

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

### Service summary

ICES Secretariat has collected relevant VMS and logbook data to produce, as a technical service to OSPAR, updated spatial data layers on fishing intensity/pressure within regions II and III of 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 from across the OSPAR area have improved in both quality and coverage. Standardized methods were used to produce the requested data layers. Surface and subsurface abrasion maps for all gears used in the OSPAR area in 2017 are presented in the Annex. A link is provided for all requested data layers.

### Request

*For OSPAR to assess benthic impact, ICES is requested to produce updated spatial data layers on fishing intensity/ pressure within the regions II and III of 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 2017 and update data layers from previous years (2009-2016) 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 2017 is backward compatible to previous year maps delivered to OSPAR as advice delivered between 2014-2017, 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 Km<sup>2</sup> (Swept area), Surface area ratio, Sub-surface area in Km<sup>2</sup> (Swept area), Sub-surface area ratio, Total Weight, Total value, Kw Fishing Hours, Fishing hours.*

### Elaboration on the service

Shapefile datasets are available at ICES (2018a)\*: <https://doi.org/10.17895/ices.data.4686>

### 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'. The indicator leads (see content contact person above) will provide the latest draft CEMP Guideline/Technical specification with the methods for*

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\*Version 2 – Upon request of the data provider outputs have been updated to better ensure vessel anonymity

, and the results from the most recent assessments produced by the OSPAR benthic expert group. 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.

*Intended use of the request output:*

*The output delivered from this request will be used to inform assessments for the OSPAR indicator BH3 – extent of physical damage for future assessment rounds as well as form a regional basis for national reporting under the Marine Strategy Framework Directive, and the next OSPAR QSR, for OSPAR regions II and III.*

*The data produced by the request will be incorporated into the calculation of abrasion layers produced following the delivery against the OSPAR request in 2017. The results will be used to update spatial analysis combining habitat distribution and sensitivity assessment to calculate the extent of physical damage to predominant and Threatened and Declining OSPAR 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 the ACOM leadership prepared and guided the process, with the relevant ICES expert group (Working Group on Spatial Fisheries Data, WGSFD) reviewing the steps taken.

An ICES VMS/logbook data call covering the years 2009–2017 was issued to all ICES Member Countries (EU Data Collection Framework [DCF] contacts and all ACOM delegates) on 18 January 2018, with a deadline for response by 31 March. The call followed the ICES VMS data policy (<http://www.ices.dk/marine-data/guidelines-and-policy/Pages/ICES-data-policy.aspx>). Countries were offered the opportunity to allow ICES to use previously submitted data for the years 2009–2016, thereby having only to additionally submit 2017 data.

After the submission deadline and prior to the WGSFD meeting (11 June 2018), ICES Secretariat filtered for countries operating in OSPAR regions II and III (Table 1) and together with the expert group chairs quality-checked the submitted data. This involved frequent correspondence with submitting countries to ensure that submission of data complied with the data call specifications. The process included generating a standard quality control (QC) report for the submission of each country, 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 submitted data. Any feedback was communicated back to the data submitters, and countries were either congratulated on a good submission or asked to re-submit corrected data.

**Table 1** Data submission status for countries operating in the OSPAR regions II (Greater North Sea) and III (Celtic Seas) to whom the 2018 ICES data call on VMS and logbook data for 2009–2017 was sent.

Country	Data submission	Country	Data submission
Belgium	✓	The Netherlands	✓
Denmark	✓	Norway	✓
France	✓	Spain	✗
Germany	✓	Sweden	✓
Ireland	✓	United Kingdom	✓

✓: Suitable data submission.

✗: No data submitted.

An additional QC 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 ([https://github.com/ices-eg/wg\\_WGSFD](https://github.com/ices-eg/wg_WGSFD)). 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 ( $0.05^\circ \times 0.05^\circ$ ).

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 Vessel Monitoring System (VMS) points for which speed and course are available at intervals of maximum 2 hours, coupled with information on vessel size and gear used derived from EU logbooks (ICES, 2018b; Eigaard *et al.*, 2016).

Vessel speeds representing fishing activity are assigned to a  $0.05^\circ \times 0.05^\circ$  grid, about 15 km<sup>2</sup> at 60°N latitude, which is the spatial resolution adopted by ICES known as the c-square approach (Rees, 2003).

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 (ICES, 2018b; Eigaard *et al.*, 2016).

Surface	< 2 cm penetration depth of the gear components.
Subsurface	≥2 cm penetration depth of 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 ground gear 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 crangon
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 outputs

Maps of total surface and subsurface SAR for 2017 are provided for the OSPAR regions II and III (Annex 1), and all requested VMS-derived data outputs for this technical service are published and available at ICES (2018a). Included here are maps of surface and subsurface abrasion pressure on the seafloor from mobile bottom-contacting fishing, for the years 2009 to 2017.

## 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 and its interpretation, and the scale at 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.
- Only VMS data from ICES countries with fishing activity in OSPAR regions II and III have been used.
- A respondent to the Data call made ICES aware that there was an issue with the aggregation of vessels in the data they had provided. As such, the country was requested to resubmit their 2017 data, as well as for previous years (2009–2016). This may introduce a bias, if this 2018 technical service is compared to previously published years of data that are not the most up to date.
- 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 time periods (e.g. 2012–2015). However, at shorter, yearly time-scales the proportion of the seafloor trawled will be overestimated because 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). The values for the most recent year 2017, submitted in this year's data call, were compared with the data for the previous year 2016, as well as against the mean of all years. The underlying data was then checked in more detail in areas that showed larger deviations.

Interactive maps were developed to allow a 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, comparing (1) the data for 2016, submitted in the 2017 data call versus the same from the 2018 data call, and (2) the data for 2016 versus the data in 2017 submitted in the 2018 data call. 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.

All maps were checked for any deviations by WGSFD experts.

Differences detected during these checks were analyzed 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 correct 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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Ellis, N., Pantus, F., and Pitcher, C. R. 2014. Scaling up experimental trawl impact results to fishery management scales – a modelling approach for a “hot time”. *Canadian Journal of Fisheries and Aquatic Sciences*, 71: 733–746.

ICES. 2016a. OSPAR request for further development of fishing intensity and pressure mapping. *In* Report of the ICES Advisory Committee, 2016. ICES Advice 2016, Book 1, Section 1.6.6.4. 27 pp.

ICES. 2016b. Interim Report of the Working Group on Spatial Fisheries Data (WGSFD), 17–20 May 2016, Brest, France. ICES CM 2016/SSGEPI:18. 244 pp.

ICES 2017. OSPAR request on the production of spatial data layers of fishing intensity/pressure. *In* Report of the ICES Advisory Committee, 2017. ICES Advice 2017, ICES Technical Service, sr.2017.17. 8 pp.

ICES. 2018a<sup>†</sup>. Spatial data layers of fishing intensity/ pressure per gear type for surface and subsurface abrasion, for the years 2009 to 2017 in the OSPAR regions II and III (ver. 2, 22 January, 2019): ICES data product release, <https://doi.org/10.17895/ices.data.4686>

ICES. 2018b. Report of the Working Group on Spatial Fisheries Data (WGSFD), 11–15 June 2018, Aberdeen, UK. ICES CM 2018/HAPISG:16. Provisional report.

Rees, T. 2003. “C-squares”, a new spatial indexing system and its applicability to the description of oceanographic datasets. *Oceanography*, 16(1): 11–19.

Rijnsdorp, A. D., Buys, A. M., Storbeck, F., and Visser, E. G. 1998. Micro-scale distribution of beam trawl effort in the southern North Sea between 1993 and 1996 in relation to the trawling frequency of the sea bed and the impact on benthic organisms. *ICES Journal of Marine Science*, 55: 403–419.

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<sup>†</sup> Version 2: Reference updated

## Annex

This Annex contains total surface (Figure 1) and subsurface (Figure 2) abrasion data for 2016 for all fishing gears in the swept area ratio of the OSPAR area. The complete set of data outputs has been republished electronically (ICES, 2018a)<sup>‡</sup>. The updated (ver. 2, 22 January, 2019) shapefile datasets are available at ICES (2018a): <https://doi.org/10.17895/ices.data.4686>

These electronic data outputs include the following:

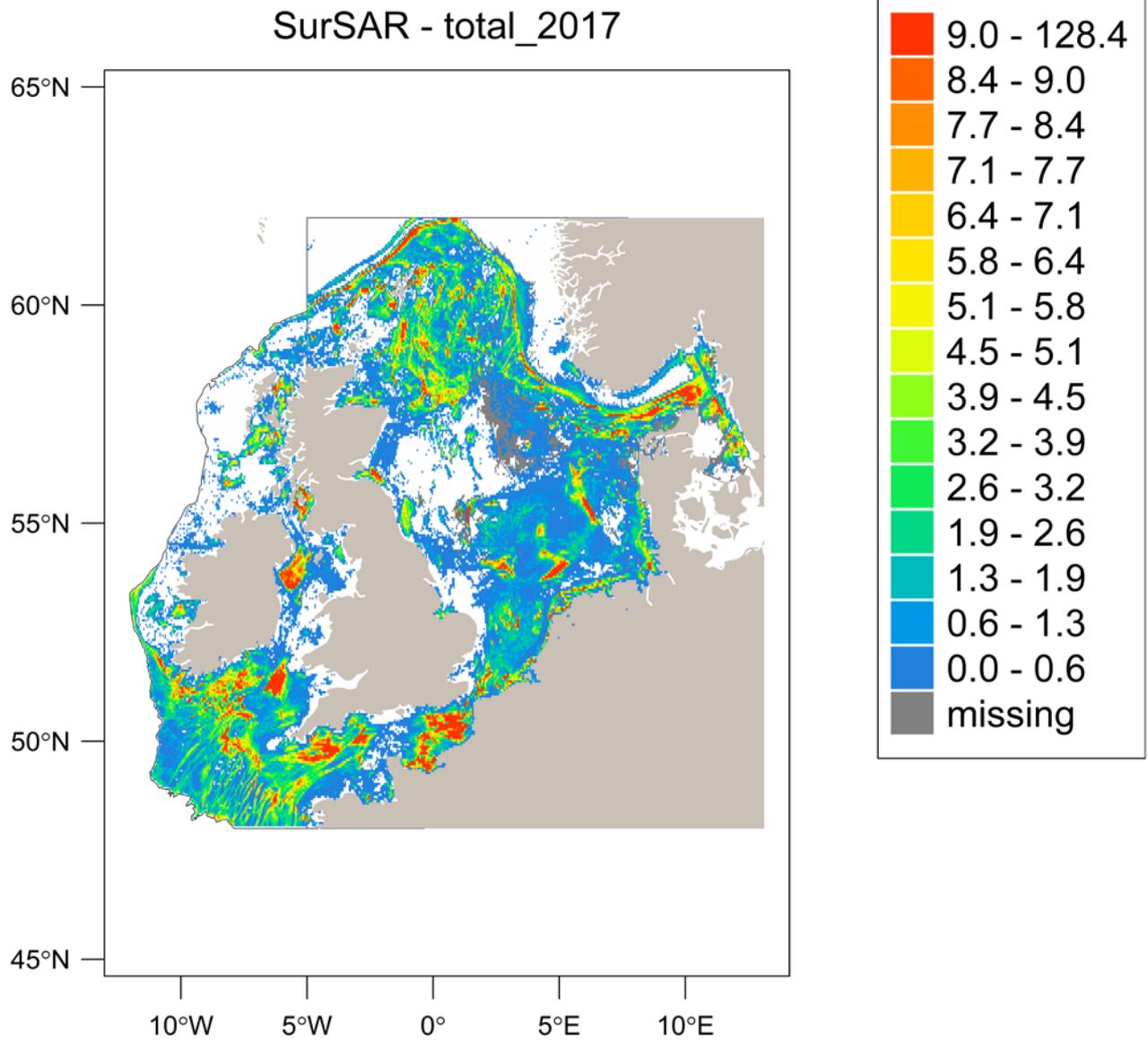
- a) Aggregated layers: total, beam trawl, dredge, demersal seine, and otter trawl.
- b) Métier layers: OT\_CRU, OT\_DMF, OT\_MIX, OT\_MIX\_CRU, OT\_MIX\_DMF\_BEN, OT\_MIX\_DMF\_PEL, OT\_MIX\_CRU\_DMF, OT\_SPF, TBB\_CRU, TBB\_DMF, TBB\_MOL, DRB\_MOL, SDN\_DMF, SSC\_DMF.

This leads to 19 layers per year, with the following attributes included in each layer: surface area in km<sup>2</sup> (Swept area), surface area ratio, subsurface area in km<sup>2</sup> (Swept area), subsurface area ratio, total weight, total value, kW fishing hours, and fishing hours. For SDN\_DMF gear there is no subsurface component. For OT\_MIX\_CRU and OT\_MIX\_DMF\_PEL none of the submitted VMS data were associated with these gear categories.

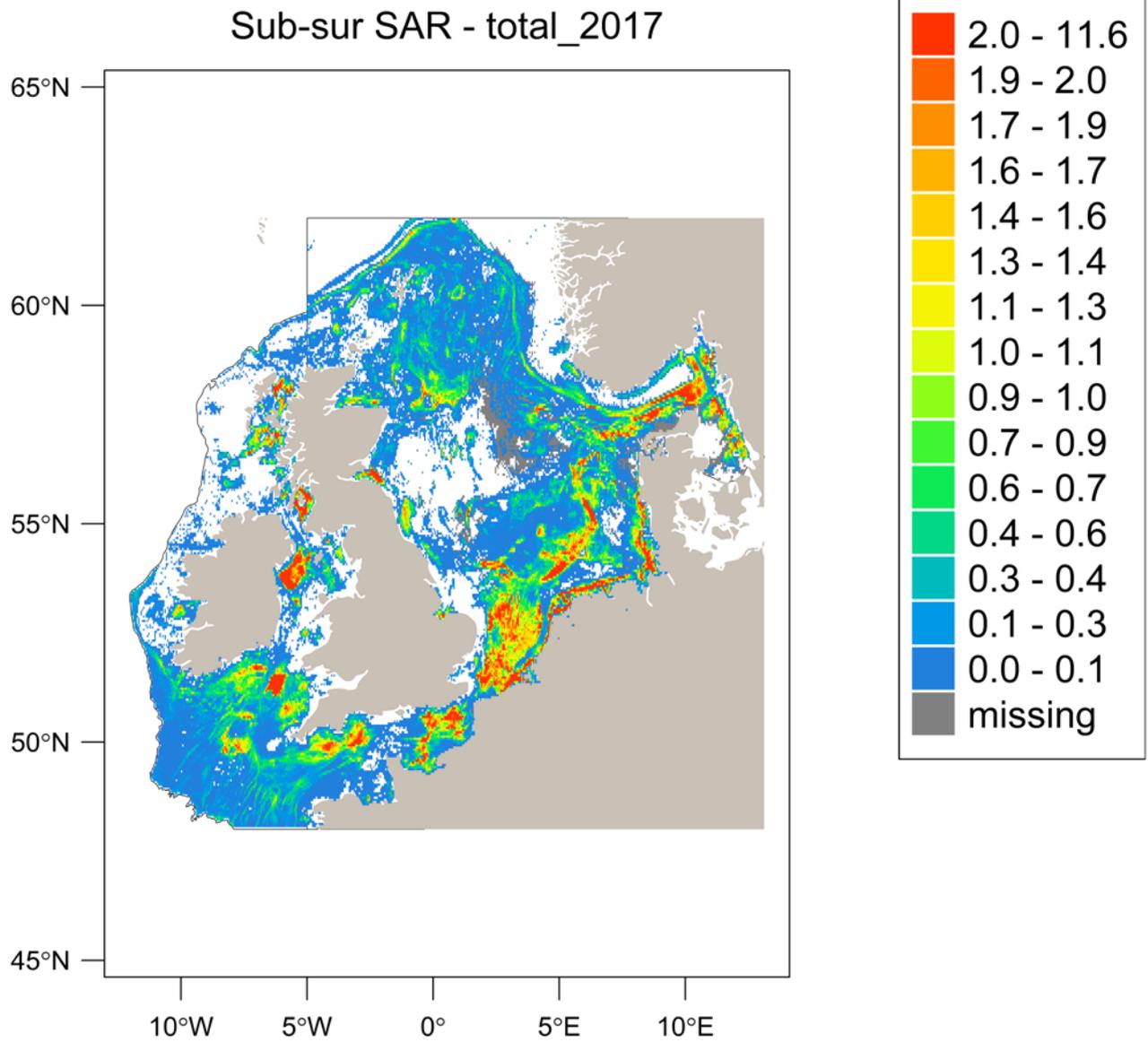
Note that caveats described in this technical service apply when interpreting these products.

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<sup>‡</sup> Version 2 – Upon request of the data provider outputs have been updated to better ensure vessel anonymity



**Figure 1** All fishing gears (i.e. total) surface swept area ratio for 2017 in the OSPAR area. Note that caveats described in this technical service apply when interpreting maps.



**Figure 2** All fishing gears (i.e. total) subsurface swept area ratio for 2017 in the OSPAR area. Note that caveats described in this technical service apply when interpreting maps.