfish. The push towards seascape-scale restoration of coastal habitats is driven by our recognition that coastal habitats do not function in isolation. The complex lifecycles of many fish species that use these habitats exemplifies their position as part of mosaics of interconnected habitats that together provide key ecological functions like nursery ground provision. By considering ecological connectivity in coastal seascapes through the lens of their role as nurseries, this presentation will highlight some of the main aspects of ecological connectivity as it relates to coastal seascape restoration. Key knowledge gaps include conceptually simple yet practically challenging issues, such as quantifying the home ranges of juveniles using coastal habitat mosaics, and identifying critical resources used by each life stage, particularly those life stages that form bottlenecks in the life cycle. Although connectivity is a complex and multifaceted issue, the effective incorporation of connectivity into coastal restoration planning can greatly enhance the ecological outcomes of these investments.

10:30 **Whose carbon is it anyway? Accounting for connectivity between blue carbon habitats**
Dr Rachel Dunk, Manchester Metropolitan University

The recognition of the importance of blue carbon in the carbon cycle and the growing interest in the restoration and creation of blue carbon habitats as a climate mitigation strategy creates a need for robust carbon accounting methodologies. While a number of standards are now available, these have been developed for specific habitat types (and restoration/creation approaches), and take variable approaches to determining the 'countable' carbon. This raises particular questions with respect to identifying and accounting for autochthonous (produced *in-situ*) and allochthonous (carbon imported from outside the site) carbon. This talk will review the various approaches to estimating and accounting for (or not!) allochthonous carbon, discussing the implications in the context of connectivity between blue carbon habitats, and suggesting potential alternative approaches for wider discussion.

10:45 Marine habitat connectivity through the soundscape
Professor Steve Simpson, University of Bristol and University of Exeter

11:05 PANEL SESSION Q&A

11:20 MORNING BREAK

11:45 SESSION 6: DECISION MAKING IN HABITAT RESTORATION

Chair: Dr Boze Hancock, The Nature Conservancy

11:50 Towards a consistent approach for monitoring, evaluation and reporting of seascape restoration
Dr Simon Reeves, The Nature Conservancy, Australia

Ecological restoration is a vital management tool to support the recovery and resilience of marine ecosystems. There are now more active marine restoration projects than ever before, and high level support for marine restoration through the United Nations Decade on Ecosystem Restoration and the UN Decade of Ocean Science for Sustainable Development (2021–2030). This acceleration and interest provides the field with an opportunity to realize our goal of seascape level restoration that provides equitably distributed benefits for society. However, this activity must be monitored and evaluated to assess success and guide future efforts. Currently, the problem is a lack of a standardized framework for monitoring and reporting the outcomes of restoraton projects. We suggest that an easy to implement and cost effective framework for monitoring, evaluation and reporting (MER) of restoration success is essential for the field to reach its full potential. Developing a consistent MER framework is challanged by the variety of different ecosystems, geographies and stages of project development. While challenging, we believe there are a number of exisiting organisations and opportunities that can begin to address this problem.

A successful, consistent MER approach allows for: (1) comparison among restoration projects; (2) adaptive management; and (3) determination of whether restoration projects are a success. Here we outline a MER framework and a newely develped data hub that TNC and partners are consistently implementing across marine restoration projects. The framework is adaptable for projects across multiple ecosystems and also enables comparison amongst more established projects globally. This presentation aims to encourage discussion around the benefits and costs of monitoring, how to implement consistant approaches to seascape restoration monitoring, evaluation and reporting across multiple ecosystems or target species and large geographic scales.

12:15 ReMeMaRe (Restoring Meadow Marsh and Reef) – the challenge of increasing confidence: how far have we come and where do we go next
Roger Proudfoot, Environment Agency, UK

ReMeMaRe (Restoring Meadow Marsh and Reef) is an initiative that was started in 2018 when Roger was asked the question "How can we achieve more environmental outcomes in estuarine and coastal waters?". The talk will discuss progress with the initiative and how we got to where we are today, the challenges faced along the way, what key questions we need answers to, to upscale practical restoration efforts in England and how the academic community can assist with our ambitions to restore estuarine and coastal habitats.

12:30 The role of habitat condition in Nature-based Solutions in the Solent

Dr Stephen Watson, Plymouth Marine Laboratory

Authors: Stephen C.L. Watson, Gordon J. Watson, Nicola J. Beaumont, Joanne Preston

Coastal habitats such as saltmarshes, seagrass meadows, bivalve reefs, reedbeds and marine sediments (littoral and sublittoral) are intricately involved in the provision of many regulating ecosystem services (ES), including those that act to regulate local water quality and climate conditions. However, such habitats are documented to be particularly difficult to include in spatial natural capital assessments due to a lack of baseline information relating to their area (extent) and condition. As such, there is a need for improved understanding of the link between habitat extent, condition and ES provision, using comparable indicators in order to take more informed management decisions. Here the UK, Solent Marine Sites (SEMS) is used as a case study system to demonstrate how Water Framework Directive (WFD) 'ecological status' and other indicators of ecosystem condition (state or quality) can be coupled with habitat extent information to deliver a more precise locally-tailored NC approach for active coastal and marine habitat restoration. Habitat extent and condition data are collected for seven Nature based Solution (NbS) relevant coastal habitats (littoral sediment, mat-forming green macroalgae, subtidal sediment, saltmarsh, seagrass, reedbeds and native oyster beds). The workflow includes: 1) biophysical assessment of regulatory ES; 2) monetary valuation; and 3) compilation of future scenarios of habitat restoration and creation. The results indicate that incorporating classifications by condition indices into local NC extent accounts improved ES benefits by 11–67%. This suggests that omitting condition from NC assessments could lead to undervaluation of ES benefits. This evidence of the potential value of restoration and importance of including condition indices in assessments is highly relevant to consider when investing in water ecosystems conservation and restoration as called for by the UN Decade on Ecosystem Restoration (2021−2030), and more generally in global nutrient neutrality and blue carbon policy strategies.

12:45 Habitat characteristics modulate fish recruitment enhancement in threatened coastal nursery habitats: a continental meta-analysis

Dr Juhyung Lee, Northeastern University, USA *(remote presentation)*

The global importance of structured coastal habitats as nursery grounds for juvenile fish is well established, owing to decades of research. However, a knowledge gap remains in how this function is modulated by shifting environmental and habitat conditions. Obtaining a theoretical and predictive understanding of these relationships will be crucial for managing nursery habitat functions under accelerating global change and habitat degradation. Here, we conducted a meta-analysis (101 studies and 1690 responses) examining how various ecological and environmental drivers modulate fish recruitment enhancement (RE) in submerged aquatic vegetation (SAV), salt marsh, and oyster habitats across North America. We found that all three habitats significantly enhance fish recruitment compared to the unstructured bottom, and multiple factors modulate the magnitude of RE in SAV (habitat cover, proximity to alternate habitats, tidal zone, and salinity), salt marsh (region, edge effect, proximity to alternate habitats, and fish taxa), and oyster reef (habitat cover and fish guild). Model selection and multi-model analysis revealed habitat characteristics (e.g., habitat cover, proximity to alternate habitat, and edge effect) and fish traits (i.e., taxa and guild) as particularly important moderators of RE. Higher RE occurred in habitat areas more structurally complex (for SAV and oysters) and adjacent to alternate nursery habitats (for SAV and

marsh). Invertebrates and benthic fishes, which are less mobile and more reliant on habitat structures, responded more strongly to the presence and changing properties of habitats (for SAV and marsh). Abiotic variables, including temperature, dissolved oxygen, and depth, generally had weak effects on RE. Conversely, salinity was an important moderator of RE in SAV, with the highest RE occurring in oligohaline areas. Our study highlights broad ecological and environmental drivers underlying fish recruitment patterns in threatened coastal nurseries and calls for increased consideration of such variables in future habitat management and restoration efforts.

13:00 PANEL SESSION Q&A

13:20 LUNCH BREAK

14:20 SESSION 7: COASTAL RESTORATION AND THE FUTURE

Chair: Will Manning, Environment Agency

14:25 Nature based solutions: opportunities and challenges

Dr Nathalie Pettorelli, Zoological Society of London

There is an increasing recognition that, although the climate change and biodiversity crises are fundamentally connected, they have been primarily addressed independently and a more integrated global approach is essential to tackle these two global challenges. Nature-based Solutions (NbS) are hailed as a pathway for promoting synergies between the climate change and biodiversity agendas. There are, however, uncertainties and difficulties associated with the implementation of NbS, while the evidence regarding their benefits for biodiversity remains limited. In this talk, I identify five key research areas where incomplete or poor information hinders the development of integrated biodiversity and climate solutions. These relate to refining our understanding of how climate change mitigation and adaptation approaches benefit biodiversity conservation; enhancing our ability to track and predict ecosystems on the move and/or facing collapse; improving our capacity to predict the impacts of climate change on the effectiveness of NbS; developing solutions that match the temporal, spatial and functional scale of the challenges; and developing a comprehensive and practical framework for assessing, and mitigating against, the risks posed by the implementation of NbS.

14:50 Mangrove restoration opportunities

Dr Thomas Worthington, University of Cambridge

Rapid losses of mangroves over the past 50 years have had negative consequences on the environment, climate, and humanity, through diminished benefits such as carbon storage, coastal protection and fish production. Restoration of mangrove forests is possible, and has already been undertaken in many settings, but such efforts have been piecemeal, and many have failed. The current work describes the findings from a new effort to locate and map, on a global scale, the places where mangroves can be restored, and to calculate the potential benefits from such restoration. The approach combines geospatial data on mangrove change, drivers of loss, and biophysical conditions with expert knowledge to derive a relative index of a mangrove patches' potential for restoration. Our analysis reveals restorable areas across the large majority of all mangrove jurisdictions world-wide. The restoration of these areas has the potential to provide significant benefits, which we quantify in terms of aboveground biomass and soil carbon, and additional commercially important mangrove affiliated species of fish and invertebrates. Our analysis provides indication at the landscape scale which mangrove areas have greater restoration potential, representing a critical tool for encouraging restoration and enabling robust, data-driven policy changes and investments.

15:05 Blue Carbon - an integrated, collaborative approach

Dan Crockett, Blue Marine Foundation

The ocean is the world's largest carbon sink, stabilising our climate and providing over half the oxygen that we breathe. Yet, we continue to destroy these precious habitats and overlook the ocean as a climate change solution. We must start to consider the true value of the ocean and the numerous co-benefits that blue carbon habitats provide, alongside carbon sequestration. Numerous challenges remain that are stalling progress including lack of funding, gaps in scientific evidence, and an opaque policy landscape. Blue Marine Foundation operates a dedicated blue carbon unit, focused on building the value of the ocean as a climate change solution. Blue Marine is proactively and collaboratively funding blue carbon research, market development, quantification of c0-benefits using technology, research into emerging habitats and integrated habitat restoration. Dan will speak about learnings from the global market, opportunities for collaboration on this topic and outline a vision for the future of the ocean as a climate change solution.

15:20 Coastal Restoration: Implications for human health and wellbeing

Professor Michael Depledge CBE FRCP, University of Exeter Medical School & Eden Project

Pollution, habitat destruction and the ruthless exploitation of marine biota in coastal zones has led over many decades to a decline in biodiversity and, in some locations, ecosystem collapse. To try to address this dire situation the United Nations have designated the period from 2021-2030, the "Ocean Decade". Objectives include achieving a clean ocean and restoration of healthy and resilient coastal ecosystems that are safe and accessible for humans, while also providing inspiration and engagement. This initiative echoes many earlier national and international efforts with similar goals, but which have resulted in only limited success. How then can we make further progress?

In this presentation, the situation will be reframed to focus on how we might transform human interactions with coastal zones worldwide. While there is much in our near shore ecosystems that directly or indirectly threatens coastal communities, these environments also contain a wealth of resources that can be used to foster human health and wellbeing. In the context of coastal zone restoration, examples will be described which illustrate the importance of considering human needs in restoration plans, such as the provision of access to blue space, as well as the creation of new opportunities for employment and the alleviation of poverty. The value of "ocean literacy" in engaging coastal communities in tackling "wicked coastal problems" will also be discussed. In particular, the case will be made for further developing the meta-discipline of "Oceans and Human Health" which embraces and explores the intimate interconnections between human health, wellbeing and the seas around us.

15:45 PANEL SESSION Q&A

16:05 AFTERNOON BREAK

16:25 SESSION 8: OPERATIONALISING SEASCAPE RESTORATION

Chaired discussion; Chair: Caroline Price, The Crown Estate

17:25 CLOSING COMMENTS

17:30 DAY 2 CLOSE

END OF SYMPOSIUM

SPEAKER & CHAIR BIOGRAPHIES

DR TUNDI AGARDY

SOUND SEAS

Dr Tundi Agardy is Director of Sound Seas, providing independent policy and science guidance to donor agencies and multilaterals, working with national and local authorities to design and implement marine plans, undertaking ecosystem services assessments, creating MPAs and OECMs, and catalysing coastal restoration. Tundi has global field experience, focused on Caribbean and Mediterranean regions. At Forest Trends she created the MARES Program to protect marine ecosystem services through market-based mechanisms, and served as Senior Scientist for WWF and Senior Director of Conservation International's Global Marine Program. She also advises Living Oceans Society, World Ocean Observatory, and Endangered Landscapes Program (OSP).

DR RONALD BAKER

UNIVERSITY OF SOUTH ALABAMA, USA AND DAUPHIN ISLAND SEA LAB

Ron has over 20 years' experience in studying coastal ecosystems, particularly their role as nurseries for ecologically and economically important species. Together with his students and collaborators, he has studied nursery function from a range of perspectives, including context dependence in fish-habitat associations, food web dynamics through dietary and stable isotope studies, the significance of pulsed events on lifecycle dynamics, and connectivity through movement ecology of key fishery species. Ron received a PhD from James Cook University in North-eastern Australia, and completed post-docs with NOAA Fisheries on the Gulf of Mexico in Galveston Texas, and with the Smithsonian at the Marine Station at Fort Pierce, Florida. He joined the University of South Alabama as an Assistant Professor in 2018, and is based at the Dauphin Island Sea Lab.

DAN CROCKETT

BLUE MARINE FOUNDATION

Dan Crockett is a director at Blue Marine Foundation. His particular focus is on blue carbon and valuing the ocean as a solution to climate change. He speaks broadly on this topic, including at COP26 and the United Nations Ocean Conference 2022. He has played a key role in the establishment of the UK Blue Carbon Forum, the Verra Seascape Carbon Initiative and sits on the technical advisory board of Wilder Carbon. He is a trustee and treasurer of Surfers Against Sewage.

ALISON DEBNEY

ZOOLOGICAL SOCIETY OF LONDON

Alison Debney has been championing the protection, restoration and sustainable management of wetland habitats across the globe for 25 years. As Conservation Lead for wetland restoration at the Zoological Society of London (ZSL), Alison has worked across a range of ecosystems including mangroves in Asia and Africa, Amazonian flooded forests and urban rivers in central London. In 2010, Alison turned her attention to the plight of coastal habitats in the UK and started to advocate that active restoration was a necessary step in their recovery. Leading by example, Alison helped to establish the first native oyster restoration project in Europe – the Essex Native Oyster Restoration Initiative (ENORI) and currently acts as its chair. She is Co-Chair of the Native Oyster Network for UK & Ireland in collaboration with the University of Portsmouth, and is a steering board member for the European Native Oyster Restoration Alliance (NORA). Alison has recently been elected to the board of the Wetlands International - European Association. Alison leads a portfolio of wetland restoration projects in the UK including ENORI, The Wild Oyster Project, Restoring the Thamescape, Restoring London's Rivers as well as many projects focusing on Essential Fish Habitat particularly in estuarine environments. Alison also leads several projects conserving the animals that depend on these important coastal habitats including sharks, seals, eels, smelt, and, soon to be seen again, sturgeon.

EMERITUS PROFESSOR MICHAEL DEPLEDGE CBE PHD, DSC, FRSB, FRCP

UNIVERSITY OF EXETER MEDICAL SCHOOL & EDEN PROJECT

Professor Depledge has conducted medical and ecotoxicological research for more than 45 years. His findings appear in over 400 publications in the peer-reviewed international literature. His studies address the

interconnections between the environment and human health, especially the ecotoxicity of anthropogenic chemicals, including pharmaceuticals, and the threat posed by antimicrobial resistance. He has also pioneered the use of the marine environment in fostering improvements in human health and wellbeing. Professor Depledge was formerly a founding board member of Natural England, a Commissioner of the Royal Commission on Environmental Pollution and Chief Scientific Advisor of the Environment Agency. He was also the founder of the European Centre for Environment and Human Health (University of Exeter, UK).

DR RACHEL DUNK

MANCHESTER METROPOLITAN UNIVERSITY

Dr Rachel Dunk is a Principal Lecturer and Carbon Literacy Consultant at Manchester Metropolitan University. Her research and knowledge exchange interests focus on the science and policy of climate change, carbon accounting and management, and climate/carbon literacy. She has over twenty years of experience researching the chemistry of the greenhouse gases and carbon storage and management, with a particular interest in marine carbon stocks and fluxes.

DR PHILINE ZU ERMGASSEN

UNIVERSITY OF EDINBURGH

Philine is a visiting researcher in the Changing Oceans Group at the University of Edinburgh, and an independent consultant. Since completing her PhD at the University of Cambridge on the interactions between freshwater invasive species, Philine has worked internationally to build the science case for coastal habitat restoration. Through her work with The Nature Conservancy, Philine has developed tools for using ecosystem services to set long-term habitat restoration goals, quantitative models of fish nursery habitat value, and numerous guidelines on native oyster habitat restoration. Most recently Philine worked with the Native Oyster Restoration Alliance community, supporting critical international collaborative efforts to move the needle on the scale and scope of oyster restoration in Europe.

CELINE GAMBLE

ZOOLOGICAL SOCIETY OF LONDON

Celine Gamble is a Restoration Project Manager in the Estuaries & Wetlands Conservation team of the Zoological society of London. Celine manages The Wild Oysters Project, a national collaboration, led by the ZSL, Blue Marine Foundation and British Marine, working with the marine industry and local communities and organisations, to deliver restoration sites in England, Scotland and Wales. She also works to coordinate the Native Oyster Network (UK & Ireland), which aims to facilitate the restoration of our native oyster via action, communication and providing evidence for policy change. Celine has been awarded visiting researcher status at the University of Portsmouth, as she supports restoration fieldwork and native oyster research carried out by the Institute of Marine Sciences at the University of Portsmouth. Celine is an author and editor of the "European Native Oyster Habitat Restoration Handbook, UK and Ireland" (2020), the "European Guidelines on Biosecurity in Native Oyster Restoration" (2020), the "European Native Oyster Habitat Restoration Monitoring Handbook" (2021) and the "Seagrass Restoration Handbook" (2021) and has a broad, high-level experience of marine coastal habitat restoration in the UK and Europe. Celine's experience combines scientific research and science communication, along with events coordination and project management.

ANGUS GARBUTT

UK CENTRE FOR ECOLOGY & HYDROLOGY (UKCEH)

Angus Garbutt is the UKCEH coastal science lead and an expert saltmarsh in saltmarsh restoration, management and processes. His work focuses on field experimentation, long-term and national scale monitoring, quantifying relationships between ecosystem function and the goods and benefits they provide. Angus is Chair of the UK Saltmarsh Specialists Forum bringing together experts from policy, science, consultancy and the NGO's to share knowledge and best practice. The current focus is on building the evidence base on connectivity between land, sea and people.

DR BOZE HANCOCK

THE NATURE CONSERVANCY

Boze is the Senior Marine Habitat Restoration Scientist for TNC's Global Oceans Team. Boze comes from a fisheries research background in Western Australia and has spent the last 20 years based in the US developing marine habitat restoration in new geographies. He provides technical support for partners and numerous projects throughout TNC's global portfolio. He collaborates to provide science support for marine habitat restoration, particularly through quantifying the ecosystem services these habitats provide and making the results available to the marine restoration community. He works with SER and the UN Decade to help align our work and unify the field under the UN Decade.

GWENAËL HANON

ARK NATURE

Gwenaël is thrilled by everything aquatic and, after having studied aquaculture and marine ecology at Wageningen University, has worked as a marine ecologist in both in the consultancy and non-profit sector. Since working at ARK Rewilding Netherlands he has been inspired by the rewilding philosophy and approach; where nature itself determines as much as possible what the landscape will look like, and where there is room for mutual gains between the ecosystem and sustainable business models. ARK's rewilding projects showcase the resilience and natural dynamics of marine ecosystems but also that enough space and time is needed to achieve real ecological recovery.

DR JUHYUNG LEE

NORTHEASTERN UNIVERSITY, USA

Juhyung Lee earned his bachelor's degree from Seoul National University (Biology Education major) in 2014. He acquired PhD from Stanford University in 2020 (Biology major) under the supervision of Dr Fiorenza Micheli. Since 2020, he has been working as a postdoctoral researcher at Northeastern University under the supervision of Dr. Jonathan Grabowski and in collaboration with The Nature Conservancy. His research utilizes experimental and quantitative approaches to broadly understand how global change will modify resilience and vital functions provided by coastal marine habitats, as well as mechanisms underpinning these changes.

WILL MANNING

ENVIRONMENT AGENCY, UK

Will is an Advisor in the Environment Agency's (EA) national Estuarine and Coastal Planning team. As part of this role, he primarily works on policy influencing the estuarine and coastal (E&C) environment and the restoration initiative "Restoring Meadow, Marsh and Reef (ReMeMaRe)" (pronounced "re-memory"), which aims to enable the recovery and restoration of E&C habitats, with a current focus on the priority habitats: seagrass meadows, saltmarsh and native oyster beds and reefs.

DR DOMINIC MCAFEE

UNIVERSITY OF ADELAIDE, AUSTRALIA

Dominic is a marine ecologist working on the recovery of Australia's lost shellfish reefs. His research seeks to understand and leverage the ecological and social complexities of the marine and social environment in which restorations take place, so we can develop solutions that ensure marine habitat restoration is both a social and environmental success. His primary research interest is in developing efficient methods to co-restore multiple habitats that interact to maximise the productivity and resilience of restored ecosystems.

PROFESSOR PIPPA MOORE

NEWCASTLE UNIVERSITY

Pippa is a Professor of Marine Science at Newcastle University who's research interests include climate change ecology, kelp forest ecology and marine eco-engineering. For the last 10 years she has described the structure and function of UK kelp forests as well as undertaking research into developing sustainable management of the kelp harvesting industry in Chile and Peru. She has worked for a number of years on determining the blue carbon potential of kelp and spends quite a bit of time these days trying to get people to recognise the huge knowledge gaps in this area.

DR NATHALIE PETTORELLI

ZOOLOGICAL SOCIETY OF LONDON

Dr Nathalie Pettorelli is a senior scientist at the Zoological Society of London. She has published over 200 scientific contributions on biodiversity monitoring, climate change ecology, and the use of satellite remote sensing to support wildlife management and conservation. She is the Editor in Chief of Remote Sensing in Ecology and Conservation, and the co-chair of the IUCN rewilding group.

DR SIMON J. PITTMAN

OXFORD SEASCAPE ECOLOGY LAB, UNIVERSITY OF OXFORD

Simon is an Honorary Research Associate at the University of Oxford working in collaboration with the Oxford Seascape Ecology Lab. He leads a course on Marine Ecosystems in Oxford's School of Geography and the Environment and mentors research students worldwide. Simon is Editor of Seascape Ecology, the first academic book on the subject and serves as a Contributing Editor for Marine Ecology Progress Series. In addition to his academic work, Simon is the Director of Seascape Analytics, a marine science consultancy informing marine protected area management and marine spatial planning. To support global marine conservation, he also volunteers as a science advisor to the Marine Connectivity Working Group of the IUCN World Commission on Protected Areas and serves on the Science Council to the Marine Conservation Institute's Blue Parks initiative.

DR JOANNE PRESTON

UNIVERSITY OF PORTSMOUTH AND UK NATIVE OYSTER NETWORK

Joanne's research supports restoration of coastal habitats, particularly oyster reefs, seagrass and saltmarsh. Her research is focused on the ecology of these species and habitats, and their interactions with environmental pressures such as climate change, microplastics, disease, invasive species and excessive nutrients (eutrophication). In 2017, Joanne co-founded the UK and Ireland Native Oyster Restoration Network in collaboration with ZSL, she is the Monitoring Working group lead for the European Native Oyster Restoration Alliance. Joanne also co-chairs the ConnECTER Special Interest Group (SIG) which aims to promote and facilitate scientific research that improves the understanding of habitat and ecosystem restoration and application of Nature-based Solutions (NbS) in the UK.

CAROLINE PRICE

THE CROWN ESTATE

Caroline is a marine biologist with more than 18 years' experience working across the maritime sector. As a Senior Development Manager of Habitat Creation in The Crown Estate marine team, she is working to unlock opportunities for strategic habitat creation and restoration in the coastal and marine space, supporting the UK's collective goals around nature recovery and a net zero future.

ROGER PROUDFOOT

ENVIRONMENT AGENCY, UK

Roger Proudfoot is the Environment Agency's Estuary and Coast Planning Manager for England and Chair of the UK Healthy Biologically Diverse Seas Evidence Group (HBDSEG). He has 33 years' experience of marine environmental monitoring, assessment, and management. Roger has been instrumental in the protection and improvement of estuarine and coastal waters through the implementation of European legislation including the Water Framework Directive. More recently he has overseen the reporting of the state of biodiversity for the UK Marine Strategy and is responsible for initiating the Restoring Meadow Marsh and Reef partnership (ReMeMaRe) which aims to restore estuarine and coastal habitats in England's waters. Roger continues to lead and shape the Environment Agency's approach to the management of England's near-shore seas and estuaries and UK more widely.

DR SIMON REEVES

THE NATURE CONSERVANCY, AUSTRALIA

Simon began his science career studying how Antarctic flora and fauna survive the long-dark polar winter under changing climactic conditions. Currently, Simon works as Data and Science manager with The Nature Conservancy in Australia. His work is focused on how impact and success is measured and reported for conservation projects. Simon oversees and implements monitoring for marine and terrestrial conservation

programs with a particular emphasis on integrating the latest science into the design, delivery and scale-up of marine restoration projects. Simon has a MSc in Antarctic science and a PhD in marine ecology from the University of Tasmania.

DR RUTH THURSTAN

UNIVERSITY OF EXETER

Ruth Thurstan is a senior lecturer at the University of Exeter's Cornwall Campus. She uses documentary archives to understand the magnitude and drivers of marine ecosystem change over the past decades to centuries. During her PhD she explored changes to the UK's marine fisheries from the Industrial Revolution to the present day. During postdoctoral fellowships in Australia, she used interviews and a popular media to understand ecological and social changes in Australia's east coast recreational fisheries over the last 150 years. She has been back in the UK since 2017 and has relished the opportunity to further explore long-term changes in our marine ecosystems, and to expand this research to wider European seas.

PROFESSOR GRAHAM UNDERWOOD

UNIVERSITY OF ESSEX

Graham is Professor of Marine and Freshwater Biology in the School of Life Sciences at the University of Essex. He has worked on estuarine ecology, biogeochemistry, microbial ecology for over 30 years. His interests range from microbial diversity and function, primary production and organic carbon fluxes, through to whole estuary functioning and approaches to restoration. He is currently Chair of NERC's Science Committee, served for a 10 year period on the Environment Agency's Eastern Regional Flood and Coastal Committee, and is a NERC Knowledge Exchange Fellow (2022-2025), on a project called "Delivering Multifunctional Natural Capital Approaches for Future Coasts". He is co-chair (with Jo Preston) of the Connectivity in Estuarine, Coastal and Transitional Ecosystem Restoration (ConnECTER) Special Interest Group (SIG).

DR RICHARD UNSWORTH

PROJECT SEAGRASS

Richard is Chief Scientific Officer for Project Seagrass and an associate professor at Swansea University. He works on applied aspects of seagrass ecology helping to inform conservation actions, particular focus has been on seagrass ecosystem service provision, habitat restoration and ecosystem resilience. He has published over 150 academic articles and reports, and led the UK's first major seagrass restoration project. His claim to fame is that he's one of the few people to ever have kite surfed in a desert and he once met hulk hogan.

DR STEPHEN WATSON

PLYMOUTH MARINE LABORATORY

Dr Stephen Watson is an interdisciplinary Ecosystem Services Scientist at Plymouth Marine Laboratory. A marine ecologist and ecosystem services analyst by training, his research utilises: ecological indicators, GIS, ecosystem models (e.g., Ecopath, InVEST) and methods of environmental economic evaluation. He was a Senior Research Associate on the Solent Natural Capital Project (2017-2020) at the University of Portsmouth and has worked on issues such as the impact of multiple stressors and tipping points on ecosystem services as part of the wider Valuing Nature Network (VNP) and Biodiversity & Ecosystem Service Sustainability (BESS) research programmes.

DR JAKUB WEJCHERT

DIRECTORATE-GENERAL FOR ENVIRONMENT, EUROPEAN COMMISSION

Jakub Wejchert is a Senior Policy Officer at the DG Environment, European Commission. He currently works on the team developing the Nature Restoration Law. This has included work on concept development, ecosystem restoration, target setting, biodiversity indicators, ecosystem condition, as well as socio-economic aspects. Previously he contributed to the EU 2030 Biodiversity Strategy and prior to that the EU negotiations on the Sustainable Development Goals. He holds a PhD and BA in Natural Sciences, from Trinity College Dublin. A few years ago, Dr Wejchert received an Advanced Diploma on Ecological Monitoring from the University of Cambridge.

DR THOMAS WORTHINGTON

UNIVERSITY OF CAMBRIDGE

Thomas' research focuses on the conservation of ecosystems and organisms from landscape to global scales, particularly coastal and freshwater habitats. As the world continues to look to nature-based solutions to help solve the climate and biodiversity crises, this research will become more important and influential. He produced the first global map of mangrove restoration potential, which generated interest from governments and NGOs. He is currently developing a number of tools and datasets that can be used to support the conservation and restoration of coastal and freshwater environments.

POSTER ABSTRACTS

1. HABITAT SUITABILITY MODELLING FOR INFORMING RESTORATION SITES (AND THE VALUE OF USING HIGH RESOLUTION MODELLED HYDRODYNAMIC DATA)

Chiara Bertelli
Swansea University

Habitat suitability modelling (HSM) is a tool that is increasingly being used to help guide decision making for conservation management. It can also be used to focus efforts of restoration in our oceans. To improve on model performance, the best available environmental data along with species distribution data are needed. Marine habitats tend to have ecological niches defined by physical environmental conditions and of particular importance for shallow water species is wave energy.

As part of the ReSOW (Restoring Seagrass for Ocean Wealth) SMMR project we are looking at several sites across an environmental, ecosystem services and potential 'social acceptance' gradients in closer detail. For the HSMs, the use of high-resolution modelled wave height and hydrodynamic data is also being investigated to see if model predictions at a fine-scale can be improved.

2. MARINEFF: BIOLOGICAL ENHANCEMENT OF COASTAL INFRASTRUCTURE

Ken Collins
Ocean and Earth Science, University of Southampton

The EU/Interreg funded project RECIF (2012-2015) developed waste shell concrete formulations specifically for artificial reefs. Its successor MARINEFF (2018-2023, €5million www.marineff-project.eu/en/) continued the development of these by evaluating further formulations to maximise both the goal of the MARINEFF programme is to use the formulations to enhance and protect coastal and transitional water ecosystems in cross-border Channel regions. The project aims to realise new biomimetic marine infrastructures, aiming to optimise shell concrete physical performance, endurance and biological attractiveness to improve the ecological status of coastal and transitional Channel waters, as well as to involve professionals and stakeholders in the project.

MARINEFF has 11 partners across the English Channel with 4 demonstration projects: oyster enhancement modules, artificial rock pools, breakwater blocks and mooring sinkers. The free to attend public end of project symposium to disseminate the results will be held at the Institute of Marine Sciences, University of Portsmouth, 8th March 2023. To register interest contact Ken Collins kjc@noc.soton.ac.uk.

3. ECOSYSTEM REDLISTING ASSESSMENT OF EUROPEAN NATIVE OYSTER REEFS

Philine zu Ermgassen[1], Ruth Thurstan[2], Hannah McCormick[3], Celine Gamble[3], Joanne Preston[4], Stephane Pourveau[5], Jose Farinas-Franco[6], William Sanderson[7], Åsa Strand[8], Chris Gillies, Boze Hancock[9]

[1] University of Edinburgh
[2] University of Exeter
[3] Zoological Society of London
[4] University of Portsmouth
[5] Ifremer
[6] Galway-Mayo Institute of Technology
[7] Herriot Watt University
[8] IVL Swedish Environmental Research Institute
[9] The Nature Conservancy

Native "flat" oyster reefs, formed by *Ostrea edulis*, were once widespread throughout their European range. Currently reefs are only formed on a small-scale across a handful of sites.

We developed ecosystem definitions of the European Native Oyster reefs and ecosystem collapse based on historical and current data. We then applied the definitions to available data on the current distribution and

habitat quality data from across Europe to develop scenarios for criteria A, B and D of the IUCN ecosystem red listing process. The process is explained and the provisional results of the assessment at shared.

4. WHAT MAKES A HABITAT A HOME: HABITAT ASSOCIATIONS OF JUVENILE EUROPEAN SEA BASS, *DICENTRARCHUS LABRAX*, IN ESTUARINE NURSERIES

Howard Freeman[1], Albert Smith[1], Aaron Lamphiere[1], Dr Leanne Hepburn[1], Dr Martin Taylor[2], Dr Alex Dumbrell[1], Dr Kieran Hyder[3], Dr Ewan Hunter[4], Dr Thomas Cameron[1]

[1] University of Essex
[2] University of East Anglia
[3] Centre for Environment, Fisheries and Aquaculture Science (CEFAS)
[4] Agri-Food and Biosciences Institute (AFBI)

Nursery habitat selection in juvenile European sea bass, *Dicentrarchus labrax,* is poorly understood. Few studies explore the role of the complex estuarine mosaic of structurally different habitats in driving juvenile fish distributions, primarily focussing on saltmarshes. Here we determined how abundance and condition of juvenile sea bass differs between low and high tide estuarine habitats: saltmarshes, oyster reefs and shingle, sand, and mud edge habitat. Our findings suggest that at high tide, juvenile sea bass show no preference among shallow habitats, but saltmarsh and sand may exhibit a higher foraging potential. At low tide a shift to the use of more complex, less profitable shingle and oyster reef occurs, resulting in a trade-off between foraging potential and predator avoidance. Our findings provide evidence that multiple habitats in the estuarine mosaic are important to juvenile sea bass and should be given due consideration in further studies of juvenile fish habitat usage.

5. NATIVE OYSTER NETWORK – UK & IRELAND: RESTORING THE UK'S OYSTER BELT

Celine E. Gamble[1,2], Alison Debney[1] and Joanne Preston[2]

[1] Zoological Society of London
[2] Institute of Marine Sciences, University of Portsmouth

The Native Oyster Network was established by the Zoological Society of London and the University of Portsmouth, to facilitate the restoration of the native oyster, *Ostrea edulis*, across the UK & Ireland. This network aims for an ecologically coherent and collaborative approach to native oyster restoration, by promoting communication between native oyster restoration projects to promote best practise. We also strive to increase the awareness of the social and political worth of native oysters.

We will introduce the aims of the Native Oyster Network and overview the projects and partnerships that form the network. We will outline the key methods and approaches that we have identified as essential to facilitate restoration on a national scale in the UK & Ireland. We will share our two recent publications we have produced with the European NORA Network: European Native Oyster Habitat Restoration Handbook and European Guidelines on Biosecurity in Native Oyster Restoration.

As native oyster restoration in the UK is still in the early stages, we do not currently know what success looks like. Despite this, equipped with a new sense of enthusiasm from the establishment of the Network, that brings together expertise from scientists, conservationists, fishers and government, we are optimistic that successful restoration is attainable. We are keen to share successes and learnings from the UK & Ireland and hear from international shellfish restoration practitioners.

6. WILD OYSTERS PROJECT: FIRTH OF CLYDE, CONWY BAY & TYNE & WEAR

Celine E. Gamble[1], Luke Helmer[2], Matt Uttley[2], Alison Debney[1]

[1] Zoological Society of London
[2] Blue Marine Foundation

The Wild Oysters Project is a UK oyster restoration project launched in June 2020, developed as part of a new collaboration between the Zoological Society of London (ZSL), Blue Marine Foundation (Blue Marine) and British Marine.

The Wild Oysters Project is working together to restore marine life, inspire ocean stewardship and achieve system change required to recover our seas. This project is using seabed restoration expertise gained by ZSL and partners as part of the Essex Native Oyster Restoration Initiative (ENORI), and caged oyster systems suspended under marinas developed by Blue Marine and University of Portsmouth with the Solent Oyster Restoration Project, combining the two elements for the first time at scale in the UK.

Wild Oysters has established oyster rehabilitation hubs in the Firth of Clyde (Scotland), Conwy Bay (Wales) and Tyne & Wear (England). At each oyster rehabilitation hub, we are working with local stakeholders to install oyster nurseries from marina pontoons, carrying out oyster seabed restoration and delivering an extensive public outreach and biological sciences education programme to both primary and secondary students.

The Wild Oysters project is adopting an innovative approach to build capacity for ocean recovery, by collaborating with our industry partner British Marine and facilitating the l local coastal partnerships. We look forward to presenting our progress to date at the ZSL symposium.

7. INTEGRATED COASTAL HABITAT RESTORATION? THE POTENTIAL FOR SEAGRASS, SALTMARSH AND NATIVE OYSTER RESTORATION IN THE MEDWAY AND SWALE

Morwenna Grigg[1], Thea Cox[1] and Anna Cucknell[1]

[1] Zoological Society of London

Seagrass, saltmarsh, and native oyster habitats individually support an abundance of biodiversity and provide critical ecosystem services such as carbon storage, water filtration, wave attenuation, and flood risk mitigation. An integrated approach to coastal habitat restoration has the potential to further enhance ecosystem connectivity and resilience between these habitats. The Medway and Swale Estuaries are tributaries of the Thames and offer a potential site for integrated habitat restoration. Here, coastal habitats such as seagrass and native oyster beds had not recently been documented, hence, we have begun collecting baseline data on habitat extent and condition to compare against future restorative efforts. Native oyster surveys by means of benthic trawling revealed native oysters, *Ostrea edulis*, to be present in the Medway, although seemingly in small numbers. Seagrass beds were mapped using remote sensing and ground truthing techniques. We discovered both *Zostera marina* and *Zostera noltei* species, though beds were dominated by *Z. noltei*. We also carried out condition assessments of seagrass health and associated biodiversity, as well as monitoring seed development. Our efforts have primarily been focused on *Z. noltei*, which is relatively understudied in comparison with *Z. marina*, and we hope to work with other *Z. noltei* projects to understand more about this species. A habitat suitability model will be developed to assess potential restoration sites, and we hope to measure the impact of restoration across coastal habitats in a more holistic way.

8. ASSESSING THE IMPACT OF NOVEL INTERTIDAL AND SUBTIDAL AQUACULTURE SYSTEMS ON EUROPEAN OYSTER (*OSTREA EDULIS*) MORTALITY, GROWTH, CONDITION AND ECOSYSTEM PROVISION

Harris-Scott, E.[1]; Morrall, Z.; van der Schatte Olivier, A.; Preston, J. and Watson, G.

[1] University of Portsmouth

The decline in *Ostrea edulis* (*O. edulis*) populations over the past century and subsequent decline of reef habitat has caused substantial loss of ecosystem services including nitrogen (N) bioremediation; resulting in reduced mitigation of eutrophication by coastal and estuarine ecosystems previously abundant with oysters. Oyster aquaculture systems can provide the means to expedite the establishment of restored oyster reefs by supporting broodstock culture *in situ* for restoration; these can also deliver a suite of associated ecosystem services. Comparing subtidal suspended broodstock cages and intertidal Ortac boxes at multiple locations, we monitored long-term survival, growth, condition and N% biomass to analyse the effect of culture method on oyster health and bioremediation. Broodstock cages were deployed ~1 m below the surface on floating structures, ORTACs were positioned 0.5 m above intertidal mudflat substrate (equating to 16-hour mean immersion per day). Results showed similarity in condition index between culture methods however, subtidal oyster shell growth and weight increases were greater than intertidal oysters within the same locations. Across all locations, ORTAC oysters had a greater N% tissue biomass ($\bar{x}$ 8.27%) than subtidal ($\bar{x}$ 7.05%). Faster

growth rate in cages led to increased tissue biomass and greater total N remediation. However, low N assimilation rate calculated for subtidal oysters (~ 1.6 kg N tonne^{-1}) indicates that utilising restorative aquaculture as a tool to combat eutrophication will be ineffective without upscaling. Nevertheless, significant reductions in environmental impact would be realised through decreasing reliance on capture fisheries and transitioning to aquaculture production that supports restoration efforts.

9. CAN UK INTERTIDAL SEAGRASSES BE CONSIDERED A NATURE-BASED SOLUTION?

A. Malcolm-McKay[1], R. J. Lilley[2]; R. Unsworth[2,4]; W. Manning[3]; T. Gardiner[3]; L. C. Cullen-Unsworth[2] and T. C. Cameron[1]

[1] School of Life Sciences, University of Essex

[2] Project Seagrass

[3] Environment Agency

[4] Swansea University

Ongoing changes to the planet's climate are threatening critical marine ecosystems and habitats. For foundation species, such as seagrass, adaptation strategies are unlikely to be able to keep up with warming rates and sea level rise. Catastrophic losses of seagrass coverage have been observed globally and have prompted scientists and experts to form a collaborative push towards a focus on seagrass research, conservation and restoration. Yet, knowledge gaps remain across geographical regions and species-specific contributions of services, in particular for the UK and the intertidal species, *Zostera noltei*. Habitat restoration is increasingly identified as a 'nature-based solution' to offsetting carbon emissions, and perceptions of seagrass as a 'solution' is commonplace in these discussions. However, questions arise about the suitability of certain seagrass species for restoration. Recent attempts have also highlighted the need to identify suitable restoration areas, prior to recovery efforts. *Z. noltei* is currently a targeted species for restoration, yet little is known of its ecosystem services and present status in targeted areas. Using a North Sea estuary complex as a case study, local seagrass meadows will be assessed and environmental conditions will be measured, as well as the carbon sequestration potential and carbon flux of intertidal seagrass and other habitats in the estuarine seascape. This aims to discern ideal environmental conditions for seagrass growth and to explore the historical decline and distribution changes to *Z. noltei* meadows across Essex/Suffolk. Results also aim to identify the carbon offsetting potential and establish suitable locations for seagrass restoration in the region.

10. IMPLEMENTATION OF TECHNIQUES FOR THE RESTORATION OF THE INTERTIDAL VERMETID REEFS IN THE MEDITERRANEAN SEA

Emanuela Claudia La Marca[1], Francesca Ape[1,3], Marco Martinez[1], Alessandro Rinaldi[1], Valeria Montalto[1], Evelyn Scicchigno[1], Marco Spoto[1], Enrico Dini[2], Simone Mirto[1]

[1] Institute of Anthropic Impacts and Sustainability in Marine Environment, National Research Council (IAS-CNR), Italy

[2] Monolite UK Ltd., UK

[3] Institute of Marine Science, National Research Council (ISMAR-CNR), Italy

Vermetid reefs are intertidal bioconstructions with a valuable role for the coastal ecosystems, representing biodiversity hotspots, affecting the bio-geomorphological and chemical processes and providing services to humans. In the Mediterranean Sea, these reefs are built by gregarious gastropods belonging to the *Dendropoma* complex and crustose coralline algae and are protected by European legislation. However, environmental and anthropogenic stressors threaten their persistence in some parts of the basin and guidelines for their restoration still lack.

Here we tested different engineered substrates to achieve new vermetid colonies, aiming for their transplantation to depleted reefs for restoration purposes. We investigated the settlement rate of the central-Mediterranean *Dendropoma cristatum* and the reef-associated benthic fauna on artificial tiles made of different concretes (i.e. geopolymer, or "green cement" due to the reduced energy consumption for its production; pozzolanic and sand; magnesian; pozzolanic, magnesium and sand), engineered through different topographies (i.e. holes and crevices of 1 and 2 millimetres).

Regardless of the material, the hole presence played a role for both the reef-builder species and the benthic fauna, with a significantly higher vermetid density and invertebrate taxonomic richness and individual

abundance on this topography. Among the materials, the geopolymer showed the highest durability under field conditions. The selection of geopolymer substrates engineered with the hole interstices is an important achievement which may allow the design of the first steps of a protocol for the restoration of degraded vermetid reefs. Studies regarding the post-settlement dynamics on these engineered substrates are ongoing and necessary to further advance this research.

11. DOES MECHANICALLY REMOVING ALGAL MATS AN OFFER A SUITABLE REMEDIATION METHOD TO IMPROVE COASTAL WATER QUALITY AND REDUCE NUTRIENT POLLUTION?

Zoe Morrall
University of Portsmouth

Increases in nutrients from agricultural runoff, sewage discharge and industry lead to widespread eutrophication, often resulting in extensive algal mat coverage in the coastal zone. These mats decrease light availability, increase siltation, accumulate organic matter and increase anoxic conditions impacting key coastal habitats (e.g. seagrass and saltmarsh) and species (wading birds, fish and shellfish). Although reducing the nutrient inputs is paramount, many studies have suggested direct mat removal as a cost effective and immediate solution to begin to achieve nutrient reduction. However, no studies have assessed the efficacy and impact of removing algal mats from intertidal mudflats; a habitat most frequently impacted by algal mats. In early summer of 2022 at four sites in the Channel region (2 UK and 2 French), we will assess the success and ecological effects of removing approximately 400 m^2 of algal mat (potential upscaled remediation of 62.5 – 177.5 kg N ha−1 yr−1) using a floating boat platform. Data on removal efficiency (e.g. biomass removed and levels of entrained algae remaining) will be gathered at the time of removal. Subsequent repeated sampling of the sites over 6 months will monitor both short and longer-term effects including: algal mat recovery, sediment changes, benthic community and wading bird behaviour (e.g. feeding). Removal amounts will then be scaled at the regional level to calculate the potential bioremediation of mechanical removal for nitrogen and phosphorous and also compared to other approaches (e.g. habitat restoration). This novel scientific assessment at relevant temporal and spatial scales will enable European policymakers to make evidence-based decisions to achieve nutrient neutrality and Good Environmental Status, as well as assess the impact of physical removal as a way to combat smothering of key habitats such as saltmarsh and seagrass.

12. THE EUROPEAN NATIVE OYSTER RESTORATION ALLIANCE (NORA): WHO WE ARE AND WHAT WE DO

Hein Sas
The European Native Oyster Restoration Alliance (NORA)

NORA was created in 2017, with the purpose of creating more awareness of the need for native oyster reef restoration in European marine waters and to assist in spreading the knowledge on how to do that, in the worlds of science, governments, offshore industry and NGO's and with the public at large. It has fulfilled these purposes, by creating publications, setting up working groups on key topics and organising conferences. As a result, the network of participants has grown from ca. 70 to 400 persons, but more engagement is still required. The poster will underline this.

13. ENVIRONMENTAL IMPACTS ON NORTHERN MARINE FOOD WEBS ACROSS SPATIOTEMPORAL SCALES

AL. Shurety[1], M. Thompson[2], E. Couce[2], T. Cameron[1] and E. J. O'Gorman[1]
[1] University of Essex
[2] Centre for Environment, Fisheries and Aquaculture (CEFAS)

Commercially important fish stocks have declined dramatically, and sea surface temperatures have increased by approximately 0.5 °C over the last few decades within coastal habitats of the Northern Ocean. The combined impacts of commercial fishing and climate change will have deep rooted consequences for food web structure and ecosystem function. Here, we will investigate how these environmental stressors shape food web structure and function across temporal and spatial scales. Food webs will be constructed using an

unprecedented database of fish stomach contents from the Northern Ocean, spanning >70 years and >50 million predator-prey body mass measurements. We will also use the Allometric Diet Breadth Model (ADBM) to determine whether we can reliably predict food web structure from individual body mass data. These food webs will allow us to assess the recent impact of commercial fishing and climate change on food web structure in North Sea coastal habitats, as well as predict the future trajectory of food webs within the Northern Ocean. Such research outputs have the potential to provide clear cut advice and comparisons for sustainable management despite the complexity of ecosystems.

14. H2O SOURCE2SEA: USING NATURE TO MANAGE DROUGHT & FLOODING

Sherece Thompson
Kent Wildlife Trust

The H2O: Source2Sea project (2019- 2023) is funded by Interreg and is a partnership between Kent Wildlife Trust, Kent County Council, Nausicaa, and CPIE. The project achievements to date include; the creation of a rainwater harvesting tool (Kent County Council), planting hedgerows to slow sediment in flash floods (CPIE), pond creation surrounding the Stour to manage ground-water levels (KWT), creation of natural capitol valuation tool (KWT), and engaging with over 500,000 people about Nature-based Solutions (Nausicaa).

Focusing on the Stour our coastal efforts have looked into the feasibility of habitat restoration on an ecosystem scale in the Sandwich and Pegwell Bay area. Kent Wildlife Trust hired Exo Environmental consultancy services to survey the existing saltmarsh and produce a condition report in terms of its use as a NbS to coastal flooding. Exo also surveyed for the presence of seagrass and native oyster reefs surrounding Sandwich and Pegwell Bay using ariel drones and bathymetry kit. The initial findings point to a highly mobile site with a constrained saltmarsh due to hard barriers like the main road and the golf course. A final restoration feasibility report will be produced by March 2023 highlighting the scope for restoration of these 3 habitats.

Through sharing our work and our thinking in terms of restoring coastal habitats for the purpose of NbS to flood management we hope to engage with those who may be able to forward any potential restoration work when the H2O project comes to an end in March 2023.

15. SEAGRASS DISTRIBUTION AND SPATIAL VARIATION IN QUALITY - SEASCAPE CONTEXT AND INFLUENCES ON CARBON STORAGE?

Emma A Ward[1], Sarah Reynolds[2], Federica Ragazzola[3], Marianna Cerasuolo[4] and Joanne Preston[1]
[1] Institute of Marine sciences, School of Biological Sciences, University of Portsmouth
[2] School of the Environment, Geography & Geosciences, University of Portsmouth
[3] Department of Integrative Marine Ecology, Ischia Marine Centre, Stazione Zoologica Anton Dohrn
[4] School of Mathematics & Physics, University of Portsmouth

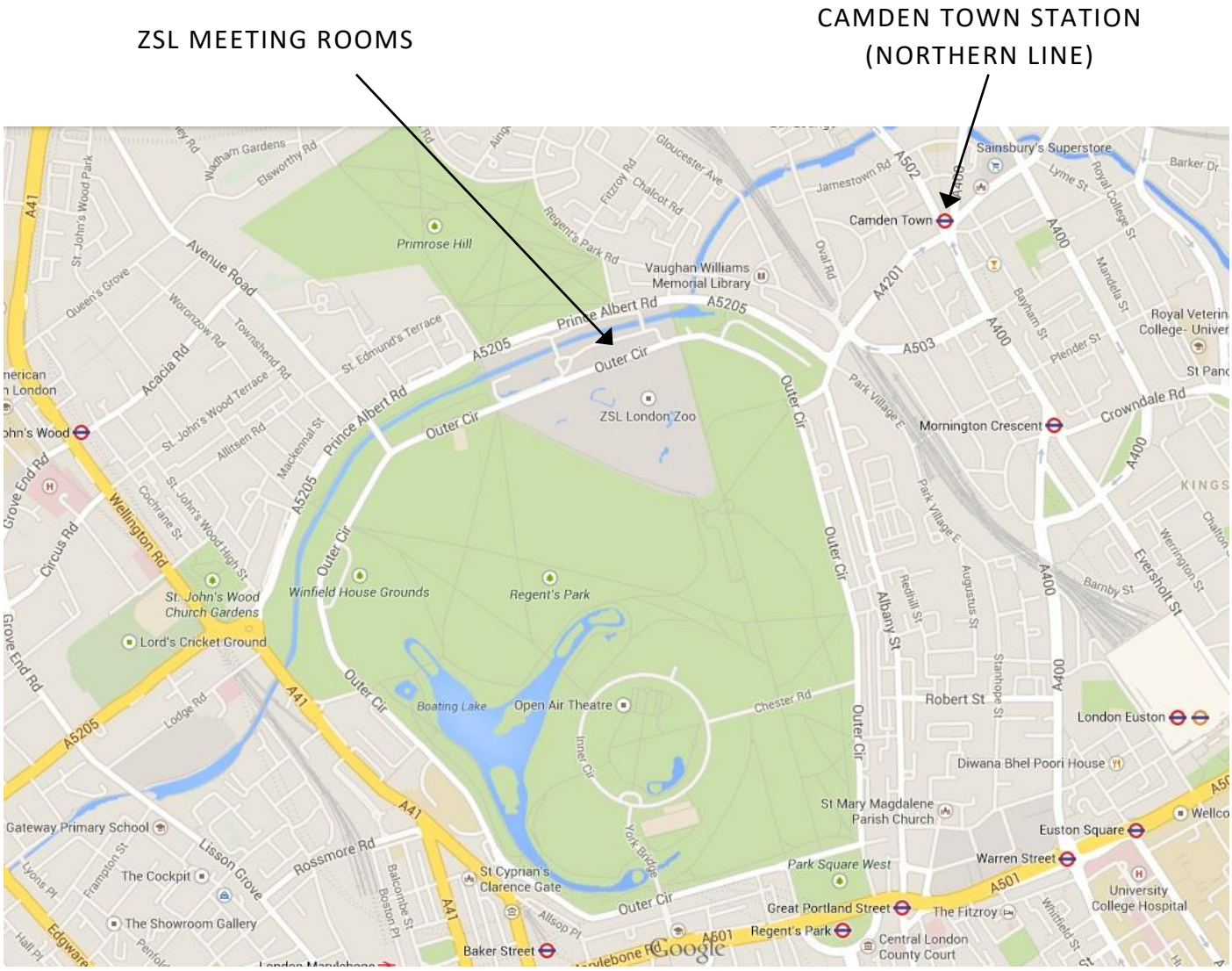
Producing accurate estimates of habitat extent and quality is a prerequisite to determining their ecosystem services (ES) provision, but often variation in quality exists within a habitat, likely influencing ES provision. Seagrass meadows have been cited as important habitats for ES including carbon sequestration, nutrient remediation and coastal protection (sediment stabilisation). However, the submerged nature of seagrass meadows, especially in turbid environments such as those found in the UK, can create difficulties producing maps of their extent. Seagrass meadows are also heterogenous environments with varied architectural and morphological characteristics. To provide accurate data on seagrass ES and functionality, mapping needs to distinguish both the area and the quality of habitat. Therefore, seagrass meadows pose a suitable habitat to assess spatial variation in quality and the subsequent influence this has on ES. This study maps intertidal seagrass spatial distribution via several seagrass characteristics; seagrass species composition, density and canopy height. It also incorporates spatial mapping of adjacent habitats (i.e., algal mats and saltmarsh). Sediment cores were collected across several habitat quality classifications derived from the spatial habitat quality maps, to focus on sedimentary carbon and nitrogen retention within these habitats. The spatial mapping highlights several important factors: i) demonstrable edge effects; ii) high spatial variation in seagrass density characteristics, which act as indicators of habitat quality; iii) the presence of green macroalgal mats negatively influences seagrass distribution. Therefore, variation within the seagrass seascape

(species composition and density), alongside adjacent habitat types (algal matt) within the wider seascape should be considered when assessing ES provision.

SITE MAPS & TRAVEL INFORMATION

LOCATION FOR DINNER ON DAY 1 – THE MAPPIN PAVILION

ENTRANCE TO HUXLEY LECTURE THEATRE FROM OUTER CIRCLE



To walk between ZSL London Zoo and Camden Town underground station takes around ten minutes.

Transport for London Travel information
Telephone: 0843 222 1234 (24 hours a day); Textphone: 020 7918 3015

BUS 274 to Camden Town and Baker Street
www.tfl.gov.uk/
www.citimapper.com

Taxi numbers
Taxi One-Number bookings: 0871 871 8710
Call-A-Cab: 020 8901 4444
Computer Cab: 020 7908 0207
DataCab: 020 7432 1540
Dial-A-Cab: 020 7253 5000
Radio Taxis: 020 7272 0272
Addison Lee: 020 7387 8888

THANK YOU FOR ATTENDING