

1.6.2.4 EU request for guidance on how pressure maps of fishing intensity contribute to an assessment of the state of seabed habitats

Advice summary

ICES advises that a mechanistic, quantitative approach based on biological principles should be used to assess the sensitivity of habitats to fishing pressure. Although an alternative expert-led categorization approach has been proposed and is further developed, a mechanistic approach will be more reliable and transparent and will allow for the development of objectively measurable, reliable, and meaningful indicators of the state of seabed habitats. In addition, a mechanistic approach can provide a way of comparing between the effects of pressures other than fishing, and cumulating these pressures for an overall assessment of the state of seabed habitats.

Request

ICES is requested to provide guidance on how pressure maps of fishing intensity [might best] contribute to an assessment of the state of seabed habitats.

Elaboration on the advice

ICES advises that maps of seabed habitat are combined with those of fishing intensity for assessing the state of seabed habitats. This requires an assessment of the sensitivity of the communities associated with each habitat. There are two main methods to evaluate this sensitivity: a mechanistic, quantitative approach and a categorization approach led by expert judgement. The former is still under development but offers a more objective, data-led approach that can be used to generate statistically reliable indicators that can incorporate uncertainty. A mechanistic approach is also relatively easy to update in light of new information. In contrast, the categorization approach has been further developed but should not be used statistically as a similar impact score can mean entirely different things ecologically. The categorization approach is not easy to update transparently, cannot be used to assess consistently across different pressures (and therefore is difficult to use for cumulative assessment), and cannot provide consistent information on uncertainty.

ICES recommends that the categorization approach only be used for identifying particularly valued and sensitive habitats and communities. ICES advises that there be a separation of assessment of such habitats and communities from those that are more widespread and often more used by human activities.

Suggestions

There are several inputs to the assessment of the state of seabed habitats, most of which could be improved to reduce uncertainty and increase precision.

Habitat maps could be improved and widened in their coverage with further surveys; the greatest gains can be achieved in areas where fishing occurs but there are no (or poor) habitat maps and in areas that might contain more sensitive habitats than are mapped at present. Similarly, information about the prevailing benthic communities should be refined.

Fishing pressure maps could be improved in a number of ways; the greatest gains could be made by ensuring all Member States report their fishing activity (vessel monitoring system, VMS, records) when requested. Further improvements would require legislation to increase the frequency of polling of VMS systems from the current minimum two-hourly rate and to include a greater proportion of the fleet (vessels below 12m in length using mobile bottom-contacting gear).

This advice covers only the direct effects of bottom fishing on seabed communities and not the indirect biological effects or the physical effects on seabeds. These should be considered if comprehensive assessments of the effects of bottom-contacting fishing are to be made.

Basis of the advice

Background

Rationale: Member countries and Regional Sea Conventions (RSCs) are developing indicators of impacts on benthic habitats from anthropogenic activities for MSFD purposes (D1 biodiversity and D6 seafloor integrity). EU projects are also developing approaches across European seas (including the Mediterranean and Black Sea). Fishing pressure is being considered as part of this need. As part of this process ICES has provided bottom fishing pressure maps using VMS and logbook data to OSPAR and HELCOM. The next challenge for the process of developing indicators is to interpret what these fishing pressure maps mean in terms of impact on benthic habitats and their utility in management. Early progress on this has been made by European-funded projects and RSCs.

ICES is asked to provide guidance in the interpretation of these pressure maps in relation to impacts on benthic habitats and the related indicators. Central to this would be to identify both the environmental benefits and trade-offs for fisheries.

Management objectives

ICES notes that there are two broad management objectives associated with the state of seabed habitats. The first is the protection and conservation of particularly valued and sensitive habitats and communities in deep and shallow waters. In a global context, some of these habitats and communities have been described and defined as Vulnerable Marine Ecosystems. The sensitivity of areas holding these communities or habitats is such that any bottom-impacting fishing may severely or permanently damage and degrade them and as a consequence many become closed to these forms of fishing. Once particularly valued and sensitive habitats and communities have been defined, the main scientific activity needed for such areas is to find and map them – the main management need is to bring forward appropriate control measures. ICES recommends therefore that the state of these areas be assessed separately from the state of other seabed habitats.

The other objective relates to the state of more widespread habitats and communities that are not covered by the category of particularly valued and sensitive habitats and communities. These habitats are not as sensitive, but their health may be valued for their ecosystem services or there may be a general wish to avoid degradation. Condition metrics for these areas are required under the EU's Marine Strategy Framework Directive (for both Descriptors 1 and 6) to ensure that structure and functions of ecosystems are safeguarded and that benthic ecosystems are not adversely affected.

Results and conclusions

Two approaches to evaluating sensitivity of seabed habitats and communities

Sensitivity of the benthic community can be estimated using mechanistic, quantitative approaches and expert judgement-led categorization approaches. The mechanistic, quantitative approaches are based on basic biological principles of growth, reproduction, and mortality of organisms, parameterized by empirical studies for each habitat category to provide a quantitative estimate of the trawling impact on a continuous scale. In expert judgement-led approaches sensitivity is categorized (using estimates of resistance and resilience) for each habitat based on a selection of key species, and used to provide an assessment of the impact of several levels of trawling intensity.

Although the categorization approach can be used to define particularly valued and sensitive habitats and communities that require protection against bottom trawling, it is not suitable for assessing the condition of habitats where managers want to regulate existing fishing pressure to avoid habitat degradation beyond a certain threshold. The reason is that class boundaries are arbitrarily defined and not quantitatively linked to trawling intensity. It is not a valid approach to combine pressure with sensitivity to indicate impact, as different combinations of sensitivity and pressure can result in similar impact scores which are not ecologically comparable. Due to this fundamental flaw, it is neither meaningful to further combine impact scores of the grid cells across habitats or a management area to derive an overall impact score at the regional scale nor to assess temporal changes.

Quantitative approaches are therefore preferable over expert judgement since they lead to transparent and reproducible criteria for calculating the sensitivity scores. These criteria can be updated with increasing availability of data and understanding.

Key points of the two approaches

Both approaches	
Use habitat and fishing pressure maps	
Mechanistic quantitative approaches	Categorical approaches
Based on our understanding of how trawling affects the population dynamics of benthic organisms and community composition	Based on categorizing the sensitivity of habitats and fishing pressure in categories with expert-defined boundaries
Outputs are continuous and policy-makers can choose their own thresholds for defining condition (including Good Environmental Status (GES)).	Outputs are categorical and thresholds for defining condition have been implicitly defined when class boundaries are set.
Possible to meaningfully combine impact scores across space and time	Not possible at present to meaningfully combine impact scores across space and time
Can be developed to allow a consistent approach between a variety of human pressures on benthic communities	Cumulated pressures cannot be considered without reassessing sensitivity. Very difficult to use consistently across pressures.
Can take explicit account of impact in previous years to assess current condition	Impact from previous years cannot be easily partitioned
Increases in understanding of trawling impacts and population dynamics of benthos can easily be incorporated through updated parameter values.	Updated parameters would require expert re-evaluation.
Methodology is still under development and needs more refinement.	Methodology further developed.
Uncertainty in parameters of the model can be assessed in a straightforward way using appropriate statistical methods.	Difficult to assess or express uncertainty
Objective and transparent use of knowledge and information, therefore more reproducible	Affected by the choice of experts; more difficult to reproduce results

Mapping pressure

Methods and approaches to mapping fishing intensity in terms of surface and sub-surface abrasion have been developed and are being further improved by ICES (2014a, 2015a, 2015b, and 2016b) for the Northeast Atlantic and the Baltic Sea. At present these maps are made at the c-square scale for a number of both technical and confidentiality reasons. Pressure should ideally be mapped with the same granularity (scale) as for habitats, or at least the granularity of the two sets of maps should nest within each other. If assessments are required of the state of seabed habitats in the Mediterranean and Black Seas, then the mapping of pressure in these areas will be required.

Assessing sensitivity

Mechanistic approaches are based on basic population dynamic theory which allows us to estimate the impact of trawling as a function of the mortality imposed by trawling (resistance) and the recovery rate (resilience) of the benthic community. As taxa differ in their mortality rates caused by fishing (mostly trawling) and in their rate of recovery, bottom fishing will lead to a shift in the community composition where long-lived taxa are reduced relative to short-lived taxa.

Within the FP7-project BENTHIS, two example mechanistic approaches have been developed (ICES, 2016c). The first approach estimates the equilibrium biomass relative to carrying capacity of the untrawled habitat given empirical estimates of the trawl mortality rate and recovery rate of benthic taxa. The second method builds on the longevity distribution of the benthic community. It estimates the proportion of the benthic community that is unimpacted by trawling from the proportion of the biomass comprised by taxa with a life span that is shorter than the average interval between two trawling events. This interval is given by the reciprocal of the trawling intensity. Both examples convert the trawling intensity into an estimate of the trawling impact at the level of the grid cell on a continuous scale between 0 (degraded) to 1 (unimpacted). The impact scores can be mapped and used to calculate indicators of seafloor integrity at the level of habitats or management areas (regional scale). Mechanistic approaches are still under development but could be used to derive preliminary indicators. The examples available provide a proof of concept. The methods however require further development and peer review before they can be applied to management. The longevity approach provides a worst case estimate because it assumes that all benthos will be removed by a single trawl event, and that the recovery time will equal the lifespan of the taxa. In an alternative formulation, the same

reasoning can be applied but using the community composition in terms of the age at maturation instead. The population dynamic approach is considered to give an optimistic estimate of the benthic impact since benthic biomass may recover well before recovery of other community properties (e.g. biodiversity, size structure) occurs. In addition, the way in which species parameters (mortality rate from trawling, recovery rate) can be applied to specific benthic communities needs further study. Once a mechanistic description of how bottom trawling impacts the benthic community typical for each habitat becomes available, threshold levels can be set at which the benthic community can be considered in a poor state relative to policy objectives. Understanding of the relationship between trawling intensity and benthic structure or function can help define threshold levels for GES.

The mechanistic approach can be used to inform managers about the relationships, and therefore trade-offs, between benthic impacts and the landings or revenue of the fisheries.

Sources and references

ICES. 2014a. OSPAR request on mapping of bottom fishing intensity using VMS data. In Report of the ICES Advisory Committee, 2014. ICES Advice 2014, Book 1, Section 1.6.6.5. 11 pp.

ICES 2014b. Second Interim Report of the Working Group on Spatial Fisheries Data (WGSFD), 10-13 June 2014, ICES Headquarters, Copenhagen, Denmark. ICES CM 2014/SSGSUE:05. 102pp.

ICES. 2015a. OSPAR request to support the development of common and candidate OSPAR biodiversity indicators for benthic habitats: pressure maps. In Report of the ICES Advisory Committee, ICES Advice 2015, Book 1, Section 1.6.6.3. 11 pp.

ICES. 2015b. HELCOM request on pressure from fishing activity (based on VMS/logbook data) in the HELCOM area relating to both seafloor integrity and management of HELCOM MPAs. In Report of the ICES Advisory Committee, ICES Advice 2015, Book 1, Section 8.2.3.2. 24 pp.

ICES. 2016a. Third Interim Report of the Report of the Working Group on Spatial Fisheries Data (WGSFD), 17-20 May 2016, Brest, France. ICES CM 2016/SSGEPI:18.

ICES. 2016b. OSPAR request for further development of fishing intensity and pressure mapping. In Report of the ICES Advisory Committee, 2014. ICES Advice 2016, Book 1, Section 1.6.6.4. 28pp.

ICES. 2016c. Report of the Workshop on guidance on how pressure maps of fishing intensity contribute to an assessment of the state seabed habitats (WKFB), 31 May –1 June 2016, ICES Headquarters, Copenhagen, Denmark. ICES CM 2016/ACOM:46. 108 pp.

Annex(es)

Principles of good practice for assessing the state of the seabed (adapted from ICES 2016c)

Pressure maps of fishing intensity should be estimated by bottom impacting fishing gears (métiers) from high resolution (VMS) data and logbook data distinguishing between surface and subsurface (>2 cm) abrasion at the 0.05°x0.05° c-square resolution.

The preferred method for linking the habitats to the c-square is to weight by proportional presence.

Habitat maps should be used at the highest spatial and thematic resolution possible. The newest EUNIS classification scheme should be used.

Actual observations of habitat/benthic community distribution should be used where available rather than models.

Maps should include confidence.

Within the MSFD context, sensitivity should be based on a quantitative analysis of the mortality and recovery dynamics of the benthic community by habitat to allow for a mechanistic impact assessment.

Within the MPA context, sensitivity can be assessed by expert judgement with a combined sensitivity score that includes both resistance and resilience.

Sensitivity scoring of the benthic community should distinguish between the sensitivity for surface and subsurface abrasion.

Fishing impact should be assessed using a mechanistic approach based and parameterised on empirical data; this is particularly important for the setting of thresholds of these impacts and for the quality of the seafloor.

Interpreting the relative impact of fishing requires other activities to be considered. There is a need to ascertain the status and impacts generated from different human activities to understand seabed integrity.

The whole evidence base and assessment process should be transparent and accessible to all stakeholders.