ICES AND ECOSYSTEM-BASED MANAGEMENT

The importance and rationale of EBM to ICES

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ICES sees Ecosystem-based Management (EBM) as the primary way of managing human activities affecting marine ecosystems. Ecosystem-based Fisheries Management (EBFM) addresses the fishing sector. These approaches to management of marine activities have been described by a number of organizations (FAO, CBD, Arctic Council, NOAA, CFP, MSFD) and applied in relevant legislation. Certain key phrases illustrate the central tenet of these ecosystem approaches: management of human activities, consideration of collective pressures, achievement of good environmental status, sustainable use, optimization of benefits among diverse societal goals, regionalization, trade-offs, and stewardship for future generations.

ICES role is to provide the evidence for ecosystem-based decision making for the management of fisheries and other sectors in the ICES area. The role and vision is further described in the Advisory Plan[1]. The evidence is required to explore the consequences of likely trade-offs (central to EBM) in the management of and between sectors and their impacts and services from the biodiversity of species and habitats. This is to support sustainable development aimed at both human and ecosystem well-being and stewardship of marine ecosystems. EBFM should result in fisheries management that maintains sustainable fisheries and resilient and productive ecosystems. ICES provides the knowledge base to achieve this end, as encapsulated in its mission "*to advance and share scientific understanding of marine ecosystems and the services they provide and to use this knowledge to generate state-of-the-art advice for meeting conservation, management, and sustainability goals.*"

EBM is a process towards this goal, and the organization is incrementally using its network of researchers, data centre, and advisory role to provide the scientific basis for operational management. As the process is incremental, it allows ICES to respond appropriately to the changing demands of a developing policy landscape and dynamic ecosystem.

Evidence base and tools

ICES is committed to facilitating the incorporation of a wider range of scientific knowledge into the evidence base that informs decision- makers and society about the state and trends of our seas and oceans, the consequences of human use, and options for conservation and management. The interconnected challenges encountered by managers of natural resources, species and habitat biodiversity targets while adapting to climate change are central to ICES.

Since 1992, the ICES Working Group on Ecosystem Effects of Fishing Activities (WGECO) has considered the framework and application of both EBM and EBFM. Through its outputs, WGECO has provided leadership in the development of major concepts, such as those underlying the European Marine Strategy Framework Directive (MSFD). These concepts have propagated throughout the ICES network, driving further development of the evidence required to provide relevant and timely operational advice.

Through its data centre and with strategic partners, ICES also provides operational information products to underpin the exploration of what can be called the safe-operational space for trade-offs. The data centre is leading European initiatives to improve collaboration between resource use scientists and conservation practioners by building common vocabularies and data sharing between organizations such as FAO fisheries, EUROSTAT, and OBIS (Ocean Biogeographic Information System). It is also working with the ICES working groups on marine spatial planning, habitat mapping,

[1] ICES. 2019. Advisory Plan. http://doi.org/10.17895/ices.pub.5468

cumulative effects, and fisheries spatial data to make the provision of spatial data consistent across various data sources, to enable clear and traceable provenance of information for decision making.

A series of integrated ecosystem assessment groups are in place to cover a number of regional parts of the ICES area, the ecoregions [2]. These groups are developing methods and tools to make the ecosystem approach operational. Their ecosystem assessments include ecosystem trend analyses, the building of Bayesian networks, and methods to qualify, quantify, and prioritize regional anthropogenic pressures. The impact of climate change on marine ecosystems is a key issue that ICES builds into its work.

Regional Seas with supporting ICES integrated ecosystem assessment groups.

Application of evidence base to EBFM

Three main outputs are provided to support EBM: advice on fishing opportunities, fisheries overviews, and ecosystem overviews. These products are continually developing to address new information as well as changes in the ecosystem, legislation, and the drivers of fisheries. Spatial management and regional priorities are addressed as all of the advice is given by ecoregion. The ecoregions reflect both the biogeography of the ICES area and the management of the area by national and regional authorities.

Advice on fishing opportunities has evolved from the traditional focus on single species catch options. It now includes an assessment of the stock status, the exploitation rate in relation to maximum sustainable yield (MSY), and projections of the consequences of fisheries actions for each stock impacted by fisheries in the European ICES area. The assessments are a mixture of analytical

[2] ICES. 2020. Definition and rationalefor ICES ecoregions. InReport of the ICES Advisory Committee, 2020. ICES Advice 2020, Section 1.4. https://doi.org/10.17895/ices.advice.6014

and knowledge-limited (proxy) approaches which encompass target species, bycatch species, and deep sea and elasmobranch fisheries. Where evidence exists of productivity changes in the ecosystem or fish stocks, researchers are encouraged to consider the evidence and implications for management of these changes.

Advice on fishing opportunities uses rules, with associated reference points, that reflect policy objectives. The ecosystem approach is integrated into the reference points, which are based on the current state of the ecosystem and updated to reflect any effects of the ecosystem on stock dynamics. Where appropriate, such as with forage fish or cannibalistic fish, estimates of the temporal variation of natural mortality are built into the stock assessments to consider the implications for fish for top predators or density effects on stock dynamics. ICES also advises ranges for Fmsy (95% of MSY) that account for threat to stock biomass.

The fisheries overviews are summaries of the activities and impacts of the fleets fishing in the ICES area. They describe the fleets operating in each ecoregion, the composition of their catches, and their interactions with the ecosystem, thus documenting the goods and services derived from fishing. Mixed fisheries considerations, which describes the consequences and options for management of mixed fisheries, are part of these overviews. Mixed fisheries advice highlights the impossibility of the objective of maximum sustainable yield for all stocks and provides trade-off options between different management strategies. Methods have been developed to include information on the impact of fisheries on the sea bed and the impact of bycatch of endangered, protected, or threatened species[3] within the fisheries overviews.

Building the evidence base for EBM

The ecosystem overviews use qualitative methods to identify and focus on the top five priority human activities and resulting pressures that can be locally managed within each ecoregion. They thus put fishing activities into the context of the trends and status of the marine ecosystem as a whole. Quantitative methods to further assess these pressures are currently being developed. In many ecoregions, ICES considers that fishing contributes major anthropogenic pressures on the ecosystem. The approach of assessing activities, pressures, and state of the ecosystem provides the flexibility to monitor for cumulative effects of the pressures on the ecosystem and to accommodate impacts of climate change as they become apparent. Work is being done with the regional sea commissions – OSPAR, HELCOM, and ICES Member Countries – to keep these overviews relevant to the knowledge needs of management. Regional aquaculture overviews are also being developed.

In addition to these three main areas of advice, ICES is regularly asked to provide bespoke advice on issues relating to EBFM and EBM. For example in recent years, methods have been devised to assess the status of information limited stocks, monitor recreational fishing, describe the impact of fishing on the ecosystem of the Baltic Sea ,impact of cetacean bycatch in fishing gear and potential management measures and the impact of fishing on the seabed. ICES data centre also hosts and maintains the OSPAR and HELCOM impulsive noise register, marine litter datasets (collected in conjunction with ICES coordinated surveys), a biodiversity portal (aimed at seal and bird populations) and the North Atlantic vulnerable marine ecosystem (VME) portal, which all provide a valuable resource to our partner environmental and fisheries organizations. They also facilitate the

[3] ICES. 2020. Road map for ICES bycatch advice on protected, endangered, and threatened species. In Report of the ICES Advisory Committee, 2020. ICES Advice 2020, section 1.6. https://doi.org/10.17895/ices.advice.6022

production of advice that is integrated into the overall framework for EBM in a strategic and responsive manner.

Engagement with society

People are central to EBM. Any process that engages with society needs to be transparent, adaptive, and inclusive. Assurances should be given of proper quality control so that personal bias in science and advice is minimized and good professional standards are upheld. Transparency is at the core of science and means that ICES science processes, documentation, and products must be open to observation and scrutiny for the users of the science and advice. The evidence base and methodologies used to provide knowledge products are openly accessible in the highest resolution that the underlying data sources allow. Inclusiveness is at the core of an ecosystem approach.

ICES engages with the users of its science and advice to define the issues of concern, understand interests, bring in other sources of knowledge, and ensure that advice relates to societal choices. Inclusiveness is implemented through scoping processes, where scientists engage with requesters of advice and stakeholders to ensure that their questions and issues are addressed ICES works hard to ensure the legitimacy and credibility of its advice. The “benchmark” is now widely used throughout the organization to enable stakeholder input into method development and knowledge acquisition. Industry-science partnerships feed information through to ICES products. Working groups look at the provision of goods and services, and its strategic initiative on the human dimension challenges. ICES and its partners work to incorporate trans-disciplinary approaches to the provision of knowledge for society, whilst also liaising with international bodies and research projects to maintain relevance. Ensuring that the provision of knowledge remains independent and yet also open and challengeable is key.

Summary

In its Strategic Plan, ICES renews its commitment to better understanding marine ecosystems and securing the benefits that people derive from them. The implementation of EBM is a continuous and iterative process. The principles of EBFM and EBM are clear and are being incorporated into every facet across the data, science, and advisory programmes. EBM requires the consideration of broader issues, where the impacts of marine sectors intersect and society needs information on trade-offs between such activities and with marine ecosystems. Regular reviews of progress are made to ensure the momentum of incorporating EBFM and developing methods for EBM are being maintained.