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Report on the processing, review and
production of data products for
ACOM's Vulnerable Marine Ecosystems
Advice Drafting Group (ADGVME)

14 June 2018



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Contents

Rationale	1
Request for advice EU (DG MARE): VMEs and fishing footprint	1
1 Processing of VMS and log book data and the production of spatial layers of fishing intensity and footprint	2
2 Technical review of spatial layers of fishing intensity and footprint by the Working Group on Spatial Fisheries Data (WGSFD)	5
3 Production of final integrated data products used in ICES advice to the EU (DG MARE) on VMEs and fishing footprint advice sr.2018.10	7

Rationale

This report describes the following steps taken by ICES to process and review VMS and logbook data culminating in an integrated VMS – VME data product:

- 1) Processing of VMS and log book data and the production of spatial layers of fishing intensity and footprint.
- 2) Technical review of spatial layers of fishing intensity and footprint by the Working Group on Spatial Fisheries Data (WGSFD).
- 3) Production of final integrated data products used in ICES advice to the EU (DG MARE) on VMEs and fishing footprint advice (sr.2018.10).

VME related data products used by ADGVME were developed and reviewed separately by the Working Group on Deep-water Ecology (WGDEC):

ICES, 2018. Report of the ICES/NAFO Joint Working Group on Deep-water Ecology (WGDEC), 5–9 March 2018, Dartmouth, Canada. ICES CM 2018/ACOM:26. 126 pp.

This report, along with the code to produce the final data products used in the advice to the EU (DG MARE) on VMEs and fishing footprint (sr.2018.10), is published as:

ICES. 2018. Documentation of the processing, review and production of data products for ACOM's Vulnerable Marine Ecosystems Advice Drafting Group (ADGVME), 14 June 2018, Copenhagen, Denmark. DOI: <https://doi.org/10.17895/ices.pub.4430>

Request for advice EU (DG MARE): VMEs and fishing footprint

Advice on a prioritised list of bottom fisheries closures areas where VMEs are likely to occur, taking into account the current fishing footprint

ICES is requested to advice on a list of areas where VMEs are likely to occur and should be closed off from bottom fishing, in particular in areas deeper than 800 m. This advice should also include a footprint analysis of where bottom fishing is occurring (and has occurred), by collating and describing bottom fishing activity in the North East Atlantic 2009-2011 (or other period 2012-2016). In this work ICES is requested to:

- a) Collect all relevant national VME data. Building on the existing ICES VME data base, prepare spatial layers and a lists of areas where VMEs are likely to occur in the North East Atlantic, in particular in areas deeper than 800 m.*
- b) Collect all relevant national VMS and logbook data 2009-2011 (or other period 2012-2016). Prepare spatial layers on the intensity of bottom fishing, that describe the fishing footprint occurring (and that has occurred) in the North East Atlantic*. Issuing of a VMS and logbook data call, data collation, quality checks and analysis of data should be done in accordance with the standards developed by ICES (2017).*
- c) Combine information from (a) and (b) above to advice on a prioritised list of fisheries closures areas, and a set of management options in line with European Commission's deep-sea access regulation (see intended use section).*

**footprint analysis of bottom fishing is conditional to all countries successfully submitting requested VMS and logbook data, as set out in the ICES data call.*

1 Processing of VMS and log book data and the production of spatial layers of fishing intensity and footprint

Post-processing

An ICES VMS/logbook data call covering the years 2009–2017 was issued to all ICES Member Countries (EU DCF contacts and all ACOM delegates) on 18 January 2018, with a deadline for response by 31 March 2018 (http://www.ices.dk/marine-data/Documents/Data_calls/20180118_VMS_DATA_Call.pdf). 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 the ICES secretariat, 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. No data were received from Spain, Greenland, Faroe Islands, or Russia.

Table 1 Data submission status for countries operating in the ICES area to whom the 2018 ICES data call on VMS and logbook for 2009–2017 data was sent.

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

✓: Suitable data submission

✗: Unsuitable 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). 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 describe the “footprint” of bottom fishing activity during reference years 2009–2011. 2016 was also produced as a

reference year for the ADGVME. Both mobile and static bottom contacting gear were included. VMS positions from vessels with speeds representing this fishing activity were assigned to a 0.05×0.05 degree grid, about 15 km² at 60°N latitude, which is the spatial resolution adopted by ICES known as the c-square approach (Rees, 2003).

Mobile bottom contacting gear

For mobile bottom contacting fishing, intensity was expressed as swept area ratio (SAR) that was estimated by métier following the approach of Eigaard *et al.* (2016) at a resolution of c-squares. ICES (2017b) 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 log books (ICES, 2017a; Eigaard *et al.*, 2016).

Static bottom contacting gear

Presence (and absence) of static bottom contacting fishing activity within the resolution of c-squares were also prepared. This included all fishing registered under the métier level 4 codes, FPO (fishing pots), LLS (long lines) and GNS (set gill nets), with the exclusion of métier level 5 codes within the GNS category: GNS_SPF and GNS_LPF, set gill nets targeting small and large pelagic fish.

Data outputs:

The above geographical files (shapefiles) and maps were made available for review by WGSFD, as well as to ADGVME on their SharePoint site.

Caveats

The absence of VMS data for vessels less than 15 m length was noted, for the period 2009–2011, and how this biases the understanding of the spatial fisheries footprint. It was suggested that other means could be explored to address this problem. For vessels of 12–15 m, adopting a VMS reference period after 2012 could be considered. In addition, logbook for vessels of 10–15 m in length could provide relatively coarse (to statistical rectangle) spatial information for the 2009–2011 reference period.

Several caveats, listed below, should be taken into account when considering the spatial layers produced 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.

- VMS data for vessels less than 15 m were not required during the reference period (2009–2011). This is a gap in understanding of the fisheries footprint. This introduces a bias in the analysis that is expected to be strongest in areas where deep waters occur close to the coast, e.g. Iberia and the Azores.
- VMS and log book data from Greenland, Faroe Islands, Russia, Spain (Table 1) were not received, introducing a bias in footprint in areas fished by those countries. This is likely to be in the Bay of Biscay, southern Celtic Seas, and in Iberian waters.
- Data on fishing locations for vessels less than 12 m are not available and are therefore not included. This introduces a bias in the assessment that is expected to be strongest in coastal areas.

- Fishing pressure (SAR, swept area ratio) depends on the spatial resolution of the fishing pressure data. Pressure is calculated at a resolution of 0.05×0.05 degrees.
- Spatial layers 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 sea floor 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).

Source and references

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2 Technical review of spatial layers of fishing intensity and footprint by the Working Group on Spatial Fisheries Data (WGSFD)

Reviewers appointed by WGSFD: Josefine Egekvist (DTU-Aqua, Denmark) and Neil Campbell (Marine Scotland Marine, UK)

Review provided to: ADGVME (Advice Draft Group Vulnerable Marine Ecosystems)

Review period: 4-6 June 2018

Review Comments

This report only answers part of the overall request dealing with the processing and production of VMS log book derived products. WGSFD notes that reporting on how it is intended to combine the VME's and the fisheries data are missing from this report.

The relevant part of the request asks ICES to "Collect all relevant national VMS and logbook data 2009–2011 (or other period 2012–2016). Prepare spatial layers on the intensity of bottom fishing, that describe the fishing footprint occurring (and that has occurred) in the North East Atlantic. Issuing of a VMS and logbook data call, data collation, quality checks and analysis of data should be done in accordance with the standards developed by ICES (2017)."

The paragraph about data submission and status describes the process in the 2018 data-call, but data from 2016 and 2009–2011 are used for the maps. It says in table 1 that the UK data submission* was unsuitable, but looking at the maps, data seem to be included from the UK (but that is probably from previous data submissions?). We understand there have been issues with the UK's 2017 submission, but it is not clear if data provided in previous years was included in the effort maps for the 2009–11 and 2016 period. Why was it decided to use 2016 and 2009–2011, and not the rest of the time series?

**it should be noted that prior to the ADGVME, the UK re-submission of VMS and logbook data was received and quality assured by ICES to be included in the overall analysis.*

The work to process the VMS data into spatial layers looks to have been performed appropriately to pre-agreed standards of quality. It is not apparent from what is given here if any effort has gone into collating logbook data referred to in the request, or what if any use has been made of the NEAFC VMS data which is available to ICES. Data from some important fishing nations in the North East Atlantic are missing (Faroe Islands, Greenland, Russia, Spain).

The specification of a narrow range of years in the request, sometime after the peak of deepwater fisheries that this request is focussed on, suggests to me that historical significant adverse impacts on VME indicator organisms will likely be missed in the present analysis, therefore the area of suitable habitat for these species may be underestimated.

More detailed comments:

Reference year 2009–2011 - this is a fairly narrow range of years, so will capture a snapshot of activity that may not be representative of impacts at a timescale relevant to VME organisms or the kind of temporal variability in European fisheries. By way of comparison, NAFO used logbook data from 1986 – 2008 and VMS from 2003 – 2008, while SEAFO used 1987 – 2011 to perform a similar exercise.

Maps and visualization –

- Can the outputs be "clipped" to only cover the North East Atlantic area requested.
- Difficult to distinguish fishing from land. Would recommend to use another colour.
- In both maps there are strange lines crossing Bay of Biscay. Also a lot of activity with passive gears in the Barents Sea in 2016 compared to the 2009–2011 reference period.
- A strange line is crossing Iceland. Not intuitive that darker colours represents least fishing activity, while lighter colours represents most fishing activity. The header could include "MBCG" to make it clearer.
- Some strange lines in the map, crossing Iceland, Greenland and Norwegian Basin. A lot of extra fishing activity in the Barents Sea in 2016 compared to 2009–2011
 - P Production (based on review by WGSFD and ADGVME input) of data products used in the EU advice (sr.2018.10)
 - Production (based on review by WGSFD and ADGVME input) of data products used in the EU advice (sr.2018.10)

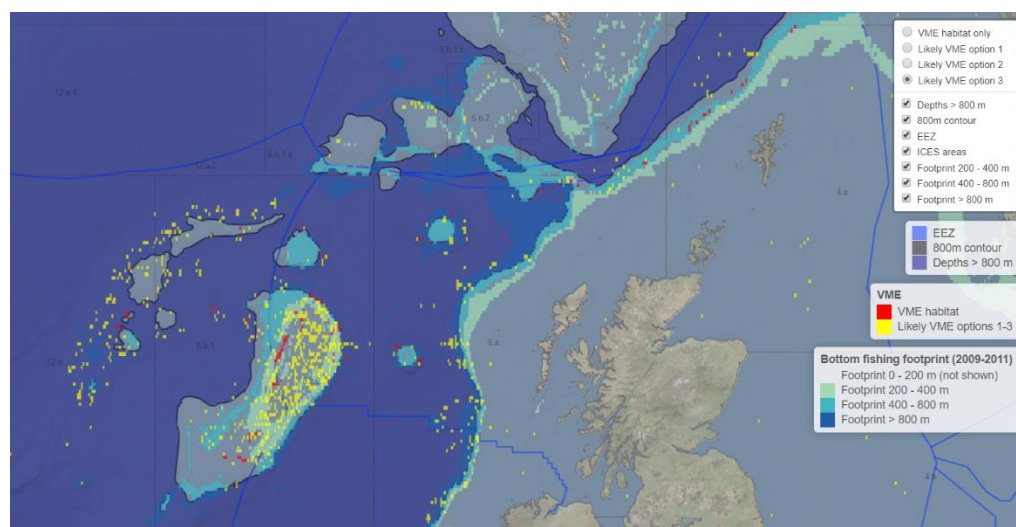
3 Production of final integrated data products used in ICES advice to the EU (DG MARE) on VMEs and fishing footprint advice sr.2018.10

The review by WGSFD was presented and taken on board at ADGVME. Further insight was gained on VME data layers from WGDEC 2018 and RGVME. Following discussions at ADGVME, geographical files (shapefiles) and maps with the following layers/attributes were produced:

- For the reference year 2009–2011 any presence of bottom fishing activity by c-square. This included all bottom fishing gears, as defined by ICES (2017) for both mobile gears and for level 4 static gear codes, FPO (fishing pots), LLS (long lines) and GNS (set gill nets), were included. Metier level 5 codes were excluded for set gillnets: GNS_SPF and GNS_LPF, set gill nets targeting small and large pelagic fish.
 - Each c-square was allocated to a depth based on its centre point.
 - Bottom fishing footprint were described in waters >800m, 800-400m, and 400-200m.
- The three options for data used to show “areas where VMEs are likely to occur” in water >200m were produced:
 - 1) High VME index, with high and medium confidence
 - 2) High or Medium VME index, with any level of confidence
 - 3) Any VME index, with any level of confidence

The above were based on ICES WGDEC 2018 VME index that has three levels (high, medium and low) likelihood and three levels of confidence (high, medium and low) associated with each likelihood class.

- The EEZ, ICES sub-division, as well as the 800 m depth contour were included.



The code to produce the steps detailed above (and screen shot shown above) is provided in a zip file within the collection DOI: <https://doi.org/10.17895/ices.pub.4430>