# Operational Evaluation Tools for Fisheries Management Options

# EFIMAS

## Policy Brief

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European fisheries management is rapidly changing toward a more responsive and efficient system and increasing stakeholder participation in decision making is an important part of that. Participation brings about changes in the role of science, as well, and the EFIMAS project has contributed to the development of the **FLR** suite of tools for facilitating science-based decision making in a participatory context. The classic role played by science in fisheries is to set limits on exploitation according to objective criteria. Under conditions of high stakes and high uncertainty this traditional role is undermined as stakeholders use the political flexibility that uncertainty creates and managers try to make their own decisions easier by turning political problems into technical ones.

With the right tools, science can play a helpful role even when uncertainty is high. One strategy is **Participatory modelling**. The approach uses scenario-based models to evaluate different options. **Participatory modelling** can involve managers, the fishing industry, conservation NGOs and any other group concerned with developing good, science-based policy. **Participatory modelling** is not a substitute for using science to set limits. But when limits are needed, this technique can focus on crafting strategies to meet them in efficient ways. Modelling can force stakeholders to clarify their objectives and explicitly address the trade-offs implied by various strategies.

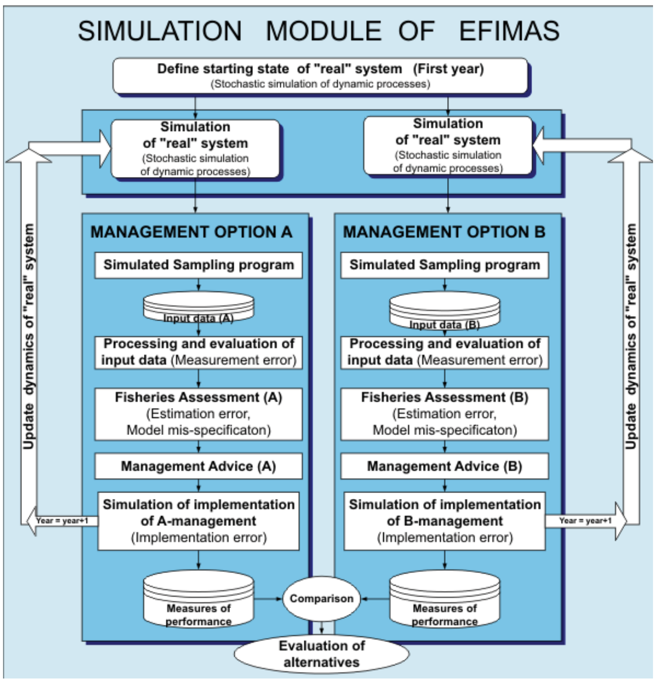
**FLR**, a common modelling framework for evaluating management strategies is a key tool for **Participatory modelling**. It facilitates collaboration across disciplines, ensures that models and software once developed are easily validated, and widely available. In particular it details how to implement a variety of fishery, biological and economic models and software

in a common framework so that alternative management strategies and procedures can be evaluated for their robustness to uncertainty before implementation. The design of the framework, including the adoption of object-orientated programming, can be extended to new processes and new management approaches – for example ecosystem-based approaches. **FLR** is open source, which is important for promoting transparency and allowing technology transfer between disciplines and researchers

The EFIMAS project has developed the **FLR** tools to take account of the dynamics in the fisheries systems in Europe, including policy priority areas such as fleet and mixed fisheries interactions. The evaluations include such things as using alternative stock and fishery assessment

models and can include economic components. Importantly, emphasis is placed on many kinds of uncertainties including those found in the data collection, assessment, modelling, advisory, management and implementation processes. The input data are generated by a descriptive model, called the "operating model" which is assumed to represent the "true" system. The input data are then processed by the "knowledge production model", which can either be a traditional stock assessment model or one of several alternative fish stock or bio-economic fleet based assessment models. By simulating the effect that the resulting management actions would have on the "true" system a range of performance measures are generated, covering the resource and the fishery. The tools can consider many management alternatives such as minimum mesh size, minimum landing size, closed areas, closed seasons and effort regulations. The performance measures enable the comparison of a range of management options under alternative management systems and objectives.

In the same way that a pilot might fly in a simulator before flying for real, the simulation tool evaluates the robustness of various scenarios to give more holistic management advice and allow the informed considerations of alternatives actions.




## Example One: Baltic Cod

Ensuring the efficiency of regulations for Baltic Cod required testing some important assumptions about the relationship between where and how much people fished and how the Baltic Cod stock would change as a result. To achieve this, the behaviour of the fishers needed to be integrated into the exercise. We needed to understand how fleet behaviour would change across both time and space in response to both how the fish moved and the implementation of regulations involving area- and season-based restrictions. A simulation frame was developed in R using the **FLR** open-source platform. The model we developed consists of three sub-models: (i) a multi-stock module that considers how the populations of fish stocks in different areas change; (ii) a multi-fleet module taking into account of the heterogeneity of the fishing practices; and, (iii) a management module that could examine both conventional management techniques and permanent or temporary closed areas and seasons. All these components operate on a spatial grid matching underlying data in monthly and spatially dis-aggregated observations. We used log-book data to assess fishing patterns and developed some equations suggesting how fishing patterns might change in response to either management measures or fluctuations in the fish stocks. Finally, we added an economic description of the fishery to the model. We are able to consider how economic conditions might have an impact on the displacement of fishing effort, changes in fishing activities or vessel capacity. We used this model to test various scenarios for the Baltic Cod fishery. These included two different ways to design the operating model, two different scenarios of environmental impacts, and three different management strategies. The simulated management regimes we evaluated included TAC management, with among other a one-year time lag TAC, compared to effort management in the form of direct effort control as well as indirect effort control through closed areas and seasons (as suggested by DG MARE) Also the "F-adaptive approach" suggested and implemented by EU and considered in the ICES Baltic Fisheries Assessment Working Group for the recovery

of the Baltic Cod was tested as well as different environmental conditions. The different environmental scenarios cover situations of favourable conditions for cod recruitment in connection with a larger inflow of Atlantic seawater into the Baltic Sea compared with low-inflow situations followed by relatively low recruitment. We finally examined different assumptions about how fishers might behave in response.
Submitted by DTU-Aqua.

## Example Two: North Sea flatfish

In 2004 there were initiatives to develop a management plan for the North Sea plaice stock, which has been below the precautionary reference point and required action. Tools were needed to assess and communicate the trade-offs between different management options. We developed three types of models: (1) spatial models for plaice management which were used by the North Sea Regional Advisory Council in formulating their advice in 2005; (2) Mixed fishery models to evaluated the flatfish management plan proposed by the DG MARE; and, (3) Bio-economic impact assessments for plaice and sole. We feel that the experience of carrying out these evaluations cooperatively have helped bridge gaps between science, conservation groups, the fishing industry, and managers, and even between scientific disciplines. Interpreting the contents of management plan has involved close interaction between scientists and managers. The interaction with the industry and conservation groups has focussed on choices among management options, e.g. through specific “stakeholder scenarios” of effort allocation. The case study has contributed to the integration of biological and economic disciplines through the dissemination and linking of fishery and economic simulation models. Results have been of use both the ICES Working Group on the North Sea and Skagerrak as well as DG MARE’s Scientific Technical and Economic Committee on Fisheries (STECF). One challenge we found was finding a level of detail in modelling that seemed to fit everyone’s needs. Although it is possible to model any level of detail with the tools available, the interpretation and communication of detailed results is difficult in a management context. We also concluded that there are elements in management plans that can only be addressed by evaluating several different interpretations of what those elements really mean.
Submitted by IMARES.

## Example Three: Mediterranean Swordfish

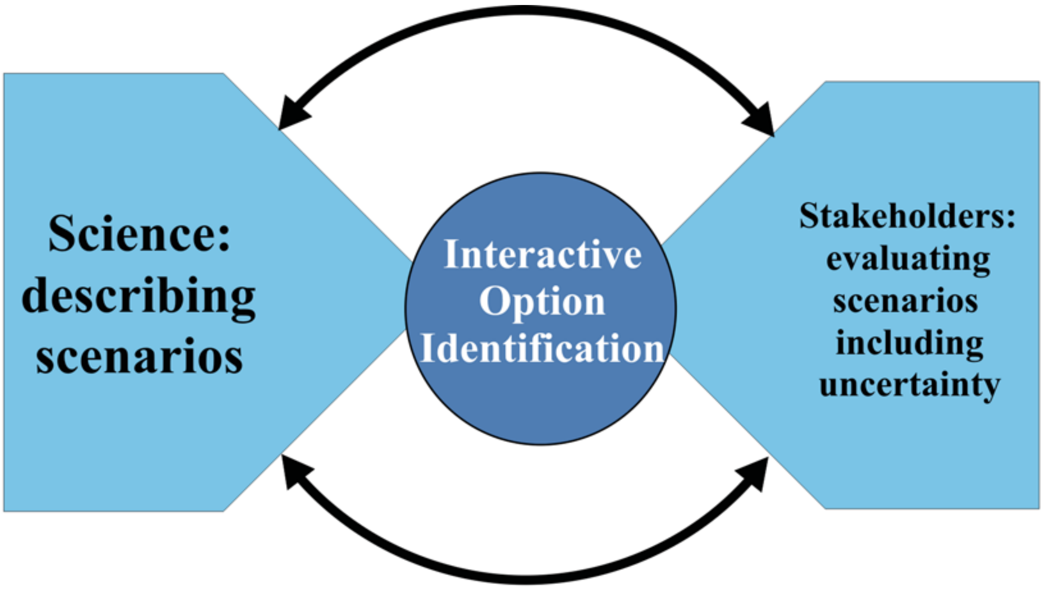
The objective of the study was to evaluate the biological and economic implications of different management measures concerning the Mediterranean swordfish stock. Based on past discussions with scientific groups at the International Commission for the Conservation of Atlantic Tunas, the study focused on different kinds of temporary closures aiming to protect juvenile fish. Medium term predictions on the levels of landings, spawning stock biomass, gross and net revenue were obtained by means of simulations performed under the FLR framework. Results indicated that landings, spawning stock biomass, gross and net revenue were increasing with the increase of the duration of the fishery closure with the response of the spawning stock biomass and net revenue being always more profound. Final scenario development was made in collaboration with fishers and local level managers through an interactive process.
Submitted by IMBC.

Models have to help resolve problems in all sectors, including with the fishermen, in order for them to be a useful tool. ... We need to manage the whole fishery, not just the fish! It is important to look at the whole picture. We forget this sometimes as biologists.

Spanish fisheries scientist

... from a few cases [of partnerships between science and the fishing industry], a lot of fishermen have a better relationship with scientists as a result and vice versa. You really do see that building a trust.

UK women in fisheries focus group




**Participatory Modelling: Science Promoting Transparency**

Science, if we look at the definition should be objective; at the very least, it should try to be objective through use of methodologies. But fortunately or unfortunately science isn't independent from the society which is producing it.

Greek Conservation NGO focus group

... just to trust a mathematical model isn't enough and I would not understand the mathematics, but I would understand the basic assumptions and that is where the link between the modeller and the man on the street is important. You have got to make the model understandable to me and to others.

Irish managers' focus group

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http://www.efimas.org

http://FLR-project.org/doku.php

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