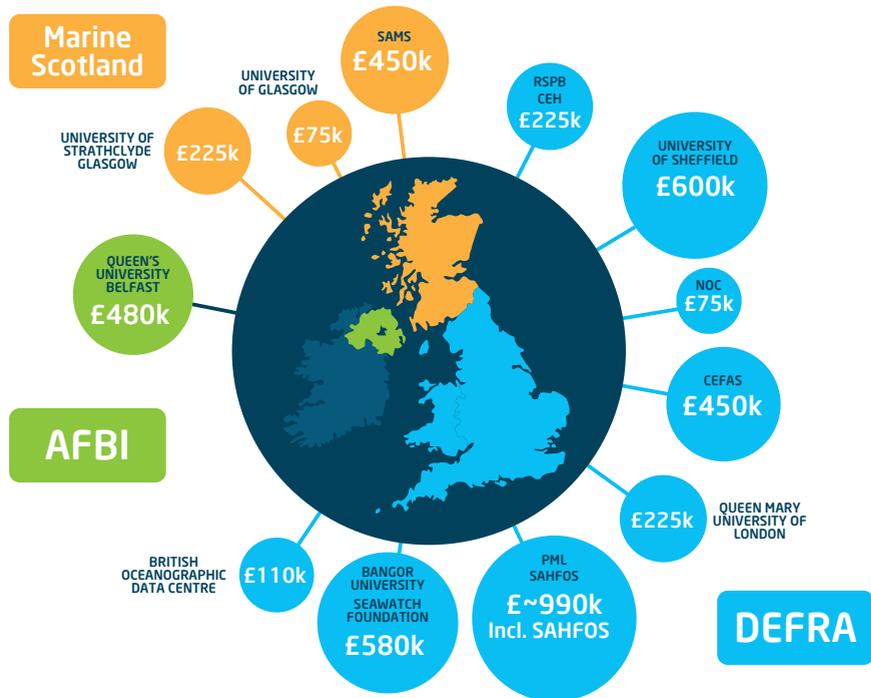


# 1

## MARINE ECOSYSTEMS RESEARCH PROGRAMME – ADDRESSING POLICY QUESTIONS



**Marine Ecosystems Research Programme**



be applied to answer many of the policy and other stakeholder questions that arise. Often models do not make immediate impacts but rather enable, support and add to other analyses. Some model contributions are included here, other less obvious but no less important **model outputs and developments are reported through scientific papers - a full list is available via the MERP website** and a separate leaflet deals with the models and their outputs.

Connecting science with policy and management is not always easy, but MERP researchers are unanimous in their desire to see their work filtering through to inform policy and management decisions necessary under various guidelines, directives and legislations including: OSPAR (MSY), MSFD (GES), the new CFP, ICES, Habitats Directive, Birds Directive, as well as the recently published marine section of the UK Government report, 'A Green Future: Our 25 Year Plan to Improve the Environment', and the aspirations for the UK marine environment.

### MERP researchers welcome discussions with stakeholders beyond the end of the programme and into the future.

A list of the current Principal Investigators (PIs) for the various modules in MERP can be found on the MERP website. ([www.marine-ecosystems.org.uk/Contact](http://www.marine-ecosystems.org.uk/Contact))

At the beginning of the Marine Ecosystems Research Programme, stakeholders identified 15 policy questions they hoped MERP outputs would inform. As with all scientific programmes, analysis of results and publication of research can continue after research is brought to a close, MERP is no exception. However, already **MERP has produced outputs that are or have the potential for use within the policy and/or management setting.** As more papers are published and taken up by relevant stakeholders the impacts of MERP will become more widespread and influential for many years ahead.

### The Marine Ecosystems Research Programme - relevant marine science for policy and management.

The Natural Environment Research Council (NERC)/Department for Environment, Food and Rural Affairs (Defra) - funded Marine Ecosystems Research Programme set out to integrate existing marine data and target new data with current models and knowledge of marine ecosystem services, in order to improve our understanding of the whole UK marine ecosystem. The 5 year, £5 million programme has brought together more than 50 scientists from 12 research institutes and a large number of supporting organizations that have made data and expertise available to achieve MERP's aim. The strength of MERP and the quality of its outputs are a testament to the approach which: brought together scientists with different expertise and experience to work together; utilised and developed the best available modelling approaches; merged existing data from a range of sources and added new data where necessary; linked process understanding and ecosystem state to services; and related its outputs to better understanding relevant

to policies. It has been an underlying target that MERP would bring together and further develop a suite of marine ecosystem models, provide vital evidence and tools and advice to support Marine Strategy Framework Directive (MSFD), the Marine and Coastal Access Act, the Marine (Scotland) Act, the Common Fisheries Policy (CFP) and inform the OSPAR Joint Assessment and Monitoring Programme. MERP science has already fed into these and other guidelines, directives and legislations. Applying MERP outputs to forecasting any changes in the provision of ecosystem services as a result of natural and human pressures is an equally important outcome of MERP. The approach has been to follow The National Ecosystem Assessment (2011) guidance, focussing on: food provision, biological checks and balances, leisure and recreation and bioremediation of waste.

### Policy questions answered

In addition to laboratory studies, field work, sampling cruises, undertaken in MERP there is a strong marine ecosystem modelling component. Indeed there has been continuous development and bringing together of the models used in MERP to provide a modelling foundation which can

Two interactive infographics are available on the MERP website. One of these demonstrates how each of the models addresses different trophic levels and scales within the marine ecosystem, and enables you to see which is the most appropriate model for your particular questions. Links are provided to the relevant model's web-site for more information, and give a link to the PI responsible for the model in MERP.

The second reflects the main text of this leaflet and provides an easy way to access how MERP is contributing to addressing the policy questions under the three key sections (see right).

**MERP - ADDRESSING POLICY QUESTIONS**

Analysis of results and publication of research can continue after research programmes finish, however, already MERP has produced outputs that are or have the potential for use within the policy and/or management setting, such as in OSPAR (MSY), MSFD (GES), the new CFP, ICES, Habitats Directive, Birds Directive, as well as the recently published marine section of the report, 'A Green Future: Our 25 Year Plan to Improve the Environment'. As more papers are published and taken up by relevant stakeholders the impacts of MERP will become more widespread and influential for many years ahead. Some model contributions are included here, other less obvious but no less important model outputs and developments are reported through scientific papers - a full list is available via the MERP website.

This interactive infographic provides a broad overview of how MERP research fits with policy questions. Rolling your cursor over one of the three categories below will take you to specific questions and how MERP has addressed them.

- 1** The state of food-webs (or their components) in relation to specified targets.
- 2** Effects of natural and anthropogenic change on the state of marine food-webs and the services they provide.
- 3** Future state of marine food-webs and ecosystem service provision under scenarios reflecting management situations in UK waters.

# 1 The State of Food-webs (or their components) in relation to specified targets.



## ➤ Are we achieving Good Environmental Status (GES) for MSFD descriptors 1,4 and 6 at regional scales?

A report has been submitted to the EU on interaction between GES indicators based on StrathE2E. EU has accepted the functional group aggregations in StrathE2E as an operational basis for assessing food web GES.

Development and testing of Typical Length as an indicator for fish community status

continues: adopted by OSPAR as main indicator to assess fish diversity; IPBES planning to use this indicator in assessment of "Biodiversity and Ecosystem Function in Europe and Central Asia".

Rationale developed for choosing indicators and their target ranges for assessing GES.

Quantitative predictions of the time it will take for GES indicators used to assess the descriptors to recover from fishing pressure, these include assessments of uncertainty resulting from model choice.

Trait values added to L4 plankton series allowing it to be used for OSPAR 2017 Intermediate Assessment for one of three pelagic indicators, namely PH1: planktonic lifeforms. The only UK time series available for use in this assessment it was a case study in two OSPAR reports developing indicators of GES.

The potential of using cetacean and seabird long-term survey data sets for trend analysis in relation to Descriptor 1 (Biodiversity), is being investigated. Also contributing to the

OSPAR Common Indicator guidelines for abundance of regularly occurring cetaceans.

## ➤ Are we achieving Conservation Objectives for species and habitats at local MPA scales?

Submitting evidence within Special Areas of Conservation for bottlenose dolphin and harbour porpoise in Wales.

## ➤ What is the relationship between ecosystem services and GES?

Report on interaction between GES indicators based on StrathE2E modelling, submitted to EU.

Rationale developed for choosing indicators and their target ranges for assessing GES. Outcome suggests GES and achievement of societally preferred mix of ecosystem services are not naturally aligned objectives: GES sets boundaries as to the mix of ecosystem services we can rely on.

► **Identification of areas of particular importance to fish populations.**

Seabed types are important and often chosen specifically by fish species. Existing maps are patchy at best. Models have been developed in MERP that 'fill the gaps' in our knowledge by predicting seabed sediment types. This work is relevant to identifying areas of importance.

► **How can we define and describe biodiversity hotspots?**

Biodiversity hotspots for top predators (cetaceans/seabirds) have been identified, these findings are being incorporated into a wider multi-taxa comparison. Species distribution data across taxa

(incl fish) and spatial scales is being combined with spatial information on environmental and anthropogenic pressures to identify key stressors (e.g. climate, fishing) on marine species diversity, highlight locations where environmental and anthropogenic threats to marine species diversity are greatest and highlight locations that are accepted priorities for marine conservation/management measures.

► **How are populations of vulnerable species (cetaceans, seabirds, elasmobranchs etc) distributed in space and time?**

Synthesis and analysis of cetacean and seabird sighting data is transforming our knowledge of space-time distributions.

► **Where do key foraging areas for seabirds occur in space and time?**

Analysis of seabird space-time distributions is a transformative advance.



**2**

**Effects of natural and anthropogenic change on the state of marine food-webs and the services they provide.**

► **How does the removal (e.g. by tidal lagoon projects etc.) or alteration (e.g. by towed fishing gears) of benthic habitats affect populations of marine mammals and birds (mammals and birds included in the Habitats Directive)?**

StrathE2E modelling in the ICES WKTRADE workshop shows the scope for sensitivity of all trophic levels including top predators to benthic impacts of towed gears.

Further work including risk mapping continues.

The effects of displacement of benthic-feeding seabirds from offshore windfarms



© RGH Evans/SWF

(effectively habitat loss) who may have to forage in lower quality habitats, with negative consequences, is being quantified.

► **What are the impacts of removal or change of fish prey species on marine bird and mammal populations (Habitats and Birds Directives)?**

StrathE2E in ICES WKTRADE workshop, and simulations of landing obligation strategies show scope for sensitivity of all trophic levels, including top predators, from the range of effects on fishing.

Further work including risk mapping is being carried out.

► **Evaluate cumulative impacts, to allow for ability to strategically assess the capacity of cetaceans and seabirds to cope with cumulative impacts across their ranges.**

This work is ongoing but forms an important part of risk mapping exercises being done for seabirds and cetaceans in relation to several

human activities (fishing with different gears, offshore renewable development, seismic surveys, recreational activities, shipping). These are being examined individually and cumulatively. Impact evaluation methods are being developed.

Cumulative effects of multiple offshore windfarms on the demography of seabirds is being estimated. A subset of seabirds, where sufficient data allow population-level consequences to be assessed, is being used.

Modelling with EwE has highlighted the need to include temperature as an ecosystem driver for advice on better sustainable fisheries management.

► **How do impacts on rare and/or threatened habitats and species affect ecosystem services?**

Work on non-monetary valuation of marine ecosystems demonstrates the central importance of red-listed seabirds and mammals in marine users' shared cultural values.

**Marine Ecosystems Research Programme: in figures**

**£5M**

funded by Natural Environment Research Council and Department for Environment, Food and Rural Affairs - launched June 2015.

**5 YEAR**

programme of scientific research and model development

**50**

UK scientists from 12 research organizations: (full list on website)



**5**

newsletters available on website



**7**

Biannual progress reports produced

**60**

MERP associated scientific publications, so far

**4**

research cruises

**7**

mini-cruises

**8**

benthic cruises



**40**

external contributors to seabird and cetacean data



**8**

marine ecosystem models



**140**

external presentations including to: Defra, Scottish Government, Natural Resource Wales, ICES, ASCOBANS, Un Sustainable Development Group, JNCC, Natural England, PICES, European Parliament, UNEP, MMO, CSIRO, UN, and numerous international conferences and meetings.



Project video gives outline of MERP research and other activities.

'Day in the life of our research vessel -time lapse video

MERP has collated existing data and identified crucial knowledge gaps that required filling for a better understanding of the marine ecosystem. Empirical data, obtained from observations, measurements and experimental activities is essential for populating model simulations to ensure they are more closely aligned to the 'real world', thus more useful for policy and management. As data become available they are lodged with the British Oceanographic Data Centre (BODC).

## MERP Stakeholder Advisory Group

- Lyndsey Dodds - Celtic Sea Partnership
- Mark Dickey-Collas - ICES
- Natalie Askew - JNCC
- Matt Frost (Chair) - MBA
- Adam Cook - MMO
- Edward Ross - Marine Scotland
- Dale Rodmell - NFFO
- John Baxter - SNH
- Peter Barham - Seabed Users Group
- Kirsten Ramsay - Welsh Govt/NRW



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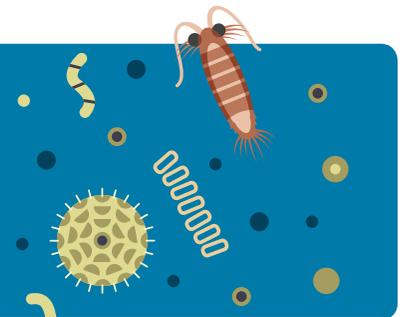
**Centre for Ecology & Hydrology**  
NATURAL ENVIRONMENT RESEARCH COUNCIL



➤ [WWW.MARINE-ECOSYSTEMS.ORG.UK](http://WWW.MARINE-ECOSYSTEMS.ORG.UK)

# 3

## Future state of marine food-webs and ecosystem service provision under scenarios reflecting management situations in UK waters.



### ➤ What are the effects of changes in fisheries management on the environment, particularly through food-web effects?

StrathE2E modelling in ICES WKTRADE workshop shows scope for sensitivity of all trophic levels including top predators to benthic impacts of towed gears.

Work continues to investigate impacts of alternative fisheries management approaches.

MERP model ENSEMBLE suggest top-down effects in marine food-webs, especially at lower trophic levels, are weak. But, also found that a moderate increase in nutrient enrichment can generate strong top down effects – modifications to fish community through fishing can change phytoplankton community structure.

### ➤ What are the responses of indicators to specific management measures for MSFD descriptors?

StrathE2E modelling in the ICES WKTRADE workshop of MSFD, measures to improve seabed status indicators.

Investigations continue for top predator indicator species that form MSFD biodiversity descriptor in relation to specific management measures.



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Obtained, using the MERP model ENSEMBLE, quantitative predictions of the time it will take for GES indicators used to assess Descriptors 1, 4 and 6 to recover following adoption of MSY management targets under new CFP.

Studies also showed how different policy options to implement the new CFP affects fish community size structure and fish species richness.

### ➤ What are the future changes in ecosystem services in response to different management scenarios?

Mathematical methods and model simulations showed how adoption of different policy options to implement new CFP affects



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fisheries yields. Choices of both objectives and management strategies can have tremendous impacts on yields. The current strategy will result in rather low yields.

MERP has been jointly funded by the Natural Environment Research Council (NERC) and the Department for Environment, Food and Rural Affairs (Defra).

➤ [www.marine-ecosystems.org.uk](http://www.marine-ecosystems.org.uk)

