Approaching and implementing ecosystem-based fisheries management and climate change adaptation strategies

- Ecosystem-Based Fisheries Management (EBFM) considers multiple species in the ecosystem and their connections (both between species and between species and fisheries) to facilitate sustainable fisheries management
- EBFM builds on from single species approaches and ecosystem approaches to fisheries management, thus includes many similar aspects, but allows for more adaptive and iterative approaches, including possible trade-offs
- The consideration of trade-offs, especially in the face of climate change, can allow fisheries under EBFM to become adaptive rather than reactive, developing long-term anticipatory strategies that will reduce future economic costs, reduce vulnerability to the fishery system, and allow natural systems to build up and/or maintain a buffer against climatic shocks
- Via the iterative approach of EBFM, learning is incorporated into each new EBFM cycle, thereby also a better understanding of how target stocks may change in the future in response to climate change, and when potential new opportunities arise
- Many necessary components to start EBFM implementation are already present in fisheries, providing the platform to build from, with clear objectives for the future specified and regularly reviewed

What is Ecosystem-Based Fisheries Management?

The marine environment is changing in response to anthropogenic and environmental impacts, which can influence how we use ocean resources in the future. Strategies enabling ocean users to anticipate changes are available, and many of these options can already be implemented to support the management of fish and squid stocks and maximise overall fishery yield. In fact, around the world there is a move towards this type of ocean management. The management style in question is Ecosystem-Based Fisheries Management (EBFM), which considers multiple (if not all) species in the ecosystem and their connections (both between species and between species and fisheries).

Taking this wider perspective towards fisheries management allows for the inclusion of species interactions, habitat requirements, and environmental impacts on the marine food web and thereby species of commercial interest. It further provides an avenue to consider potential competing effects between fisheries objectives, provide an avenue to incorporate ecological, economic, and social objectives, and anticipate future changes. For example, to understand whether and when it may be more beneficial for fisheries to shift target species. In this, EBFM provides a platform to optimise fishery yield overall. To make EBFM a success, co-management, stakeholder participation, and regular review of goals and objectives is required. EBFM is being implemented or is already implemented across the world, including, for example, in the USA, EU, Chile, South Africa, and CCAMLR.

How does it benefit fisheries?

Traditional fisheries strategies can be strongly focused on short-term fixes, but these are unlikely to benefit fisheries in the long-term, especially under climate change conditions. EBFM integrates long-term strategies that focus on building and maintaining resilience and adaptive capacity in the environment and fishery system. This is significant, because implementing long-term, anticipatory strategies can contribute to reducing economic costs in the future, reduce vulnerability to the fishery system, and allow ecosystems at risk to build up a buffer. For example, CCAMLR developed specific decision rules for varying management measures for the krill fisheries via the EBFM framework to minimise ecosystem shocks.

The EBFM framework also naturally allows for the inclusion of climate change adaptation (CCA) strategies to be streamlined into ocean management. Fishery systems can be negatively impacted by changing environmental conditions, but as species move poleward this may also provide new opportunities for fisheries. Via explicitly stating and working towards goals and objectives related to climate change and CCA, CCA strategies become part of the EBFM strategy. Further, by explicitly monitoring for biological and environmental responses to climate change, and by specifying varying management measures beforehand for changing conditions, responding to change becomes adaptive rather than reactive, which can reduce economic cost. In addition, by considering climate change effects and the potential for increased vulnerability and/or risk for certain ecosystem components (including target

species), management measures can be developed on time to appropriately work with and reduce vulnerability and risk to the fishery system. For example, the BEFM implementation for the North Pacific Fishery of the USA, especially for the Bering Sea incorporates climate information in fishery management decisions and they have implemented climate-enhanced stock assessments. This includes conducting risk assessments for changes in species distributions in the fishery area.

How is it implemented?

There is a common misconception that the implementation of EBFM is difficult or impossible, but this is rarely the case. Instead, it is important to recognise that not everything has to be done at once, but that a stepwise approach should be taken. The EBFM framework centres on five main questions or steps[1], which are iterative, allowing to customise the EBFM implementation to the needs and constraints of the region:

(1) Where are we now?

    What is the current ecological, economic, and social understanding of the marine environment, their health status and trends, and what are the threats?

(2) Where are we going?

    What is the vision of and for the fishery system, and what are the strategic objectives for the fishery system management? Which objectives are the most important for all stakeholders, and which can be addressed now?

(3) How will we get there?

    What operational objectives can be developed from selected strategic objectives to delineate what will and what will not be addressed in this iteration. Operational objectives allow for considering trade-offs between management strategies, measuring progress, and ensuring continued feasibility of EBFM. Management strategy evaluation, a common policy analysis approach, can be used to test the strengths and weaknesses of

[1] Levin et al. (2018) Building effective fishery ecosystem plans. Marine Policy 92, 48–57

alternative scenarios. Population and ecosystem modelling approaches can support these efforts and aid decision making.

(4) How will we implement the plan?

Specific projects, based on chosen operational objectives and management strategies, are developed considering available resources. Here, it becomes clear that projects share overlap with conventional fisheries management as, for example, projects can include fisheries surveys, stock and bycatch assessments, etc. Projects, however, are not limited to fisheries-specific components, but can relate to other aspects of the ecosystem (which, through food-web interactions, can affect fisheries indirectly). The range of projects allows for the cooperation between different stakeholder, who may have different objectives but would all benefit from EBFM.

(5) Did we make it?

Regular review of the projects and objectives is important for monitoring success, changing strategies that do not work well, and provide opportunities to include and/or streamline other objectives. EBFM is an iterative approach, allowing the opportunity for learning and building on previous success.