

OSPAR request on the production of spatial data layers of fishing intensity/pressure

Service summary

ICES has collected relevant vessel monitoring system (VMS) and logbook data to produce, as a technical service to OSPAR, updated spatial data layers on fishing intensity/pressure within the OSPAR Maritime Area. As this technical service follows on from previous years' advice and technical services, significant time efficiency was achieved by automating the VMS/logbook process. Improved data quality control checks were implemented. Data submitted by ICES Member Countries from across the OSPAR area have improved in both quality and coverage. Standardized methods were used to produce the requested data layers*. A link is provided for all requested data layers presented in the format agreed/requested by OSPAR.

Request

For OSPAR to assess benthic impact, ICES is requested to produce updated spatial data layers on fishing intensity/pressure within the OSPAR maritime area according to the details set out in the sections below.

Following on from the format of the previous OSPAR requests; OSPAR requests ICES, using the draft CEMP Guidelines of the 'Extent of Physical damage indicator' (BH3), to:

- a) *Collect relevant national VMS and logbook data for 2018, 2019 and 2020 and update data layers from previous years where necessary.*
- b) *Prepare spatial layers for the OSPAR maritime area (including ABNJ) on the intensity of fishing using mobile bottom contacting gears. To ensure that 2020 is backward compatible to previous year maps delivered to OSPAR as advice, ICES is requested to specifically produce fishing intensity/pressure spatial layers containing the following information per c-square and per year:*

Aggregated layers: total, beam trawl, dredge, demersal seine, otter trawl

Metier layers: OT_CRU, OT_DMF, OT_MIX, OT_MIX_CRU, OT_MIX_DMF_BEN, OT_MIX_DMF_PEL, OT_MIX_CRU_DMF, OT_SPF, TBB_CRU, TBB_DMF, TBB_MOL, DRB_MOL, SDN_DMF, SSC_DMF

This (the above) equals 19 layers per year with the following attributes included in each layer: Surface area in Km² (Swept area), Surface area ratio, Sub-surface area in Km² (Swept area), Sub-surface area ratio, Total Weight, Total value, Kw Fishing Hours, Fishing hours.

Elaboration on the service

Shapefile datasets, CSV files with WKT (well-known text) geometry columns, are available at ICES (2021a).

Basis of the service

Background

From the OSPAR request:

Supplementary information to assist in the interpretation of the service:

The request is focused on the fishing abrasion layers underpinning the OSPAR 'Extent of Physical damage indicator' (BH3). The latest CEMP Guideline/ Technical specification with the methods for analysis is available online at; <https://www.ospar.org/documents?v=37641>. The results from the most recent BH3 indicator assessments produced by the OSPAR benthic expert group for the OSPAR Intermediate Assessment 2017 is available online at:

* The code is available at: https://github.com/ices-taf/2021_2007-36_SpecialRequest

<https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/biodiversity-status/habitats/extent-physical-damage-predominant-and-special-habitats/>.

The fishing abrasion layers are used for spatial analysis combining habitat distribution and their associated sensitivity ranges for the calculation of a physical damage index for predominant and special habitats.

Methods

Post-processing

This technical service was completed using the methods established by ICES in its 2017 advice on the production of spatial data layers of fishing intensity/pressure (ICES, 2017). ICES Secretariat and Advisory Council (ACOM) leadership prepared and guided the process, with the relevant ICES expert groups (the Working Group on Spatial Fisheries Data [WGSFD] and the Working Group on Spatial Fisheries Data Governance [WGSFDGOV]) reviewing the steps taken.

An ICES VMS/logbook data call covering the years 2009–2020 was issued to all ICES Member Countries (EU Data Collection Framework [DCF] contacts and all ACOM delegates) on 2 February 2021, with a deadline for response by 31 March (ICES, 2021b). The call followed ICES VMS data policy (ICES 2019a) and VMS and logbook data from 2009 to 2020 was requested.

After the 31 March submission deadline and prior to the WGSFD meeting (7 June 2021), ICES Secretariat together with the expert group chairs quality-checked the submitted data. This involved frequent correspondence with countries to ensure that submission of data complied with the data call specifications. The process included generating a standard quality control (QC) report for each country's submission, with checks undertaken by the expert group chairs. This is done upon submission and, where relevant, for any resubmission, with the aim of detecting discrepancies in the data. Any feedback was communicated back to the data submitters, and countries were either congratulated on a good submission or asked to resubmit corrected data. Table 1 shows the countries that submitted data and the outcome of these QC checks.

Table 1 Data submission status for countries operating in the OSPAR Maritime Area to whom the 2021 ICES data call on VMS and logbook data for 2009–2020 was sent.

Country	Data submission	Country	Data submission
Belgium	✓	Lithuania	✓
Denmark	✓	The Netherlands	✓
Estonia	✓	Norway	~
Faroe Islands	✗	Poland	✓
France	✓	Portugal	~
Germany	✓	Russia	✗
Greenland	✗	Spain	✓
Ireland	✓	Sweden	✓
Iceland	~	United Kingdom	✓
Latvia	✓		

✓: Suitable data submitted.

✗: No data submitted.

~: No suitable data submitted

An additional QC check was undertaken on the full VMS dataset (all countries combined) to produce an overview QC report. All R scripts and SQL code used to access and process the VMS data are available on GitHub[†]. Once approved, the aggregated data from all countries were stored in a separate database.

Processing of VMS data

Data that passed the quality control checks were used to produce geographical files (shapefiles) and maps. The production of these spatial data layers of fishing intensity/pressure is based on the fishing pressure estimated by métier, following the approach of Eigaard *et al.* (2016) at a resolution of c-squares (0.05° × 0.05°, about 15 km² at 60°N latitude), which is the spatial resolution adopted by ICES (Rees, 2003).

[†] https://github.com/ices-eg/wg_WGSFD.

ICES (2016a) defines the swept-area as the cumulative area contacted by a fishing gear within a grid cell over one year. The swept-area ratio (SAR, also defined as fishing intensity) is the swept-area divided by the surface area of the grid cell. The area contacted by fishing gear is provided by geographically distinct VMS points for which speed and course are available at intervals of maximum two hours, coupled with information on vessel size and gear used derived from EU logbooks (Eigaard *et al.*, 2016; ICES, 2018a).

Vessel speeds representing fishing activity are assigned to the 0.05° × 0.05° c-square grid.

Estimates on total SAR within each grid cell were calculated by métier. In addition to total surface and subsurface SAR, another four higher-level métier groupings (beam trawl, dredge, demersal seine, otter trawl) and fourteen lower-level BENTHIS gear groupings (OT_CRU, OT_DMF, OT_MIX, OT_MIX_CRU, OT_MIX_DMF_BEN, OT_MIX_DMF_PEL, OT_MIX_CRU_DMF, OT_SPF, TBB_CRU, TBB_DMF, TBB_MOL, DRB_MOL, SDN_DMF, SSC_DMF) were specifically considered.

Table 2 Glossary of terms and BENTHIS métier groupings used to define higher-level métier groupings (Eigaard *et al.*, 2016; ICES, 2018b).

Surface	< 2 cm penetration depth of the gear components
Subsurface	≥ 2 cm penetration depth of the gear components
beam trawl (TBB)	For beam trawls (TBBs) the footprint consists of two components: (i) the shoes of the beam and (ii) the groundgear. Before that part of the footprint is made by the tickler chains of the trawl, if such chains are deployed.
dredge (DRB)	For dredges (DRBs) the groundgear component defines the footprint which is homogeneous across the entire width of the dredge, even if teeth are used
demersal seine (DS)	For seines (DSs) two main types of footprint occur: (i) from the seine rope, and (ii) from the seine groundgear
otter trawl (OT)	For otter trawls (OTs), the footprint is composed of (i) the otter boards, (ii) the sweeps, and (iii) the trawl groundgear
BENTHIS métier	14 standard BENTHIS métier groupings (see below) that have similar gear footprints, and which can be aggregated up to describe higher-level gear groupings (beam, dredge, demersal seine, otter trawl)
OT_CRU	Otter trawl for <i>Nephrops</i> or shrimp
OT_DMF	Otter trawl for cod or plaice
OT_MIX	Otter trawl for other species
OT_MIX_CRU	Otter trawl for mixture of species with focus on shrimp (note: no data were submitted for this gear category)
OT_MIX_DMF_BEN	Otter trawl for mixed benthic fish
OT_MIX_DMF_PEL	Otter trawl for benthic-pelagic fish (note: no data were submitted for this gear category)
OT_MIX_CRU_DMF	Otter trawl for <i>Nephrops</i> and mixed fish
OT_SPF	Otter trawl for sprat or sandeel
TBB_CRU	Bottom trawl for <i>crangon</i>
TBB_DMF	Bottom trawl for sole and plaice
TBB_MOL	Bottom trawl for molluscs
DRB_MOL	Dredge for scallops and mussels
SDN_DMF	Danish seine for plaice and cod (note: there is no subsurface component for this gear)
SSC_DMF	Scottish seine for cod, haddock, and other flatfish

Landings values (euros) and weights (kg) were calculated from logbook data by each country prior to data submission to ICES.

The production of spatial data layers of fishing intensity/pressure are discussed in detail in ICES (2016a, 2016b).

Data can be considered sensitive if the activities of individual vessels can be inferred from the data (ICES, 2019). Following the provisions made in the ICES VMS data call and the guidelines produced by ICES WGSFD in 2019 (ICES, 2019), values for sensitive data (i.e. fishing hours, total value and average kW) from c-squares with two vessels or fewer have been classified into categories (ranges) that are wide enough so that individual vessels cannot be identified.

Anonymity was ensured by converting sensitive values into one of 20 categories, specified by a lower and upper bound. Checks are undertaken to ensure that each category had three or more vessels contained within it. Categories are defined separately for each layer but are common across years so that data can be accumulated over time if necessary. Importantly, the lowest category is defined from zero to an upper value that is defined as the 5th percentile of the values for which there are three or more vessels contributing to it. This ensures that the lowest category range contains cells with one, two, and three or more vessels; therefore, it cannot be assumed that the lowest category contains only single vessel values. The remaining categories are defined using percentiles so that each category has a meaning in terms of the range of observed values. For example, if you combine the top ten categories you will have the cells with values greater than the median, or the top category with highest 5% of values; this is a consequence of splitting into 20 categories.

The resulting outputs have been evaluated by ICES VMS Governance Group (WGSFDGOV) to ensure the approach used aligns with VMS data policy.

The layers considered sensitive by WGSFDGOV and aggregated up to two vessels or more/c-square were: total weight, total value, kW fishing hours, fishing hours.

The layers that were not considered sensitive and thus were not classified in cases where fewer than three vessels/c-square were present were: surface area in km² (swept-area), surface area ratio, subsurface area in km² (swept-area), subsurface area ratio.

Data outputs

All requested VMS-derived data outputs for this technical service are published and available at ICES (2021a).

Caveats

Several caveats, listed below, should be taken into account when considering this technical service and its data. These caveats relate to issues concerning the provision of vessel data, its interpretation, and the scale on which data are informative.

- Data on value and weight were not quality-checked in full by the expert groups and can therefore be inconsistent and/or not meet the quality standards. ICES is considering ways in which future data submissions on value and weight may be made more consistent.
- Data on fishing locations for vessels less than 12 m are not available and are therefore not included in the technical service. This introduces a bias in the assessment that is expected to be strongest in coastal areas.
- VMS data from Portugal, Iceland and Norway have not been used as the submitted data did not pass the quality check hence showing a lesser extent and distribution of fishing effort than the actual values.
- Fishing pressure (SAR, swept-area ratio) depends on the spatial resolution of the fishing pressure data. Pressure is calculated at a resolution of $0.05^\circ \times 0.05^\circ$.
- It is possible that the valuation of landings has been treated differently by different countries, potentially introducing bias.
- In 2011, a lower fishing intensity is observed due to reduced fishing for *Nephrops*; these crustaceans were difficult to catch in the early part of the season as water temperatures were lower in that year.
- Data outputs in this technical service assume a uniform distribution of trawling within each c-square. When using the data products of this technical service it should be noted that the above assumption will apply when trawling is evaluated over longer periods (e.g. 2012–2015). However, at shorter, yearly time-scales the proportion of the seabed trawled will be overestimated because in the model trawling is randomly distributed at small spatial scales (Rijnsdorp *et al.*, 1998; Ellis *et al.*, 2014; Eigaard *et al.*, 2016).

Additional information

VMS and logbook data quality control checks

A quality control (QC) template (coded in SQL and R) was run on the aggregated dataset to calculate and check the most important variables (number of submitted records, fisheries effort, landings, etc.) for each year so that any questionable deviations could be identified. Secondly, maps were created from the aggregated data, showing any differences by c-square (VMS data) or by ICES rectangle (logbook data).

Interactive maps were developed to allow internal group review of the data submitted to ICES aggregated to national level, looking at the BENTHIS métiers, JNCC gear groups, and the overall total. These maps were reviewed by WGSFD experts for all gear categories. This allowed the group to review individually and as a group if any differences were acceptable or if aspects of the data needed to be reviewed. These maps are not included in this service.

All maps were checked for any deviations by WGSFD experts.

Differences detected during these checks were analysed in more detail. In some cases, a reasonable explanation for the difference (e.g. known changes in fishing effort) could be found. In other cases, errors were identified so that data could be corrected and re-submitted. Based on the analyses run during the meeting, WGSFD finally concluded that the data for all BENTHIS métiers are as accurate as possible. The rigorous quality control procedures imposed on the submitted VMS and logbook data served to increase the reliability of the data used to produce the requested data products, as well as reliability of future advice outputs.

Sources and references

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