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16.2 ICES ecosystem overviews

UPDATED VERSION AVAILABLE SINCE 2021

Introduction

The ecosystem overviews (EOs) have been developed through a system of workshops and reviewed by ICES integrated ecosystem assessment groups, based on information provided by expert groups that specialize in state descriptors and using automated data products and GIS layers from accepted legitimate sources. The ecosystem overviews were completed by an advice drafting group and approved by ICES Advisory Committee, ACOM.

The audience for the overviews includes client commissions and stakeholders as well as the ICES community and networks. Owing to the range of audiences, the overviews will be evolving documents, driven by top–down processes (advisory requests and ICES decisions about strategic direction) and bottom–up processes (information streams highlighting "new" issues from the ICES community and network). The ecosystem overviews will increase ICES capacity to provide the integrated advice that is expected to meet the future needs of client commissions.

The aim of this process is to have an overview for each ICES ecoregion (Figure 12.2.1).

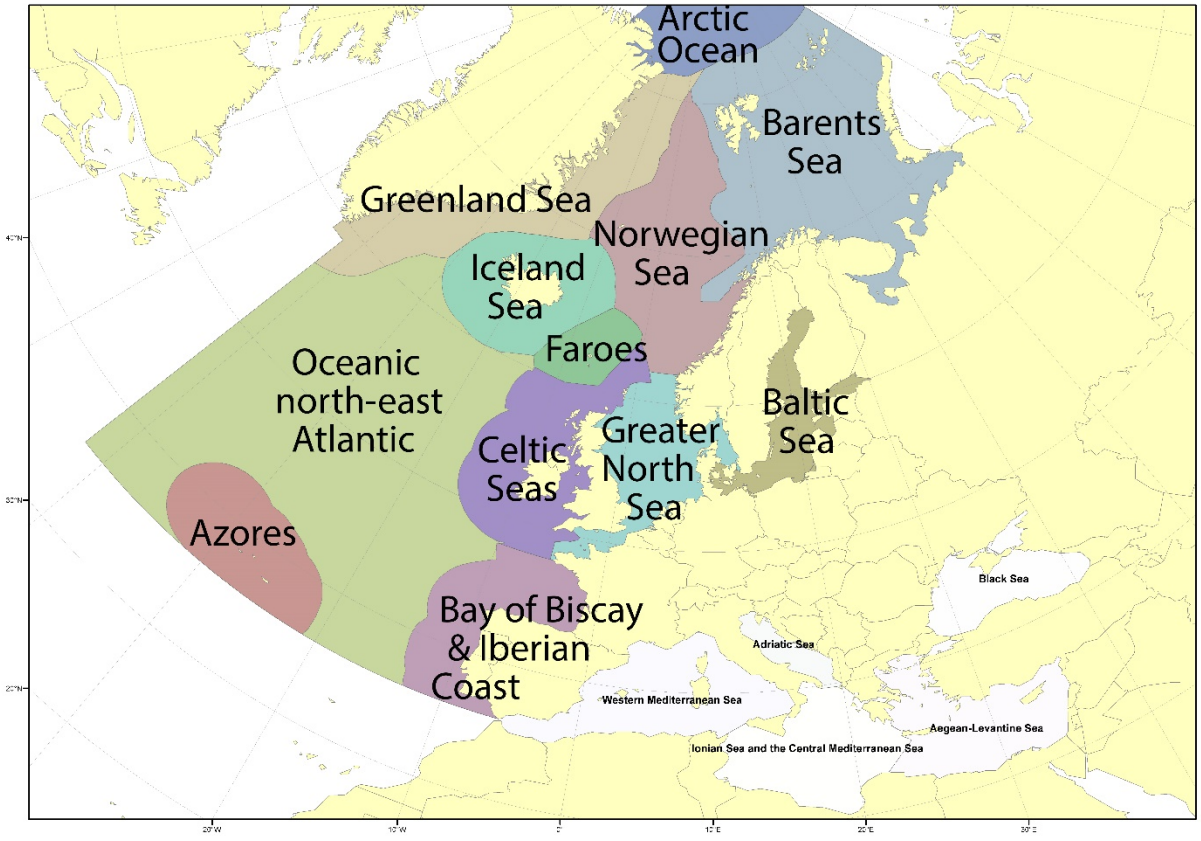

Figure 12.2.1 ICES ecoregions.

The purposes of the ecosystem overviews in the ICES advice are to:

a) describe the location, scale, and the management and assessment boundaries of the ecoregion;
b) describe the distribution of human activities and resultant pressures (in space and time) on the environment and ecosystem; and
c) describe the state of the ecosystem (in space and time) and to comment on pressures accounting for changes in state.

The overviews focus on regionally manageable pressures and describe the implications of variability in the system. They summarize the trends in the predominant pressures and human impacts that affect living resources. Also, as the environment and ecosystems vary over time, sometimes with a trend and sometimes with a step change, the overviews provide those preparing the advice and those receiving it with information on natural variability, trends, and step changes in the dynamics of their respective ecosystems. The information will be based on the best available evidence. The overviews are expected to materially influence the advice.

The overviews are structured around four sections.

1. **Ecoregion description** – Maps and text showing boundaries of ecosystem and depth contours, relevant management and assessment regions, human usage, catchment areas, and designated areas (i.e. Natura 2000 areas). Appropriate subregions should be described.
2. **Key signals within the environment and ecosystem** – Focus only on changes on time and space scales that have consequences for advice. The major trends and shifts that are required to provide advice should be described.
3. **Activity and pressure** – Identify regional priorities, listing the predominant pressures in the ecoregion, with an indicative list of activities. It is the ambition to assess cumulative pressure from multiple activities.
4. **State** – Short concise descriptions of the main state of the ecosystem components within each ecoregion, linking the selected pressures to the state of the ecosystem.

Current methodology to develop pressure–state relationships in ecosystem overviews

The core of the EOs are figures that relate the main regional pressures with (a) the activities that most directly impose these pressures, and (b) the ecosystem components that are most impacted by these pressures (Figure 12.2.2, an example from the Celtic Seas EO). Generally, expert judgment (a panel of experts, across the pressures, and ecosystem components) is required in order to make these relationships explicit, as in many cases there is very little or no quantitative information available on a given activity–pressure–ecosystem component pathway. The following methodology is suggested for documenting how the pressures are selected for each region:

1. List all identifiable main pressures of the ecoregion (see Pressure Glossary for Ecosystem Overviews in Annex A) of pressures, modified from the Options for Delivering Ecosystem-Based Marine Management [ODEMM] project (www.emodnet-seabedhabitats.eu).
2. Consider the "risk" each individual pressure poses in the region (Table 12.2.1) in terms of:
   a) Probability of occurrence (1 = not likely to occur, to 3 = frequent or recurrent),
   b) Magnitude of the pressure, i.e. in space and/or severity of impact (1 = low, to 3 = high).
3. Choose the top (five) pressures from a management perspective. Evaluate if these five pressures are of real importance for the region; accompanying text can accommodate less important pressures.
4. For each pressure:
   a) Determine the main human activities contributing to these pressures, i.e. what can be managed locally and are ODEMM activities visible? Note that climate change issues will have a short separate section within the OEs. Evaluate the relationship between pressure and activity (Table 12.2.2; 1 = weak link, to 3 = strong link).
   b) Evaluate the main relationships between the ecosystem components and each of the five pressures (Table 12.2.3; 1 = weak link, to 3 = strong link). Remember that ecosystem components are fixed.
5. Do any sources support these links? This is not an essential requirement since expert judgment is used, but important to underpin the links or to highlight the need for research. Such sources also include reports and national impact assessments, etc.
6. Document the selection criteria if other methods have been followed (i.e. one of NOAA's Integrated Ecosystem Management methodologies such as ODEMM, Ocean Health Index, Integrated Trend Analyses, Bayesian Belief Network, or Ecological Risk Assessment).

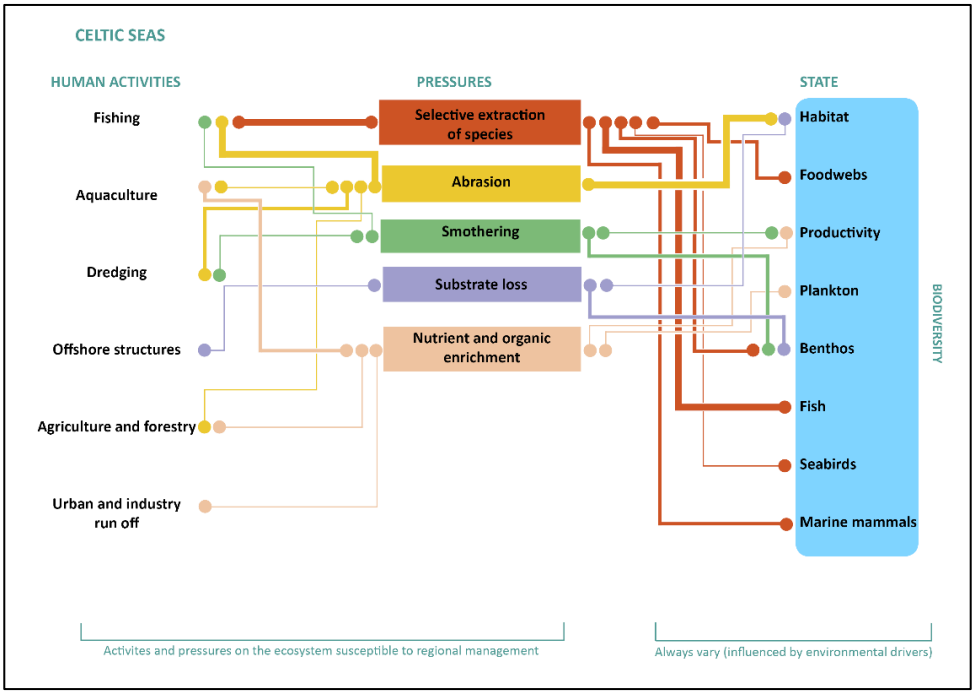

Figure 12.2.2 Main regional pressures. An example from the Celtic Seas EO.

Table 12.2.1 Example of a table to record pressure selection.

Pressure	Probability of occurrence	Magnitude (low = 1, high = 3)	Total
Selective extraction of species	3	3	6
Abrasion	2	5	6
Underwater noise	2	1	3
Other	…	…	…

Table 12.2.2 Example of a table defining the relationship between pressure and main human activities.

Pressure	Human activity	Strength of link
Selective extraction of species	fishing	3
	aquaculture	1
	dredging	2
	forestry…	1
Abrasion	…	
Smothering	…	
Other	…	

Table 12.2.3 Example of a table defining the relationship between pressure and the state of the ecosystem.

Pressure	Ecosystem component	Strength of link	Examples of literature
Selective extraction of species	foodwebs	2	reference
	benthos	2	Substrate maps. EU EMODNET seabed habitats; www.emodnet-seabedhabitats.eu
	fish	3	i.e. ICES, 2016
	seabirds	1	Strategic Environmental Assessment for MSFD
	marine mammals	2	…
Abrasion	…		
Smothering	…		
Other	…		

Ecosystem overview guidelines

The guidelines below apply to the production of ecosystem overviews:

- Non-changing elements such as geography should not be described in any detail, nor should key attributes of systems that are very well known to the expected readership.
- Any ecosystem state information should identify links back to pressures and drivers.
- Visual tools should be used to describe the dominant pressures and interactions, simplified to a degree so that results are intelligible and useful.
- Though systems are complex in reality, simplification is a necessity. Use either the top impacts or those pressures most amenable to management controls.
- Different regions should reflect different pressures/ecosystem drivers, with the differing interactions between pressures/drivers and ecosystem state being identified for the various regions. The reports will be written for the region as a whole; any important differences within the region should be reflected in a few brief subregion bullets.
- The text should be assertive and use specific language, without too many qualifications, stating what are facts and what are not.
- Where data from an area is partial, e.g. if three out of four countries are providing data for a region, it was agreed to use a pragmatic approach by assessing whether the available data may be considered to give a reliable impression of trends/pressures, etc., across that region.
- Where particular pressures, such as contamination, reflect a series of localized datasets, a set of time-series from these differing locations is deemed as possibly misleading rather than useful.
- Data and knowledge sources must be cited.
- Where possible, production should be automated using GIS methods and open databases.

Climate change

Climate change is incorporated in the ecosystem overview (EO) as a distinct pressure (not included in the top five pressures) because the climate change effect can be across all activities and state components. A separate climate change section follows the pressure section and should include and distinguish:

- Evidence of **ongoing effects** of climate change on relevant environmental variables, ecosystem state components and/or human activities, based on **past and present observations** (e.g. time-series of sea surface temperature, atmospheric forcing, or upwelling strength; and temporal variations in plankton species composition, fish spatial distribution, or marine traffic distribution, in response to one or more environmental drivers).
- Evidence of **anticipated effects** of climate change on relevant environmental variables, ecosystem state components, or human activities, based on **future projections** (e.g. forecasted anomalies in sea surface temperature, projected species distribution in response to future thermal regimes, projected spatial distribution of fishing effort with shifting productivity, etc.)
- A description of **possible effects** on **strengths of relationships** between the top five pressures and human activity and/or ecosystem state components (e.g. ice cover reduction will open new routes for maritime transport that can increase the introduction of contaminating compounds and negatively impact the state of marine mammals).
- A brief paragraph listing the **key knowledge gaps** for assessing climate change impacts on the ecoregion.

For ongoing (observed) effects, evidence of climate change should consist of directional trends and/or persistent changes in the mean or variance. For ecosystem state components and human activities, trends should be expressed over time and in association with one or more environmental drivers.

For anticipated effects and model-based projections, downscaled (or regional) models should be used whenever possible. If regional models are not available, global ensemble models (e.g. the NOAA tool) may be used, but the uncertainty layer associated with the projection should be presented.

Where climate change has been shown to affect a component in the state sections of the ecosystem overviews, a succinct sentence or two describing these effects will be appropriate.

Annex A

ICES glossary of principal pressures in ICES ecoregions

Pressure	Explanation and examples
Abrasion	Abrasion pressures relate to disturbance of the substrate at or below the surface of the seabed; aggregate and other mineral extraction is not covered by this pressure. Abrasion pressure is associated with bottom-contacting mobile and set fishing activities, in particular otter trawling, dredging for shellfish, and navigation and beam trawling. Other activities with a limited spatial footprint also cause abrasion.
Climate change	Climate change is a directional and non-random process that affects both the mean and the variance in environmental parameters and ecosystem state components, as well as human activities and resultant pressures. The human component of climate change is caused by the release of CO_2 and other gases. This release also has other effects such as acidification of marine waters.
Introduction of contaminating compounds	Examples of this pressure include discharges from ships, from hydrocarbon exploration and production, atmospheric deposition, and riverine inputs. Compounds of concern include: • For marine sediments the main transition elements and compounds of concern include arsenic, cadmium, chromium, copper, mercury, nickel, lead, and zinc. • Organometallic compounds such as tributyltin (TBT) and its derivatives can be highly persistent and even low levels of exposure can cause chronic toxicity. • Hydrocarbons, including polyaromatic hydrocarbons (PAH). • Priority substances listed in Annex II of Directive 2008/105/EC[1]. • Synthetic compounds, including pesticides, antifoulants, and pharmaceuticals.
Introduction of non-indigenous species (NIS)	The direct or indirect introduction of NIS, e.g. Chinese mitten crabs *Eriochier sinensis*, slipper limpets *Crepidula fornicata*, Pacific oyster *Crassostrea gigas* and their subsequent spreading and out-competing of native species. Ballast water and hull fouling can facilitate the spread of NIS. This pressure is also associated with aquaculture, translocation of organisms, or from accidental releases.
Marine litter	Marine litter is any persistent, manufactured, or processed solid material that is discarded, disposed of, or abandoned in the marine and coastal environment. Marine litter consists of items that have been made or used by people and deliberately discarded or unintentionally lost into the sea and on beaches, including such materials transported into the marine environment from land by rivers, draining, or sewage systems, or by winds. For example, marine litter consists of: plastics, wood, metals, glass, rubber, clothing, paper, etc. Land-based sources of marine litter include tourism, sewage, and illegal or poorly managed landfills. Sea-based sources include shipping and fishing.
Noise	Ocean noise refers to sounds made by human activities that can temporarily or permanently interfere with, or impair the ability of marine animals to hear natural sounds in the ocean. Noise may also cause physiological or behavioural effects. Human activities that cause ocean noise include marine traffic (shipping), recreational boating, fishing vessels, energy exploration, military sonar, and inshore and offshore infrastructures (construction and operations).
Nutrient and organic enrichment	Increased levels of nitrogen, phosphorus, silicon (and iron) in the marine environment compared to background concentrations. Anthropogenic sources include waste water, terrestrial/agricultural runoff, sewage discharges, aquaculture, and atmospheric deposition. Nutrient enrichment may lead to eutrophication (see also organic enrichment).
Selective extraction of species	The commercial exploitation of fish and shellfish stocks, including smaller scale harvesting, recreational fishing, and scientific sampling. Ecological consequences include the sustainability of stocks, impacting energy flows through foodwebs, and the size and age composition within fish stocks. This pressure includes bycatch associated with fishing activities.
Selective extraction of non-living resources from the seabed and subsoil	This pressure relates to marine aggregate extraction and mining. Some removal of benthic organisms and alteration of seabed topography may also occur.

[1] DIRECTIVE 2008/105/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 December 2008 on environmental quality standards in the field of water policy, amending and subsequently repealing Council Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and amending Directive 2000/60/EC of the European Parliament and of the Council. Official Journal of the European Union, L 348: 84–97.

Pressure	Explanation and examples
Smothering	Smothering pressures relate to siltation or sedimentation on the surface of the seabed. Activities associated with this pressure type include marine and coastal construction, aquaculture, land claim/reclamation, navigation dredging, disposal at sea, marine mineral extraction, fishing, cable and pipeline laying, and various construction activities.
Substrate loss	This pressure type includes both: • the permanent loss of coastal habitats (associated with activities such as land claim, new coastal defences); and • the permanent change of one marine habitat type to another through a change in substratum, including artificial substrates (e.g. concrete). Associated activities include the installation of infrastructures such as hydrocarbon production facilities, wind farm foundations, marinas, pipelines, cables, and scour protection.