ICES WGSFD REPORT 2017

SCICOM STEERING GROUP ON ECOSYSTEM PRESSURES AND IMPACTS

ICES CM 2017/SSGEPI:16

REF. SCICOM
ACOM

Interim Report of the Working Group on Spatial Fisheries Data (WGSFD)

29 May - 2 June 2017

Hamburg, Germany

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

H. C. Andersens Boulevard 44–46
DK-1553 Copenhagen V
Denmark
Telephone (+45) 33 38 67 00
Telefax (+45) 33 93 42 15
www.ices.dk
info@ices.dk

Recommended format for purposes of citation:

ICES. 2017. Interim Report of the Working Group on Spatial Fisheries Data (WGSFD), 29 May – 2 June 2017, Hamburg, Germany. ICES CM 2017/SSGEPI:16. 42 pp.

For permission to reproduce material from this publication, please apply to the General Secretary.

The document is a report of an Expert Group under the auspices of the International Council for the Exploration of the Sea and does not necessarily represent the views of the Council.

© 2017 International Council for the Exploration of the Sea

https://doi.org/10.17895/ices.pub.8563

Contents

Executive summary

The Working Group on Spatial Fisheries Data (WGSFD) met at the Thünen Institute, Hamburg, Germany, 29 May – 2 June 2017. ICES had issued a data call for aggregated VMS and logbook data for the years 2009–2016 (updates for 2009–2015, new data for 2016).

In preparation to the meeting, WGSFD had prepared a Quality-Control document that processed submitted Member State data and generated indicators that were carefully scrutinized by WGSFD experts for quality. In case concern was raised, data submitters were consulted and asked to revise and resubmit data if necessary. This substantially improved understanding potentially outlying data and the data quality as a whole. The ICES data centre facilitated this entire process. At the meeting, this process was repeated using the entire dataset submitted and comparisons were made with last years submitted data. After another round of careful scrutinizing the data, any necessary fixes were incorporated and final data products prepared by the ICES data centre.

Furthermore, the group was updated on a number of VMS/AIS/Logbook related projects which are ongoing at national labs, including a presentation on Individual Stress Level Analyses (ISLA), ghostnet detection using AIS in Denmark, seabed disturbance estimation using AIS in the Mediterranean and estimation of the stability of seabed disturbance by the Dutch beamtrawl fleet.

On request by NEAFC, members of WGSFD had analysed and produced maps of fishing activity in NEAFC areas using the VMS and logbook information collected by NEAFC. This exercise was not straight forward as the data available didn't follow a standardized format as is common for all other VMS and logbook data available to WGSFD. Product was delivered to ICES WGDEC.

Furthermore, WGSFD addressed methods to estimate DCF indicators 5–7. As the definition of these indicators has changed recently, including methods to calculate them, WGSFD will no longer continue to develop best methods to calculate these. Members of the group did evaluate how aggregation behaviour could influence the absolute value of the indicators. Tables and figures showing the DCF indicators, using different methodologies to calculate them are given for the entire time-series as well as per year and ecoregion.

WGSFD has the ambition to publish a peer-reviewed paper on quantifying and explaining the spatio-termporal variability of fishing fleets across the ICES areas and to present best-practices on how to analyse and use VMS data from a world-wide perspective. Discussions in the group were held to outline the manuscripts, data needs, analyses methodology and angle of message to convey. Other potential paper topics were listed as well but were not given priority at this stage.

1 Administrative details

Working Group name

Working Group on Spatial Fisheries Data (WGSFD)

Year of Appointment within current cycle

2016

Reporting year within current cycle (1, 2 or 3)

2

Chair(s)

Niels Hintzen, the Netherlands

Christian von Dorrien, Germany

Meeting venue

Hamburg, Germany

Meeting dates

29 May – 2 June 2017

2 Terms of Reference and Summary of workplan

A	Develop robust methods to calculate fishing pressure indicators	WGSFD has in 2013–2015 worked on method to calculate DCF indicators 5, 6 and 7. This output can be used for ICES ecoregion advice. The method could be implemented by the ICES data centre as a standard output for the ICES ecoregion advice, depending on conditions on use of VMS data. This work fit into ICES science plan Ecosystem Pressures and Impacts (EPI)
B	Work on standardized methods to produce spatial fishery distribution products	Products on spatial fishery distribution. These products are used in ICES advice, and are also of interest to other ICES expert groups as an input to fisheries descriptions and fisheries impacts. WGSFD want to work on standardized methods that can be implemented by the ICES datacentre.
C	Review ongoing work for analysing spatial fisheries data.	As input for ToRs a) and b), WGSFD need to keep up to date with ongoing work for analysing spatial fisheries data.
D	Initiate innovative methods to analyse spatial fisheries data	To make use of the expertise in the WGSFD group to develop methods/analysis on spatial fisheries data of value for the ICES community. To ensure scientific excellence investments needs to be made to stay a relevant group for the future.

Summary of Work plan

Year 1	Continuing WGSFD work from 2013–2015 on improving methods and ensuring high quality of VMS/logbook data processing from data request formats, quality checks and processing data to be implemented by the ICES data centre. Improving methods to calculate fishing intensity and inititiate development of innovative methods to analyse spatial fisheries data, including the sandeel fishery in the North Sea as a case study. A request from OSPAR is expected again in 2016. Invite an expert on DCF indicators.
Year 2	Continuing WGSFD work from 2013–2015 on improving methods and ensuring high quality of VMS/logbook data processing from data request formats, quality checks and processing data to be implemented by the ICES data centre. Improving methods to calculate fishing intensity and inititiate development of innovative methods to analyse spatial fisheries data.
Year 3	Continuing WGSFD work from 2013–2015 on improving methods and ensuring high quality of VMS/logbook data processing from data request formats, quality checks and processing data to be implemented by the ICES data centre. Improving methods to calculate fishing intensity and inititiate development of innovative methods to analyse spatial fisheries data.

3 List of Outcomes and Achievements of the WG in this delivery period

- Quality Control (QC) procedure and results (maps & tables) for individual countries and for the aggregated results.
- Standardized script (available on WGSFD github page) of calculation of indicators.
- Presentation and summaries thereof to WGSFD on new science in the field of spatial fisheries data analyses.
- Outline of two manuscripts to be written intersessionally by WGSDF members.

4 Progress report on ToRs and workplan

4.1 ToR A: Develop robust methods to calculate fishing pressure indicators

4.1.1 Methods

In previous years a number of indicators for assessing the physical disturbance from bottom-contacting fishing gears were proposed (e.g. Jennings & Lee 2012, Piet & Hintzen 2012, Eigaard *et al.* 2017) including the DCF indicators 5, 6, and 7 (ICES WGSFD, 2016). Here, we largely follow the same approaches estimating indicators describing fisheries distribution, aggregation, or the extent of areas, which were not fished (Table 4.1.1). Indicators were calculated annually and for multiple years for ecoregions. All calculations were based on swept area (SA) or swept area ratios (SAR) of bottom-contacting gears per c-square (0.05°x0.05°) and can be estimated either separately for different gear types or for a group of gears such as all towed gears with bottom contact.

Formerly, the number or the cumulative size of grid cells affected by fishing was used for indicator calculations. Because of the swept area approach we are now able to compute better estimations of the area affected by fishing, even if data have been aggregated on a 0.05°x0.05° c-square grid. The calculations performed during WGSFD 2017 are based on different assumptions about trawling track distributions within grid cells. If trawling is assumed to be regular (Fig. 4.1.1.a), the SAR of a cell can be interpreted as the mean number of times the seabed in the cell was impacted by a fishing gear. A swept-area ratio of 1 indicates that the swept area equals the cell area. Under this assumption the proportion p of the cell i trawled by gear type/group j would be

$$p_{i,j} = SAR_{i,j} \quad if\ SAR_{i,j} \leq 1;\ else\ p_{i,j} = 1$$

With SAR being the swept area ratio of the respective grid cell and gear type/ group.

Summing up the grid cell areas trawled per region would result in an overestimation of the spatial extent of fishing activities. A more realistic approach would be to assume a random or aggregated distribution of trawling tracks within grid cells (Fig 4.1.1.b and c). To estimate this we followed the rational from (Ellis *et al.* 2014), using the negative binomial distribution (NB), being the best-known distribution for describing count data arising from an aggregated process. The NB has two parameters: the mean μ and the aggregation parameter β. μ is interpreted as the SAR of a grid cell, and therefore the proportion of a grid cell being trawled n times can be derived from the underlying NB assuming different levels of aggregation (β).

$$P_{i,j}(n|SAR, \beta) \quad = \frac{\Gamma(SAR/\beta + n)}{n!\,\Gamma(SAR/\beta)}\left(\frac{\beta}{\beta+1}\right)^{n}\left(\frac{1}{\beta+1}\right)^{SAR/\beta}$$

If β = 0 $P_{i,j}$ equals the Poisson probability as proposed by (Gerritsen *et al.* 2013) for randomly distributed trawling tracks. If β > 0 some degree of aggregation is assumed. Here we use the example from (Ellis *et al.* 2014) and estimated the probability assuming a high degree of aggregation (β = 1.24). For n = 0, a given β and a specific SAR the proportion of the grid cell i that has not been trawled can be calculated.

The proportion derived directly from the SAR and even from the Poisson distribution (1-P(0|SAR, β = 0) likely overestimates the area within a grid cell that is affected by trawling, whereas 1-P(0|SAR, β = 1.24) probably underestimates the affected area size by assuming a high degree of trawling aggregation. The indicators proposed by WGSFD and the ways how they are calculated are described below (Table 4.1.1).

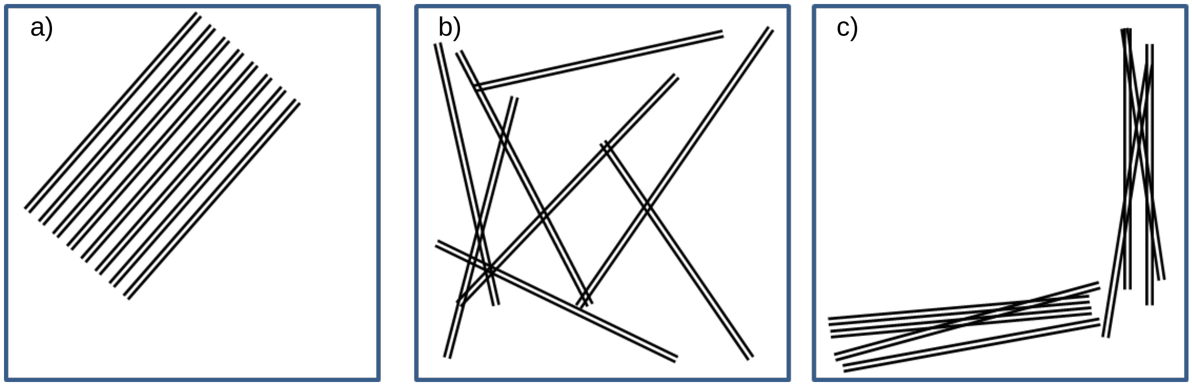

Figure 4.1.1. Illustration of trawling track patterns within a grid cell. a) regular trawling, b) random trawling, c) aggregated trawling.

Table 4.1.1. Fishing pressure indicators computed during WGSFD 2017.

No	Indicator name	Definition
I_1	Fishing intensity	Average fishing intensity (SAR) per ecoregion
I_2	Spatial extent of fishing activities	Area (in km²) affected by fishing activities (gear specific/bottom-contacting gears) divided by the ecoregion area, using the cumulative size of all grid cells fished. (a) If SAR<1 only the respective proportion of the cell area is used; (b) Assuming a random distribution of trawling tracks in each grid cell, the proportion of the cell area that is affected is calculated; (c) Assuming a highly aggregated distribution of trawling tracks in each grid cell, the proportion of the cell area that is affected is calculated
I_3	Aggregation of fishing activities	(a) The proportion of the ecoregion area where 90% of the total swept area occurs. (b) Measure of area affected by fishing activities (gear specific/ bottom-contacting gears) relative to the overall variation in fishing intensity based on the Gini-Index (Woillez *et al.*, 2007) divided by the ecoregion area.
I_4	Areas not impacted by mobile bottom contacting gears	Relative size of the area not affected by fishing activities. This indicator is closely related to indicator 2 (former DCF5) and thus can be calculated assuming different trawling patterns. However, no gear specific estimates are provided.
I_5	Extent of persistently unfished areas	Same as Indicator 4 but summing up SAR values per grid cell over several years to identify areas that remain unfished over the respective period.

4.1.1.1 Indicator for average fishing intensity

This indicator quantifies the average fishing intensity within an ecoregion with SAR being the swept area ratio of a grid cell i and gear type j and n being the total number of grid cells within an ecoregion.

$$I_{1,j} = \left(\sum_{i}^{n} SAR_{i,j}\right)/n$$

4.1.1.2 Indicator describing the spatial extent of fishing activities (~ DCF indicator 5)

The spatial extent of the area affected by fishing can be generally described as

$$I_{2,j} = \left(\sum_{i}^{n} p_{i,j} * a_i\right)/n$$

With $p_{i,j}$ being the proportion of a grid cell i impacted by gear j, and a_i represents the size of the grid cell i. It is reported in relative terms, i.e. in relation to the size of the entire region of interest (e.g. ICES ecoregions).

WGSFD based the proportion of the grid cell fished on swept area ratios (SAR) in order to prevent bias introduced by grid cells where the swept area is smaller than the total c-square area. Depending on the métier and environmental conditions trawling tracks show different spatial patterns. We thus propose three different options to calculate the proportion of the grid cell affected by a fishing gear and would recommend to use option b) assuming a random distribution of trawling tracks.

(a) The initial approach corresponds to indicator DCF5 calculated by WGSFD in 2016 (ICES WGSFD, 2016). It sums up the areas corresponding to the swept area of a c-square, when the swept area was lower than the c-square area, and to the area of a c-square, when the swept area was greater than the c-square area. Thus the proportion of a grid cell i and gear type j can be described as

$$p_{i,j} = SAR_{i,j} \quad if\ SAR_{i,j} \leq 1;\ else\ p_{i,j} = 1$$

With SAR being the swept area ratio of a grid cell i and gear type j.

The underlying assumption of this indicator is a regular trawling pattern (Fig. #.a). It thus overestimates the impacted area.

(b) In the second approach we assume a random distribution of trawling tracks, and the expected proportion of the grid cell covered can be described by the Poisson distribution or the NB with $\beta = 0$:

$$p_{i,j} = (1 - P_{i,j}) \quad with\ P_{i,j} \approx \mathrm{NB}(0|\mathrm{SAR}, \beta = 0)$$

With $P_{i,j}$ being the probability that a grid cell i is not impacted by gear j.

The resulting indicator does not assume any aggregation of trawling tracks. However, the degree of aggregation is dependent on the type of fishery as well as on the underlying habitat. Therefore there is no generally applicable aggregation parameter and the group recommends to use this approach as best but still precautionary proxy to estimate the size of the area affected by fisheries.

(c) For comparative reasons we finally computed the same indicator assuming a high degree of aggregation of trawling tracks within grid cells. The expected proportion of the grid cell covered can be then described by the NB with β =1.24 (Ellis *et al.* 2014).

$$p_{i,j} = (1 - P_{i,j}) \quad with\ P_{i,j} \approx \text{NB}(0|\text{SAR}, \beta = 1.24)$$

With $P_{i,j}$ being the probability that a grid cell i is not impacted by gear j.

The final indicator likely underestimates the total area impacted by fishing gears. However, it gives an example how aggregation of fishing activities, can be accounted for, e.g. along depth gradients.

4.1.1.3 Aggregation of fishing activities (~ DCF indicator 6)

The aggregation of fishing activities was described in two different ways, using the same approaches as described in ICES WGSFD (2016).

The first approach is inspired from the work of (Jennings & Lee 2012). It summarises the proportion of the impacted area containing the top x% of the fishing intensity of a given mobile bottom contacting gear or a group of those gears. For this, the grid cells of an ecoregion are sorted in decreasing order of fishing pressure (SAR). The cumulative SAR values can then be conveniently represented on a curve relating the proportion of the fished area to the proportion of the fishing intensity. The final indicator can be calculated in the same way as the indicator describing the total extent of fishing activities, but considering only those grid cells that experience a previously defined percentage (here: 90%) of the total effort. For details see (ICES WGSFD 2016).

The drawback of this approach is that one needs to consider many arbitrary thresholds to characterize the aggregation of any fishing activity. Consequently, an alternative approach was considered and reported for representing the aggregation indicator inspired from the work by Woillez *et al.* (2007). It is a measure of area relative to the overall variation in fishing intensity. It is tightly linked to the aggregation curve described in the initial approach. However, it rather describes the spreading area and is simply defined as twice the area below the curve:

$$I_{3b,j} = 2 \int \frac{I - I(A)}{I} dA$$

With A being the cumulative area occupied by all fishing intensity values, I(A) is the corresponding cumulative fishing intensity; and I is the overall fishing intensity. For further details please refer to ICES WGSFD (2016).

As in the previous year the group decided to report both indicators, as they were judged to be complementary. The spreading area of fishing intensity was reported in relative terms, i.e. in proportion to the total area of an ICES ecoregion. Both indicators were computed per year and per ICES ecoregion for mobile bottom contacting gears and other gear groups (Otter, Beam, Dredge, Seine).

4.1.1.4 Areas not impacted by mobile bottom contacting gears (~ DCF Indicator 7)

The indicator describing the size of the area not impacted by mobile bottom contacting gears is closely connected to the indicator described in 1.1.1.2, the former DCF5 indicator. Similar to I_2 the indicator can be expressed as

$$I_4 = n - \sum_{i}^{n} p_i * a_i$$

With n being the size of the total area, for which the indicator should be calculated (ICES ecoregion), p_i being the proportion of a grid cell i impacted by all mobile bottom contacting gears, and a_i represents the size of the grid cell i. The expected proportion of a grid cell covered can be calculated in the same way as described in 1.1.1.2, i.e. assuming different trawling patterns. However, SAR values are not gear-specific but represent the sum of all SARs from bottom-contacting gears.

The indicator can be reported in relative terms, i.e. in relation to the size of the entire ICES ecoregion of interest.

4.1.1.5 Extent of persistently unfished areas

This indicator is calculated in the same way as I_4, but uses the sums of multiannual SAR values instead of annual estimates to calculate the grid cell specific proportions impacted by mobile bottom contacting gears. Therefore, it represents the size of the area that remains unfished over a previously defined period. Here we compute indicators for the time period 2009–2016, which represents the time, where regulations according to VMS remained unchanged. Further valuable information can be generated by mapping persistently unfished areas.

4.1.2 Results

Results consist of output tables compiling the various values of the above described indicators from different ICES ecoregions, years and gear groups (mobile bottom contacting gears, otters, beams, dredges and demersal seines). All these tables are available in Annex 3.

In the section below, a series of plots have been generated to illustrate indicators time-series for the mobile bottom contacting gears.

4.1.2.1 Indicator for average fishing intensity

The highest average fishing intensity occurred in the Bay of Biscay and Iberian coast, the Celtic Seas and the Greater North Sea ICES ecoregions (Figure 4.1.2.1). For these areas, the indicator is quite stable.

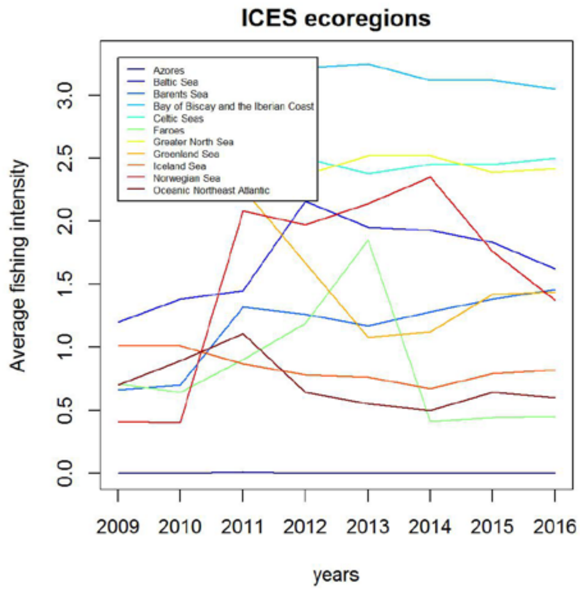

Figure 4.1.2.1. Average fishing intensity for mobile bottom contacting gears per ICES ecoregions

4.1.2.2 Indicator describing the spatial extent of fishing activities (~ DCF indicator 5)

Figure 4.1.2.2 (left) illustrates the percentage of the Greater North Sea area that was swept by all mobile bottom contacting gears, assuming 3 distributions of trawling pattern within grid cells. The 3 assumptions did not change the trend of the indicator, but they scaled the indicator time-series at different levels.

When assuming a random trawling pattern within grid cells, the Greater North Sea ecoregions showed the highest percentage of area that was swept by all mobile bottom contacting gears with ~47%, followed by Celtic Seas with ~28% (Figure 4.1.2.2 right). No specific trend appeared for these indicators.

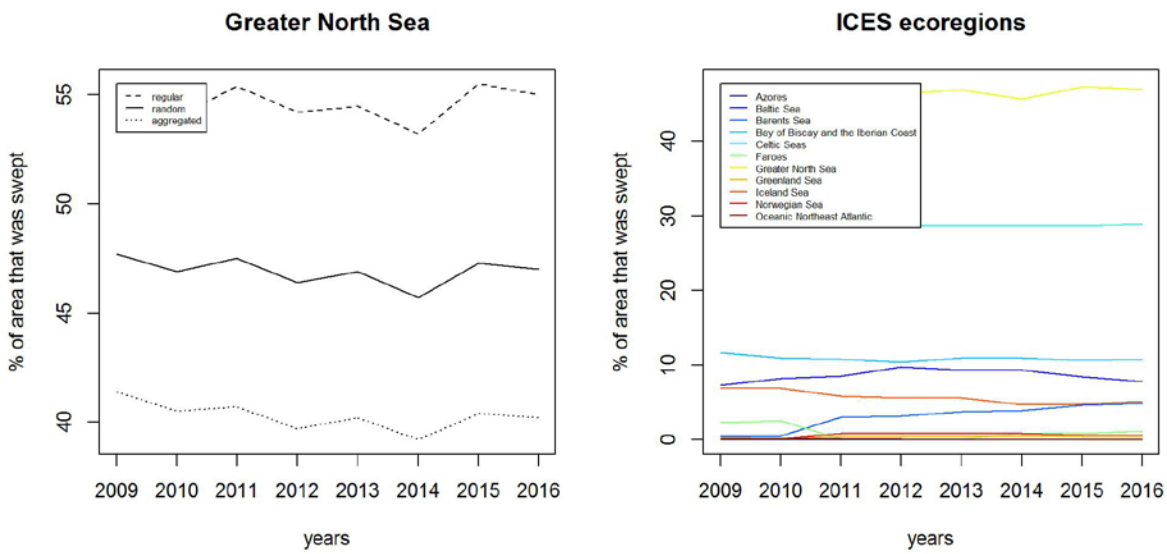

Figure 4.1.2.2. Left) Percentage of the Greater North Sea area that was swept by all mobile bottom contacting gears, assuming 3 distributions of trawling pattern within grid cells. Right) Percentage of ICES ecoregion area that was swept by all mobile bottom contacting gears, assuming random trawling pattern within grid cells.

4.1.2.3 Aggregation of fishing activities (~ DCF indicator 6)

Figure 4.1.2.3 (left) illustrates the percentage of spreading area of fishing intensity of ICES ecoregion areas for all mobile bottom contacting gears. We found again the same two ICES ecoregions: the Greater North Sea, and Celtic Seas ecoregions, that distinguished themselves with values above 15%. Thus, these two ecoregions showed fishing with a large spatial extent and at the same time a high level of aggregation.

This statement vanished if the percentage of the fished area containing the top 90% of the fishing intensity is considered (Figure 4.1.2.3 right). All ICES ecoregions are within the range 30 to 50% for this indicator. Again, no specific trend appeared, meaning that the aggregation of the fishing activities is stable over years.

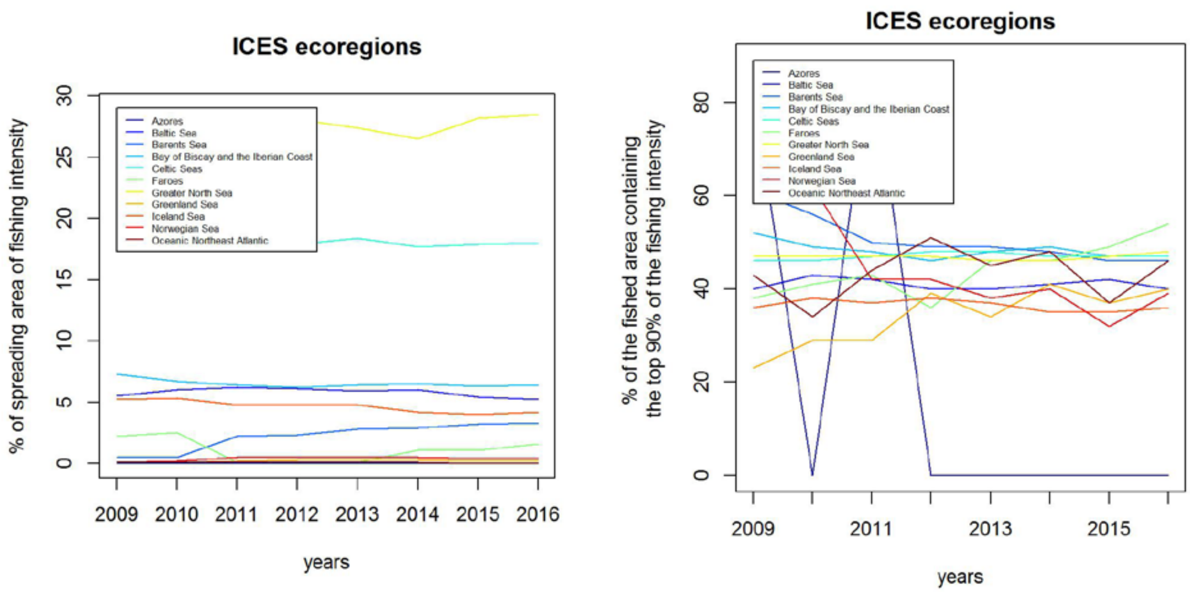

Figure 4.1.2.3. Left) Spreading area of fishing intensity relative to the ICES ecoregion area for mobile bottom contacting gears (in %). Right) Percentage of the fished area containing the top 90% of the fishing intensity for all mobile bottom contacting gears.

4.1.2.4 Areas not impacted by mobile bottom contacting gears (~ DCF Indicator 7)

Figure 4.1.2.4 (left) illustrates the percentage of the Greater North Sea area not impacted by mobile bottom contacting gears, assuming 3 distributions of trawling pattern within grid cells. As before, the 3 assumptions do not changed the trend of the indicator, but they scaled the indicator time-series at different levels.

When assuming a random trawling pattern within grid cells, the Greater North Sea ecoregions showed the lowest percentage of area not impacted by mobile bottom contacting gears with ~52%, followed by Celtic Seas with ~71% (Figure 4.1.2.4 right). No specific trend appeared for these ICES ecoregions.

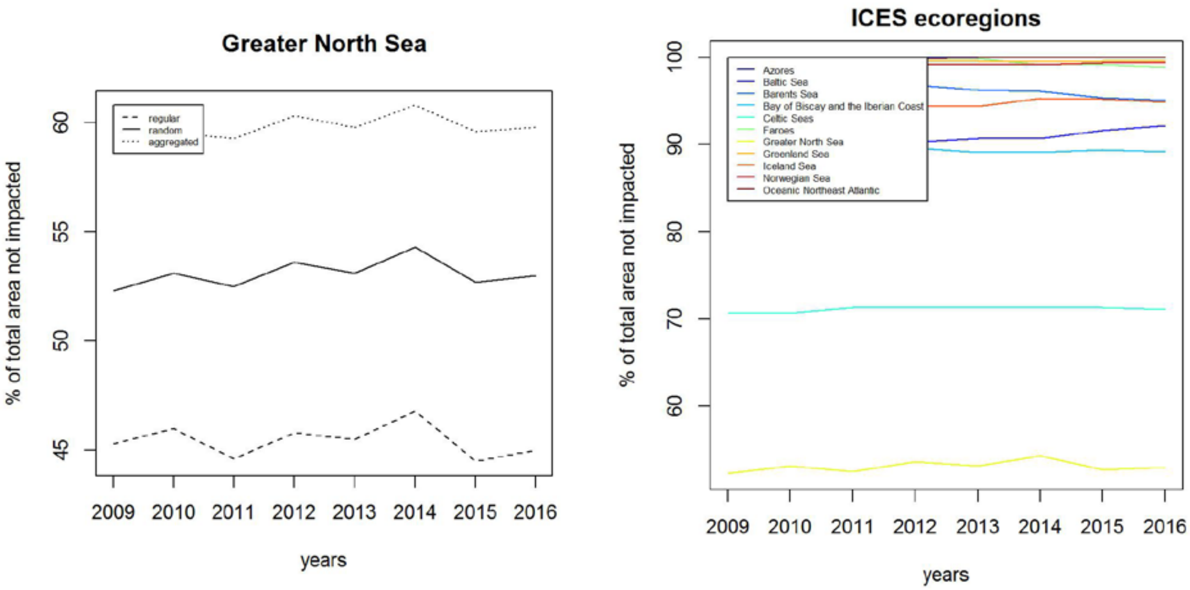

Figure 4.1.2.4. Left) Total area not impacted by mobile bottom contacting gears relative to the Greater North Sea area (in %), assuming 3 distributions of trawling pattern within grid cells. Right) Total area not impacted by mobile bottom contacting gears relative to ICES ecoregion area (in %), assuming random trawling pattern within grid cells.

4.1.2.5 Extent of persistently unfished areas

Table 4.1.2.5 reported the proportion of ICES Ecoregion area that were persistently unfished, i.e. over years 2009–2016, by mobile bottom contacting gears. The Greater North Sea showed the lowest values with 23.8%, followed by the Celtic Seas with 53.5%.

Table 4.1.2.5. Proportion of ICES Ecoregion area that were persistently (i.e. over years 2009–2016) unfished by mobile bottom contacting gears.

ICES Ecoregions	% of persistently unfished area
Azores	100.0
Baltic Sea	83.7
Barents Sea	88.4
Bay of Biscay and the Iberian Coast	82.6
Celtic Seas	53.5
Faroes	95.6
Greater North Sea	23.8
Greenland Sea	98.6
Iceland Sea	86.3
Norwegian Sea	98.4
Oceanic Northeast Atlantic	99.8

References

Eigaard OR, Bastardie F, Hintzen NT, Buhl-Mortensen L, Buhl-Mortensen P, Catarino R, Dinesen GE, Egekvist J, Fock HO, Geitner K, Gerritsen HD, González MM, Jonsson P, Kavadas S, Laffargue P, Lundy M, Gonzalez-Mirelis G, Nielsen JR, Papadopoulou N, Posen PE, Pulcinella J, Russo T, Sala A, Silva C, Smith CJ, Vanelslander B, Rijnsdorp AD (2017) The footprint of bottom trawling in European waters: distribution, intensity, and seabed integrity. ICES Journal of Marine Science 74:847-865

Ellis N, Pantus F, Pitcher CR (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

Gerritsen HD, Minto C, Lordan C (2013) How much of the seabed is impacted by mobile fishing gear? Absolute estimates from Vessel Monitoring System (VMS) point data. ICES Journal of Marine Science: Journal du Conseil 70:523-531

Jennings S, Lee J (2012) Defining fishing grounds with vessel monitoring system data. ICES Journal of Marine Science: Journal du Conseil 69:51-63

Piet GJ, Hintzen NT (2012) Indicators of fishing pressure and seafloor integrity. ICES Journal of Marine Science: Journal du Conseil 69:1850-1858

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

Woillez M, Poulard Jean-Charles, Rivoirard Jacques, Petitgas Pierre, Bez Nicolas (2007). Indices for capturing spatial patterns and their evolution in time, with application to European hake (*Merluccius merluccius*) in the Bay of Biscay. ICES Journal of Marine Science, 64(3), 537-550.

4.2 ToR B: Work on standardized methods to produce spatial fishery distribution products

The quality of the output produced by WGSFD and the ICES secretariat is highly dependent on the quality of the data provided by the member states as well as the routines to process and analyse these data. Due to the complexity of the data and the different setups individual countries have for holding and extracting VMS /Logbook data, trying to standardize workflows and/or final products can be a challenging task. To address these issues, WGSFD in 2015 proposed developing a best practices guide and workflows in R to help states stream line data extraction, cleaning, aggregating and submission processes. The R-script was sent out to national data-submitters to be used for the combination and aggregation of fisheries data on national levels. Although not all countries used the R-script, the quality of submitted data improved over the last years. In the case of missing data for average vessel speed, this was estimated by calculating the average vessel speed from all available data, separated for each metier (level 4). The status of data submissions is given in table 4.2.1.

Table 4.2.1. Status of data submission.

	Data submitted	Comments
Belgium	Yes	
Denmark	Yes	Some potential issues found during the meeting will be clarified in due time
Estonia	Yes	Data were submitted during the meeting of WGSFD
Faroe Islands	No	
Finland	Yes	
France	Yes	
Germany	Yes	
Greenland	No	
Iceland	Yes	Only VMS data, including métiers, could be submitted
Ireland	Yes	
Latvia	Yes	
Lithuania	Yes	
Netherlands	Yes	
Norway	Yes	
Poland	Yes	
Portugal	Yes	
Russia	No	
Spain	No	
Sweden	Yes	
UK	Yes	

An additional way to achieve a high quality of the data products is to identify any potential issues and doubtful results in the submitted and aggregated data as early as possible. Once these issues are highlighted, a deeper analysis on the data could reveal whether these deviances are reflecting true changes or are based on errors in the data that can to be corrected.

A thorough quality check process increases both, the reliability on the data used in the analysis as well as the confidence by the final recipient in the advice given. With the aim of establishing a homogenous aggregation of data products based on VMS and logbooks data and also with the aim of facilitating the task to evaluate the quality of the data collected, processed and provided by the Member States, WGSFD together with the ICES Data Centre implemented a number of improvements on the quality check reports that were sent to the data submitters in 2017.

This year, WGSFD, ICES secretariat and ICES Data Centre increased their effort further to ensure that data submissions and aggregated data do have the best quality possible. To achieve this, a multi-step approach, following a four-eye principle wherever possible, was implemented.

Each national data submission was analysed with the help of a standardized R-script that was developed by the ICES Data Centre together with the WGSFD chairs. First, summaries were calculated for 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, that show any differences for each c-square (VMS data) or ICES rectangle (logbook data) by comparing the values for the most recent year submitted against the data from the year before as well as the mean of all years. Thus, it was easier possible to identify areas that showed larger deviations, so that the underlying data could be checked in more detail. The resulting quality check reports were checked by one of the WGSFD chairs, commented and sent back via the ICES Data Centre to the data provider.

The same script was used at the WGSFD meeting to produce two quality check reports on the aggregated data, one on the data submitted 2017, the other on the data submitted last year. These reports were compared by WGSFD experts using the values of the year 2015 to detect any larger deviations. This helped to detect and resolve an issue that happened while aggregating the submitted data in the main data base during the meeting. No checks were done on all static and active midwater gears, due to the lack of expertise present.

Based on the VMS data aggregated for all submitted national data, two sets of maps for each main gear group (Benthis métiers) were produced:

a) Presence - absence of data for each c-square;

b) Difference in surface abrasion values for each c-square between years 2015 and 2016.

A third set of maps was created to search for any differences in surface abrasion values for each c-square for the year 2015, comparing the data submitted in 2016 versus the data submitted in 2017.

All those maps were checked for any deviations by all WGSFD experts in plenary during the meeting.

Any differences detected during these checks were analysed in more detail. Either, a reasonable explanation for the difference (e.g. known changes in fishing effort) could be found. In some cases, errors could be identified, so that the 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 (Table 4.2.2). The whole process increased the validity of the data to be used for future outputs.

Table 4.2.2. Results of quality checks carried out on aggregated data set. Gear groups based on BENTHIS-métiers.

Gear group	Presence-Absence per c-square	Differences SA-values 2015 to 2016
DRB_MOL	o.k.	o.k
OT_CRU	o.k	o.k
OT_DMF	o.k	o.k
OT_MIX	o.k	o.k
OT_MIX_CRU_DMF	o.k	o.k
OT_MIX_DMF_BEN	o.k	o.k
OT_SPF	o.k	o.k
SDN_DMF	o.k	o.k

SSC_DMF	o.k	o.k
TBB_CRU	o.k	o.k
TBB_DMF	o.k	o.k
TBB_MOL	o.k	o.k

The method developed by WGSFD in 2015, including a workflow and an R-script, to calculate fishing intensity from the data available through the data call was implemented by the ICES Data Centre in advance of the 2017 meeting. In estimating intensity, values of both gear width and the proportion of the gear that contacts with the sea floor are required. As this information is not readily available from the log-book, values were derived from the EU funded BENTHIS project. Thus, as an initial step in estimating fishing intensity, some preliminary work was required to assign DCF level 6 métiers to the BENTHIS métiers. Measures of both the average vessel power (kW) and average vessel length (m) for each métier per c-square were included in submitted data, to estimate bottom contact values for individual gears based on the relationship between gear size and vessel power/length as published by Eigaard *et al.* (2016). For Danish and Scottish seines, the proportions for subsurface abrasion used in this year's calculations were updated to values of 0 % and 5 %, respectively, compared to 5 % and 14 as used in last year's calculations, thus being in line with the data for these gears as given in Eigaard *et al.* (2016). A change in threshold definition for subsurface abrasion caused this update. A revised and checked code was used to aggregate the data submitted, allocate them to Benthis metiérs, and calculate gear width as well as abrasion proportions.

All scripts (R and SQL) used to produce the quality checks (reports and maps) are stored on the ICES GitHub, so that the routines can be checked, updated and used again for coming data calls in a standardized way. Also, data submitter can download and adapt these routines to use them for own quality checks on their national data before these are submitted.

WGSFD discussed further work to improve data quality checks. Potential ideas that could be followed are identification of additional maps, defining ranges and outliers that would trigger additional checks of the data. Also, the potential to develop more sophisticated algorithms for data checks could be investigated.

In a first steps, the quality check reports will be further improved, to increase their readability and possibilities to identify any data issues. To achieve this, concrete proposals for improvement will be forwarded to the ICES Data Centre to be included in the underlying scripts and routines.

4.3 ToR C: Review ongoing work for analysing spatial fisheries data

4.3.1 Individual Stress Level Analyses (ISLA)

Torsten Schulze

Individual Stress Level Analyses (ISLA) comprises the small scale estimation of fishing effort, catch or revenues for a grid of 0.05° c-squares (1.5 nm x 3 nm). By estimating the revenue and potential loss per individual vessel from future area closures for the fisheries (e.g. wind farms or nature conservation sites), the stress per vessel can be aggregated to ‘stress level’ profiles of national fleets (Figure 4.1.1), regions or harbours (Figure 4.3.2). Individual stress level is defined as the percentage of the total revenues of a vessel which would get lost if an area will be closed for fishing in future.

The output figures can easily be communicated to decision makers and other stakeholders to inform about the potential outcome of management options. ISLA allows for analysing sensitive industry data and communication of results in an anonymous way, enabling a discussion in the public.

Scenarios based on spatial management (exclusion or restriction of gears in certain areas) can be tested. ISLA is implemented in R, using vms-tools functions. Due to confidentially issues of the data, currently the code needs be run by national experts. The aggregated and anonymized output can then be shared.

Needed input: TACSAT, EFLALO, shapes of managed areas, information on management (gears, times). For more information, see Coexist Deliverable 3.2 (Schulze *et al.* 2010: Report on economic analysis in coastal fisheries on the basis of revenue for individual profession and fishing trips). www.coexistproject.eu

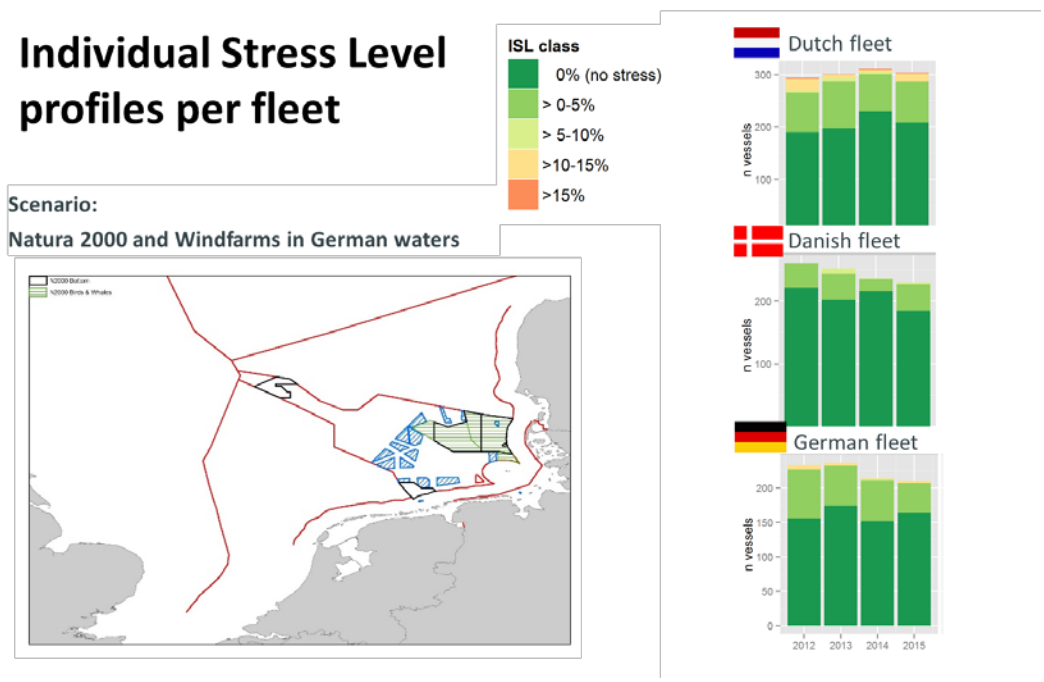

Figure 4.3.1. Test of a future “Natura 2000 and Windfarm in the German waters” Scenario. Individual Stress Level profiles of the Dutch, Danish and the German fleet assuming the effort distribution of the year 2012 to 2015.

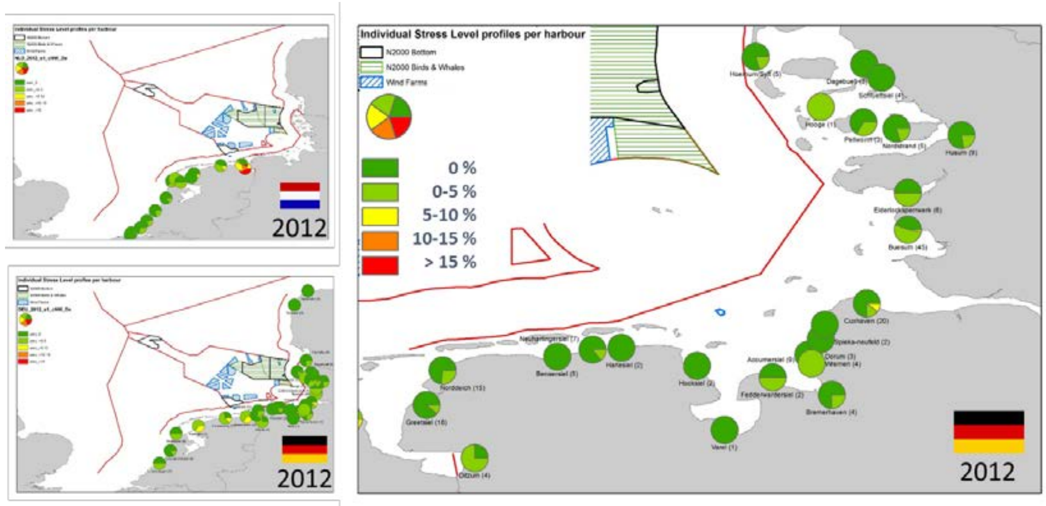

Figure 4.3.2. Test of a future "Natura 2000 and Windfarms in the German waters" scenario. Individual Stress Level profiles of harbour communities of the Dutch and the German fleet assuming the effort distribution of the year 2012.

4.3.2 How stable are fishing grounds in time and space

Niels Hintzen

A presentation on a case study looking in to the stability of fishing grounds by the Dutch beamtrawl fleet was presented to WGSFD. In the study the stability in aggregation, the untrawlable habitat proportion and preference of spatial location was studied. Results indicate that all three indicators show substantial stability in time and space in especially the Southern North Sea where most of the effort is allocated. In the central North Sea areas seem to be fished with more variability and changes in spatial location.

4.3.3 AIS for Ghostnets project

Josefine Egekvist

The analysis on VMS and AIS data was done in relation to a pilot study on Ghostnets, on derelict fishing gears in the Danish EEZ. The idea was to use VMS to identify conflict zones with overlap between active and passive gears, wrecks and marine traffic. After the identification of the conflict zones, interviews were conducted with fishermen and divers to get their view on how big the problem is. Many passive gears are small vessels that don't have VMS, and therefore it was tested if AIS could supplement the VMS data. VMS is mandatory for vessels larger than 12 m, while AIS is mandatory for fishing vessels larger than 15 m. However, AIS is a security system, and smaller vessels can have it voluntarily. AIS data have been made publicly available with no cost from the Danish Maritime Agency. The data were downloaded, filtered for fishing vessels and to a position every 5 minutes and a test was run on 2015.

To get information about the gear, normally the logbook register is used, but logbooks are only mandatory for vessels larger than 10 m (8 m in the Baltic). So it was investigated if the primary gear from the vessel register could be used by comparing it with the gear reported in the logbook register where it was available. This showed that for some gears there was a good agreement between the two data sources, but for others the quality of the gear in the vessel register doesn't seem to be good. Therefore it was decided only to use AIS data for vessels that fill in logbooks.

It was tested how much the use of AIS data as a supplement to VMS data would increase the coverage of spatial fisheries data in relation to the total fisheries by merging with the logbook and sales notes register. The Danish sales notes register also contain landings from all vessels, and the effort for those is assumed to be one day per landing. In 2015, 25% of the vessels had VMS, and by adding the AIS the coverage increased to 31%. When looking at landings, the coverage increased from 97% to 98%, the coverage of value of landings increased from 94% to 96% and the effort (days at sea) from 57 to 65%. Speed profiles were plotted, and they look similar to the VMS speed profiles. It was found that in some areas that are poorly covered by VMS data there is a good coverage of AIS data. This is the case of e.g. Øresund where trawling is not allowed, and therefore the AIS data adds valuable information.

For the Ghostnets pilot study, the coverage of vessels fishing with active and passive gears was assessed by making coherent polygons if positions were less than 2 km from each other. The overlap between active and passive fishing gears was mapped by quarter, and some conflict zones were identified. Maps of overlaps between wrecks and active/passive fishing gears were also made, and overlaps between passive gears and marine traffic were identified. This was used as the basis for interviews with fishermen and sports divers, and will also be used when selecting sites for a pilot survey on Ghostnets.

4.3.4 Assessment of level of disturbance on the seabed by bottom trawling in the Mediterranean Sea through AIS data

Carmen Ferrà

Within the EMODnet MedSea Checkpoint project, a new approach to map bottom trawl fishing effort and the change in level of disturbance was needed due to the difficulty to collect VMS data from EU countries. The analysis described by Natale *et al.* 2015 was followed in order to identify fishing pings from AIS data for three different years (2012-2014) with some variations: because of the presence of non EU countries, the link with EU fleet register was avoided and the analysis was performed seasonally in order to identify possible gear changer during a year period.

Different speed profiles from known vessels were analysed to distinguish métiers and to set up the values of EM parameters better matching with the bottom trawl behaviour. Parameters obtained from the EM algorithm together with the vessel length were used to perform a cluster analysis in order to identify bottom trawl vessels and for these vessels the speed confidence interval related to the fishing phase was calculated.

Subsequently, tracking layers from fishing pings were built and fishing tracks were extracted filtering each vessel for its speed confidence interval and a reliable duration for the fishing activity. Finally, the impact of bottom trawling was computed using a 0.01°x0.01° grid, spatial joining each cell with intersecting monthly swept tracks and summing up relative lengths (km). In addition, changes in level of disturbance between two consecutive years were mapped using only vessels that were AIS equipped in both years. This work confirms the suitability of this monitoring system to obtain reliable information on the extent of effort from bottom trawl fishing activities, and its possible application as an alternative to VMS data.

4.4 ToR D: Initiate innovative methods to analyse spatial fisheries data

Within this ToR the group held an in-depth discussion on potential relevant topics to display our capabilities in analysing and interpreting spatial fisheries data. A number of topics of interest to WGSFD and ICES in general were listed and are given below:

- Automatic, high speed, identification of fishing activity of VMS records that cannot be linked to logbook data;
- Area extent used by fish species within a management area;
- Fisheries indicators bias in relation to spatial scale of data;
- Predictive spatio-temporal fisheries model;
- Quantifying and understanding spatio-temporal variability of the fishing fleet;
- Micro-scale distribution of MPAs;
- Micro-behaviour of fishermen;
- Best practice on analysing small scale fisheries;
- Ground-truthing gillnet / small-scale fisheries distribution and effort;
- Fisheries distribution then (18^{th}/19^{th} century) and now (21^{st} century);
- Best practices on analysing VMS and logbook data from a world-wide perspective.

Each of these topics were scored on: 1) time to success, 2) data availability, 3) novelty, 4) coverage, 5) man-power requirement and 6) legal issues. From this, two topics were selected and added to the ToR for 2018.

A subgroup further detailed the potential outline of the two papers listed.

4.5 Cooperation with other WG

4.5.1 Analysis of NEAFC VMS Data for WGDEC

In 2016 WGSFD was requested to support WGDEC with the analysis of NEAFC VMS and catch data, describing '"fisheries activities in and in the vicinity of such (VME) habitats" (areas defined by WGDEC) within the NEAFC Convention Area in 2015. If possible, descriptions should be made of each area near such habitats, and separate each bottom contact gear type (e.g. static or mobile gears)'. Due to the timing of the working groups, this support was provided intersessionally. WGDEC had a subsequent term of reference in 2017 to 'Provide all available new information on distribution of VMEs in the North Atlantic with a view to identifying potential new closures to bottom fisheries or revision of existing closures to bottom fisheries. In addition, provide new information on location of habitats sensitive to particular fishing activities (i.e. vulnerable marine ecosystems, VMEs) within EU waters' and WGSFD were requested once more to support this by performing an equivalent analysis with NEAFC VMS and catch data from 2016.

Vessel monitoring system (VMS) data were received from NEAFC, via the ICES Secretariat, along with catch information from logbooks, authorisation details, and vessel information from the NEAFC fleet registry. These tables were linked using a unique identifier (the "RID" field) which changes on a six-monthly basis to protect anonymity of vessels. As there is no date information in the catch records, catches can only be linked to vessels at this level of resolution, complicating the interpretation of results.

The VMS data was filtered in R to exclude all duplicate reports, polls outside the year 2016, and messages denoting entry and exit to the NEAFC regulatory area ("ENT" and "EXT" positions). The time interval between consecutive pings for each vessel was calculated and assigned to each position. Any interval values greater than four hours were truncated to this duration, as this is the minimum reporting frequency specified in the Article 11 of the NEAFC Scheme of Control and Enforcement.

Examination of the speed field of the VMS data showed that there were issues with data quality. The "estimated speed" and "vessel speed" columns contained no values, and while the "SP" field did contain numeric values, they ranged from zero to 700, suggesting a problem with decimal places, however not in a consistent manner across the dataset. As a means of avoiding this problem, a derived speed was calculated as the orthodromic distance between consecutive points reported by a vessel, divided by the time difference between them, using the WGS84 ellipsoid. In this instance, a speed of 5 knots or lower has been used to demarcate fishing from non-fishing pings for all gears.

Rasters of effort (time associated with pings at derived speeds of 0–5 knots were prepared for the area from 39.5°N to 64°N and 42°W to 7°W (i.e. covering the area of the NEAFC regulatory area in which there are spatial measures for the protection of VMEs) for vessels registered as using mobile bottom contact gears (otter trawl - OTB, twin-rigged otter trawl - OTT, pair trawl - PTB and shrimp trawl - TBS), static gears (gear codes "LL", "LLS", "LLD", "GND", "GNS" and "LNB"), and vessels which had no recorded gear code ("NULL" and "NIL"). Vessels lacking a gear code comprised 12.5% of records in the VMS dataset.

For vessels recorded as using mobile bottom contacting gears, consecutive pings at fishing speed (0–5 knots) were grouped into putative tows, to assist with interpretation of data and to serve as a quality check. These tows were plotted in ArcGIS as separate maps. Histograms of effort at depth were prepared for vessels using mobile bottom gears, using the GEBCO 1' grid data set.

A set of four maps (bottom-trawl tow-lines, gridded effort for vessels registered as using bottom contact gear, static gear, and no gear type registered) were provided to WGDEC, in addition to depth profiles of VMS positions at fishing speeds of vessels registered as using bottom contact gears, for the following areas:

- Mid-Atlantic Ridge;
- Reykjanes Ridge;
- Southern Rockall Bank;
- Hatton Bank;
- East Rockall Bank.

The code used to perform this analysis was uploaded to the ICES Github site to facilitate performance of this task in the future.

5 Revisions to the work plan and justification

Given the progress made by WGSFD in 2016 & 2017 it was suggested to draft new ToRs for the 2018 meeting and develop a new line of work to reinstigate the identity of WGSFD. The new ToRs for 2018 are:

1. Develop methods to estimate fishing activity and/or effort of static gears using from positional data, logbook data, observer data and questionnaires
2. Work towards manuscripts to be published in peer-reviewed journals that:
    a. Quantify and explain the spatio-termporal variability of fishing fleets across the ICES areas
    b. Present best-practices on how to analyse and use VMS data from a world-wide perspective

Furthermore, ToR A has been concluded and will not be re-addressed in 2018. ToR B, C and D will remain.

6 Next meetings

Venue proposal (default): ICES HQ, Copenhagen, Denmark

Alternative venue proposals (to be confirmed): Edinburgh, DTU-Aqua, Lysekil

Annex 1: List of participants

Name	Address	Phone/Fax	Email
Neil Campbell	Marine Scotland Science Marine Laboratory 375 Victoria Road AB11 9DB Aberdeen United Kingdom	+44 (0) 1224 275572	Neil.Campbell@gov.scot
Rabea Diekmann	Thünen Institute of Fisheries Ecology Palmaille 9 22767 Hamburg Germany	+49 40 38905 135	Rabea.diekmann@thuenen.de
Christian von Dorrien (Co-Chair)	Thünen Institute of Baltic Sea Fisheries Alter Hafen Süd 2 18069 Rostock Germany	+49 381 8116 106	christian.dorrien@thuenen.de
Dan Edwards	Joint Nature Conservation Committee, Inverdee House, Torry, Aberdeen, AB11 9QA, UK	+44 7793677536	Dan.edwards@jncc.gov.uk
Josefine Egekvist	Charlottenlund Slot Jægersborg Allé 1 2920 Charlottenlund Denmark	+45 35883438	jsv@aqua.dtu.dk
Carmen Ferrà Vega	National Research Council (CNR)-Institute of Marine Sciences (ISMAR) Largo Fiera della Pesca 1, 60125 Ancona, Italy	+39 071 2078819	carmen.ferra@an.ismar.cnr.it
Maurizio Gibin	European Commission Joint Research Centre Institute for the Protection and Security of the Citizen (IPSC) Maritime Affairs Unit TP05A Via Enrico Fermi 2749 I-21027 Ispra (VA)	+39 0332 786770	maurizio.gibin@jrc.ec.europa.eu
Niels Hintzen (Co-Chair)	Haringkade 1, 1976CP, Ijmuiden, The Netherlands	+31 317 487090	Niels.hintzen@wur.nl
Irina Jakovleva	Fisheries Service under the Ministry of Agriculture Naujoji uosto str. 8 A Klaipeda Lithuania	+37046310660	Irina.Jakovleva@zuv.lt

Patrik Jonsson	Swedish University of Agricultural Sciences Institute of Marine Research Turistgatan 5 P.O. Box 4 453 21 Lysekil Sweden	+46 733 842283	Patrik.jonsson@slu.se
Maksims Kovsars	Institute of Food Safety, Animal Health and Environment (BIOR) Fish Resources Research Department 8 Daugavgrivas Str. 1048 Riga Latvia		Maksims.Kovsars@bior.lv
Roi Martinez	Pakefield Road Lowestoft Suffolk NR33 0HT United Kingdom	+44 (0) 1502 562244	roi.martinez@cefas.co.uk
Jeppe Olsen	Charlottenlund Slot Jægersborg Allé 1 2920 Charlottenlund Denmark		jepol@aqua.dtu.dk
Carlos Pinto	H. C. Andersens Boulevard 44-46 DK 1553 Copenhagen V Denmark	+45 33386713	carlos.pinto@ices.dk
Perttu Rantanen	Natural Resources Institute Finland (Luke) Itäinen Pitkäkatu 3 20520 Turku Finland	+358 404801606	perttu.rantanen@luke.fi
Yves Reecht	Marine Institute Rinville ORANMORE – Co. Galway H91 R673 Ireland	+353 91 38 7536	Yves.Reecht@marine.ie
Torsten Schulze	Thünen Institute of Sea Fisheries Palmaille 9 22767 Hamburg Germany	+49 40 38905 117	Torsten.Schulze@thuenen.de
Nora Tassetti	National Research Council (CNR)-Institute of Marine Sciences (ISMAR) Largo Fiera della Pesca 1, 60125 Ancona, Italy	+39 071 2078819	nora.tassetti@an.ismar.cnr.it

Mathieu Woillez	Ifremer, STH Centre de Brest Technopole de Brest -Iroise P.O. Box 70 29280 Plouzané France	+33 (0)2 29 00 85 65	Mathieu.Woillez@ifremer.fr
Sebastian Valanko	H. C. Andersens Boulevard 44-46 DK 1553 Copenhagen V Denmark		Sebastian.Valanko@ices.dk
Einar Hjörleifsson	Skúlagata 4, 101 Reykjavík, Iceland		einarhj@hafro.is

Annex 2: Recommendations

Recommendation	Adressed to
1. Detailled spatial-temporal information on movement and activity of static gear fisheries is lacking and limits the potential to provide effort estimation for these fisheries. It is recommended to initiate case-study examples to collect GPS positions and their associated activity (steaming, setting gear, hauling gear) and make these available to WGSFD for further analyses.	RCM

Annex 3: Tables of indicators

The results below are output tables compiling the various values of indicators for the different ICES ecoregions, years and gear groups (mobile bottom contacting gears, Otter, Beam, Dredge and Demersal seine gears). Only surface abrasion indicators are reported in this annex.

Distribution of fishing activities (DCF indicator 5)

All mobile bottom contacting gears

Table: Percentage of ICES ecoregion area that was swept for all mobile bottom contacting gears, assuming a regular trawling.

	2009	2010	2011	2012	2013	2014	2015	2016	all
Azores	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Baltic Sea	8.7	9.8	10.0	11.0	10.6	10.7	9.9	9.1	17.5
Barents Sea	0.6	0.6	3.6	3.9	4.5	4.8	5.5	5.9	13.2
Bay of Biscay and the Iberian Coast	13.2	12.2	12.2	11.6	12.2	12.3	12.0	12.2	18.2
Celtic Seas	33.5	33.6	32.9	32.8	32.8	33.0	32.9	33.1	49.0
Faroes	2.8	3.0	0.1	0.1	0.1	1.0	1.0	1.4	5.1
Greater North Sea	54.7	54.0	55.4	54.2	54.5	53.2	55.5	55.0	79.6
Greenland Sea	0.3	0.3	0.4	0.5	0.5	0.6	0.5	0.4	1.6
Iceland Sea	8.5	8.4	7.1	6.8	6.9	5.8	5.9	6.3	15.2
Norwegian Sea	0.1	0.1	0.9	0.9	0.9	0.9	0.7	0.7	1.7
Oceanic Northeast Atlantic	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.2

Table: Percentage of ICES ecoregion area that was swept for all mobile bottom contacting gears, assuming a random trawling.

	2009	2010	2011	2012	2013	2014	2015	2016	all
Azores	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Baltic Sea	7.3	8.2	8.5	9.7	9.3	9.3	8.4	7.8	16.3
Barents Sea	0.4	0.5	3.0	3.2	3.7	3.9	4.6	4.9	11.6
Bay of Biscay and the Iberian Coast	11.7	10.9	10.8	10.4	10.9	10.9	10.6	10.8	17.4
Celtic Seas	29.3	29.3	28.7	28.7	28.7	28.7	28.7	28.9	46.5
Faroes	2.3	2.5	0.1	0.1	0.1	0.8	0.8	1.1	4.4
Greater North Sea	47.7	46.9	47.5	46.4	46.9	45.7	47.3	47.0	76.2
Greenland Sea	0.3	0.2	0.4	0.4	0.4	0.5	0.4	0.3	1.4
Iceland Sea	7.0	6.9	5.8	5.6	5.6	4.7	4.8	5.1	13.7
Norwegian Sea	0.1	0.1	0.8	0.8	0.8	0.8	0.6	0.6	1.6
Oceanic Northeast Atlantic	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.2

Table: Percentage of ICES ecoregion area that was swept for all mobile bottom contacting gears, assuming an aggregated trawling.

	2009	2010	2011	2012	2013	2014	2015	2016	all
Azores	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Baltic Sea	6.0	6.8	7.2	8.4	7.9	8.0	7.2	6.5	15.1
Barents Sea	0.3	0.4	2.4	2.6	2.9	3.2	3.7	4.0	10.0
Bay of Biscay and the Iberian Coast	10.3	9.6	9.6	9.2	9.6	9.5	9.4	9.5	16.6
Celtic Seas	25.3	25.3	24.9	24.9	24.9	24.8	24.9	25.1	44.0
Faroes	1.8	1.9	0.1	0.1	0.1	0.6	0.6	0.8	3.6
Greater North Sea	41.4	40.5	40.7	39.7	40.2	39.2	40.4	40.2	72.7
Greenland Sea	0.2	0.2	0.3	0.4	0.3	0.4	0.3	0.3	1.2
Iceland Sea	5.7	5.6	4.7	4.4	4.4	3.7	3.8	4.1	12.3
Norwegian Sea	0.1	0.1	0.7	0.7	0.7	0.7	0.5	0.5	1.4
Oceanic Northeast Atlantic	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.2

Demersal seine

Table: Percentage of ICES ecoregion area that was swept for demersal seine, assuming a regular trawling.

	2009	2010	2011	2012	2013	2014	2015	2016	all
Baltic Sea	0.8	0.7	0.7	0.7	0.4	0.4	0.3	0.3	1.6
Barents Sea	0.0	0.0	0.4	0.5	0.5	0.5	0.5	0.6	1.6
Bay of Biscay and the Iberian Coast	0.5	1.3	1.6	1.7	2.0	1.8	1.6	1.7	3.4
Celtic Seas	2.1	2.5	2.9	2.5	2.8	2.9	2.7	2.4	7.9
Faroes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Greater North Sea	13.0	11.7	11.6	11.1	11.2	10.9	11.3	11.9	31.6
Norwegian Sea	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.1	0.2
Oceanic Northeast Atlantic	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table: Percentage of ICES ecoregion area that was swept for demersal seine, assuming a random trawling.

	2009	2010	2011	2012	2013	2014	2015	2016	all
Baltic Sea	0.7	0.6	0.6	0.6	0.3	0.3	0.3	0.3	1.4
Barents Sea	0.0	0.0	0.4	0.4	0.5	0.5	0.5	0.5	1.3
Bay of Biscay and the Iberian Coast	0.4	1.1	1.4	1.5	1.8	1.6	1.5	1.5	3.1
Celtic Seas	1.8	2.1	2.5	2.2	2.4	2.4	2.2	2.1	6.8
Faroes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Greater North Sea	10.8	9.7	9.7	9.3	9.4	9.2	9.5	10.0	27.8
Norwegian Sea	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.1	0.2
Oceanic Northeast Atlantic	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table: Percentage of ICES ecoregion area that was swept for demersal seine, assuming an aggregated trawling.

	2009	2010	2011	2012	2013	2014	2015	2016	all
Baltic Sea	0.6	0.5	0.4	0.5	0.3	0.3	0.2	0.3	1.2
Barents Sea	0.0	0.0	0.3	0.4	0.4	0.4	0.4	0.4	1.1
Bay of Biscay and the Iberian Coast	0.3	0.9	1.2	1.3	1.5	1.4	1.3	1.3	2.7
Celtic Seas	1.4	1.7	2.1	1.8	2.0	2.0	1.8	1.7	5.8
Faroes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Greater North Sea	8.8	7.9	7.9	7.7	7.7	7.6	7.9	8.3	24.4
Norwegian Sea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Oceanic Northeast Atlantic	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Otter

Table: Percentage of ICES ecoregion area that was swept for otter, assuming a regular trawling.

	2009	2010	2011	2012	2013	2014	2015	2016	all
Azores	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Baltic Sea	8.3	9.3	9.7	10.7	10.4	10.5	9.6	8.8	17.2
Barents Sea	0.6	0.6	3.3	3.6	4.1	4.4	5.2	5.4	12.7
Bay of Biscay and the Iberian Coast	12.9	11.8	11.7	11.2	11.8	12.0	11.8	11.8	18.1
Celtic Seas	31.9	31.8	31.0	31.1	31.0	30.9	30.8	30.9	46.9
Faroes	2.8	3.0	0.1	0.1	0.1	1.0	0.9	1.4	5.1
Greater North Sea	40.4	39.3	41.4	40.0	40.6	40.0	42.1	41.2	68.2
Greenland Sea	0.3	0.3	0.4	0.5	0.5	0.6	0.5	0.4	1.6
Iceland Sea	8.5	8.4	7.1	6.8	6.9	5.8	5.9	6.3	15.2
Norwegian Sea	0.1	0.1	0.9	0.9	0.8	0.9	0.7	0.6	1.6
Oceanic Northeast Atlantic	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.2

Table: Percentage of ICES ecoregion area that was swept for otter, assuming a random trawling.

	2009	2010	2011	2012	2013	2014	2015	2016	all
Azores	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Baltic Sea	6.9	7.8	8.3	9.4	9.0	9.1	8.2	7.5	16.0
Barents Sea	0.4	0.5	2.7	2.9	3.3	3.6	4.3	4.5	11.0
Bay of Biscay and the Iberian Coast	11.4	10.4	10.3	9.9	10.4	10.4	10.3	10.4	17.3
Celtic Seas	27.8	27.6	27.0	27.1	26.9	26.8	26.8	26.9	44.4
Faroes	2.3	2.5	0.1	0.1	0.1	0.8	0.8	1.1	4.4
Greater North Sea	35.2	34.1	35.5	34.2	35.0	34.3	35.8	35.1	63.7
Greenland Sea	0.3	0.2	0.4	0.4	0.4	0.5	0.4	0.3	1.4
Iceland Sea	7.0	6.9	5.8	5.6	5.6	4.7	4.8	5.1	13.7
Norwegian Sea	0.1	0.1	0.8	0.7	0.7	0.8	0.6	0.5	1.5
Oceanic Northeast Atlantic	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.2

Table: Percentage of ICES ecoregion area that was swept for otter, assuming an aggregated trawling

	2009	2010	2011	2012	2013	2014	2015	2016	all
Azores	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Baltic Sea	5.6	6.4	6.9	8.1	7.7	7.7	6.9	6.3	14.8
Barents Sea	0.3	0.4	2.2	2.3	2.6	2.9	3.5	3.6	9.5
Bay of Biscay and the Iberian Coast	10.1	9.2	9.1	8.7	9.0	9.1	8.9	9.0	16.4
Celtic Seas	24.0	23.8	23.2	23.4	23.3	23.0	23.1	23.3	41.9
Faroes	1.8	1.9	0.1	0.1	0.1	0.6	0.6	0.8	3.6
Greater North Sea	30.2	29.2	30.1	29.0	29.7	29.1	30.2	29.7	59.4
Greenland Sea	0.2	0.2	0.3	0.4	0.3	0.4	0.3	0.3	1.2
Iceland Sea	5.7	5.6	4.7	4.4	4.4	3.7	3.8	4.1	12.3
Norwegian Sea	0.1	0.1	0.7	0.6	0.6	0.7	0.5	0.4	1.3
Oceanic Northeast Atlantic	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.2

Beam

Table: Percentage of ICES ecoregion area that was swept for beam, assuming a regular trawling

	2009	2010	2011	2012	2013	2014	2015	2016	all
Bay of Biscay and the Iberian Coast	0.5	0.4	0.4	0.3	0.4	0.4	0.3	0.3	1.2
Celtic Seas	2.4	2.5	2.6	2.6	2.6	2.4	2.4	2.4	7.2
Greater North Sea	14.5	15.1	14.5	14.5	14.4	13.3	13.6	14.1	26.8

Table: Percentage of ICES ecoregion area that was swept for beam, assuming a random trawling

	2009	2010	2011	2012	2013	2014	2015	2016	all
Bay of Biscay and the Iberian Coast	0.4	0.3	0.3	0.2	0.3	0.3	0.2	0.3	1.1
Celtic Seas	1.9	2.0	2.1	2.0	2.1	1.9	1.9	1.9	6.2
Greater North Sea	11.8	12.3	11.6	11.5	11.4	10.6	10.7	11.2	24.7

Table: Percentage of ICES ecoregion area that was swept for beam, assuming an aggregated trawling

	2009	2010	2011	2012	2013	2014	2015	2016	all
Bay of Biscay and the Iberian Coast	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.9
Celtic Seas	1.4	1.4	1.5	1.5	1.5	1.4	1.4	1.4	5.3
Greater North Sea	9.5	9.8	9.1	9.0	9.0	8.3	8.3	8.7	22.6

Dredge

Table: Percentage of ICES ecoregion area that was swept for dredge, assuming a regular trawling

	2009	2010	2011	2012	2013	2014	2015	2016	all
Baltic Sea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Bay of Biscay and the Iberian Coast	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Celtic Seas	1.1	0.9	1.1	1.1	1.2	1.5	1.6	1.7	4.3
Greater North Sea	1.8	1.9	1.9	2.2	2.3	2.7	2.6	2.6	6.4
Iceland Sea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table: Percentage of ICES ecoregion area that was swept for dredge, assuming a random trawling

	2009	2010	2011	2012	2013	2014	2015	2016	all
Baltic Sea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Bay of Biscay and the Iberian Coast	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Celtic Seas	0.9	0.7	0.9	0.9	1.0	1.2	1.3	1.3	3.6
Greater North Sea	1.4	1.5	1.5	1.8	1.8	2.1	2.1	2.1	5.6
Iceland Sea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table: Percentage of ICES ecoregion area that was swept for dredge, assuming an aggregated trawling

	2009	2010	2011	2012	2013	2014	2015	2016	all
Baltic Sea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Bay of Biscay and the Iberian Coast	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Celtic Seas	0.6	0.5	0.6	0.7	0.7	0.9	0.9	1.0	3.0
Greater North Sea	1.0	1.1	1.1	1.3	1.3	1.6	1.5	1.6	4.8
Iceland Sea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Aggregation of fishing activities (DCF indicator 6)

All mobile bottom contacting gears

Table: Spreading area of fishing intensity relative to the ICES ecoregion area for mobile bottom contacting gears (in %).

	2009	2010	2011	2012	2013	2014	2015	2016	all
Azores	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Baltic Sea	5.5	6.0	6.2	6.1	5.9	6.0	5.4	5.2	7.0
Barents Sea	0.5	0.5	2.2	2.3	2.8	2.9	3.2	3.3	5.2
Bay of Biscay and the Iberian Coast	7.3	6.7	6.4	6.2	6.4	6.5	6.3	6.4	7.6
Celtic Seas	18.8	18.7	18.0	17.9	18.4	17.7	17.9	18.0	20.2
Faroes	2.2	2.5	0.1	0.1	0.1	1.1	1.1	1.6	2.8
Greater North Sea	29.0	28.0	28.1	28.1	27.4	26.5	28.2	28.5	32.1

Greenland Sea	0.1	0.1	0.2	0.3	0.3	0.3	0.2	0.2	0.4
Iceland Sea	5.2	5.3	4.8	4.8	4.8	4.2	4.0	4.2	5.8
Norwegian Sea	0.1	0.2	0.5	0.5	0.5	0.5	0.4	0.4	0.6
Oceanic Northeast Atlantic	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1

Table: Percentage of the fished area containing the top 90% of the fishing intensity for the mobile bottom contacting gears.

	2009	2010	2011	2012	2013	2014	2015	2016	all
Azores	82	0	89	0	0	0	0	0	82
Baltic Sea	40	43	42	40	40	41	42	40	31
Barents Sea	61	56	50	49	49	48	46	46	39
Bay of Biscay and the Iberian Coast	52	49	48	46	48	49	47	48	41
Celtic Seas	46	46	47	48	48	47	47	47	40
Faroes	38	41	43	36	46	46	49	54	31
Greater North Sea	47	47	47	47	46	46	47	48	46
Greenland Sea	23	29	29	39	34	41	37	40	20
Iceland Sea	36	38	37	38	37	35	35	36	31
Norwegian Sea	64	62	42	42	38	40	32	39	21
Oceanic Northeast Atlantic	43	34	44	51	45	48	37	46	27

Demersal seine

Table: Spreading area of fishing intensity relative to the ICES ecoregion area for demersal seine (in %).

	2009	2010	2011	2012	2013	2014	2015	2016	all
Baltic Sea	0.4	0.4	0.4	0.3	0.2	0.2	0.2	0.2	0.5
Barents Sea	0.0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.4
Bay of Biscay and the Iberian Coast	0.5	0.8	0.9	0.9	1.1	1.0	0.9	0.9	1.2
Celtic Seas	1.2	1.3	1.5	1.3	1.4	1.6	1.5	1.4	2.3
Faroes	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.2
Greater North Sea	7.6	6.4	6.1	5.6	5.7	5.3	5.6	6.1	9.4
Norwegian Sea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oceanic Northeast Atlantic	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table: Percentage of the fished area containing the top 90% of the fishing intensity for the demersal seine.

	2009	2010	2011	2012	2013	2014	2015	2016	all
Baltic Sea	39	36	49	38	43	41	42	46	22
Barents Sea	0	0	47	47	44	41	40	42	28
Bay of Biscay and the Iberian Coast	50	36	38	37	33	33	35	35	22
Celtic Seas	45	41	41	40	40	43	46	44	25
Faroes	0	0	0	0	0	0	86	0	86
Greater North Sea	50	48	46	45	45	42	43	45	32

Norwegian Sea	0	0	50	37	32	34	19	31	22
Oceanic Northeast Atlantic	0	0	0	0	0	0	79	0	79

Otter

Table: Spreading area of fishing intensity relative to the ICES ecoregion area for otter (in %)

	2009	2010	2011	2012	2013	2014	2015	2016	all
Azores	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Baltic Sea	5.6	5.9	6.1	5.9	5.8	5.9	5.4	5.0	6.9
Barents Sea	0.5	0.5	2.2	2.3	2.9	3.1	3.4	3.4	5.6
Bay of Biscay and the Iberian Coast	7.1	6.4	6.3	6.0	6.2	6.4	6.4	6.4	7.5
Celtic Seas	18.2	18.1	17.5	17.5	17.9	16.9	16.9	17.0	19.6
Faroes	2.2	2.5	0.1	0.1	0.1	1.1	1.0	1.6	2.7
Greater North Sea	21.7	21.1	21.7	22.0	21.3	21.1	22.8	23.0	25.8
Greenland Sea	0.1	0.1	0.2	0.3	0.3	0.3	0.2	0.2	0.4
Iceland Sea	5.2	5.3	4.8	4.8	4.8	4.2	4.0	4.2	5.8
Norwegian Sea	0.1	0.2	0.5	0.5	0.4	0.5	0.4	0.4	0.6
Oceanic Northeast Atlantic	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1

Table: Percentage of the fished area containing the top 90% of the fishing intensity for otter

	2009	2010	2011	2012	2013	2014	2015	2016	all
Azores	82	0	89	0	0	0	0	0	82
Baltic Sea	41	43	41	40	40	41	42	40	31
Barents Sea	61	56	51	51	51	50	48	48	41
Bay of Biscay and the Iberian Coast	51	48	48	46	47	49	48	48	41
Celtic Seas	47	47	48	49	49	47	47	47	40
Faroes	38	41	43	36	46	46	47	54	31
Greater North Sea	42	42	43	44	43	43	44	45	38
Greenland Sea	23	29	29	39	34	41	37	40	20
Iceland Sea	36	38	37	38	37	35	35	36	31
Norwegian Sea	64	62	41	42	39	40	34	43	21
Oceanic Northeast Atlantic	43	34	44	51	45	48	37	46	27

Beam

Table: Spreading area of fishing intensity relative to the ICES ecoregion area for beam (in %)

	2009	2010	2011	2012	2013	2014	2015	2016	all
Bay of Biscay and the Iberian Coast	0.8	0.6	0.7	0.6	0.7	0.7	0.6	0.6	0.8
Celtic Seas	3.6	3.7	3.5	3.2	3.5	3.4	3.4	3.3	4.0
Greater North Sea	10.9	11.3	11.8	11.3	11.1	10.3	10.9	11.0	12.8

Table: Percentage of the fished area containing the top 90% of the fishing intensity for beam.

	2009	2010	2011	2012	2013	2014	2015	2016	all
Bay of Biscay and the Iberian Coast	57	55	57	55	54	56	55	56	46
Celtic Seas	46	48	45	46	46	46	48	47	38
Greater North Sea	44	45	48	47	47	44	47	45	40

Dredge

Table: Spreading area of fishing intensity relative to the ICES ecoregion area for dredge (in %)

	2009	2010	2011	2012	2013	2014	2015	2016	all
Baltic Sea	0.0	0.0	0.0	0.1	0.1	0	0.0	0.0	0.1
Bay of Biscay and the Iberian Coast	0.0	0.0	0.0	0.0	0.1	0	0.0	0.0	0.1
Celtic Seas	1.8	1.5	1.4	1.5	1.8	2	1.8	1.9	2.4
Greater North Sea	2.5	2.2	2.0	2.4	2.8	3	3.0	3.0	3.5
Iceland Sea	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0

Table: Percentage of the fished area containing the top 90% of the fishing intensity for dredge

	2009	2010	2011	2012	2013	2014	2015	2016	all
Baltic Sea	24	36	55	40	40	42	34	35	36
Bay of Biscay and the Iberian Coast	89	59	69	50	43	31	34	34	25
Celtic Seas	40	37	35	34	38	35	33	32	26
Greater North Sea	38	35	33	35	37	37	37	37	28
Iceland Sea	0	0	0	0	0	39	29	23	22

Areas not impacted by mobile bottom contacting gears (DCF indicator 7)

All mobile bottom contacting gears

Table: Total area not impacted by mobile bottom contacting gears relative to the ICES ecoregion area (in %), assuming regular trawling.

	2009	2010	2011	2012	2013	2014	2015	2016	all
Azores	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Baltic Sea	91.3	90.2	90.0	89.0	89.4	89.3	90.1	90.9	82.5
Barents Sea	99.4	99.4	96.4	96.1	95.5	95.2	94.5	94.1	86.8
Bay of Biscay and the Iberian Coast	86.8	87.8	87.8	88.4	87.8	87.7	88.0	87.8	81.8
Celtic Seas	66.5	66.4	67.1	67.2	67.2	67.0	67.1	66.9	51.0
Faroes	97.2	97.0	99.9	99.9	99.9	99.0	99.0	98.6	94.9
Greater North Sea	45.3	46.0	44.6	45.8	45.5	46.8	44.5	45.0	20.4
Greenland Sea	99.7	99.7	99.6	99.5	99.5	99.4	99.5	99.6	98.4
Iceland Sea	91.5	91.6	92.9	93.2	93.1	94.2	94.1	93.7	84.8

Norwegian Sea	99.9	99.9	99.1	99.1	99.1	99.1	99.3	99.3	98.3
Oceanic Northeast Atlantic	99.9	99.9	99.9	99.9	99.9	100.0	100.0	100.0	99.8

Table: Total area not impacted by mobile bottom contacting gears relative to the ICES ecoregion area (in %), assuming random trawling.

	2009	2010	2011	2012	2013	2014	2015	2016	all
Azores	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Baltic Sea	92.7	91.8	91.5	90.3	90.7	90.7	91.6	92.2	83.7
Barents Sea	99.6	99.5	97.0	96.8	96.3	96.1	95.4	95.1	88.4
Bay of Biscay and the Iberian Coast	88.3	89.1	89.2	89.6	89.1	89.1	89.4	89.2	82.6
Celtic Seas	70.7	70.7	71.3	71.3	71.3	71.3	71.3	71.1	53.5
Faroes	97.7	97.5	99.9	99.9	99.9	99.2	99.2	98.9	95.6
Greater North Sea	52.3	53.1	52.5	53.6	53.1	54.3	52.7	53.0	23.8
Greenland Sea	99.7	99.8	99.6	99.6	99.6	99.5	99.6	99.7	98.6
Iceland Sea	93.0	93.1	94.2	94.4	94.4	95.3	95.2	94.9	86.3
Norwegian Sea	99.9	99.9	99.2	99.2	99.2	99.2	99.4	99.4	98.4
Oceanic Northeast Atlantic	99.9	99.9	99.9	99.9	100.0	100.0	100.0	100.0	99.8

Table: Total area not impacted by mobile bottom contacting gears relative to the ICES ecoregion area (in %), assuming aggregated trawling.

	2009	2010	2011	2012	2013	2014	2015	2016	all
Azores	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Baltic Sea	94.0	93.2	92.8	91.6	92.1	92.0	92.8	93.5	84.9
Barents Sea	99.7	99.6	97.6	97.4	97.1	96.8	96.3	96.0	90.0
Bay of Biscay and the Iberian Coast	89.7	90.4	90.4	90.8	90.4	90.5	90.6	90.5	83.4
Celtic Seas	74.7	74.7	75.1	75.1	75.1	75.2	75.1	74.9	56.0
Faroes	98.2	98.1	99.9	99.9	99.9	99.4	99.4	99.2	96.4
Greater North Sea	58.6	59.5	59.3	60.3	59.8	60.8	59.6	59.8	27.3
Greenland Sea	99.8	99.8	99.7	99.6	99.7	99.6	99.7	99.7	98.8
Iceland Sea	94.3	94.4	95.3	95.6	95.6	96.3	96.2	95.9	87.7
Norwegian Sea	99.9	99.9	99.3	99.3	99.3	99.3	99.5	99.5	98.6
Oceanic Northeast Atlantic	100.0	99.9	99.9	100.0	100.0	100.0	100.0	100.0	99.8

Demersal seine

Table: Total area not impacted by demersal seine relative to the ICES ecoregion area (in %), assuming regular trawling.

	2009	2010	2011	2012	2013	2014	2015	2016	all
Baltic Sea	99.2	99.3	99.3	99.3	99.6	99.6	99.7	99.7	98.4
Barents Sea	100.0	100.0	99.6	99.5	99.5	99.5	99.5	99.4	98.4
Bay of Biscay and the Iberian Coast	99.5	98.7	98.4	98.3	98.0	98.2	98.4	98.3	96.6

Celtic Seas	97.9	97.5	97.1	97.5	97.2	97.1	97.3	97.6	92.1
Faroes	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Greater North Sea	87.0	88.3	88.4	88.9	88.8	89.1	88.7	88.1	68.4
Norwegian Sea	100.0	100.0	99.9	100.0	99.9	99.9	99.9	99.9	99.8
Oceanic Northeast Atlantic	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table: Total area not impacted by demersal seine relative to the ICES ecoregion area (in %), assuming random trawling.

	2009	2010	2011	2012	2013	2014	2015	2016	all
Baltic Sea	99.3	99.4	99.4	99.4	99.7	99.7	99.7	99.7	98.6
Barents Sea	100.0	100.0	99.6	99.6	99.5	99.5	99.5	99.5	98.7
Bay of Biscay and the Iberian Coast	99.6	98.9	98.6	98.5	98.2	98.4	98.5	98.5	96.9
Celtic Seas	98.2	97.9	97.5	97.8	97.6	97.6	97.8	97.9	93.2
Faroes	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Greater North Sea	89.2	90.3	90.3	90.7	90.6	90.8	90.5	90.0	72.2
Norwegian Sea	100.0	100.0	99.9	100.0	99.9	100.0	100.0	99.9	99.8
Oceanic Northeast Atlantic	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table: Total area not impacted by demersal seine relative to the ICES ecoregion area (in %), assuming aggregated trawling.

	2009	2010	2011	2012	2013	2014	2015	2016	all
Baltic Sea	99.4	99.5	99.6	99.5	99.7	99.7	99.8	99.7	98.8
Barents Sea	100.0	100.0	99.7	99.6	99.6	99.6	99.6	99.6	98.9
Bay of Biscay and the Iberian Coast	99.7	99.1	98.8	98.7	98.5	98.6	98.7	98.7	97.3
Celtic Seas	98.6	98.3	97.9	98.2	98.0	98.0	98.2	98.3	94.2
Faroes	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Greater North Sea	91.2	92.1	92.1	92.3	92.3	92.4	92.1	91.7	75.6
Norwegian Sea	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.9	99.9
Oceanic Northeast Atlantic	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Otter

Table: Total area not impacted by otter relative to the ICES ecoregion area (in %), assuming regular trawling.

	2009	2010	2011	2012	2013	2014	2015	2016	all
Azores	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Baltic Sea	91.7	90.7	90.3	89.3	89.6	89.5	90.4	91.2	82.8
Barents Sea	99.4	99.4	96.7	96.4	95.9	95.6	94.8	94.6	87.3
Bay of Biscay and the Iberian Coast	87.1	88.2	88.3	88.8	88.2	88.0	88.2	88.2	81.9
Celtic Seas	68.1	68.2	69.0	68.9	69.0	69.1	69.2	69.1	53.1
Faroes	97.2	97.0	99.9	99.9	99.9	99.0	99.1	98.6	94.9
Greater North Sea	59.6	60.7	58.6	60.0	59.4	60.0	57.9	58.8	31.8

Greenland Sea	99.7	99.7	99.6	99.5	99.5	99.4	99.5	99.6	98.4
Iceland Sea	91.5	91.6	92.9	93.2	93.1	94.2	94.1	93.7	84.8
Norwegian Sea	99.9	99.9	99.1	99.1	99.2	99.1	99.3	99.4	98.4
Oceanic Northeast Atlantic	99.9	99.9	99.9	99.9	99.9	100.0	100.0	100.0	99.8

Table: Total area not impacted by otter relative to the ICES ecoregion area (in %), assuming random trawling.

	2009	2010	2011	2012	2013	2014	2015	2016	all
Azores	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Baltic Sea	93.1	92.2	91.7	90.6	91.0	90.9	91.8	92.5	84.0
Barents Sea	99.6	99.5	97.3	97.1	96.7	96.4	95.7	95.5	89.0
Bay of Biscay and the Iberian Coast	88.6	89.6	89.7	90.1	89.6	89.6	89.7	89.6	82.7
Celtic Seas	72.2	72.4	73.0	72.9	73.1	73.2	73.2	73.1	55.6
Faroes	97.7	97.5	99.9	99.9	99.9	99.2	99.2	98.9	95.6
Greater North Sea	64.8	65.9	64.5	65.8	65.0	65.7	64.2	64.9	36.3
Greenland Sea	99.7	99.8	99.6	99.6	99.6	99.5	99.6	99.7	98.6
Iceland Sea	93.0	93.1	94.2	94.4	94.4	95.3	95.2	94.9	86.3
Norwegian Sea	99.9	99.9	99.2	99.3	99.3	99.2	99.4	99.5	98.5
Oceanic Northeast Atlantic	99.9	99.9	99.9	99.9	100.0	100.0	100.0	100.0	99.8

Table: Total area not impacted by otter relative to the ICES ecoregion area (in %), assuming aggregated trawling.

	2009	2010	2011	2012	2013	2014	2015	2016	all
Azores	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Baltic Sea	94.4	93.6	93.1	91.9	92.3	92.3	93.1	93.7	85.2
Barents Sea	99.7	99.6	97.8	97.7	97.4	97.1	96.5	96.4	90.5
Bay of Biscay and the Iberian Coast	89.9	90.8	90.9	91.3	91.0	90.9	91.1	91.0	83.6
Celtic Seas	76.0	76.2	76.8	76.6	76.7	77.0	76.9	76.7	58.1
Faroes	98.2	98.1	99.9	99.9	99.9	99.4	99.4	99.2	96.4
Greater North Sea	69.8	70.8	69.9	71.0	70.3	70.9	69.8	70.3	40.6
Greenland Sea	99.8	99.8	99.7	99.6	99.7	99.6	99.7	99.7	98.8
Iceland Sea	94.3	94.4	95.3	95.6	95.6	96.3	96.2	95.9	87.7
Norwegian Sea	99.9	99.9	99.3	99.4	99.4	99.3	99.5	99.6	98.7
Oceanic Northeast Atlantic	100.0	99.9	99.9	100.0	100.0	100.0	100.0	100.0	99.8

Beam

Table: Total area not impacted by beam relative to the ICES ecoregion area (in %), assuming regular trawling.

	2009	2010	2011	2012	2013	2014	2015	2016	all
Bay of Biscay and the Iberian Coast	99.5	99.6	99.6	99.7	99.6	99.6	99.7	99.7	98.8
Celtic Seas	97.6	97.5	97.4	97.4	97.4	97.6	97.6	97.6	92.8
Greater North Sea	85.5	84.9	85.5	85.5	85.6	86.7	86.4	85.9	73.2

Table: Total area not impacted by beam relative to the ICES ecoregion area (in %), assuming random trawling.

	2009	2010	2011	2012	2013	2014	2015	2016	all
Bay of Biscay and the Iberian Coast	99.6	99.7	99.7	99.8	99.7	99.7	99.8	99.7	98.9
Celtic Seas	98.1	98.0	97.9	98.0	97.9	98.1	98.1	98.1	93.8
Greater North Sea	88.2	87.7	88.4	88.5	88.6	89.4	89.3	88.8	75.3

Table: Total area not impacted by beam relative to the ICES ecoregion area (in %), assuming aggregated trawling.

	2009	2010	2011	2012	2013	2014	2015	2016	all
Bay of Biscay and the Iberian Coast	99.7	99.8	99.8	99.8	99.8	99.8	99.8	99.8	99.1
Celtic Seas	98.6	98.6	98.5	98.5	98.5	98.6	98.6	98.6	94.7
Greater North Sea	90.5	90.2	90.9	91.0	91.0	91.7	91.7	91.3	77.4

Dredge

Table: Total area not impacted by dredge relative to the ICES ecoregion area (in %), assuming regular trawling.

	2009	2010	2011	2012	2013	2014	2015	2016	all
Baltic Sea	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.9
Bay of Biscay and the Iberian Coast	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Celtic Seas	98.9	99.1	98.9	98.9	98.8	98.5	98.4	98.3	95.7
Greater North Sea	98.2	98.1	98.1	97.8	97.7	97.3	97.4	97.4	93.6
Iceland Sea	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table: Total area not impacted by dredge relative to the ICES ecoregion area (in %), assuming random trawling.

	2009	2010	2011	2012	2013	2014	2015	2016	all
Baltic Sea	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.9
Bay of Biscay and the Iberian Coast	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Celtic Seas	99.1	99.3	99.1	99.1	99.0	98.8	98.7	98.7	96.4
Greater North Sea	98.6	98.5	98.5	98.2	98.2	97.9	97.9	97.9	94.4
Iceland Sea	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table: Total area not impacted by dredge relative to the ICES ecoregion area (in %), assuming aggregated trawling.

	2009	2010	2011	2012	2013	2014	2015	2016	all
Baltic Sea	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.9
Bay of Biscay and the Iberian Coast	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Celtic Seas	99.4	99.5	99.4	99.3	99.3	99.1	99.1	99.0	97.0
Greater North Sea	99.0	98.9	98.9	98.7	98.7	98.4	98.5	98.4	95.2
Iceland Sea	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Average fishing intensity

All mobile bottom contacting gears

Table: Average fishing intensity per ICES ecoregion for mobile bottom contacting gears.

	2009	2010	2011	2012	2013	2014	2015	2016	all
Azores	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Baltic Sea	1.20	1.38	1.45	2.16	1.95	1.93	1.83	1.62	8.52
Barents Sea	0.66	0.70	1.32	1.26	1.17	1.28	1.38	1.46	3.34
Bay of Biscay and the Iberian Coast	3.01	3.03	3.30	3.22	3.25	3.12	3.12	3.05	18.45
Celtic Seas	2.28	2.27	2.42	2.50	2.38	2.45	2.45	2.50	14.50
Faroes	0.71	0.64	0.90	1.19	1.85	0.41	0.44	0.45	1.32
Greater North Sea	2.62	2.57	2.52	2.37	2.52	2.52	2.39	2.42	17.19
Greenland Sea	2.39	3.26	2.26	1.67	1.08	1.12	1.42	1.44	3.60
Iceland Sea	1.01	1.01	0.87	0.78	0.76	0.67	0.79	0.82	4.60
Norwegian Sea	0.41	0.40	2.08	1.97	2.14	2.35	1.76	1.37	4.75
Oceanic Northeast Atlantic	0.70	0.89	1.11	0.64	0.55	0.50	0.64	0.60	1.64

Demersal seine

Table: Average fishing intensity per ICES ecoregion for demersal seine.

	2009	2010	2011	2012	2013	2014	2015	2016	all
Baltic Sea	2.28	1.46	1.26	1.92	3.11	2.55	2.96	1.81	5.27
Barents Sea	0.00	0.00	2.01	2.16	2.39	2.67	2.88	2.75	5.02
Bay of Biscay and the Iberian Coast	0.46	1.22	2.11	2.00	1.85	1.74	2.43	2.08	6.94
Celtic Seas	1.64	1.64	2.05	2.09	1.87	1.62	1.53	1.71	5.09
Faroes	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.17
Greater North Sea	1.50	1.64	1.72	1.89	1.81	1.96	1.95	1.92	6.25
Norwegian Sea	0.00	0.00	1.48	2.01	2.28	2.55	4.42	3.13	6.28
Oceanic Northeast Atlantic	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.21

Otter

Table: Average fishing intensity per ICES ecoregion for otter.

	2009	2010	2011	2012	2013	2014	2015	2016	all
Azores	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Baltic Sea	1.04	1.27	1.38	2.06	1.88	1.87	1.78	1.59	8.07
Barents Sea	0.66	0.70	1.18	1.10	1.00	1.09	1.20	1.30	2.87
Bay of Biscay and the Iberian Coast	2.94	2.82	2.91	2.85	2.79	2.71	2.68	2.65	16.40
Celtic Seas	2.21	2.18	2.26	2.36	2.24	2.32	2.37	2.40	13.50
Faroes	0.71	0.64	0.90	1.19	1.85	0.41	0.45	0.45	1.32
Greater North Sea	2.21	2.15	2.15	1.97	2.14	2.11	1.92	1.93	12.68
Greenland Sea	2.39	3.26	2.26	1.67	1.08	1.12	1.42	1.44	3.60
Iceland Sea	1.01	1.01	0.87	0.78	0.76	0.67	0.79	0.82	4.62
Norwegian Sea	0.41	0.40	2.09	1.93	2.11	2.32	1.52	1.12	4.50
Oceanic Northeast Atlantic	0.70	0.89	1.11	0.64	0.55	0.50	0.63	0.60	1.64

Beam

Table: Average fishing intensity per ICES ecoregion for beam.

	2009	2010	2011	2012	2013	2014	2015	2016	all
Bay of Biscay and the Iberian Coast	0.33	0.34	0.29	0.25	0.29	0.29	0.23	0.27	1.53
Celtic Seas	0.28	0.29	0.32	0.36	0.33	0.30	0.31	0.32	1.75
Greater North Sea	0.87	0.90	0.77	0.80	0.81	0.75	0.73	0.74	4.79

Dredge

Table: Average fishing intensity per ICES ecoregion for dredge.

	2009	2010	2011	2012	2013	2014	2015	2016	all
Baltic Sea	0.13	0.11	0.20	0.11	0.10	0.15	0.14	0.22	0.34
Bay of Biscay and the Iberian Coast	0.05	0.01	0.00	0.01	0.01	0.02	0.02	0.06	0.04
Celtic Seas	0.21	0.21	0.25	0.25	0.23	0.26	0.29	0.30	1.04
Greater North Sea	0.24	0.29	0.31	0.33	0.29	0.33	0.31	0.32	1.43
Iceland Sea	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01