

# Ecosystem models-how are they useful for fisheries managers?

Marine Theme Objective: Science for Integrated Management

## What's the problem?

Mathematical models are used widely in fisheries management, traditionally at the level of the fish population of concern. Many different modelling approaches have been developed to evaluate i) the effects of other parts of the ecosystem (predators, food availability, climate) on the population and ii) the relative effects of human activities on ecosystem structure and function. Expectations for stock recovery and fisheries yields in general, will be very different depending on the interactions between species and other natural processes and the way these interactions are modelled.

## What are the aims of the project?

This project will test, refine and evaluate the usefulness of existing models for addressing ecosystem and multispecies considerations in fisheries management.

The project aims are:

1. To assess the importance of interactions between predators and their prey in comparison with other sources of uncertainty in fisheries models;
2. To help predict ecosystem knock-on effects of management actions; and
3. To collate Defra and EU modelling activities.

The model comparisons will focus on the North Sea, and the Celtic Sea/western-approaches (Figure 1). The project will also address general issues e.g. assumptions on model performance as well as the usefulness of models (e.g. problems encountered when applying models to pressing fisheries management problems). Where appropriate, the project will facilitate further development of novel modelling techniques.

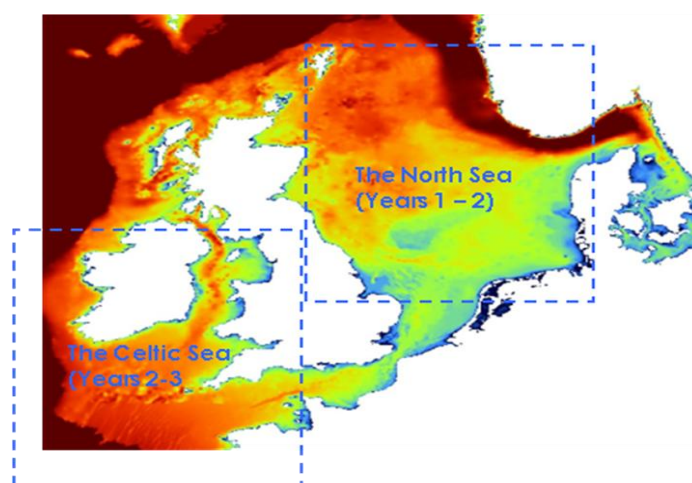


Figure 1: The two case study regions included in the fisheries models (Source: Cefas)

## Which policy areas will the research inform?

This project will contribute to: the FAO Code of Conduct on Responsible Fishing; the management of the Common Fisheries Policy; Defra's 'Securing the Benefits' report on the future of the UK fishing industry; and the Marine Strategy Framework Directive. It will also inform the International Plan of Action for the Management of Fishing Capacity (FAO 1999), the EU Habitats Directive (EEC 1992) and the 2002 World Summit on Sustainable Development.

## What are the results from the project and how will they be used?

Most activities carried out in this project so far have focused on the North Sea. The development and validation of a detailed 'Ecopath with Ecosim' model has been carried out. The model accounts for food web interactions among a wide range of species and has been used with stakeholders to investigate possible multispecies implications of managing fish stocks to achieve 'Maximum Sustainable Yield' (MSY).

Further work on the North Sea Ecopath Model has focused on the development and validation of a spatial version ('Ecospace'), which can be used to investigate possible multispecies implications of establishing marine protected areas in the region. It has been used to investigate the consequences of simulated 'closures' of proposed Special Areas of Conservation (SACs) to all fisheries.

A North Sea model of the changes in abundance of different sizes of animals through time due to predation and fishing mortality have been used to evaluate system-wide effects of changes in fishing pressure and primary productivity (climate change). The model also takes into account coupling between fish and benthic communities (see Figure 2) and aids evaluation of the wider effects of harvesting and environmental changes on overall ecosystem health and the large-scale effects of climate change on fisheries production.

A multispecies size-structured fish community model representing 12 of the most commercially important and abundant species in the North Sea is being validated for testing the robustness of ecosystem indicators (such as the "large fish indicator") and their responsiveness to different management strategies. Further work will continue on the North Sea models and will be broadened to include the Celtic Sea in more detail.

The project has also supported part of the ongoing "DAPSTOM" (Integrated Database and Portal for Fish Stomach Records) initiative. The DAPSTOM database now includes in excess of 145,000 individual stomach contents records and is freely accessible to the general public, through the website [www.cefas.co.uk/dapstom](http://www.cefas.co.uk/dapstom).

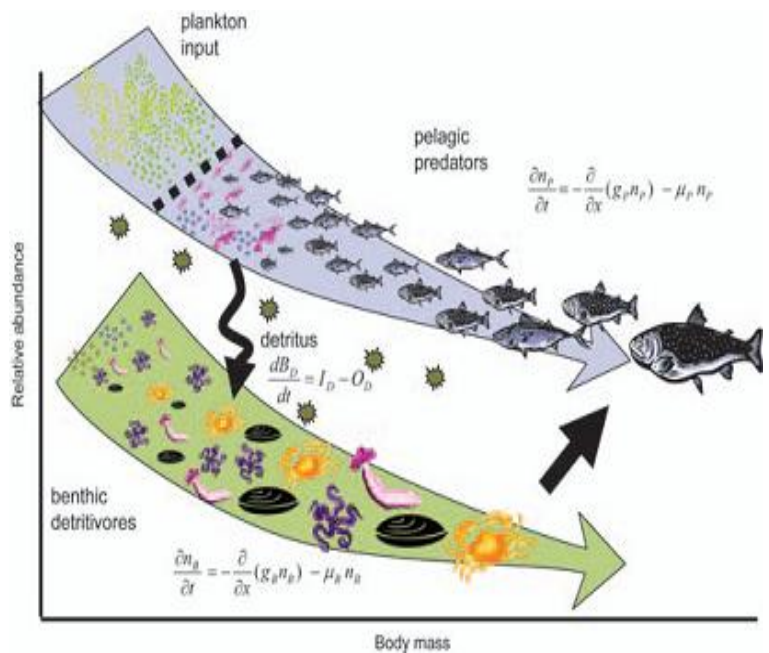


Figure 2: A detailed description of a coupled benthic-pelagic size spectra model applied to the North Sea. (Source: Julia Blanchard 2009 Journal of Animal Ecology Publication).

## Where can I find further information about this and related research?

Cefas are responsible for delivering this research. For further information on the project, please contact Dr John Pinnegar ([john.pinnegar@cefas.co.uk](mailto:john.pinnegar@cefas.co.uk)).

Alternatively, please contact Defra's Marine and Fisheries Science Unit: [marinescience@defra.gsi.gov.uk](mailto:marinescience@defra.gsi.gov.uk).

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