

## **MareFrame**

### **A summary description of project context and the main objectives**

The MareFrame project was initiated in order to facilitate increased implementation of Ecosystem-based Approach to Fisheries Management (EAFM) in Europe. The importance of such an approach has been highlighted by many experts in the field of fisheries management, i.e. moving from single-species to multispecies ecosystem approaches when considering management decisions and potential socio-economic impacts. The adoption of EAFM was done in co-creation with stakeholders in all development phases, to ensure that ownership lies with them and to increase the chance of acceptance and uptake of the project outcomes.

The **vision of MareFrame** is to significantly increase the use of ecosystem-based approach to fisheries management (EAFM) when providing advice relating to European fish stocks.

The **overall objective of MareFrame** is to remove the barriers preventing more widespread use of EAFM through development of new tools and technologies, development and extension of ecosystem models and assessment methods, and development of a decision support framework that can highlight alternatives and consequences; all in close collaboration with the stakeholders in the co-creation processes.

The context for MareFrame is a long history of projects that are focused on establishing the scientific basis for an EAFM. In the past, many ecosystem models have been developed and extended, data has been collected, and a great deal of scientific knowledge has been created. Yet very little of this was translated into the actual advice provided for the management of European fishing stocks. While the scientific basis for multi-species and ecosystem management exists, in practice both the stock management and the advice provided are on a single-species basis.

The single-species models, model the population dynamics of a single fish stock as exploited by a single fishing fleet (even if there are multiple fleets) to assess the status, and provide a short term forecast to recommend a total allowable catch (TAC). An ecosystem model on the other hand, considers multiple species caught in several fisheries, either by taking multiple fleets into account and/or the predator-prey interactions between the various species. An ecosystem model also considers other components of the ecosystem; essentially the food-web related to the fish species and ultimately the entire ecosystem, including the hydrodynamics. Ecosystem models should also include the human element: ideally the socio-economic components of the fishery.

MareFrame addressed important issues within the Common Fisheries Policy (CFP), Marine Strategy Framework Directive (MSFD) and Habitat Directive (HD), who did call for the development of EAFM to improve sustainable resource management, ensure preservation of marine biodiversity and assess environmental status of marine waters to proclaim Good Environmental Status (GES). The importance of such an approach has also been highlighted by many international organisations including ICES, GFCM, STECF, and JRC.

MareFrame identified nine specific objectives (SO) to increase the use of EAFM:

- **SO1** To identify the paths for implementing EAFM through co-creation with stakeholders
- **SO2** Apply novel analytical methods and integrate state-of-the-art data into EAFM
- **SO3** Design an integrated and harmonised database containing collated ecosystem data suitable for supporting EAFM development, the MareFrame DataBase (MFDB).
- **SO4** Extend existing ecosystem models
- **SO5** Develop innovative ecosystem based assessment methods/tools and conduct performance evaluation
- **SO6** Apply and configure the extended ecosystem models and the assessment tools in the respective case studies
- **SO7** Develop, test, and adapt a DSF
- **SO8** Compare and evaluate the developed ecosystem based models and the decision support system, including the socio-economic impact
- **SO9** Develop interactive learning tools to facilitate the implementation of EAFM

Fulfilment of these objectives was designed to align the scientific, political, and socio-economic views for holistic management of marine ecosystems. MareFrame developed new tools and technologies, extended ecosystem models and assessment methods to address multispecies concerns and developed a new Decision Support Framework (DSF) for risk management. The new DSF was designed to assist with the selection of preferred scenarios, understand the underlying preferences and identify trade-offs. The DSF highlights alternative management actions and its consequences and provides evidence basis for policy makers on the trade-offs of various management options. The development and adoption of the EAFM was done in collaboration with stakeholders whose co-creative process and training proved essential. The co-creation process is iterative and helped addressing changes required in the work, broadened knowledge, supported learning, and improved scientific acceptability (credibility), policy relevance (salience), and social robustness (legitimacy).

The new Decision Support Framework (DSF) combines co-creation process, ecosystem models, decision support tools and educational resources:

- Co-creation process, involving cooperation with stakeholders to identify, analyse, and explore how to address the problem
- Ecosystem models, to understand the likely consequences of management options
- Set of computerised Decision Support Tools (DST) that aid complex planning and decision-making and scenario visualisation tools (dashboard & infographics)
- Educational resources to facilitate the use of the DSF

MareFrame provides a DSF roadmap on how to enhance the implementation of EAFM. It includes guidance on how to implement and improve EAFM in Europe within the CFP and MSFD and how to involve stakeholders in decision processes through co-creation.

Ten ecosystem models (Gadget; gadget-like, EwE, EwE like, Atlantis, MSPM, T-ONS, Green-, amber- and red models) were tested and compared within and across eight ecosystems. This was to explore the direct and ecosystem-mediated implications of alternative management strategies, and to couple the implementation of an Integrated Ecosystem Assessment to ad-hoc DSTs. The MareFrame case studies were chosen as each of them have pressing management challenges identified by stakeholders, including managers, that require an EAFM approach to be solved. Alternative management scenarios were explored in all case studies using the online DSTs.

The new DSF was tested and adapted to eight case studies (CSs), seven across Europe, i.e. Baltic Sea, North Sea, Northern & Western Waters - Icelandic Waters, Northern Waters - West Scotland, South-Western Waters – Iberian Waters, Mediterranean Waters - Strait of Sicily and Black Sea, and one in Chatham Rise, New Zealand. Model outputs were standardised to ensure the comparison of results across models in each CS and between CSs.

Decision-making relating to EAFM is highly complex due to the multiple policies that are involved, the differences in concerns and priorities between stakeholders, and the need to integrate information from multiple sources with inherently different reliabilities. Effective planning and decision-making in such a context can be systematically aided by DST, which allow for interactive analysis of focal problems as well as the test of alternative scenarios through simulation. DST include new tools and technologies such as indicators, the MareFrame Database (MFDB), software and visualisation tools. The MFDB, is a tool to store and retrieve data for analyses of ecosystems, including input to ecosystem models and other tools that i.e. enable comparisons between relevant "what-if?" scenarios, where stakeholders and decision makers can evaluate likely effects of management decisions on biological-, ecological-, social- and economic indicators. MFDB can be used in all case studies and is completely generic, meaning that anyone, anywhere can set up the database for their own system. The database provides input data to assessment tools in the DSF. The MFDB is released as open source and is available for programmers to automate the generation of EMs. Each MFDB server acts as a site for sharing data in CSs and to run program codes and will be usable beyond the end of the MareFrame project. Multi-Criteria Analysis (MCA) and Bayesian Belief Networks (BBN) of socio-economic impacts built on the co-creation process and data from the case studies. The DSF platform that includes the DSTs software and visualisation tools (dashboard, online training game & infographics) is available at the MareFrame website.

Educational resources included Webinars and interactive learning tools for education and training of the key users of the DSTs to support the integration of EAFM and to facilitate management decision making. To consolidate project output as a learning module in a learning content management system, an enhanced LCMS (tutor-web) was used to store the knowledge generated.

MareFrame aimed to identify and enhance cooperation with other related projects, discuss further collaborative funding opportunities, facilitate student exchange and participation, discuss publication strategies, management of IPs and project dissemination. A daughter project of MareFrame, MSCA-ETN SAF21, is educating 10 PhD students in social sciences and fisheries management.

The project partners, including SMEs, Advisory Councils (ACs) and ICES, aimed to co-create, design, develop, demonstrate and evaluate the use of innovative monitoring systems and decision support tools for fisheries advice through training actions, role-play and workshops with stakeholders. Indicators of GES were developed and tested, as well as models for EAFM.

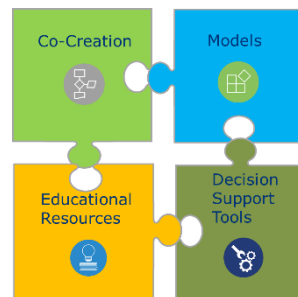
The MareFrame exploitation and dissemination plan contained strategy and implementation measures envisaged to communicate the objectives, activities and dissemination of the project outputs. A special Issue of the Fisheries Research journal will be dedicated for peer-reviewed publications on MareFrame results.

The impact of MareFrame is expected to be through the use of the Decision Support Framework (DSF). It is composed of:

- **Co-creation process**
- **Ecosystem models**
- **Decision Support Tools**
- **Educational resources**



DSF



The adoption of EAFM in co-creation with stakeholders in all development phases, ensures that ownership lies with them and increases the chance of acceptance and uptake of outcomes. Several models were compared for each area. The DSTs are user friendly. Education resources help interaction between stakeholders and scientists. The outputs of MareFrame will be used beyond the life of the project.

The knowhow that MareFrame has brought forward:

- Knowledge on how to implement EAFM in Europe
- Evidence-based policy brief on how to improve EAFM advice within the CFP and MSFD
- How to involve stakeholders in the decision processes through the co-creation process