BIANNUAL ACHIEVEMENTS REPORT February 2017

[Marine Ecosystems Research Programme]

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Programme's key achievements and overall progress over the last 6 months:

Keeping a clear view of progress across the entire MERP ecosystem is no easy task given the increasing complexity of the programme as it nears its end. Most components of the programme that were funded in the original tranche are nearing completion, with less than a year to run, and the focus is on developing and releasing products while using them in ongoing work. Data products synthesising large amounts of existing and new information across large scales are becoming available, covering seabed sediments, infauna, seabirds and cetaceans among other components, along with syntheses which provide information about species and their traits. A key MERP product is the Trait Explorer, which uses algorithms to infer traits of species from knowledge about other species and their relationships. Analyses based on these products are informing models, and R tools for analysing them are available. Most of the fieldwork and experimental work has been completed, though some sample analysis remains to be done. Highlights of new knowledge emerging include new insights into the role of jellyfish in the marine ecosystem, and the importance of macroalgal production near to the coast as a source of food. The MERP model ensemble is functioning, and we are on the verge of being able to link data, models and services in a quantitative framework to assess consequences of potential management actions. Major developments have been made in modelling the marine ecosystem, ranging from a much better understanding of how ecosystems change, and why, to incorporating and evaluating many new processes into modelling systems. We have demonstrated how these enhanced models may be used to provide policy advice. Work in the two WP3 projects (Trade-offs and Cumulative Impacts) is proceeding at pace, and is also due for completion next year. ERSEM development continues to be spectacular, and is currently funded to continue for at least another year. We have engaged widely, with many presentations at the major ecosystem modelling conference AMEMR for example, followed by a major contribution to a European Marine Board expert workshop, and more recently presenting a briefing to Defra.

Key Achievements

Synthetic mapping of the northwest European Shelf sedimentary environment for applications in marine science (University of Strathclyde) – Mike Heath

It is commonly assumed that mapping of seabed sediments is a 'job done' as a result of several national and European-scale projects. However, the outputs from these projects are entirely in terms of the area distributions of discrete seabed habitats or whole sediment classes, e.g. fine muddy sand. Whilst these are essential for some marine planning tasks, they are not suitable for other tasks, such as the configuration of ecosystem models, which require data on continuous measures of sediment properties. A **MERP data product was compiled using** international data sets on individual sample-by-sample measurements of sediment composition, grain size, and carbon and

nitrogen content for a large part of the NW European shelf from the Bay of Biscay to the northern limits of the North Sea and the Faroe Islands. We used a combination of gridding where the data density was high, and a machine-learning algorithm to predict the sediment data for areas where there were no samples, to produce an integrated atlas of a range of continuous properties of the seabed.

Ecosystem service trade-offs between wildlife recreation and industrial activities (CEH, Bangor University, SAMS, University of Glasgow, RSPB, Sea Watch Foundation) – Francis Daunt

Top predators have a direct influence on the provisioning of competing ecosystem services including wildlife tourism, fisheries and offshore renewable energy developments, through the interplay between human activities and top predator distribution, abundance and behaviour. MERP scientists have produced a series of distribution maps for each of the main UK seabird and cetacean species to capture monthly and interannual variation in top predator diversity and abundance throughout UK waters. Models have been used to identify the major environmental drivers of variation in space and time. Breeding season distribution maps of seabirds have been combined with energetics models to map predation pressure and overlap with offshore renewable developments for four seabird species (black-legged kittiwake, European shag, razorbill and common guillemot). Top predators play a crucial role in cultural values and sense of place in coastal communities and directly affect livelihoods through tourism and recreation. Social science research on cultural values, experiences and identities is producing a documentary film based on the results of 40 stakeholder interviews conducted with representatives of the regulatory, provisioning and tourism/recreation sectors, in the Southwest of England and West Coast of Scotland. Stakeholders contributed information about their experiences and knowledge relating to ecosystem services and identified potential trade-offs between wildlife recreation and other activities in the marine environment and preferred marine management strategies that minimise competing interests. Stakeholders identified various aspects of Natural Capital important to them and the role of biodiversity in enhancing or detracting from their capacity to benefit from ecosystem services.

Best available estimates for MSFD indicator recovery times and quantification of residual uncertainty (University of Sheffield, QMUL, Cefas, University of Strathclyde, SAMS) – Axel Rossberg

An important measure taken by the UK and other countries to achieve GES is the reform of the Common Fisheries Policy (CFP), which aims at exploitation rates of marine fish consistent with attaining Maximum Sustainable Yield (MSY). These rates are generally lower than historic rates, and thought to reduce pressure on the marine ecosystem as a whole, so allowing the system to recover from previous overexploitation. From a policy perspective, it is important to understand how much time it will take, after implementation of the reformed CFP, for marine environmental status as determined by the UK's GES indicators to recover. Firstly, because slow natural recovery of indicators legitimised delays in attaining GES beyond 2020, and secondly because slow recovery of indicators demonstrates particular vulnerability of the ecosystem components they represent.

MERP addressed this question using the MERP Model Ensemble, a group of marine ecosystem models covering a large variety of different model architectures and philosophies, and different study areas. Using this model ensemble, it became possible to make not only quantitative predictions of expected typical recovery times, but also to determine the uncertainty in these predictions resulting from our still incomplete understanding of the dynamics of marine ecosystems. A newly developed statistical method synthesises outputs from the MERP Model Ensemble to quantify not only best estimates but also the remaining scientific uncertainty. The method is here

applied to predict recovery times of GES indicators after reducing fishing pressures levels typical for 1985-1999 to approximate MSY levels.

Issues encountered

The fact that post-doctoral research assistants were generally employed on contracts which meant they would leave the programme before its end has generally been managed. Knowing when they would leave has allowed us to plan in advance, with one or two exceptions which have been quickly and efficiently resolved. Decisions by more senior researchers to move to new employers have been more difficult to manage. Several key staff have moved at short notice. Sometimes this has had little impact on the programme, but some elements of the programme are behind schedule as a result. That being said, knock-on effects for the Programme have so-far been fairly limited and PIs are confident they will complete the programme of work on time.

Trying to complete work already funded in tandem with the new work in WP3 is proving a challenge, but we are confident that we will deliver on most fronts to the original timetable. One or two no-cost extensions may be requested to tidy things up next year and to ensure that the opportunities to deliver products and impact from the programme are not missed.