

## Your Guide to the SMMR Annual Conference

**The Sustainable Management of UK Marine Resources Conference will take place from 14th – 16th May 2024, in Bristol, and online.**

Building on the success of past conferences, this year's event will feature presentations, discussions, and workshops exploring the varied work underway in the SMMR programme, both from our funded project teams and across the SMMR-Network.

For those joining us online, please keep an eye on your inboxes. Links and joining instructions will be emailed directly to you. If you experience difficulties joining, please email [smmruk@st-andrews.ac.uk](mailto:smmruk@st-andrews.ac.uk).

### About SMMR

The Sustainable Management of UK Marine Resources (SMMR) programme is working to break down barriers between science and policy, and integrate disciplines to support decision-making within the UK Exclusive Economic Zone.

The SMMR programme comprises two elements:

- The **UKRI SMMR Strategic Priorities Fund**, a £12.4m initiative dedicated to funding marine research to address critical knowledge gaps.
- The **SMMR-Network**, a community of researchers and policy stakeholders who see mutual benefit in collaboration, discussing and developing more holistic solutions to marine management.

Combining these two elements, the programme aims to bring together marine scientists, policy makers, industry representatives, wider stakeholders and the public to build a strong marine research community. It is hoped that this highly collaborative and critical programme of research will give rise to new approaches for managing UK marine environments, whilst informing and invigorating UK marine policy.

### Three Core Themes

The programme has three core themes: **understanding values** associated with the marine environment, **building tools** to support management, and designing interventions to **support policy**. You can find out more about these key themes on the [SMMR website](#).

### Six Funded Projects

All six of the SMMR-funded projects will be present at this year's conference, and will be running a selection of workshops on Tuesday and Thursday.

You can find out more about each of the funded projects by clicking on the icons below.



**ROCC**

Resilience of Coastal Communities



**MSPACE**

Marine Spatial Planning  
Addressing Climate Effects



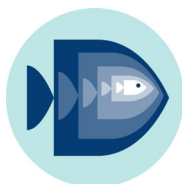
**ReSOW UK**

Restoration of Seagrass for Ocean Wealth



**CO-OPT**

Resilient Coasts:  
Optimising Co-Benefit Solutions



**Pyramids of Life**

Working With Nature for a Sustainable Future



**Diverse Marine Values**

Integrating Diverse Values into Management

If you have any questions before, during, or after the conference, please reach out to a member of the organising team via email to [smmruk@st-andrews.ac.uk](mailto:smmruk@st-andrews.ac.uk).

[Email Us](mailto:smmruk@st-andrews.ac.uk)



## SMMR Conference Programme Outline

### Tuesday 14<sup>th</sup> May 2024

Tuesday conference activity will be reserved for workshops. These workshops can be closed or open to attend depending on the preference of the workshop host.

Studio 1	Diverse voices in marine research and policy	1030-1230	Open
Studio 1	Deliberative approaches to stakeholder engagement	1400-1600	Closed
Studio 2	Diverse Value Exhibition		Open
The Suite	Co-Opt & Diverse Values: Communicating climate change information	1100-1300	Open
The Suite	Mapping and understanding ocean literacy for England	1400-1600	Open
The Boardroom	PoL team meeting & project legacy workshop	1000-1700	Closed
The Middle Suite	Gina Reinhardt MSPACE meeting	1300-1700	Closed

### **Diverse voices in marine research and policy**

This workshop will invite a discussion about the challenges of engaging diverse voices in research and policy consultations for sustainable management of UK marine resources. The SMMR [Resilience of Coastal Communities](#) project team will share their experiences of collecting oral histories, survey and interview data in sites across the Southwest UK with a particular focus on the challenges of including female and younger voices. The [Diverse Marine Values](#) project team will offer their insights into incorporating the diverse values and voices of other harder-to-reach groups. Please join us to share your own experiences of engaging and collaborating with diverse voices. Through the workshop we aim to collate our joint perspectives on the blind-spots we might inadvertently introduce into research and consultation, the barriers to more inclusive research and engagement, and any insight on strategies or best-practice that can address these challenges.

## **CoOpt + Diverse Values: Communicating Climate Change Workshop**

An inherent challenge of climate change research is the ability to communicate scientific information to non-specialist audiences. Tailoring information for various audiences, including policy makers and members of the public involves utilising a range of methods and techniques to ensure that the message is received effectively. This workshop aims to synthesise the learning from the SMMR projects about the best strategies to communicate and engage with communities about coastal protection decisions, as well as to reflect more broadly on the experiences and expectations of researchers tasked with communicating and disseminating their research. *Participants will be encouraged to submit their reflections in advance of this workshop via a short survey <https://forms.office.com/e/u4stH5k9ig>*

## **Mapping and understanding ocean literacy for England**

This workshop will be the first in a series of actions designed to co-develop an ocean literacy strategy for England. Defined as ‘having an understanding of the ocean’s influence on your, and your influence on the ocean’, ocean literacy has been positioned as a key mechanism for change and central to achieving the goals set out by the UN Ocean Decade’s Ten Challenges. In the UK, recent years have seen ocean literacy increasingly at the forefront of discussions about ocean and coastal management, governance and research priorities. Drawing on the results from the 2022 UK wide ocean literacy assessment as well as outputs from the Diverse Marine Values project, this workshop will map existing ocean literacy activities and initiatives across England, identify current gaps and barriers and highlight opportunities and priorities for the development of a co-designed strategy. Crucially, the workshop and ongoing related activities will look to the work that has already been undertaken in Wales to develop a national ocean literacy strategy for Wales.

## **Wednesday 15<sup>th</sup> May 2024**

### **09:00 – 09:30** Registration

There will be a CEEDS tool testing area available all day, together with poster boards to view during the networking sessions.

### **09:30 – 10:15** Welcome Session

- Welcome Talk Prof David Paterson & Dr Mark James (SMMR Champions) – 5 mins

- Plenary talk from Stella Alexandroff, OceanKAN organisation – 30 mins plus 10 mins for questions – “*Building a Bottom-Up, Global Network to Share Sustainable Practices in the Co-Design of Ocean Science?*”. Q&A to be supported by Dr Emma McKinley.

**10:15 – 11:00** Session 1 (3 talks)

- Examining the role of seagrass restoration on recreational demand in Great Britain (Danny Campbell)
- Connecting governance and practice views on the barriers and solutions to scaled seagrass restoration in the UK (Ally Evans)
- Predicting *Zostera marina* seagrass carbon stock using machine learning and earth observation to support carbon accounting (Nicola Wilson)

**11:00 – 11:30** Coffee Break and Networking

**11:30 – 12:45** Session 2 – Dedicated ROCC session – Chair: Louisa Evans

This panel will present findings from the [SMMR Sustainable Development and Resilience of Coastal Communities \(ROCC\)](#) project. This research uses past, present and future-looking approaches to examine how resilience, wellbeing and marine sustainability can be enhanced together in policy and practice, noting potential for important divergence and trade-offs among these objectives. Our presentations will bring together conceptual development; new data from oral histories, surveys and interviews of diverse marine resource-users, and; analysis of elite interviews with managers and policy-makers to showcase the breadth of the transdisciplinary research conducted in phase 1 of ROCC.

- Introducing the resilience nexus (Louisa Evans)
- Responding to change in the past (Sien Van Der Plank)
- Values and change (Pamela Buchan)
- Adaptive capacities for responding to change in the present (Sarah Sutcliffe)
- Trade-off decision-making (Matt Fortnam)
- Decision-making for the future (Océane Marcone)
- Q&A

**12:45 – 13:45** Lunch and networking

**13:45 – 15:00** Session 3 (5 talks) – Chair Edd Hind-Ozan

- Are different values systems influencing the decision-making process? Learnings from an iterative fuzzy cognitive mapping exercise (Marta Meschini)
- How can we use geovisualization to build towards equitable marine and coastal decision-making (Chris Reilly)
- Constructing a large-scale relational map of UK North Sea social-ecological entities to predict emergent effects of the expansion of offshore wind energy in the region (Will Burton)
- Taking account of societal perspectives and values in the Scottish marine context (Kay Barclay)
- The minimum complexity necessary: the value of a simple Social-Ecological Systems analysis in holistically managing the marine environment (Gemma Smith)

**15:00 – 15:30** Coffee Break and Networking

**15:30 – 16:45** Session 4 (5 talks) – Chair John Murray

- Diverse values and the arts for marine management (Tim Acott)
- Bringing the ocean to the stage: Performing Coastal Values and Marine Management (Emma McKinley)
- Hiraeth Yn Y Môr - Equitably growing community-scale ocean literacy to aid sustainable marine management in North East Wales (Ffion Mitchell-Langford)
- Representation of the sea by HM Government: Strategies for communication to enhance ocean citizenship (Celine Germond-Duret)
- Diverse values in marine decision-making: Applying a spatial framework to identify entry points (Kathryn Fradera)

**16:45 – 16:50** Wrap up for Day 1 – David Paterson

**1700** – End of Day 1

## Thursday 16<sup>th</sup> May 2024

**0900 – 09:40** Plenary talk – Chair Prof David Paterson

- Prof Nick Hanley, University of Glasgow – 30 mins plus 10 mins for questions – *“Have we made progress in recent years on valuing ecosystem services”*.

**09:40 – 10:55** Session 5 – Chair Dr Mark James

- The Co-Benefits of Coastal Ecosystems; Economic Value of Saltmarsh Habitats in the UK (Sara Kaffashi)
- Bridging the science-policy-practice interface to improve resilience of marine ecosystems to urbanization and climate change impacts (Larissa Naylor)
- Recognising and protecting the national benefit of small-scale fisheries in the UK: 'you don't know what you've got 'til it's gone' (Sarah Coulthard)
- Fisheries in a Multi-Species Modelling Framework: Management of the Marine Living Resource of the Celtic Sea (James Rimmer)
- Biodiversity patterns under a shifting baseline: important areas for sensitive fish species to assist marine spatial planning (Joanna Bluemel)

**10:55– 11:25** Coffee Break and Networking

**11:25 – 12:10** Session 6 (3 talks) Dedicated [MSPACE](#) session – Chair Prof Ana Queiros

- MSPACE Early Warning System: Climate-smart spatial management of UK marine fisheries, aquaculture and conservation (Susan Kay)
- Co-developing climate smart spatial management scenarios (Liz Talbot)
- Exploring Preferences and Values around Marine Planning in the Aquaculture, Conservation, and Fisheries Sectors (Gina Yannitell Reinhardt and Patricia Danahey Janin)

**12:10 – 12:15** Wrap up – David Paterson

**12:15 – 13:00** Lunch and networking

### **Afternoon workshops**

Thursday afternoon conference activity will be reserved for workshops. These workshops can be closed or open to attend depending on the preference of the workshop host.

Studio 2	Diverse Value Exhibition – Echoes of the Shore	1315-1445	Open
The Suite	Opportunities and challenges for financing UK marine habitat restoration (ReSOW)	1400-1700	Open
The Boardroom	Pyramids of Life Q Method workshop	1315-1515	Open
The Middle Suite	ROCC project Steering Group meeting	1400-1530	Closed

### **DMV Exhibition - Echoes of the Shore**

This workshop explores new horizons for marine research and management. Join the Diverse Marine Values researchers for a guided tour of our exhibition showcasing the full range of arts-based research methods we used to engage local communities in eliciting lesser-heard voices in Portsmouth, Chepstow and the Shetland Islands. We will discuss how arts-based research methods can be used to enhance marine decision-making and ocean literacy through more inclusive and engaging processes. Within the backdrop of an immersive exhibition, this workshop will help researchers and practitioners explore the potential of arts-based methods, including digital storytelling, participatory theatre, photography, and community voice method. It will also delve into transdisciplinarity and ways of working differently in marine management and research settings. There will be the opportunity to pose questions to researchers and practitioners on their experiences and shared lessons.

### **Pyramids of Life Q Method workshop**

Every year, the SMMR Conference demonstrates that a sustainable and resilient management of marine ecosystems can be achieved only through interdisciplinary approaches co-developed with stakeholders recognising their respective diverse value. However, consistently capturing and synthesising the range of marine stakeholders' values, attitudes, perspectives, and viewpoints on sustainable and resilient marine management is not a trivial task. Mixed quali-quantitative approaches such as the Q-method can help.

In this workshop, Pyramids of Life project members will present and discuss protocols and tools to designing, analysing and interpreting a Q-method. To make the seminar relevant to participants, we will ask them to take part in a Q-method which will then be used to present the data preparation, analysis,



and interpretation of results. No previous knowledge or specific skills are required. During the workshop we will use R Studio and open access Q-method tools, so please bring your laptop to make the most out of the session.

### **Opportunities and challenges for financing UK marine habitat restoration**

This workshop will bring together stakeholders from the UK marine management community, restoration practitioners, economists and the finance sector to examine the opportunities and challenges of financing of marine habitat restoration, and thereby support the development of a road map towards broader adoption. Activities for the workshop will be framed by examining some UK-specific case studies of financing nature restoration, both from terrestrial and marine spheres. We will examine the long-term feasibility of applying schemes such as carbon and biodiversity credits in the UK. Alternative finance frameworks that could be employed to harness private finance in the UK will then be explored and their potential utility assessed.

### **POSTERS**

- James Forrester - Seagrass as a nature-based solution for coastal protection
- Susan Kay - Data to support marine environmental monitoring from the UK Met Office
- Clive Neil - Mapping seagrass in UK from satellite data
- Elina Apine - Social acceptance of nature-based solutions as effective coastal flood risk management schemes in the UK
- Lauren Henley - mNCEA and SMMR: Synergies and shared learning
- John Aldridge - Modelling tools to support coastal and estuary remediation
- Stefano Marra & Stephen Duncombe-Smith - Climate change and seabed disturbance - Habitat condition indicators and overlaps with climate change hotspots, tools for climate-resilient conservation.
- Ana Querios & Susan Kay - Climate Smart Management of UK Seas
- Fazeel Mohammed - Use of Predictive models in the identification of Harmful Algal blooming species can aid in the management of fisheries resources, aquaculture and coastal communities.

## **SMMR 2024 Conference Abstracts**

### **Day 1 Plenary**

#### **Ocean Knowledge Action Network – Global Knowledge Sharing for Ocean and Coastal Science and Management**

Stella Alexandroff (OceanKAN)

The Ocean Knowledge Action Network (KAN) is a modern approach to cross-network collaboration that connects people from around the globe who are trying to involve scientists, knowledge holders, and stakeholders in the co-design of ocean science and knowledge. The Ocean KAN community does this through trusted and respectful relationships, a spirit of openness, and a willingness to experiment. To this end, we have a flexible and open governance approach. An important aspect of our work is to create a space where our Indigenous and local community partners have an equal voice in all of our work. This includes day-to-day networking, the governance of our network, and leadership in our regular meetings and learning circles.

### **Session 1**

#### **Examining the role of seagrass restoration on recreational demand in Great Britain.**

Danny Campbell (University of Stirling)

This study investigates the perceived importance of seagrass restoration in the context of recreational preferences for coastal spaces in Great Britain. Through a comprehensive analysis combining revealed and stated preference methods, we aim to discern the extent to which recreationists value the abundance and condition of seagrass in these environments. Our results reveal a discernible link between past and anticipated future recreation trips and the state of seagrass. Enhanced seagrass health contributes significantly to increased visitation to coastal spaces, thereby promoting positive economic value. Notably, our analysis discerns that the frequency of recreational visits is highly sensitive to the status of seagrass for certain respondents, while others display a relatively diminished sensitivity. This differentiation is explored across demographic factors such as gender, age, income, recreation user types, site location, and residential locations. These insights shed light on recreationists' diverse value systems when engaging with coastal spaces, elucidating how these systems influence their decision-making processes regarding recreational activities.

#### **Connecting governance and practice views on the barriers and solutions to scaled seagrass restoration in the UK**

Ally Evans (Swansea University / Project Seagrass), Leanne Cullen-Unsworth (Swansea University and Project Seagrass), Eleanor Ford (Swansea University)

Seagrass restoration is rapidly gaining popularity in the UK. Increased public and political awareness of historic and ongoing declines, along with its value to people and planet, have inspired several targeted restoration projects around the coasts of Wales, Scotland and England. However, there remain several key bottlenecks in the seagrass restoration process preventing genuinely successful restoration at scales required to halt declines, let alone to increase habitat

coverage. To improve restoration success collaboratively, it is important that those involved in the governance and practice of restoration have shared understanding of what those bottlenecks are and what can be done to overcome them. Here we elucidate differing and shared perceptions regarding the barriers and potential solutions to seagrass restoration among these groups. We gathered this insight through semi-structured interviews with individuals working in the governance of seagrass restoration and with practitioners involved in active restoration projects. We highlight the key perceived barriers to successful scaled restoration, and discuss potential solutions proposed by those who know the sector best.

### **Predicting *Zostera marina* seagrass carbon stock using machine learning and earth observation to support carbon accounting.**

Nicola Wilson (University of Exeter), Dr Chris Laing (University of Exeter), Dr Bob Brewin (University of Exeter), Dr Rudy Arthur (University of Exeter)

A key barrier for seagrass restoration projects securing private finance on the voluntary carbon market is the complexity and cost of quantifying and verifying carbon stocks to validate carbon credits. Current methods for calculating carbon stocks rely on global or regional averages but due to high variability do not provide enough confidence for the carbon market. Even with standardised techniques, the rate of carbon storage in seagrass is highly variable even within species and local areas, considered to be due to environmental conditions. As credibility and transparency is crucial for the success of blue carbon markets, novel approaches are required for accurate accounting.

This research takes a data-driven approach to predict carbon stocks in the temperate seagrass species, *Zostera marina*, using environmental conditions derived from open-source earth observation data. Firstly, a dataset of *Zostera marina* seagrass locations and carbon stock values has been derived from published in-situ sampled data. A number of predictor environmental variables (representing climate, sedimentary environment, flow regime and geography) have been calculated and extracted using earth observation data and globally available datasets. Using this dataset, a predictive model of carbon stock from the predictor variables has been developed using a gradient boosting decision tree algorithm (XGBoost).

In the current model, approximately 65% of the variability of organic carbon stock in *Zostera marina* beds is explained by 18 variables in the train set and nearly 30% variability in the test set with variables related to the hydrodynamic environment and human impact showing the highest feature importance. This approach shows promise in using machine learning to predict carbon stocks with opportunities for further development as a tool to support carbon accounting at multiple scales.

### **Session 2 - Dedicated ROCC session**

This panel will present findings from the [SMR Sustainable Development and Resilience of Coastal Communities \(ROCC\)](#) project. This research uses past, present and future-looking approaches to examine how resilience, wellbeing and marine sustainability can be enhanced together in policy and practice, noting potential for important divergence and trade-offs among these objectives. Our presentations will bring together conceptual development; new data from oral histories, surveys and interviews of diverse marine resource-users, and; analysis of elite interviews with managers and policy-makers to showcase the breadth of the transdisciplinary research conducted in phase 1 of ROCC.

### Session 3

#### **Are different values systems influencing the decision-making process? Learnings from an iterative fuzzy cognitive mapping exercise**

Marta Meschini<sup>1</sup>(University of Liverpool), Marta Meschini<sup>1</sup> (University of Liverpool), Leonie A. Robinson<sup>1,2</sup>(University of Liverpool), Richard Dunning<sup>3</sup>, (University of Liverpool)

In the face of escalating global challenges such as climate change, increasing storminess and extreme events, rising sea levels and habitat loss, coastal regions are particularly vulnerable to the impacts of flooding and erosion. Around 40% of the world's population lives within 100km of the coast<sup>1</sup> and more than 600 million people (~10%) live less than 10 meters above sea level<sup>2</sup>. In England, more than 10 million people (~18.5% of the population) live in coastal communities<sup>3</sup>. As climate change accelerates, coastal communities, particularly those with low coastlines, are at high risk of flooding and erosion. To capture the complexity of coastal decision-making processes and to better understand how stakeholders perceive the coastal system, a social-ecological system (SES) approach was chosen. This approach takes into account the interactions between natural and human elements within the system<sup>4</sup>. The methodology used for this study was a revised Fuzzy Cognitive Mapping method<sup>5</sup> that helps to simplify and visualise stakeholders' different values systems. The study involved a range of stakeholders from different sectors, including Natural Resources Wales, NatureScot, Environmental Agency, Natural England, SEPA, EDF and DEME for the 'decision makers, advisors and industries' group; Cornwall Wildlife Trust, Fife Coast and Countryside Trust, Coastal Partnership East, Solway Firth Partnership, Coastal Partnership Network and North West Coastal Forum for the 'coastal groups and forums' group; and British Geological Survey, University of Liverpool and National Oceanography Centre for the 'researchers' group. Through a scoping workshop and subsequent activities, we worked with stakeholders to develop 11 cognitive maps to capture their views on a generic UK coastal system in relation to flood and erosion risk. This collaborative process facilitated mutual learning between researchers and stakeholders. The findings revealed differences in perceptions based on the professional roles and personal backgrounds of stakeholders. Overall, the main outcome of these activities is the development of a process to co-develop cognitive maps with stakeholders. This will ultimately lead us to develop a tool that can be disseminated to stakeholders through knowledge transfer activities. The participatory approach used for this study provided insight into stakeholder perspectives and gave them the opportunity to gain hands-on experience with the different views of the system. This understanding can ultimately contribute to more informed decision-making and improved resilience of the whole coastal social-ecological system.

#### **How can we use geovisualization to build towards equitable marine and coastal decision-making.**

Chris Reilly (Heriot-Watt University), Lauren McWhinnie (Heriot-Watt University), Karen Alexander (Heriot-Watt University), Sandy Kerr (Heriot-Watt University), Anne LeBroq (Exeter University), and Chris Leaky (NatureScot)

The use of geovisualization in environmental and marine/coastal decision-making serves an alternative purpose to that in urban development and design. Developed to provide stakeholders with a visual representation of management and planning options, geovisualization in urban decision-making focuses on the aesthetics of a project and the interactive, three-dimensional tools are an exciting way to engage stakeholders and gather feedback.

In environmental and marine/coastal decision-making context, findings from our systematic review shows that geovisualization delivers more than just an exciting experience for

stakeholders, but also serves as a learning tool to encourage marine and environmental literacies. Having a foundation of knowledge and understanding often serves as a crucial component to successful engagement when complex and scientifically informed management options form the core of these decision-making processes.

After an overview of how we have used geovisualization in the decision-making process, this presentation will present the results of our systematic review aimed to understand how we can optimise geovisualization to build towards meaningful and equitable marine and coastal decision-making through a framework designed to guide future work on their inclusion.

### **Constructing a large-scale relational map of UK North Sea social-ecological entities to predict emergent effects of the expansion of offshore wind energy in the region.**

Will Burton (AURA Centre for Doctoral Training, Department of Geography, Durham University), Professor Gavin Bridge - Department of Geography, Durham University, Dr Tom Webb - School of Biosciences, University of Sheffield

Social, Ecological, and Industrial entities in The UK North Sea interact together in complex and non-linear ways, producing unexpected outcomes that need to be carefully considered by Marine Planning bodies. As it grows in this region, the offshore wind industry increasingly effects and is affected by other already present and dynamically interacting entities. This talk discusses the results of a scoping study which uses expert perceptions from AURA Centre for Doctoral Training to construct a large-scale relational map of The UK North Sea. After more honing, this 'Fuzzy Cognitive Map' will then be used as a tool in understanding the system-wide, interconnected effects of the unprecedented expansion of the Offshore Wind Industry in the region.

### **Taking account of societal perspectives and values in the Scottish marine context.**

Kay Barclay (Scottish Government)

Understanding people's values, experiences and viewpoints is important for marine decision making, but knowing whose views to include and how to harness them can be challenging to do effectively. In the Marine Directorate of the Scottish Government the social science team are working closely with policy colleagues to bring coastal communities', the public's and key marine user groups' perspectives into policy-making processes. This talk will summarise some of the approaches we are exploring and associated challenges, in relation to marine planning and management.

### **The minimum complexity necessary: the value of a simple Social-Ecological Systems analysis in holistically managing the marine environment.**

Gemma Smith (IECS Ltd.), Michael Elliott, Jonathan Atkins, Amanda Gregory

The marine environment, characterised by its intrinsic complexity and the multifaceted interactions between natural components and anthropogenic pressures, represents a prime example of a complex and adaptive system. The necessity to manage this system in a manner that conserves biodiversity while concurrently delivering societal benefits has never been more vital; this urgency underscores the necessity for an interdisciplinary approach that embraces the complexity of marine ecosystems to foster a resilient blue economy and ensure sustainable use of marine resources. Literature in marine management advocates for holistic systems approaches, acknowledging the limitations of fragmented methodologies in addressing the

interconnected challenges posed by human activities and climate change. The study to be discussed contributes to this evolving discourse by conducting a systematic literature review of Social-Ecological System (SES) frameworks through a Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis. Our analysis identified the Integrated Systems Analysis (ISA) as a comprehensive framework that leverages the strengths of existing SES frameworks while using tools from the systems discipline and other foundational SES frameworks to mitigate limitations. The implementation of the ISA framework, however, is not without its challenges. Effective data management and active stakeholder involvement emerge as critical factors for the successful application of ISA. Furthermore, the necessity to navigate data limitations and to meticulously consider the diverse scales and scopes of systems involved presents ongoing challenges. These considerations are crucial for the future development and practical application of the ISA framework in marine management. This presentation underscores the value of adopting transdisciplinary tools and interventions, like the ISA framework, to inform policy, regulation, and management of marine resources. It highlights the critical knowledge gaps and explains future research directions aimed at enhancing the integrative capacity of operationalised ecosystem-based management practices such as a social-ecological systems approach.

## **Session 4**

### **Diverse values and the arts for marine management**

Tim Acott (University of Greenwich), Leslie, V., University of Portsmouth, Hughes, E., University of Portsmouth, McKinley, E., University of Cardiff

The concept of diverse values is advocated by the International Panel on Biodiversity and Ecosystem Services (IPBES, 2022) who argue that diverse ways of conceptualising multiple values of nature and its contributions to people is needed to achieve global sustainability. IPBES stress the importance of recognising diverse worldviews with particular importance given to indigenous and community forms of knowledge. In this paper, building on the perspectives from IPBES, we argue that an important element of transformative change for marine management and sustainability is understanding the contribution from arts and arts-based research. Drawing on the experiences of the UKRI funded Diverse Marine Values project we will explore the contributions of the arts to marine decision making and policy development through 5 dimensions;

- Activism through art
- Science communication through art
- Socially engaged art facilitating discourse
- Building empathy and new relations through art
- New knowledge generated through art

A paradigm shift is needed to fully embrace all the possibilities of arts-based approaches and transformational change in policy development and decision making will need to be embedded in new transdisciplinary practices.

### **Bringing the ocean to the stage: Performing Coastal Values and Marine Management**

Emma McKinley (Cardiff University), Erika Hughes (University of Portsmouth), Cressida Bowyer (University of Portsmouth), Jonathan Potts (University of Portsmouth), Alison Fairbrass (University College London), Stephenie Georgia (Shetland Arts)

Recent years have witnessed a seemingly constant call for improved understanding of human-ocean relationships, resulting in a 'boom' of marine social science research. However, despite this interest in the human dimensions of the ocean, coasts and seas, qualitative and arts-based research approaches remain on the periphery of ocean research. This paper explores the role of two ocean research 'outliers', intersecting arts-based practice and marine social sciences through the lens of three interconnected devised performances designed to explore the diverse values held by communities about their marine and coastal environment. The performance series was undertaken as part of the Diverse Marine Values project, bringing together ocean scientists, coastal and marine managers, and community members to create original performance pieces in two community locations. The distinct but interrelated performances combined elements of forum theatre, devised theatre, and storytelling to address marine issues important to each respective community, with a view to understanding and fostering ocean literacy.

The performance in Shetland, *Ripple Effect*, took place in collaboration with the Shetland Youth Theatre, and featured the work of ten youth performers aged 12-17. The Portsmouth performance, *Community Consultation*, featured local marine managers and has since been included in the teaching curriculum for the Coastal and Marine Management MSc at the University of Portsmouth. In each location, the performance work illustrated the ways in which theatre can serve as not only a tool for science communication, but also a research method through which human-ocean relationships can be explored. The performances helped the dramaturgical-research team, comprised jointly of specialist theatre practitioners and experts in ocean literacy, coastal management, and plastics pollution to reshape data collection and stakeholder engagement. Collaborative theatre making with area stakeholders, marine scientists, and artists led to deeper conversations and embedded engagement within each coastal community. It also led to a fundamental reshaping of the questions and approaches that marine managers and scientists asked of the communities in question. The paper presents a discussion of the challenges of bridging these related, but often distant, disciplines, and highlights the benefits of adopting transdisciplinary approaches to transform societal relationships with the ocean.

### **Hiraeth Yn Y Môr - Equitably growing community-scale ocean literacy to aid sustainable marine management in North East Wales**

Ffion Mitchell-Langford (Marine Conservation Society)

Ocean Literacy (OL) is increasingly recognized as a growing global movement (EMSEA, 2021) that seeks to contextualize the different value systems people hold when connecting with the marine environment. OL continues to emerge as an area of prioritization for decision-makers, evidenced by Welsh Government's current development of a national Ocean Literacy Strategy, and the UK's investment in conducting national ocean literacy assessments (Ocean Conservation Trust, 2022). Despite its growing popularity, the relationship between people and sea – particularly at a community-scale, amongst groups who have historically been under-represented in ocean literacy discourse – is still very poorly understood (McKinley, Burdon & Shellock, 2023). Similarly, little work has been conducted to investigate growing community-scale ocean literacy as a tool in aiding sustainable management of our MPA network and broader decision-making. *Hiraeth Yn Y Môr*, a North-East Wales-based Nature Networks 2-funded project, seeks to trial novel transdisciplinary approaches in growing ocean literacy as a means to support the sustainable management of Liverpool Bay SPA and community health & well-being. The project deploys social science techniques and community-led approaches in exploring how diverse community groups value their marine environment and might develop marine citizenship at a local scale. This talk will provide an overview of the project's approaches, learning to-date, and its application in wider sustainable marine management and decision-making in Wales.

## **Representation of the sea by HM Government: Strategies for communication to enhance ocean citizenship.**

Celine Germond-Duret (Lancaster University), Basil Germond, (Lancaster University), Chris Sanderson, (Lancaster University)

Ocean sustainability is contingent to citizens' awareness of "the benefits they receive from the marine environment" (DEFRA, 2021, p.4). However, 'sea blindness' is still dominant in Britain (Germond-Duret & Germond, 2023), and the sea is at the bottom of the list when it comes to public perception of global environmental issues (Potts et al., 2016). Enhancing public perception of the sea requires targeted communication strategies based on a critical analysis of current representations of the sea and their bias. We provide a systematic account of the way the sea is represented by HMG by applying corpus linguistic methods to the analysis of ".gov" textual production. Data shows that, although the need to protect the marine environment is present, the dominant narrative centres on economic benefits, and there is a lack of emotional vocabulary linked to the sea. We thus recommend communication strategies to better connect people and the sea in an emotional (versus utilitarian and managerial) way.

## **Diverse values in marine decision-making: Applying a spatial framework to identify entry points**

Dr Kathryn Fradera (Howell Marine Consulting / University of Highlands and Islands – Shetland)

The spatial decisions made by marine managers, regulators and policy makers impact multiple and diverse stakeholders in complex and nuanced ways. These decision-making processes have been formulated through evolving practices and incorporate a range of values from multiple sources, including the remits of statutory advisors, legal frameworks, marine management policy and guidance and community and local stakeholder representations. As marine decision-making has developed across the UK administrations, different practices have emerged to provide entry points for diverse values to be considered within these management and policy decisions.

In this talk, the methodological framework applied to case study research within the Diverse Marine Values project will be outlined along with examples and findings from the research. This methodological approach draws together the analytical framework of Socio-Ecological Systems with insights from environmental and spatial justice and is grounded in a spatial production ontology. Through its application to real-world marine decision examples, the values included within decision-making can be more clearly identified.

The decision-making processes used as case studies in this research have been drawn from around the UK and include marine licence decision, sectoral and national marine plans, and conservation byelaws. Through mapping these decision-making processes and identifying where and how values have been incorporated within them, and importantly where they have not, recommendations for future process evolution can be drawn.



## **Day 2 Plenary**

Prof Nick Hanley (University of Glasgow) – Valuing ecosystem services

### **Session 5**

#### **The Co-Benefits of Coastal Ecosystems: Economic Value of Saltmarsh Habitats in the UK**

Sara Kaffashi (Cranfield University), Anil Graves, John Bidzakin

Saltmarshes are recognised for their significant ecological benefits, including biodiversity enhancement, coastal defense, and carbon sequestration. However, determining their economic value is a complex task, often requiring advanced modelling techniques. Our research focuses on the valuation of saltmarsh ecosystems in the UK using a benefit transfer approach. The main objective is to deliver a more precise valuation that addresses the existing gap in policy decisions involving these vital ecosystems.

Through a comprehensive review of existing literature, the importance of methodological consistency in the benefit transfer approach was emphasised. Analysis of 116 documents reveals a scarcity of primary studies suitable for meta-analysis, highlighting the need for further research.

The results derived from selecting and analysing 32 observations, coupled with the application of the unweighted Ordinary Least Square (OLS) model, accounted for approximately 61% of the variance in the dependent variable. Among the 14 independent variables considered, 9 exhibited statistical significance, highlighting key factors influencing the Willingness to Pay (WTP) for saltmarshes. This study notably emphasises that saltmarsh studies that communicated diverse benefits commanded higher valuations while expanding the geographical scope of the study tends to correlate with a decrease in economic value.

Incorporating the economic valuation derived from this research, the estimated value of saltmarsh habitats in the UK stands at £991 ha/yr. Notably, this value compares to an average willingness to pay (WTP) of £1632 per hectare, as determined from primary studies.

This research contributes profoundly to our understanding of the economic value of saltmarshes. The findings suggest a more effective approach to saltmarsh conservation would be one that is localised. By recognising the variability in economic valuation across different geographical contexts, policymakers can better prioritise conservation efforts and allocate resources effectively. Moreover, the current study underlines the interconnectedness between economic value, ecological health, and societal well-being. Saltmarshes provide invaluable ecosystem services that extend beyond their immediate surroundings, contributing to the resilience of coastal communities and the broader environment. Preserving these ecosystems, therefore, is not just a matter of ecological conservation but also a crucial component of sustainable development and long-term resilience planning. Communicating these values correctly, not only enhances the effectiveness of conservation initiatives but also fosters greater community engagement and support.

#### **The Co-Benefits of Coastal Ecosystems: Economic Value of Saltmarsh Habitats in the UK**

Larissa Naylor (University of Glasgow), Mairi MacArthur, University of Glasgow

This paper details research across the policy-practice-interface to help improve marine ecosystem provision in urban coastal and estuarine settings. It tracks the process from initial research to

growing widespread implementation in practice, guidance creation and statutory policy changes that have been made to support use of 'greening the grey' via eco-engineering approaches. These approaches are used where the policy decision is to alleviate flood or erosion risks, or to build hard infrastructure (e.g. bridge footings) in the marine environment. This paper also explores how we are using coastal erosion data to change land-based policies and practices to 'make space' for marine nature on land, through creating windows of opportunity for natural landforms and the coastal habitats they provide to respond dynamically to coastal climate change pressures. Concrete examples of changes across policy, practice and the role of co-produced guidance will be presented across England, Scotland and Wales, as well as how NERC-funded projects have been catalysts to increase the scope of the first international guidelines on the use of Natural and Nature-Based Features for Flood and Erosion Risk Management.

### **Recognising and protecting the national benefit of small-scale fisheries in the UK: 'you don't know what you've got 'til it's gone'.**

Sarah Coulthard (Newcastle University), Michael Roach (National Federation of Fishermen's Organisations), Robert Clark (AIFCA), Tim Gray (Newcastle Uni), Carole White (University of East Anglia), Julie Urquhart (Countryside & Community Research Institute, University of Gloucestershire), Bryce Stewart (Marine Biological Association & University of Plymouth), Jerry Percy (NUTFA), Rachel Turner (Exeter University), Louisa Evans (Exeter Uni), Hannah Fennell (Orkney Fisheries Association), Sam Fanshawe, Emily Bulled and Joe Richards (Blue Marine Foundation), Tom Chaigneau (Exeter), Tom Hooper (Isles of Scilly IFCA), Sarah Reddy (NUTFA), Jeremy Philipson (Newcastle University).

Small-scale fisheries make valuable contributions to coastal regions and broader national benefits which, if proactively harnessed, can bolster the achievement of sustainability goals nationally and globally. However, small-scale fisheries also face cumulative challenges and marginality, which undermine their integral resilience and viability. This paper argues a need to raise the profile of small-scale fisheries in the current context of UK fisheries policy. This is poignant given the recent exit of the UK from the European Union and current re-framing of national fisheries policy through the Fisheries Act (2020), which presents new opportunities for more tailored support, but also risks of oversight through inadequate representation, difficulties in engaging the sector, and poorly understood realities of small-scale fishers who can experience change in acute and challenging ways. The paper details the decline in UK small-scale fisheries and some of the reasons underpinning this. We then articulate the diverse contributions that small-scale fisheries make to coastal regions, and the broader public, arranged as eight 'national benefits', which are particularly rich in the small-scale sector. Failure to fully consider the issues facing small-scale fisheries in the present policy landscape not only constitutes a missed opportunity, but risks the eventual loss of a significant source of food security, resource stewardship, rural development, and a valued way of life that has been part of UK identity, economy and culture for thousands of years. Whilst our focus is on UK small-scale fisheries, our framing of challenges and contributions will resonate with small-scale fisheries world-wide.

### **Fisheries in a Multi-Species Modelling Framework: Management of the Marine Living Resource of the Celtic Sea.**

James Rimmer (University of York), Gustav Delius, Jon Pitchford, Richard Law (all University of York)

Historically, fisheries have revolved around species-specific maximum sustainable yields (MSY), simplifying the complexities of aquatic ecosystems. We now have the data and computational tools necessary to better capture the community dynamics, such as predator-prey interactions, which can provide much more realistic projections of how a system will develop and respond to drivers. One example of such a tool is Mizer – a dynamic multi-species size-spectrum model of fish communities.

We are developing a Celtic Sea Mizer model to assess the trajectory of marine fishes under various management scenarios. Size-based modelling is particularly advantageous in this regard, enabling explicit investigation into size-based management options. By examining a range of strategies co-developed with industry and managers, we evaluate their impacts on ecosystem structure, species abundances, catch value, and nutritional quality, in conjunction with colleagues at CEFAS.

Our analysis scrutinises the model's sensitivity to parameters and assumptions, ensuring robustness and identifying risks. Our work aims to provide policymakers and stakeholders with actionable insights about the Celtic Sea marine living resource, ensuring that exploitation can be more sustainable and productive.

### **Biodiversity patterns under a shifting baseline: important areas for sensitive fish species to assist marine spatial planning.**

Joanna K. Bluemel (Centre for Environment Fisheries & Aquaculture Science (Cefas), Elena Couce, Robert Brookes, Murray Thompson (Cefas))

The acceleration of man-made global change and increased vulnerability of marine species affect the benefits provided by the oceans. Effective integration of human impacts on marine species is therefore essential to ensure that future marine plans are adaptive with a long-term, global outlook. Changes in marine plans, such as via the designation of new marine protected areas (MPA), highly protected marine areas (HPMAs), installation of offshore windfarms (OWFs) and designation of dredging and disposal sites, can also act to displace fishing effort. Therefore, to inform and future-proof sustainable marine plans a broader biodiversity perspective underpinned by empirical evidence is needed. We utilise data from standardised fisheries surveys and the English Observer (discard) programme to identify regional core-areas (persistent areas of high fish population density) and predict spatial changes in the distribution of sensitive fish species (currently and under future environmental change), using Bayesian Additive Regression Trees. We highlight areas of biodiversity change and examine them in relation to UK Marine Plan Areas. Our results provide evidence of fish biodiversity where spatial protections will be most effective in the long-term. These include regions of refugia from climate change, and emerging local and regional areas of high diversity of vulnerable species that could be considered for planning future HPMA designations or decisions on future protection measures.

## Session 6 - Dedicated [MSPACE](#) session

### **MSPACE Early Warning System: Climate-smart spatial management of UK marine fisheries, aquaculture and conservation**

Susan Kay (PML)

We present the 'early warning system' developed by the SMMR MSPACE project, a state-of-the-art modelling analysis showing where, and for how long, marine conservation, fisheries and aquaculture could be best supported across UK seas. It provides a climate change assessment for the entire UK EEZ, demonstrating the spatial variation in sensitivity of our marine ecosystems to climate change. Climate change refugia, areas where resilience to climate impacts are found, are identified and linked to potential for development of key sectors. Information about model validation and seabed habitat condition is included. The report and datasets are now publicly available and will be a valuable tool to inform marine spatial planning.

### **Co-developing climate smart spatial management scenarios**

Liz Talbot (PML)

The MSPACE Early Warning System used state-of-the-art analyses of ocean climate and species distribution modelling to quantify and map the UK's climate-driven vulnerabilities and opportunities arising for the effective spatial management of marine conservation areas, fisheries and aquaculture. Mapped climate change refugia and hotspots, along with information collected by the project regarding the needs and values of stakeholder pools, and economic analyses of maritime sectors, are now being used to co-develop regionally specific recommendations for the design of climate-smart, economically viable and socially acceptable spatial plans across the UK's four nations. Here, we outline the first steps taken towards the co-development of a range of possible spatial management scenarios, focussing primarily on how we use the spatial data generated by the Early Warning System. Scenarios consider four options for spatial management: business as usual (e.g. nothing about the management of marine areas changes); sectorial prioritisation scenarios, whereby climate-smart outcomes for marine conservation, fisheries and/or aquaculture are maximised; and a compromise scenario, within which climate-smart outcomes for marine conservation, food provision and other sectors (e.g. offshore wind) are balanced. The scenario maps generated by this first step are used to explore the specific economic impacts of the management strategies proposed, and as a basis for co-production of knowledge with stakeholders, regarding national and regional priorities, both within and across-sectors, to inform ongoing plan development and review.

### **Exploring Preferences and Values around Marine Planning in the Aquaculture, Conservation, and Fisheries Sectors**

Gina Yannitell Reinhardt and Patricia Danahey Janin (University of Essex)

How do varying groups of stakeholders assess elements of the marine space? We present thematic and quantitative analyses of interviews with 90 stakeholders from key sectors (planning, regulation, aquaculture, conservation, fisheries) in the devolved nations. Findings indicate that stakeholder preferences align both within sectors and within devolved nations, revealing complex layers of priorities among planning stakeholders.

## **POSTERS**

### **Seagrass as a nature-based solution for coastal protection**

James Forrester (University of Liverpool), Nicoletta Leonardi, University of Liverpool, James Cooper, University of Liverpool, Pavitra Kumar, University of Liverpool

Nature-based solutions are gaining interest for their potential to provide multiple ecosystem services, including coastal protection. Seagrass can influence coastal sediment transport and wave propagation, however, whether seagrass can be used as an effective intervention for coastal protection is unclear. Using the Delft3D model, this study looks at how seagrass affects coastal hydrodynamics in a macrotidal bay, under idealised scenarios that simulate a rise in sea level and storm wave heights, emulating projected sea conditions under climate change. Through the use of a habitat suitability model, a seagrass patch in Morecambe Bay was simulated, based on a location within the bay that is most suitable for seagrass species *Zostera marina*. Hydrodynamic simulations were run for a number of scenarios for a domain with and without a seagrass patch. Scenarios included variable boundary wave heights, sea levels and vegetation parameters, to test the influence of seagrass in future climates. Results show that there is a reduction in mean and maximum wave height inside and behind the seagrass patch, with the largest changes in wave dissipation observed during higher boundary wave conditions. In these conditions the maximum wave height reduced by over a half within the patch. Simulations examining the influence of seagrass density and canopy height found that a lower density seagrass patch reduced maximum wave height more substantially than higher density patches. Although alternative hard engineered solutions are able to attenuate wave energy more effectively than seagrass, these results demonstrate seagrass could play an important role in conjunction with salt marsh restoration or existing hard engineering solutions, helping to mitigate the risk of flooding and erosion, whilst providing additional ecosystem services such as carbon sequestration and habitat provision.

### **Data to support marine environmental monitoring from the UK Met Office.**

Susan Kay (Plymouth Marine Laboratory & Met Office)

The Met Office routinely produces publicly available datasets about marine environmental conditions which may be of use to managers, either directly or as input to management models. The products cover current conditions – a daily 5-day forecast – and historical conditions for the past 25 years. Variables include chlorophyll, oxygen, nutrients, visibility, pH, plankton biomass and primary production, as well as temperature, salinity and water currents. The datasets are produced by numerical modelling, with input from satellite and in situ observations to keep them as close as possible to real-world conditions. These products are continuously developed by the Met Office, with research input from Plymouth Marine Laboratory and the National Oceanography Centre. We are keen to hear from users and potential users of the products to understand how we can improve them to suit your needs.

### **Mapping seagrass in UK from satellite data**

Clive Neil (NOC)

The first objective of the ReSOW (Restoring Seagrass for Ocean Wealth) project is to evidence the value of seagrass restoration by conducting the first national seagrass natural capital assessment.

Remotely sensed data from satellite images provides evidence of submerged aquatic vegetation, including seagrass, and is the first step to achieving this objective.

Mapping seagrass beds using remote sensing can provide feedback for HSM by way of model validation and improving presence data. Any improvements made to modelling potentially suitable restoration sites around the UK will ultimately increase the chances of successfully restoring seagrass at these locations and increase their ability to capture and store carbon.

### **Social acceptance of nature-based solutions as effective coastal flood risk management schemes in the UK**

Elina Apine (University of St Andrews), Sara Kaffashi, Cranfield University, Marta Meschini, University of Liverpool, Tim Stojanovic, University of St Andrews

Rising global mean sea levels and more frequent flood events are increasing the risk of coastal hazards such as flooding and erosion. Coastal communities are already experiencing the impacts on property, infrastructure and livelihoods of storms and accelerated coastal erosion. Future damages to property from coastal flooding, for example, in England are projected to treble by the 2080s based on high-end scenarios of climate change. National Flood and Coastal Erosion Risk Management Strategies for England and Wales, Shoreline Management Plans in England and Wales as well as the Coastal Change Adaptation Plans for Scotland, incorporate nature-based solutions and natural flood management. However, while such solutions are recognised strategically, the implementation on a local level is still relatively slow. The common reasons cited are the lack of funding and low community acceptance.

This study assesses what influences the social acceptance of nature-based solutions for coastal flood risk management on a local scale. We employed a mixed methods research approach combining quantitative and qualitative data collection methods. We conducted postal questionnaire surveys and focus groups in four sites across the UK – Hesketh Bank (England), Pensarn (Wales), Airth (Scotland) and St Andrews (Scotland). The sites were selected to demonstrate a range of socio-demographic characteristics and baseline conditions.

The results indicate that local-level social acceptance is site dependent, relative to the current physical environment and the historical legacy of existing schemes. Demographic characteristics such as age, education and income did not impact the acceptance of nature-based solutions in our study. General attitudes towards working with nature were highly positive but, for example, in Pensarn, currently protected by a seawall, respondents struggled to see how such solutions could be implemented. Furthermore, nearly half of respondents expressed lack of understanding about nature-based solutions. Focus group participants also highlighted that funding systems often work in favour of hard-engineered solutions. To increase the social acceptance of nature-based solutions, it is essential to improve the knowledge about these solutions and provide evidence of their effectiveness.

### **mNCEA and SMMR: Synergies and shared learning**

Emily Hawkes (Department for Environment, Food and Rural Affairs)

Oceans and coastal communities are interconnected environments. However, when we look at them through a singular view of environmental science, social science or economics, they often tell us a different story.

Defra's £37 million marine Natural Capital and Ecosystem Assessment (mNCEA) programme is changing this. We are exploring the value people place on our marine and coastal environments and how decision making can be informed by natural capital approaches, which take into consideration benefits and disbenefits for the environment, the economy and for people.

Like SMMR, we are taking a holistic approach which looks across the marine system as a whole and brings together ecological, societal and economic data. This means we can better understand interactions, dependencies, and trade-offs between different marine and coastal management options, enabling us to assess the net effect for people and the environment.

By the end of Year 2, we will have delivered 47 monitoring and application projects, filling critical natural capital evidence gaps, testing new monitoring methods, developing online decision support tools, and exploring the role and values of coastal communities and marine decision makers.

This poster will provide an update on mNCEA projects, as we enter the third year of the programme, and examples of how we are using natural capital evidence and tools to inform policy within Defra, including the delivery of a Fisheries Management Plan informed by natural capital evidence and approaches.

We will invite conference attendees to consider the connections between mNCEA and SMMR to inform how we integrate outputs and learning between the two programmes going forwards.

### **Modelling tools to support coastal and estuary remediation**

John Aldridge (Cefas), Matthew Thomas (Cefas), Benjamin Cowburn (Cefas), Mike Nelson: (Environment Agency)

The CPM model was originally developed to assess possible changes in phytoplankton and macroalgal biomass in response to changes in nutrient loading. The model has recently been extended to include seagrass, saltmarsh and mussel components allowing the consequences on nutrient and carbon cycling to be evaluated for a range of remediation options. These new developments are described with an emphasis on the practical use for options appraisal for coastal remediation by restoration of saltmarsh habitats and seagrass and shellfish beds.

### **Climate change and seabed disturbance - Habitat condition indicators and overlaps with climate change hotspots, tools for climate-resilient conservation.**

Stefano Marra & Stephen Duncombe-Smith (JNCC), Liam Matear, Kirsty Woodcock, Adam Smith, Cristina Vina Herbon.

Climate change is impacting on marine species and ecosystems that are already degraded and in poor health from anthropogenic pressures. Indicators are used to assess the status of marine ecosystems and provide evidence and advice for management and policy decisions, along with monitoring progress towards conservation targets. The integration of ecosystem indicators with other data can inform progress on the effectiveness of environmental policy at different scales, from Marine Protected Areas (MPAs) to regional and international assessments. Moreover, indicators are increasingly being used to identify risks and benefits to marine ecosystem services and inform marine spatial planning and future ocean use predictions. One indicator used for national and international assessments is the OSPAR indicator "Extent of Physical Disturbance to Benthic Habitats (BH3)", which assesses the risk to seafloor habitats being disturbed from mobile

fishing gear and aggregate extraction dredging. This indicator was used in the project “Marine Spatial Planning Addressing Climate Effects” (MSPACE) in combination with climate change models to support the definition of recommendations for climate-smart marine spatial plans. In this poster we present how combining the modelled risks to benthic ecosystem condition from human activities with ocean climate change modelling can provide tools for climate-adaptive spatial management. Utilising combined outputs enabled the identification of areas at risk of disturbance from fisheries or aggregate extraction which overlap areas identified as climate change refugia, areas expected to experience minimal benthic ecosystem change. These overlapping zones represent locations where climate-adaptive spatial management measures could be directed to maximise conservation targets. Additionally, these outputs can identify overlaps with areas at risk of high levels of physical disturbance and climate change hotspots, where benthic ecosystem change could be most acute. By integrating these modelling scenarios, we can help focus sustainable management to areas facing potential cumulative pressures from both climate-driven ecosystem changes and disturbance from human activities. Moreover, combining ecosystem indicators and climate change scenarios can provide evidence to inform the designation and management of conservation sites in the future. This poster shows some of the outputs produced by the Marine Spatial Planning Addressing Climate Effects (MSPACE) project, part of the NERC/ESRC Sustainable Management of UK Marine Resources Programme.

### **Climate Smart Management of UK Seas**

Ana Querios & Susan Kay (PML)

Climate change is already affecting species and habitats in UK seas. These effects are set to markedly increase if greenhouse gas emissions continue to rise and accelerate global warming. Given this urgency, more specific guidance and support is needed to enable planners and other marine managers to implement climate-smart solutions. We present a summary infographic of the MSPACE early warning system, which illustrates the projected impacts of climate change on the marine conservation, fisheries, and aquaculture sectors in the UK Exclusive Economic Zone (EEZ), by showing where, and for how long, environmental conditions remain favourable for these sectors over this century.

### **Use of Predictive models in the identification of Harmful Algal blooming species can aid in the management of fisheries resources, aquaculture and coastal communities.**

Fazeel Mohammed (University of Bedfordshire), Tahmina Ajmal - University of Bedfordshire, Bushra Ahmed - University of Bedfordshire, Yanqing Duan - University of Bedfordshire

The United Kingdom's marine environment plays a vital role in providing resources that benefit human well-being, such as food sources, biomedicines and economic benefits through tourism. Coastal areas are crucial for many human activities, but unfortunately, any threat can lead to significant losses in commercial and recreational opportunities. In recent times, harmful algal blooms have caused massive disruption to the environmental balance resulting in reduced fishery yields and mortalities of passively valued species. Although harmful algal blooms may seem like a recent occurrence, the species of phytoplankton responsible for this are naturally occurring. However, recently, these blooms have affected many countries over large areas and by more than one toxic species. It is impossible to foresee these events due to the lack of a well-established and efficient system for the monitoring of poisonous and blooming species that are increasing in water bodies worldwide. To address this challenge, spectroscopic techniques are used as an alternative



to algal analysis through fluorescence monitoring by the excitation of fluorescent pigments in phytoplankton. One of the most successful methods for monitoring algal blooms in coastal and marine waters is to measure chlorophyll concentrations, which is an important indicator of water quality and biomass abundance. However, further analysis of the fluorescence spectra of microalgae has given light to other potential fluorophores that can be used for species monitoring and identification. Aromatic proteins like tryptophan have been effectively used in monitoring algal organic matter and have the potential to help distinguish between algal species. To effectively manage harmful algal blooms, it is important to have early warning systems in place for monitoring, as this is the first step towards implementing effective mitigation strategies. One promising approach is the use of machine learning to develop predictive tools for monitoring and managing harmful algal blooms. By utilising fluorescence and machine learning, it is possible to identify and predict blooming species. Therefore, the approach being proposed is to create a model that can provide real-time analysis of algae species identification and their toxin in conjunction with forecasting potential blooms. This technology can proactively provide steps towards managing fisheries resources, aquaculture and coastal communities, leading to a better protection of our valuable natural resources and ensuring a sustainable future.