

# How should we incorporate and communicate uncertainty and risk in fisheries management decision-making?

Marine Theme Objective: Science for integrated Marine Management

## What's the problem?

Management of marine fisheries requires the best available scientific advice but even the best advice is beset with uncertainty. Uncertainty arises from a variety of sources; from sample data, from natural variations in the environment, from the models used for assessment, from the estimates derived from the models used and from imperfect implementation of management rules. We want to be able to take into account all such sources of uncertainty in order to quantify and communicate the risks associated with different options for fisheries management to better inform the decision making process.

## What are the aims of the project?

We aim to develop a risk analysis framework for the assessment, management and communication of risk to increase our capacity to both understand and incorporate uncertainty and risk when making fisheries management decisions.

We will therefore investigate how to adapt risk analysis theory to UK and European fisheries, embracing the whole process from data collection, fish stock assessment and advice through to the implementation of management measures. We also aim to develop methods to improve communication of uncertainty and risk and their implications to fishery managers and other stakeholders, to better achieve the long-term goals of fisheries management. The risk analysis framework will encompass four main aspects:

1. Descriptions of hazardous or detrimental events or states (risk identification);
2. Probabilistic evaluations of potential outcomes and consequences of alternative management actions (risk assessment);
3. Development of a variety of tools to manage the risks identified (risk management); and
4. Development of mechanisms to ensure that the implications of management options are adequately understood by all stakeholders. The resulting framework will be applied to case studies of concern under the common fisheries policy.



Figure 1: *Nephrops norvegicus* (scampi or Dublin Bay prawn). Results from the research project are being used to develop and evaluate alternative management plans for the fishery for *Nephrops* in the North Sea in collaboration with stakeholders from the North Sea Regional Advisory Council. (Source: Cefas Crown Copyright).

## Which policy areas will the research inform?

This work will inform the fisheries management advisory process as required to meet national and international obligations with respect to the reform of the Common Fisheries Policy, the World Summit on Sustainable Development, Fisheries 2027, the UK Marine and Coastal Access Act and the Marine Strategy Framework Directive. The research will also ensure that the UK remains at the forefront of research and development into the sustainable use of renewable resources and provide the tools required to better inform fisheries management decision-making.

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

A suite of assessment and evaluation tools are being developed and implemented in the open-source software framework "R" ([www.FLR-project.org](http://www.FLR-project.org)). The framework will integrate tools for Management Strategy Evaluation and impact assessments with bio-economic models and methodology to implement an ecosystem approach to fisheries management. The project will deliver results in four main areas:

1. A review of international best practice and appropriate knowledge bases i.e. the breadth of information required to make fisheries management decisions.
2. Development and implementation of appropriate assessment and evaluation tools (Figure 2).
3. Application of tools to selected case studies in collaboration with Defra, EU research contracts, the International Council for the Exploration of the Seas (ICES), the Scientific Technical and Economic Committee for Fisheries (STECF), Regional fisheries Management Organisations (e.g. the International Commission for the Conservation of Atlantic Tunas ICCAT) and Regional advisory councils. Case studies are being undertaken by Cefas staff as part of their PhD studies thereby fulfilling an important training need.
4. Dissemination of research findings through project reports and peer review publications.

The results from the project will be used to identify and quantify the risks associated with alternative management proposals in order to better inform the decision-making process. The framework has already made a significant contribution to the evaluation of generic recovery plan proposals put forward by the European Commission. It has also been used to evaluate the efficacy of proposed recovery and management plans for specific fisheries; the fisheries for North Sea cod and western Channel sole being prime examples.

In collaboration with stakeholders from the North Sea Regional Advisory Council, tools developed under the framework are being used to evaluate alternative management plan proposals for the fishery for *Nephrops* in the North Sea (Figure 1) in a participatory modelling approach. The risk framework has already been adopted by numerous individual researchers from institutions throughout Europe many of whom have extended the tools available thereby increasing the ability of fisheries scientists to inform fisheries management decision-making.

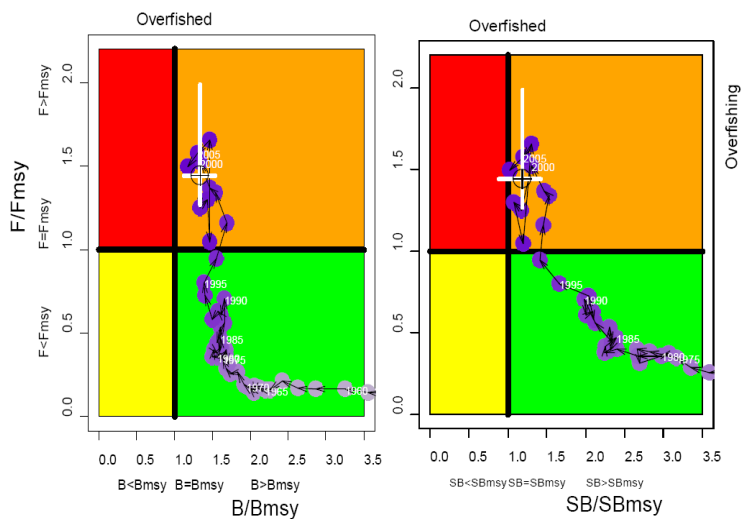


Figure 2: Visualising risk: the plot depicts the history of stock biomass and exploitation rate for two different fish stocks. The green zone indicates the safe region which represents a region of low risk. The red zone indicates a region of high risk to the stock and is a region to be avoided. (B= stock biomass; F = exploitation rate; msy = maximum sustainable yield; Bmsy is the stock biomass that will support maximum sustainable yield; Fmsy is the exploitation rate that will deliver Bmsy). (Source: Cefas Crown Copyright).

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

Cefas are responsible for delivering this research. For further information contact Dr John Casey ([john.casey@cefas.co.uk](mailto:john.casey@cefas.co.uk)) or visit [www.flr-project.org](http://www.flr-project.org).

Alternatively, please contact Defra's Marine and Fisheries Science Unit:  
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