WORKING GROUP ON SPATIAL FISHERIES DATA (WGSFD)

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i Executive summary

The Working Group on Spatial Fisheries Data (WGSFD) collates and analyses spatial fisheries data to evaluate fishing effort, intensity, and frequency in European waters. In 2025, the group began a new three-year cycle addressing data quality, workflow development, high-resolution data processing, and improved utility of outputs for the ICES community.

The group reviewed the 2025 Vessel Monitoring System (VMS) and logbooks data call, endorsed data products subject to swept area calculation revisions for seine gears, and identified critical data gaps from non-submitting countries. The group examined methods for handling high-resolution tracking data, particularly for small-scale fisheries, and explored machine learning approaches for classifying fishing activity and gear types. Work continued on standardising spatial frameworks, with particular focus on the c-squares indexing system and resolving issues with harbour position filtering.

Key findings include significant challenges with data absence from non-submitting countries (Portugal, Norway, Faroes, Greenland), which compromises data product quality in areas where fleets of these countries operate. The group identified methodological improvements needed for Scottish and Danish seine fisheries, where current swept area calculations inappropriately apply trawling methodology to fundamentally different fishing operations. High-resolution data analysis demonstrated that tracking frequencies of 30 seconds or less significantly improve fishing effort estimation accuracy, particularly for small-scale and passive gear fisheries. Machine learning classification models showed promising results for identifying gear types and fishing operations, though data availability and computational demands present ongoing challenges.

The group made four formal recommendations: publishing annual surface area ratio values at métier level 4 resolution; highlighting implications of missing VMS data in advisory processes; formally adopting c-squares as the basis of and official ICES spatial grid framework; and establishing dedicated compilation of spatially explicit data on Marine Protected Areas and offshore wind farm zones. Future priorities include developing a unified spatial fisheries data tools package, establishing quality control subgroups, preparing for mandatory high-resolution tracking implementation by 2029, and organising a hackathon to address workflow processing challenges.

ii Expert group information

Expert group name	Working Group on Spatial Fisheries Data (WGSFD)
Expert group cycle	Multiannual
Year cycle started	2025
Reporting year in cycle	1/3
Chairs	Jeppe Olsen, Denmark
	Jose Rodriguez Gutierrez, Spain
Meeting venue and dates	6-10 October 2025; Malaga, Spain (28 participants)

1 Introduction

The Working Group on Spatial Fisheries Data (WGSFD) collates and analyses spatial fisheries data in order to evaluate fishing effort, intensity, and frequency in European waters. This report provides an overview of the events and discussions that took place during the meeting held in Málaga, Spain, 6–10 October 2025.

WGSFD started a new three-year cycle with the following terms of reference:

a. Deliver an aggregated data product showing fishing effort and estimates of its impact for fisheries throughout the ICES area.
b. Support the maintenance and update of the VMS data call workflow to ensure it is adequate for the existing data requirements.
c. Develop methods to work with high resolution spatial data and implement these in the WGSFD workflow.
d. Improve the utility of WGSFD outputs to the ICES community and other potential users.
e. Establish a method to represent and present fleet coverage of the VMS data.
f. Further investigate a common spatial temporal framework representing data at ICES.

1.1 Data Call Review

The 2025 VMS and Logbooks data call (https://doi.org/10.17895/ices.pub.29146643.v1) was released later than scheduled, on 29 May, due to a number of IT changes at the ICES Secretariat which had impacts on the workflow, and the ability to upload data directly through R scripts. As a result, the data call was released with the requirement that submitters upload their data through the DATSU webpage only (Table 1). Compared to the 2024 data call, there were no structural changes requested to data format or workflow, and submitters were only reminded of the specific units which values needed to be provided in, to ensure consistency across data sets.

National quality checks were done by submitters, the ICES secretariat and the Working Group Chairs, and a subgroup of the Working Group met online on 25 September 2025 to review a comparison of submissions and the final data products. Subject to confirmation of the calculations of swept area for seine gears, the group endorsed the data product.

Table 1. Dates of VMS and Logbooks data call submissions received by the ICES Secretariat.

Country	Submission Date
Latvia	11/06/2025 14.47
Estonia	20/06/2025 12.24
Lithuania	20/06/2025 13.51
Finland	25/06/2025 13.47
Poland	27/06/2025 09.06
Sweden	27/06/2025 14.58
Belgium	28/06/2025 22.12
Ireland	30/06/2025 13.10
France	01/07/2025 08.56
Denmark	01/07/2025 15.28
Netherlands	02/07/2025 16.42
Spain	11/07/2025 12.33
Denmark	15/07/2025 15.23
Iceland	28/08/2025 15.46
United Kingdom	08/09/2025 17.41

No responses were received from Faroes, Greenland or Portugal. Norway informed ICES that it would not be able to submit data in response to the 2025 data call.

Norwegian data has not been submitted since 2021, and this is beginning to impact on quality and reliability of the ICES data product in areas where Norwegian fishers operate. Norwegian VMS and electronic catch report information are available on the Fiskeridirektoratet website [https://www.fiskeridir.no/Yrkesfiske/Rapportering-paa-havet/elektronisk-rapportering-ers]. The working group has examined this data and compared it to total the total fishing effort received under the data call (Figure 1). Other groups using this data are urged to exercise caution is when interpreting the ICES data in areas where Norwegian fisheries are active, particularly in the northern North Sea and along the Faroe-Shetland shelf edge.

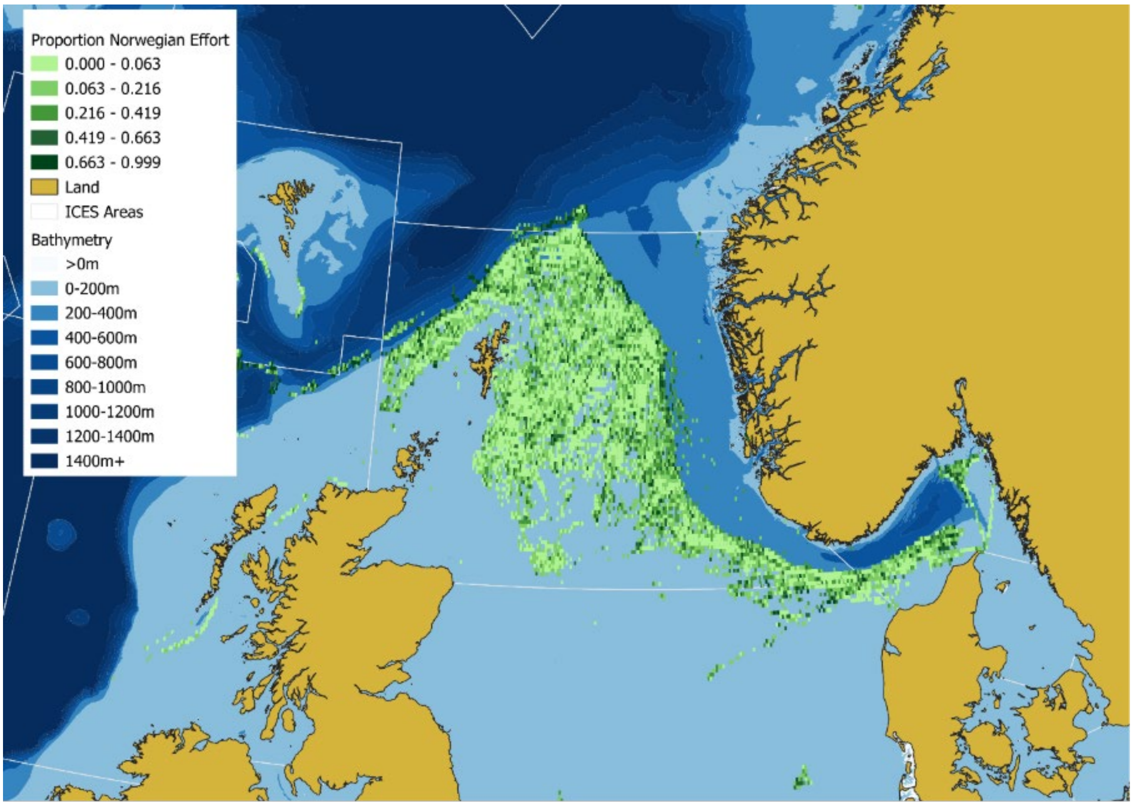

Figure 1. Fishing effort derived from Norwegian VMS data as a proportion of the total fishing effort (Norwegian + ICES VMS), hours fished, by c-square, in the northern North Sea, 2024.

1.2 Report from the Working Group on Spatial Fisheries Data Governance (WGSFDGOV)

The WGSFDGOV group has existed for a few years now. The focus is shifting from purely technical discussions towards governance aspects, facilitating data submission, managing data flow from the Data Centre to end users, and reducing the need for this working group to repeatedly discuss quality control and terminology. A key goal is to strengthen links with the Data and Information Group (DIG, ICES), which is already contributing significantly to this work. The group has mapped the governance structure and responsibilities, and an overview will be shared with members. Essentially, the group's role is to provide clarity on data governance and workflows.

The core ICES products concerned include the Ecosystem Overview and the Fisheries Overview, which are produced annually. Some of these datasets are also used by EMODnet, though many users are unaware of this, highlighting the need for better documentation. Other products include the OSPAR dataset, for example for the seafloor disturbance indicator (BH3), and HELCOM data. A strong emphasis remains on data quality control. The group's main responsibility is to ensure that the best possible version of the data is made available.

The group discussed the need for a clearer distinction in responsibilities between WGSFDGOV and WGSFD. It was noted that this is already defined in the Terms of Reference, but the group agreed that further clarification may still be useful. The example was given of management of the GitHub repository as part of WGSFDGOV's role. The group emphasised the importance of understanding the MIRO overview that will be shared.

It appears that much of WGSFDGOV's work involves communication between the Working Group, the ICES Data Centre, and the Secretariat. Originally, the idea was for the governance group to act as a facilitator between these parties, including preparing manuals and documentation. WGSFDGOV is supposed to meet quarterly to fulfil these responsibilities.

1.3 Spatial Fisheries Data Product Proposal

A presentation was delivered as part of the benchmark process for the advisory product. The presentation introduced a proposal for a spatial fisheries data product, focusing mainly on the spatial grid and the issues with using rectangles. The aim is to bring more clarity, both for our working group and for ICES and the wider scientific community. The document proposes alternatives to the current c-squares system.

Feedback from northern regions highlighted that grid cells become smaller at higher latitudes, which can make advice misleading if no standardisation is applied. The work therefore defines the pros and cons of different spatial approaches, after which ACOM and SCICOM will decide on which spatial framework to adopt. The document is being prepared for circulation. The group suggested also including a discussion on the pros and cons of data confidentiality within this framework.

Regarding small-scale fisheries (SSF) data, it was mentioned that these will be incorporated into the workflow soon, so it is important to be prepared. The maturity of these data still needs to be considered. The group discussed that the focus should not be on distinguishing small-scale versus large-scale fisheries, but rather on the data source: VMS, AIS, or other GPS-data loggers. The group agreed that we should prepare for broader data coverage and multiple input sources, as we will likely be asked for advice on this in the future.

The group noted that it would be useful to request and integrate point data from multiple sources, as this would make our work much more flexible. This approach would allow the working group to accommodate different data types and tracking systems as they become available, ensuring that the spatial fisheries data product remains adaptable to evolving data collection methods.

1.4 Data Web Services and Access to Data

A brief overview of WGSFD data licences was presented to the group. ICES uses a CC BY data licence for open-access products, meaning that most data products produced by the group are openly available. However, there is an exception for VMS and logbook data, which are covered by a specific data licence due to confidentiality restrictions. The group previously agreed that ICES should not store raw data, leading to the adoption of c-square aggregation. OSPAR later used this aggregated format for its own data calls. Currently, only two countries have not submitted data, so the overall situation is relatively good.

It was noted that the WGSFD group is no longer the main user of these data; this role has shifted to FBIT. Access to restricted data is limited to ICES expert groups preparing advice, official ICES advisory requests from countries or organisations under agreement, and designated national correspondents, although it appears that some correspondents may not always be aware of the access rules. The status of aggregated data products such as SAR and total fishing hours in terms of open availability requires clarification.

The presentation discussed connecting data for greater impact. The example was given of how work on impulsive underwater noise has evolved into several interconnected databases: the continuous noise database, JCDP (the cetacean database), and the European catalogue of sound signatures. These collectively provide valuable insight into marine noise pollution and show how different datasets can complement each other to support marine management. A potential new idea involving fish stomach content data was also mentioned.

Regarding the VMS WebApp, all available products can be accessed and downloaded via web services, provided users have a verified account. A link to the API will be shared, which allows VMS data products to be retrieved as GeoJSON files, including summary data. Currently, only three datasets are fully open and accessible without authentication, but most others require it.

In summary, there are two ways to access data: through open products or under a licence, which is only required for raw data. The group emphasised the importance of making these access conditions clear for other users. There was support within the group for the idea of sharing aggregated data more widely. It was discussed that the group can access the fisheries data through API when they need to work on it. An agreement should be signed for future access to ensure proper governance of data usage.

1.5 Presentations

The group reviewed a number of presentations of work being carried out by members, which are summarised below.

1.5.1 Uncertainty in Spatial Fisheries Data

Presenter: Neil Campbell, ICES Secretariat

This presentation addressed sources of uncertainty in spatial fisheries data and their implications for fisheries assessments. The technical precision of VMS data, specified in law is to achieve a position error of less than 500 metres with a 99% confidence interval. GPS drift remains a significant issue, though various methods exist to measure drift and interference. Tests conducted on speed thresholds to define fishing activity using Norwegian data and fixed speed thresholds showed that this approach worked for some métiers but not all. A Bayesian mixture model was explored as an alternative, and results showed only approximately 4% of the data could potentially improve in accuracy, suggesting limited benefit given the required effort.

Another key source of uncertainty is gear width. Table 4 from Eigaard *et al.* (2016) is commonly used for these calculations, but it contains considerable error. Monte Carlo simulations based on the table's parameters were used to estimate confidence intervals and swept areas, finding values ranging from 22% to 270%. It remains unclear which users rely on their own gear lengths versus simulated ones, and the bias appears to be spatial, as real gear tends to narrow with depth.

A hierarchical Bayesian model is being considered to integrate across workflows and better capture this variability. Current analyses use instantaneous rather than computed speed. More precise and consistently recorded logbook data could significantly reduce these uncertainties. The group agreed that this work could be pursued as a collaborative effort. Discussion also highlighted that bias in effort estimation is not spatially random, but concentrated mostly near harbours, and that higher spatial resolution would help address this issue.

1.5.2 Automatic classification of passive fishing gears used in multi-gear SSF trips

Presenter: Pamela Lattanzi, CNR

In Italy, small-scale fisheries (SSF) account for approximately 70% of the total fishing effort, making high-resolution geospatial SSF data essential for marine spatial planning. This study presented the application of Machine Learning to predict fishing soak time for two types of nets (gillnets and trammel nets) and three types of pots (cestini, cogolli and general nasse, selectively targeting the gastropod *Tritia mutabilis*, the cuttlefish *Sepia officinalis* and the crustacean *Squilla mantis*, respectively). The algorithm incorporated variables such as month, hour, substrate, distance from the coast, haul speed and length, gear change, and order of events. The input dataset comprised 7164 haul observations, recorded from 1,634 trips involving 10 vessels in the Ancona harbour (Marche Region). The GNSS tracking devices (Global Positioning System, GPS) installed on board these SSF boats transmitted positions at 60-second intervals.

Results showed that the estimated soak time was important as one of the main predictors for gear classification. The investigated models (Ridge Classifier, Logistic Regression, Decision Tree, Random Forest, Extreme Gradient Boosting) were trained and validated on separate sets of the initial input dataset (70% train, 20% validation, 10% test). Fine-tuning through hyperparameter settings and boosting rounds improved accuracy. Pots were classified more accurately than nets due to greater data availability. Default parameters without tuning caused overfitting, reinforcing the importance of proper model training. Overall, Machine Learning methods outperformed traditional statistical approaches, offering better classification of passive SSF gears and improving resolution from trip-level to haul-level analysis. The XGBoost model showed the best performance and minimal overfitting, supporting SSF monitoring efforts.

Discussion

The group discussed the relevance of such methods for ToR C, questioning how generalisable these models are and how their wider application could be achieved. It was suggested that instead of standardising methods, the group should aim for comparable frameworks using shared datasets, a view supported by some but contested by others. Concerns were raised that not all countries have access to validated training data, so a common, mature method should be available for those without such resources. The long-term goal is to collect harmonised AIS data from all member states, supported by standardised analysis tools like those used for the VMS logbook data call.

The development of simplified, downgraded models for broader use was proposed. The group was reminded that their ultimate aim is to support advice on production grounded in repeatability, accountability, and transparency. The group agreed that SFD's role must focus on delivering strong, science-based guidance and preparing for the increasingly collection of high-resolution data.

1.5.3 Processing via parquet and duckdb

Presenter: Einar Hjorliefsson, HAFRO

This presentation focused on handling very large datasets using Parquet and DuckDB. Parquet files function similarly to .RData files but are platform-independent and compatible with Python and DuckDB. They are fast, can be partitioned, and are efficient for storing and accessing structured data.

DuckDB is an in-process database similar to SQLite but optimised for large-scale data, operating on columns rather than rows. It can store tables or link directly to files on disk or in the cloud and can also serve as a database connection within R. The key advantage is that DuckDB performs the heavy computation externally, avoiding the need to load entire datasets into R and preventing system overload. A traditional database is still needed for data collection, but DuckDB provides a powerful and fast environment for analysis.

The group acknowledged that efficient data processing is valuable, the main objective of the working group remains delivering the final data product, noted that this is powerful approach and that the group should investigate this option for spatial data in the future, particularly as dataset sizes continue to grow.

1.5.4 MAP-SSF - Mapping Small Scale Fisheries

Presenter: María Mateo, AZTI

The MAP-SSF project addresses the characterization of small-scale fisheries (SSF) in Europe by mapping their spatial activity and assessing associated social and ecological pressures. The project is aligned with the implementation of EU Regulation (EU) 2023/2842 and aims to provide standardized methodologies and data for improved monitoring and governance.

The first Work Package (WP) collected extensive data and methodologies essential for characterizing SSF activity. A questionnaire applied to 19 case studies across Europe captured diversity in terms of definitions, legislation, spatial use, landings, reporting systems, and tracking technologies. The analysis identified patterns in gear use, catch composition, and sales channels, as well as operational challenges such as gear restrictions, spatial conflicts, and management gaps.

The second WP developed a standardized methodology to integrate multiple data sources and assess SSF activity and fishing pressure. This approach combined participatory mapping, vessel tracking systems, and Sentinel-2 imagery, supported by a neural network model to predict spatial fishing effort. The methodology was applied in four case studies: Iberian Coast in Portugal, Basque Country and Murcia in Spain, and Marche Region in Italy. Outputs included georeferenced layers of fishing effort, enabling identification of activity hotspots and overlaps with other maritime sectors, supporting spatial planning and stakeholder engagement within the Blue Economy framework.

The third WP provided recommendations to address data gaps and improve monitoring. It emphasized the integration of high-resolution tracking devices and standardized analytical frameworks to ensure consistency in scientific assessments and policy applications. These outputs contribute to EU policy instruments such as the Common Fisheries Policy, the Marine Strategy Framework Directive, and Maritime Spatial Planning, offering scalable tools for incorporating SSF into marine governance.

The project was funded by the European Environment Agency (EEA).

1.5.5 EM4SSF - Enhancing Monitoring for Sustainable Small-Scale Fisheries

Presenter: Nora Tassetti, CNR

Funded by the European Maritime, Fisheries and Aquaculture Fund (EMFAF, call for proposal: EMFAF-225-PIA-FisheriesScientificAdvice), the EM4SSF project started on 1 September with a duration of 30 months. EM4SSF aims to enhance scientific knowledge on small-scale fisheries (SSF) by strengthening regional cooperation in data collection, harmonising protocols for shared data acquisition and processing, and engaging fishers in participatory case studies to collect validation data and advance methodological approaches.

The project seeks to improve and harmonise regional monitoring initiatives, and establish shared protocols for data collection, processing, and management, supporting the scientific fisheries advisory process, especially for data-poor SSF sectors. Building on the recommendations of the ICES Workshop on Geo-Spatial Data for Small-Scale Fisheries (WKSSFGEO), EM4SSF addresses key data gaps in SSF and establishes a common framework and quality control system for high-resolution SSF geo-spatial data. This aligns with the new EU Regulation (EU 2023/2842), mandating tracking for all vessels within the next five years.

The consortium, comprising CNR, UPC, IPMA, DTU, HCMR and ICES, brings together a multidisciplinary team from five major EU member states in SSF production (Italy, Spain, Portugal, Denmark, and Greece) and four research institutes already active in regional SSF geospatial data collection, along with one institute from a member state with no prior experience in SSF tracking, thereby promoting capacity building and knowledge transfer. Through five case studies, EM4SSF will engage policy stakeholders and fishers in generating new fisheries data beyond existing national programmes, supporting the co-production of scientific advice.

Two key open working events will foster collaboration and co-development: (i) a four-day Hackathon with invited experts to harmonise and deliver repositories and codes (November 2026, Ancona, Italy), and (ii) the ICES WKSSFGEO3, continuing work from previous WKSSFGEO and WKSSFGEO2 (December 2027, ICES Headquarters, Copenhagen, Denmark). EM4SSF outcomes will address ToR C – High-resolution data, reinforcing the scientific foundation for sustainable SSF management.

1.5.6 Greater North Sea Basin Initiative

Presenter: Torsten Schultze, Thünen Institut

This study examined revenue loss and stress levels across fisheries under three scenarios: offshore wind development, marine protected areas, and their combined effect. Using VMS data from 2018 to 2022 for main métiers in the GNSBI area, the analysis assessed key fishing grounds and socio-economic impacts of spatial developments in the North Sea. Results showed distinct spatial patterns in catch and effort, with brown shrimp dominating coastal areas in both weight and value. The estimated loss in revenue varied by gear type. Although mean losses were modest, certain vessels and ports were significantly more affected. The cumulative scenario indicated that most vessels experienced stress levels below 10 percent, whilst a few exceeded 15 percent. The findings highlight uneven socio-economic impacts across fleets and regions, emphasising the need for targeted management responses.

Discussion

The group noted that this project benefited from having a common spatial fisheries dataset, which helped analyse fishery impacts in more detail. The group agreed that the dataset collected by GNSBI on offshore wind farms and related measures would be very useful for managers. Since the dataset changes over time, it will need regular updates. The group agreed to recommend that ICES assign a group to maintain and update it on an ongoing basis.

1.5.7 TAF - Transparent Assessment Framework

Presenter: Colin Millar, ICES Secretariat

The Transparent Assessment Framework (TAF) follows the FAIR principles (findable, accessible, interoperable, and reusable) and is primarily used for stock assessment in R. Currently, 68 stock assessments are hosted in the system. TAF provides a standardised workflow that helps analysts structure their work from data collection to reporting, ensuring reproducibility and transparency. The framework is built around a series of sequential components: boot (for retrieving software and data), data, method, output, and report. It promotes sound coding practices, such as sourcing data and generating outputs separately rather than overwriting files. Whilst many analysts are more familiar with producing reports than publishing code, TAF facilitates a transition towards open, code-based sharing of assessments. The framework is accessible via the TAF dashboard, its GitHub repository, and an accompanying R package.

The workflow developed by WGSFD has been successfully applied within the TAF framework, and this implementation was recognised with an award. The workflow subgroup will discuss how much of the TAF should be implemented in the formal workflow at a later stage, considering the benefits of standardisation and reproducibility alongside practical implementation requirements.

1.5.8 Electronic Reporting System (ERS) for EU Fisheries

Presenter: Maksims Kovsars, BIOR

A presentation was given on the Electronic Reporting System (ERS), which is used by fishing vessels to record and transmit activity data in accordance with Commission Implementing Regulation (EU) No 404/2011. This regulation sets out the detailed rules for applying Council Regulation (EC) No 1224/2009, which establishes the EU fisheries control system. The system allows fishermen to submit electronic reports documenting all the key stages of their fishing operations, from departure to landing, via standardised message types. Implementing this system ensures that the transmission of data between vessels and the relevant authorities adheres to the harmonised procedures defined in Regulation 404/2011, particularly Articles 37–38. These articles stipulate that member states must determine the electronic format for completing and transmitting logbook, transshipment, prior notification and landing data.

The system's structure is based on a series of coded message formats that correspond to specific operational events. The most commonly used messages include: DEP (Departure Message), submitted when a vessel leaves port, providing details of departure time, location, and intended fishing area; FAR (Fishing Activity Report), used to report ongoing fishing operations, including information on catches, gear, positions, and discards; PNO (Prior Notification), sent before entering port to declare the intention to land or transship catches, specifying expected quantities and species; RTP (Return to Port Report), transmitted upon completion of fishing activities to indicate the vessel's return to port and its expected time of arrival; and LAN (Landing Declaration), submitted after landing to confirm the actual quantities and species landed, thereby closing the reporting sequence for that trip.

Through these standardised electronic messages, the ERS ensures real-time communication between fishing vessels and control authorities, allowing for improved monitoring, data consistency, and traceability across the entire supply chain. Each message contributes to a transparent reporting cycle that aligns with EU objectives on sustainable fisheries management and compliance verification.

Although the ERS is generally effective, challenges may arise in ensuring the accuracy and consistency of the spatial and operational data reported by fishing vessels. One recurring issue is the potential misreporting of fishing coordinates, mainly when they are entered manually, and the inconsistent attribution of fishing zones and ICES statistical rectangles across messages. The coordinates provided in ERS messages may not always align with the positional data recorded by the VMS, further complicating spatial verification and compliance analysis.

Discrepancies may occur, for example, when the PNO, RTP or LAN messages indicate fishing areas that differ from those recorded in the corresponding FAR. Such mismatches may also result from operational complexities, such as landings that include catches from multiple trips or from different fishing grounds, which were reported under separate FAR messages. These data quality issues highlight the importance of cross-validation between ERS and VMS data sources for accurate spatial fisheries analysis.

1.6 Recent Publications

The group also received presentations on two papers developed with contributions from several group members: one recently published and the other currently under review.

1.6.1 Implications of low temporal resolution of vessel tracking systems

Presenter: Marta Rufino, IPMA

VMS data are too coarse to accurately represent small-scale fisheries (SSF). With the new EU regulation (2023/2842) mandating vessel tracking for all fishing vessels by the end of 2029, it is important to consider the consequences of low-resolution tracking. Based on the publication of Rufino *et al.* (2025), it was shown that infrequent position updates underestimate fishing effort, misclassify activity, and undermine spatial planning, compliance, and impact assessments.

High-frequency tracking, approximately one ping every 30 seconds, is recommended for small-scale and passive gears, whilst larger fleets using active gears may use slightly longer intervals. Future regulations should define minimum polling frequencies by fleet type and include industry support to ensure compliance. High-resolution tracking is essential for reliable fisheries management and conservation planning.

1.6.2 Towards a European small-scale fishing vessel tracking programme

Presenter: Tania Mendo, University of St Andrews

This study evaluates how the EU Fisheries Control Regulation (CR 2023/2842), which requires vessel tracking for all fishing vessels under 12 metres by 2029, might present an opportunity to better integrate small-scale fisheries (SSF) into management frameworks. Drawing on insights from 24 European institutions, the paper finds that only approximately 12% of the SSF fleet is currently tracked, mainly in net, trap, and dredge fisheries. Key barriers include high costs, limited institutional capacity, and fragmented data systems.

The authors recommend establishing harmonised data standards, using tracking data for participatory management, and promoting inclusive governance. Early implementation choices will shape the future of tracking systems and the equitable governance of European SSF. The study highlights the importance of strategic planning in the transition period before the 2029 deadline to ensure that tracking systems serve both regulatory and management needs whilst supporting the specific characteristics and challenges of the small-scale fishing sector.

2 ToR A. Deliver an aggregated data product showing fishing effort and estimates of its impact for fisheries throughout the ICES area

Most participants were involved in the work of the Workflow and High-Resolution subgroups. To optimise efficiency and avoid splitting the work into too many small groups, it was agreed to merge the work for ToR a (Quality) and ToR e (Coverage). This approach allows for better coordination and use of resources, whilst both ToRs can still remain distinct in their focus if needed.

The establishment of a specific ToR on Coverage had already been agreed last year, recognising the importance of assessing data coverage in relation to widely used fisheries datasets such as logbooks, but also potentially sales notes and others. This topic is now particularly relevant given the extensive adoption of RDBES within the ICES framework.

2.1 Goals

The subgroup identified three main goals for the combined ToR work. First, to investigate and improve quality processes through exploratory work on VMS and logbook data, identifying outliers, patterns, and workflow gaps. For coverage (ToR e), this includes developing methods to measure and present spatial data coverage, mainly VMS but also other sources, and assessing coverage quality compared to other fisheries data such as logbooks and landings. There is potential to link with RDBES data in early steps using national case studies.

Second, to propose improvements to the VMS Data Call quality control process, both to the quality template after submissions (for example, comparisons with past submissions) and before submission (for example, by sharing examples of national quality checks, which could inspire useful practices across countries).

Third, to support chairs and ICES during the annual quality process, ensuring that appropriate access arrangements are in place.

2.2 Work Plan 2025–2026: Supporting the Annual Quality Control Process

Currently, the annual Quality Control (QC) process is coordinated by ICES officers, who run the quality templates and review the national data submissions. Their role is to verify that the data are correct, identify potential issues, and determine whether the information aligns with expectations or if errors, missing information, or inconsistencies require resubmission. To accomplish this effectively, ICES relies on the support of the WGSFD Chairs and a group of people who have been chairs of the group in the past.

It was noted that this structure could be more clearly determined and that the work could benefit from the participation of additional WGSFD members, who could dedicate more time to identifying and addressing data issues. The QC process concerns national data, prior to aggregation into the multi-member state layer. Consequently, the information is considered confidential and must not be shared outside this context. It should be used exclusively for the purposes of the QC process. Experts involved will therefore need to sign an appropriate data access and confidentiality agreement, ensuring that the information is handled in compliance with ICES data policies.

It was proposed that the subgroup identify three to five members to undertake this work as part of their intersessional contribution to the Working Group. The estimated yearly workload and composition would be approximately two days of work (usually distributed across different days, depending on member states' responses to the Data Call), immediately following the national data submissions. The proposed composition includes the two WGSFD Chairs, the WGSFDGOV Chair, and three to four data submitters involved in the Quality subgroup. Several members volunteered for this work, including Paul, Lennert, and potentially Patrik.

2.3 Intersessional Work 2025–2026

The subgroup will review the member state Quality Control template and provide feedback on outliers and any other issues to the ICES officer in charge of the Data Call.

2.4 Specific Outputs for Next Year's Meeting

Some form of guidance could be developed to support this work and ensure it is carried out effectively. This possibility is to be agreed upon by the group. This would help avoid situations where the absence of experienced experts might lead to missing important issues or relevant aspects during the quality control process.

2.5 Proposed Improvements to the VMS Data Call QC Process

The group will work on proposing improvements to the VMS Data Call quality control process in two areas. First, improvements to the quality template after submissions, for example comparisons with past submissions. Second, improvements before submission, for example by sharing examples of national quality checks, which could inspire useful practices across countries. This could include proposing a list of variables, metrics, and checks that member states are conducting, providing code examples, and investigating whether it is feasible to develop common code based on codified data.

2.6 Coverage Assessment

The group will investigate coverage assessment at a later stage in the three-year ToR cycle.

3 ToR B. Support the maintenance and update of the VMS data call workflow to ensure it is adequate for the existing data requirements

3.1 Seine Gear Swept Area Calculation

The calculation of swept area ratio (SAR) is a key component in benthic pressure indicators. Whilst straightforward for predictable towing patterns such as trawling, the current workflow inappropriately applies the same methodology to Scottish and Danish seine fisheries, which operate with fundamentally different mechanics. Not all fisheries are suited for swept area calculations. For static gears such as pots, traps, or gillnets, the concept of swept area is neither meaningful nor applicable, since these gears do not continuously cover an area during fishing. Between these two extremes lie gear types such as Danish seine and Scottish seine fisheries.

The existing workflow treated Danish and Scottish seines identically to trawling, using vessel speed and gear width to calculate SAR. This approach does not reflect the actual fishing operation, where the swept area depends on the circular "loop" formed by the seine ropes rather than continuous towing distance (Figure 2).

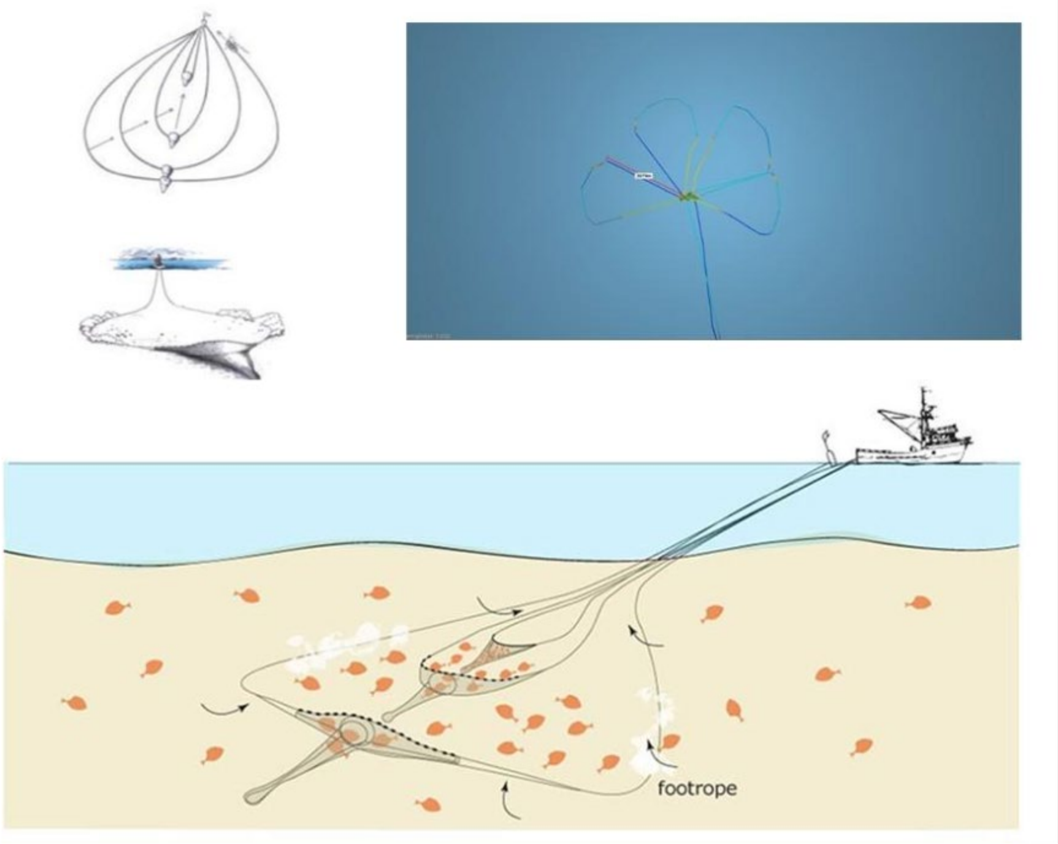

Figure 2. Illustration of the towing principles of the Scottish seine (SSC) gear, showing how the vessel advances whilst hauling in the ropes to cover a triangular seabed area (Eigaard *et al.*, 2016).

Consequently, the current trawl-style calculations misrepresent the actual seabed area impacted by these gears.

An alternative method, used in the ICES database SAR calculations, has been developed and implemented through the sfdSAR package. The approach uses `sfdSAR::scottish_seine_contact()` for Scottish seine and `sfdSAR::danish_seine_contact()` for Danish seine. These functions calculate swept area based on the rope loop geometry using the formula $A = C^2 / (4\pi)$, where A represents the calculated surface area in square kilometres and C represents the total rope length in kilometres. Standard haul durations are applied based on Eigaard *et al.* (2016), specifically 1.9125 hours for Scottish seine and 2.5912 hours for Danish seine.

For these métiers, the "gear width" field in BENTHIS represents total rope length rather than physical net width. Values may exceed 6 km, which is correct for rope length but may appear unusual to data submitters expecting typical net widths of approximately 300 metres. Because some data submitters may be unfamiliar with the technical details of these fishing techniques, they might be surprised to see gear width values of this magnitude. Unless specific rope length data are available, it is recommended to use BENTHIS gear width values from the icesVMS package, as these represent total rope length.

Clear explanation should be provided in the data call text, workflow script, and accompanying documentation regarding why the SAR calculation differs for these gear types. It is essential to clarify that the swept area is calculated differently for these gear types to avoid confusion and ensure data quality.

Proposed code modifications have been drafted for script ICES-VMS-and-Logbook-Data-Call / 2_eflalo_tacsat_analysis.R starting at line 647. The updated code includes enhanced documentation explaining the different approaches, conditional logic to apply seine-specific calculations based on gear type (LE_GEAR), and retention of standard SAR calculations for other gear types. The proposed code requires testing before implementation.

This issue has been classified as high priority as it affects the accuracy of benthic pressure indicators for Scottish and Danish seine fisheries.

Recommendations

The subgroup recommends replacing the swept area calculation for Scottish and Danish seines with gear-specific functions from the sfdSAR package. Explanatory text should be added to the data call documentation describing how SAR is calculated and why the approach differs for these métiers. Users should be advised not to replace BENTHIS gear width values with country-specific net widths for these fleet segments unless they have verified rope length data available.

3.2 Developing a Unified Spatial Fisheries Data Tools R-Package

Our current workflow relies on a wide range of functions originating from different sources. Functions from application repositories are used and called across packages, and they are interdependent. Some functions are defined within our own scripts (e.g., 0_global.R), whilst others come from R packages such as sfdSAR, vmstools, and icesVMS. SAR calculations are currently performed using sfdSAR, but these are also implemented in the ICES database, accessed through icesVMS. Any methodological updates, for example new approaches for Scottish and Danish seines, must therefore also be reflected in the database-side implementation to ensure consistency.

The icesVMS package contains the functions that connect to and extract data from the ICES database. At present, it requires updates, as the addition of habitat and bathymetry layers has caused multiple records per c-square (one per stratum), leading to incorrect SAR values when summed, since the corresponding area information is missing. In addition, we maintain separate scripts for specific tasks such as quality control.

Recently, ownership of the `csquare()` function, previously maintained externally, has been transferred under our group maintenance responsibility. This presents a clear example of why a central, well-maintained repository is needed. Important core functions like `csquare()` should have a stable home within the shared ICES spatial fisheries toolset, rather than depending on individual contributors.

Several of the packages we currently rely on are not hosted on CRAN, and their long-term maintenance is uncertain. This fragmentation poses risks to stability, reproducibility, and continuity of our workflows. Code is scattered across multiple scripts and repositories, making it difficult to maintain consistency, report issues, and ensure compatibility between different workflow components.

To ensure stability, reproducibility, and continuity, we propose consolidating all workflow-specific functions not yet included in maintained CRAN packages into a single, well-documented R package: SFDTools (Spatial Fisheries Data Tools). SFDTools would serve as a central repository for shared functions used across ICES spatial fisheries workflows. Potential maintainers could include current developers of related packages, but by hosting these tools together, we create one unified location to report issues, suggest improvements, and ensure compatibility between workflows.

All member states should be granted the ability to suggest modifications to the SFDTools source code and be informed about the changes that have been made. This could be implemented by appointing a national representative through the National Correspondent (NC). The designated person would be authorised to submit pull requests to the source code and receive information on new releases and new versions of the package. This approach ensures transparency and allows all contributing countries to participate in the development process.

Developing and maintaining such a package will require coordination and commitment from the group. As a next step, we should identify potential maintainers, link ongoing work to existing ICES tool development efforts, and outline a roadmap for integration. Whilst this will be a longer-term process, establishing SFDTools will significantly enhance transparency, interoperability, and sustainability across ICES spatial fisheries data workflows.

The consolidation of workflow functions into SFDTools would provide several key advantages. It would create a stable, well-documented repository for essential functions, ensuring long-term maintenance and reducing dependency on individual contributors. It would improve reproducibility by providing a single, version-controlled source for workflow functions. It would enhance collaboration by establishing clear channels for member states to contribute improvements and stay informed of updates. Finally, it would streamline quality control and ensure consistency across different ICES spatial fisheries workflows.

3.3 Harbour positions

To exclude VMS positions at slow or stationary speeds in harbours inflating fishing effort and swept area calculations, VMS data are currently filtered to exclude positions with a 3km buffer on known harbours. The current workflow uses the harbour data included in the VMStools library, however examination revealed that this is likely to introduce biases, though not filtering correctly for ports in Portugal, Iceland, Faroes and Norway (Figure 3).

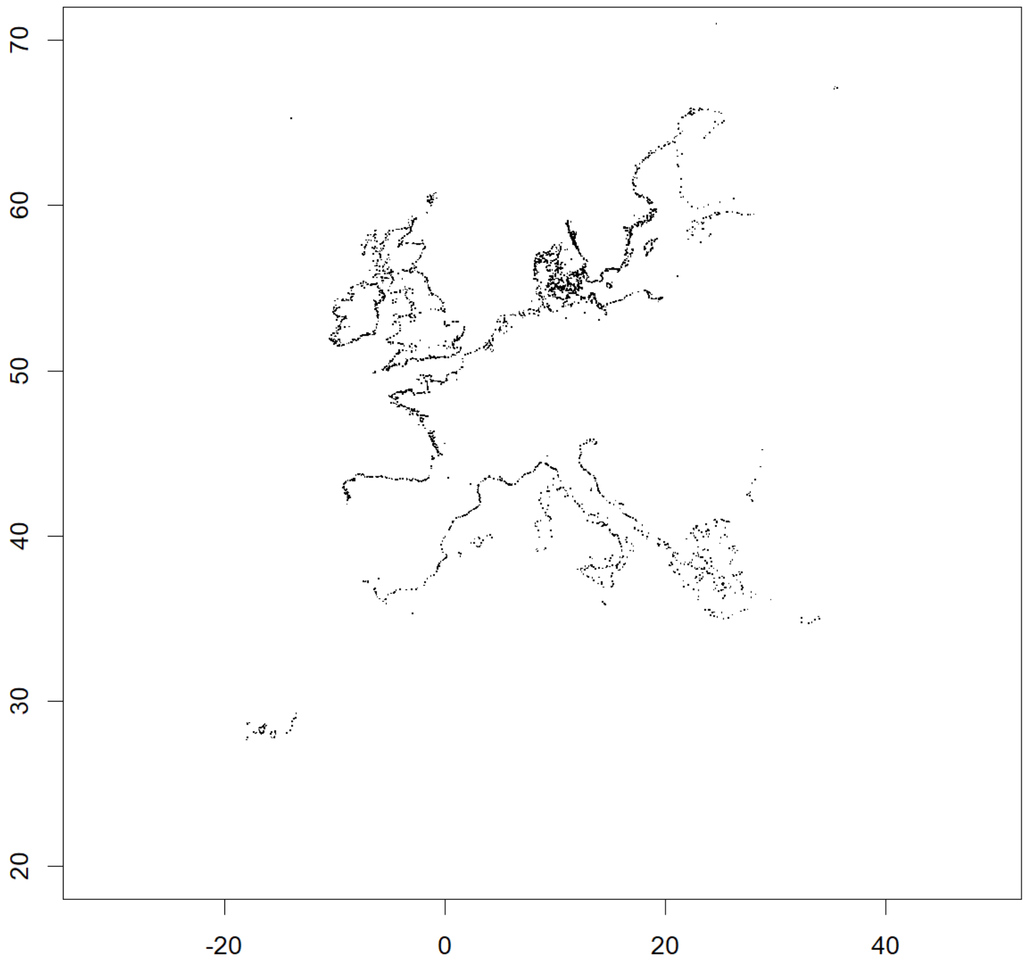

Figure 3. Port records present in the VMSTools harbour data.

As an alternative source of data, the UN LOCODE positions of registered ports was examined (Figure 4). While this is an official data set which includes some ports missing from the VMStools data set, there are clearly some errors too, which would exclude fishing activity offshore.

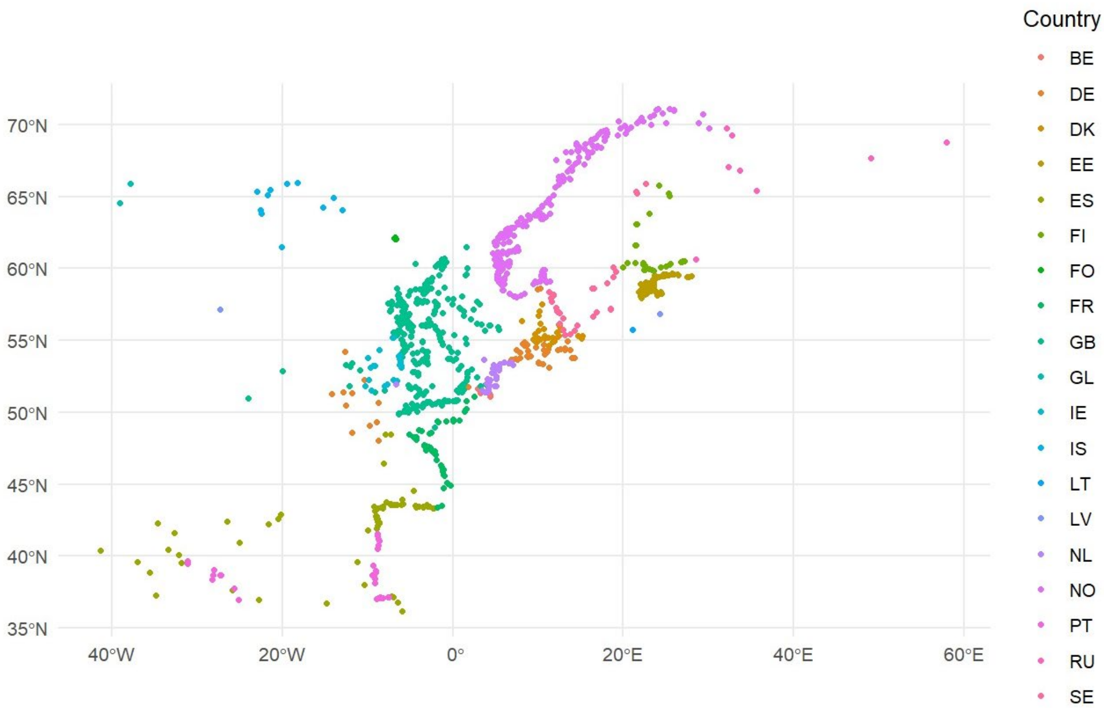

Figure 4. Harbour positions in the UN LOCODE data sets (excluding static oil production facilities).

The group agreed to intersessionally investigate the creation of a specific set of ports to use in future data calls.

4 ToR C. Develop methods to work with high resolution spatial data and implement these in the WGSFD workflow

The group specified a set of topics to work on during the meeting; a definition of high-resolution data, gaps in methodology, identification of opportunities offered by high-resolution data, and next steps to take.

4.1 Definition of high-resolution data

Regulation (EU) 2023/2842 of the European Parliament and of the Council of 22 November 2023 amending Council Regulation (EC) No 1224/2009, and amending Council Regulations (EC) No 1967/2006 and (EC) No 1005/2008 and Regulations (EU) 2016/1139, (EU) 2017/2403 and (EU) 2019/473 of the European Parliament and of the Council as regards fisheries control: https://eur-lex.europa.eu/eli/reg/2023/2842/oj/eng

According to the Control Regulation (CR), Member States (MS) should be able to track all fishing vessels, including fishing vessels of less than 12 meters in length overall (LOA), and to receive position data from them at regular and sufficiently short intervals. CR states that data should be transmitted every 30 minutes but does not clarify the interval at which it should be recorded by the vessel monitoring system.

For small-scale fisheries, Rufino *et al.* (2025) makes a case for a 30 second frequency to identify fishing operations.

After consultation of the EU control regulation, the WGSFD considers high resolution data to be positional data with an acquisition frequency of 10 min or less, lower resolution 10 min or more. In addition, the minimum frequency chosen should generate an acceptable number of points per fishing event.

4.2 Identify gaps in data/ methodology

Table 2 lists the gaps identified by ToR C working subgroup along with the capability of the subgroup to address it, its priority and the year the subgroup plans to address it. Each identified gap is described thoroughly below the table.

Table 2. Gaps identified by the ToR C working subgroup. Prioritisation and expected year of execution.

Issue	Addressed by ToR C	Priority	Year
a. Device reliability (including signal jamming)	This area is not a current priority for the group, though it may be quantifiable at the national level, and some subgroup members are exploring it through their individual projects.	Low	2027
b. Gaps in fleet segments	This is being handled by the 'Coverage & Quality' subgroup; ToR C will wait for the results and contribute high-resolution perspectives where appropriate.	Med	-
c. ICES Data Call Workflow	This area covers the potential gaps on the ICES Data Call workflow when high resolution data starts coming in. Although the Call has already some experience with Iceland using AIS high resolution data, Tor C will explore if more gaps will show up to prevent future complications on the data call.	High	2026
d. Standardising data processing methodologies	As one of the steps of the data call –preprocessing data – this area covers the gaps existing in the standardising data process.	High	2026
e. Scalable model to predict gear and fishing operations	This area will be covered after the former two are already finished. It aims at providing a single model for all the MS to apply to high-resolution data to identify gear and fishing operations.	High	2027
f. Gaps in model's classification	This area covers the uncertainty analysis of the models by optimizing the false positives and negatives in the confusion matrix based on the dependent variables of the model.	Low	
g. Data storage and processing/management - computational demand	This area is not a current priority for the working group; however, it is an issue that should be addressed soon, because the possibility of acquiring high resolution data is just a matter of time.	Low	
h. Resolution mismatch with logbooks	This area is not a current priority for the group, though it may be quantifiable at the national level, and some subgroup members are exploring it through their individual projects.	Low	
i. Challenges in vessel identification	Specific issue with the use of AIS data: link vessel identifiers between sources.	Medium	2028

4.2.1 Device reliability (including signal jamming)

Device reliability is not a specific problem of high-resolution devices. Device reliability includes failures either from the device itself (loss of battery, climate actions) or from the signal (loss of satellites). However, they should be accounted for and see if the trends over time per vessel, fishery and country. Gaps in trajectories have been studied and accounted for in several research articles (e.g. Tassetti *et al*., 2019; Ferrà *et al*., 2020; Yildiz *et al*., 2025). Gaps can be addressed using methodologies that consider both vessel trajectory and wind/sea conditions, or a more mathematical approach (e.g. Sharma *et al.,* 2025)

Signal jamming is the deliberate act of disrupting wireless communication. It can be divided into voluntary/involuntary from the fisherperson perspective. Voluntary or proactive is when the device is being switched off or the skipper covers the transmitting device. Involuntary or reactive when the signal is modified by an external body through a deep knowledge of the GPS signal, emitting from a "pseudolite" (a radio station, generally ground-based, that acts as a "pseudo-satellite") a code that is compatible with the genuine GPS codes transmitted by real satellites, but which contains intentionally disturbed information. In particular, the information about the status of the constellation clocks that you want to harm is usually 'dirtied'.

All gaps should be accounted for and explore the trends over time per vessel, fishery and country but this falls under the Coverage subgroup.

4.2.2 Gaps in fleet segments

Temporal gaps due to exceptions from the control regulation policy extending the obligation to have an onboard device.

This is being handled by the 'Coverage & Quality' subgroup; ToR C will wait for the results and contribute high-resolution perspectives where appropriate.

4.2.3 ICES Data Call Workflow

We initiated a discussion on how this process could be integrated into current workflow while combining various potential data sources.

The transition towards high resolution spatial fisheries data may have consequences for the current workflow of the WGSGFD data call, though these may vary by country and/or fleet segment. For countries, years and fleet segments where high quality data on gear use is already available for low resolution data, and where activity determination based on simple speed rules is a valid option, high resolution data would not pose any significant challenges under the current workflow (left side of Figure 5). For this, the methodology could remain the same, with the only difference being a higher data frequency, also allowing for higher resolution data products.

However, for countries, years and fleet segments where no (reliable) data on gear use is available, or where more complex decision rules may be needed – such as small-scale or passive fisheries - the current WGSFD workflow is not adequate and development of a parallel workflow is required (right side of Figure 5). Provided the resolution is sufficient, a generic simplified-gear detection model could be applied, thus, allowing a consolidation of information available from logbooks. Using available gear-suited fishing detection models could be applied to the geopositional data for identifying activity. Generic models could be developed for an application by multiple countries, or alternatively, experts could develop models specific to the local situation if the reference data needed is available.

Generic models offer the advantage of allowing scalability in the workflow if case reference data is not available to specific fisheries. Furthermore, generic models increase transparency of the methods applied. It would provide a framework similar to what the BENTHIS project currently provides for processing low resolution spatial fisheries data.

At last, from this high resolution, we could assess the fishing gear effort either using an approach based on geocomputation (Mendo *et al.*, 2023) or inference-based methodology as described in Henriques *et al.* (2024). Complementary to fishing vessel effort indicators, metrics like net length, number of hooks, pots and soaking time could be provided to the data call.

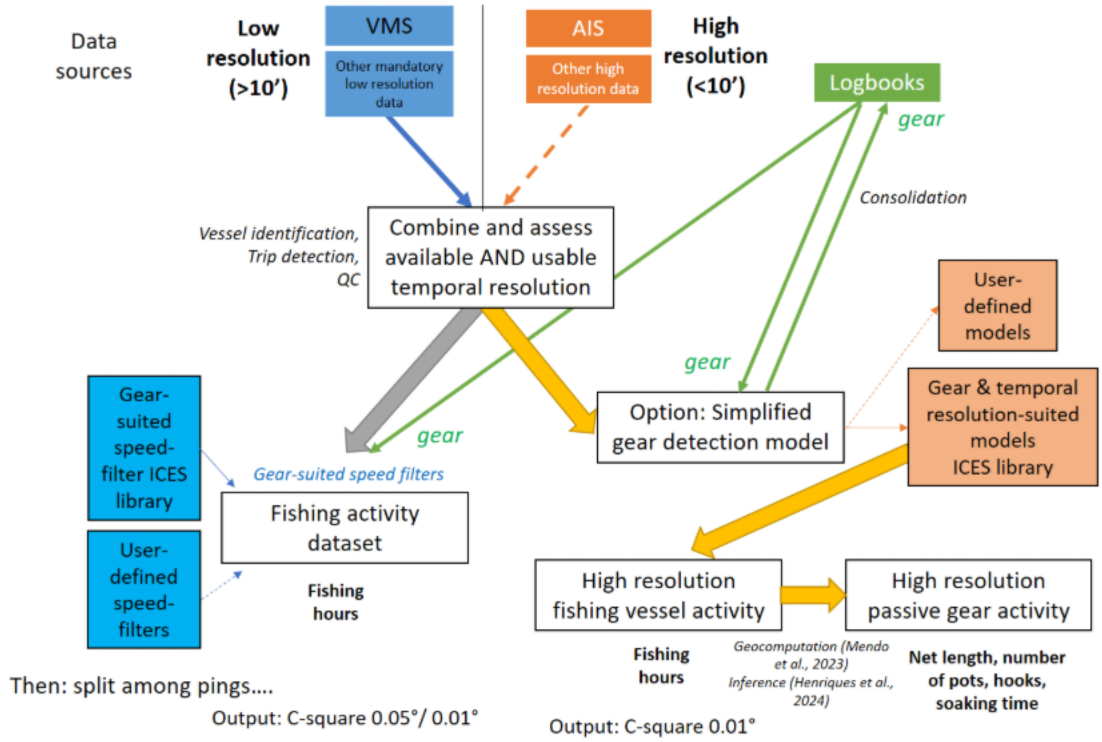

Figure 5. Comparison between high and low resolution data call workflow.

4.2.4 Scalable model to predict gear and fishing

The performance of most modelling techniques is often limited by sample size. High-resolution tracking data (vessel monitoring systems) can mitigate these limitations by providing larger and more detailed datasets, thereby enabling the use of more advanced models, including statistical (frequentist or Bayesian) and machine learning approaches (Rufino *et al.*, 2023; Samarão *et al.*, 2025; Mendo *et al.*, 2023). This development greatly expands the potential for extracting richer and more informative insights from the data.

Across the European Union (EU), Small-Scale Fisheries (SSF) represent more than 80% of the fishing fleet (https://rpubs.com/MRufino/SSF_EU_Map). In many countries, these vessels are permitted to operate using multiple fishing gears (i.e. the same vessel can fish using pots and traps, using bivalve dredges and using trammel nets). As a result, the gear type may change between fishing trips, and approximately 70% of responses in an SSF questionnaire conducted within the MAP-SSF project indicated such flexibility. This adaptability can be essential to enhance the resilience of small-scale fishers and is therefore of great importance to coastal communities. Furthermore, in several countries, logbook information is missing or not reliable, to provide detailed information on these operations.

Where validated high-resolution tracking data on these fisheries exist, or where such data can be accessed through example databases (proposed earlier by the group to be hosted by ICES), it becomes possible to develop classification models to predict the type of gear used on each fishing trip. Moreover, if these models can be transferred and applied to other countries or regions lacking this information, they would offer significant added value. The scalability of such gear-prediction models could prove to be extremely useful for future fisheries monitoring and management.

Similarly, developing behavior classification models for fishers behavior, that are applicable across broad geographic areas and multiple EU countries would be highly beneficial. Such models would enhance the comparability and coherence of analyses across the EU's continuous marine territory.

In the context of the European Horizon CIBBRiNA project, an initiative of this kind has been launched for the processing of data from various case studies. A standardized workflow is being developed that is meant to be applicable to the eight different case studies in this project. It uses the {iapesca} package developed in a similar context (Rodriguez, 2023; Sans & Rodriguez, 2023) with new functionalities for a simplified use of machine-learning models, application of geocomputation process as described in Mendo *et al.* (2023), as far as functions for c-square aggregation and mapping using {terra} package. This suggestion of workflow for processing high resolution dataset uses a dummy example for the demonstration and is publicly available on an open-gitlab repository as well as the {iapesca} package (script for data harmonization).

4.2.5 Gaps in model's classification

To obtain maps of fishing effort, it is essential to classify each point provided by the vessel tracking device, into fishing/non-fishing. This can be processed using a simpler approach, such as a fixed threshold based on the speed, or more complex methods, such as statistical or machine learning frameworks. In all cases, there are points that are wrongly classified, e.g. points that are classified as 'fishing' which are actually 'not-fishing'. Thus, it is possible to produce a binomial variable that identifies these points (i.e. 0 wrong classification, 1 good classification), and model it in function of vessel speed, métier, temporal resolution or any other dependent variables of the model. Thus, this study should produce an uncertainty analysis on the errors of the model itself and map the reliability of the data classification.

The example case study presented is from two SSF métiers, operating in three areas in Portugal (Pots.S, Dredge.NW, Dredge.SW and Dredge.S), (further details can be found in Rufino *et al.*, 2023), validated by experts and subsampled over 30 secs to 10 minutes resolution (res variable). The data was modeled using three methods, (1) fixed threshold based on speed estimated using classification regression trees ('wrong.fix'), (2) mode method (described in Rufino *et al.*, 2023) ('wrong.mo') and (3) random forest model ('wrong.rf').

It is clear that the percentage of wrongly classified observations changes across speeds, increasing substantially for speeds near 5 knots or above 10 knots, independently of the métier and resolution (Figure 6), with machine learning methods being less sensitive to speed (Figure 7).

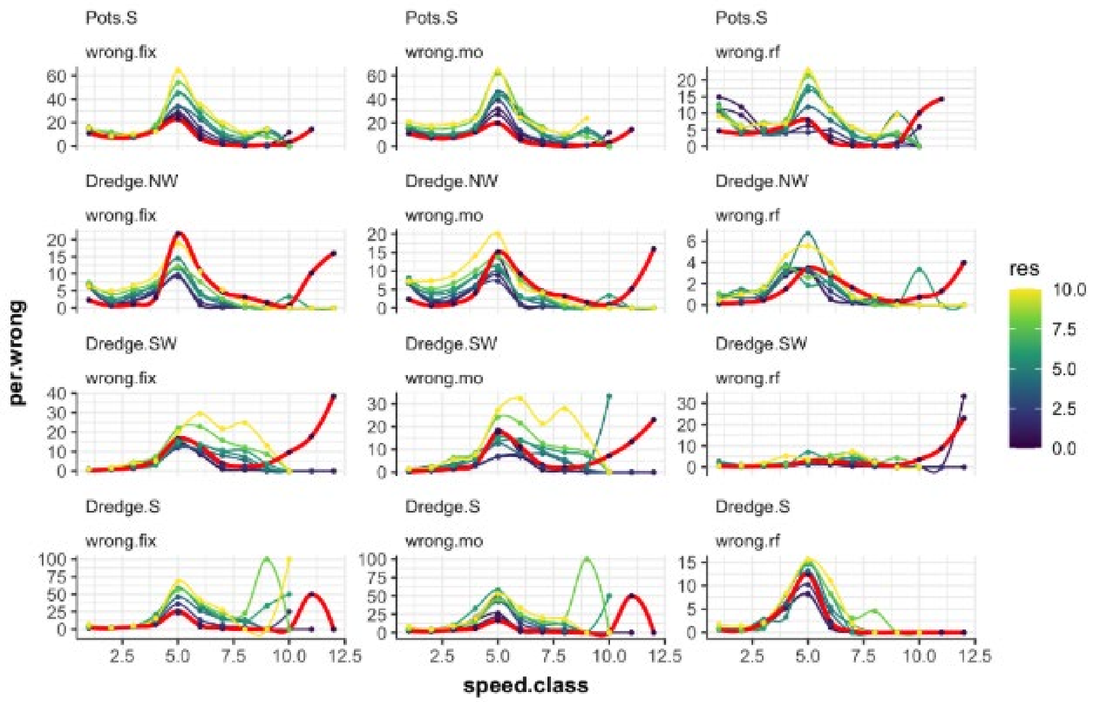

Figure 6. Percentage of wrong classifications by vessel speed, method, temporal resolution and metier. Red line: raw data.

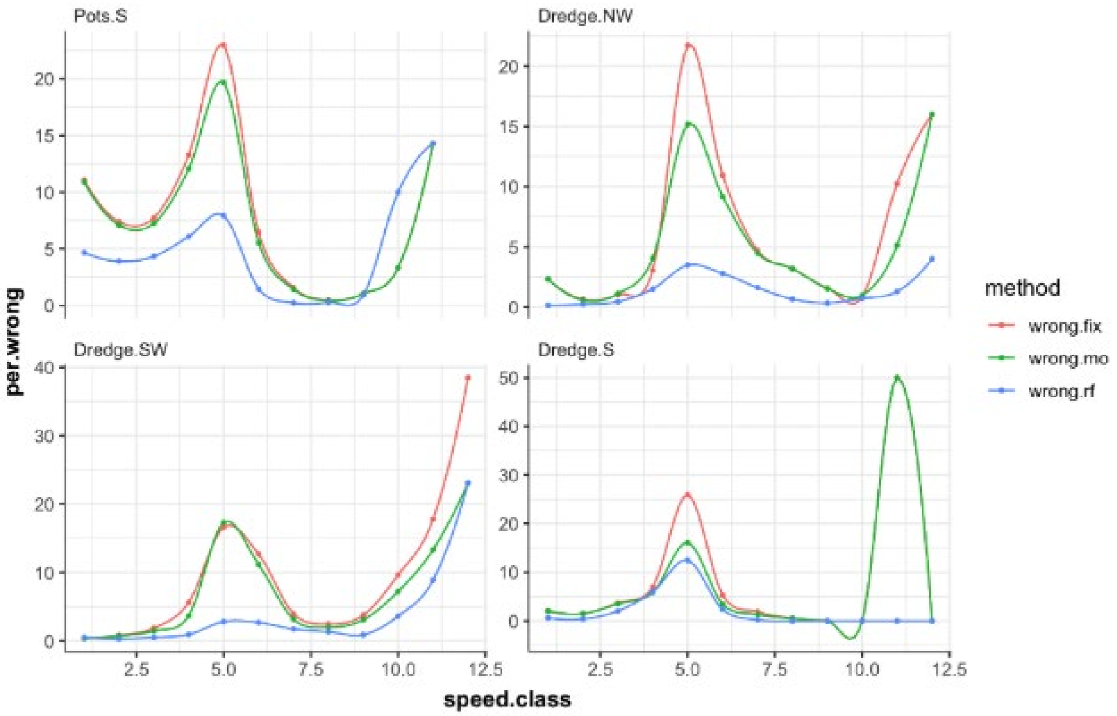

Figure 7. Percentage of wrong classifications by vessel speed, method and metier. Red line: raw data.

Further, the percentage of wrongly classified tracking points decreases exponentially with the number of points being classified (Figure 8).

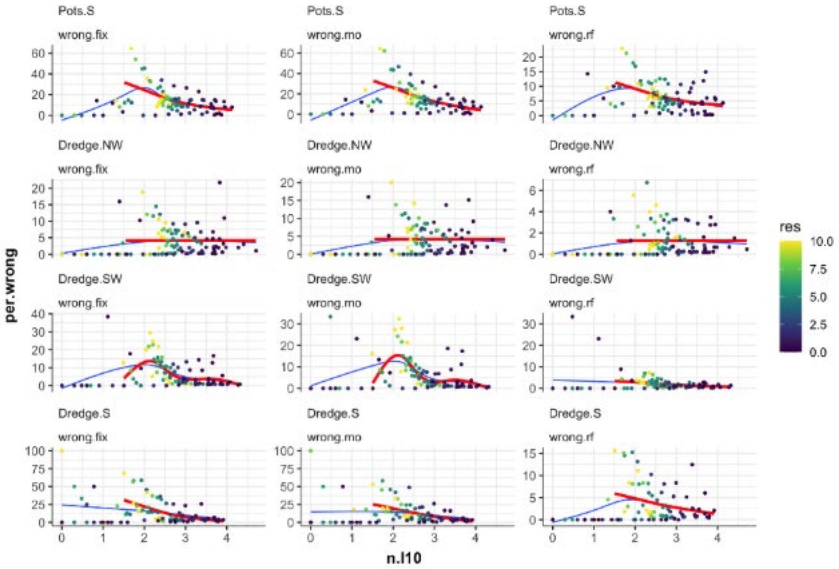

Figure 8. Percentage of wrong classifications by temporal resolution, metier and method. Red line n>1.5.

The probability of getting a wrong classification can be modelled using a GAMM, with a Bernoulli family, for example. A simple GAM model was produced, for raw resolution (using the data from the case study above) and random forest classifier. The model should then be improved, including a spatial and temporal component and the combined probabilities mapped accordingly, overlaid with the effort predictions. This provides preliminary results which should be extended in future work.

4.2.6 Data storage and processing/ management - computational demand

The comprehensive challenge of building a high-resolution, mandatory data tracking system requires coordinated solutions across technology, security, and governance to manage the vast volume of information while protecting its sensitive nature.

The core difficulty lies in managing the high computational demand generated by these high-resolution tracking data. This starts with the lack of appropriate database architectures, which must be resolved by tasking national authorities to establish a harmonized, interoperable database structure. This solution requires not only the architecture for integrating and merging data from diverse tracking systems but also the mandate for adequate, scalable computational infrastructure (storage, processing power, and cloud resources) necessary to handle the large data volumes for pre-processing, analysis, and long-term maintenance. The fundamental difference between tracking data collected every ≤10 minutes (high-resolution) and data collected less frequently (>10 minutes, low-resolution) lies in the resulting Volume, Velocity, and analytical Complexity - "the three V's (volume velocity and variety) of Big Data". Thus, the high-resolution data acquirement moves the problem from one of conventional data management (which an RDBMS - Traditional Relational Database Management Systems, e.g., PostgreSQL, Oracle - can handle) to one of Big Data management (which requires a distributed, cloud-scalable architecture with stream processing capabilities). This necessity is driven by: (i) storage scalability: the sheer cumulative volume of data (petabytes over years) exceeds the practical and economic limits of conventional databases, requiring horizontally scalable distributed storage systems; (ii) computational efficiency: processing, cleaning, and analysing the massive data volume -

especially running complex, spatiotemporal queries - would take days on an RDBMS. Big Data solutions enable parallel processing to reduce job times from days to minutes, ensuring that even non-real-time (daily or weekly) operational and analytical goals are met. Obviously, the high resolution shifts the approach from manageable hardware costs to high, variable cloud spending and substantial investment in specialized security and human expertise.

4.2.7 Resolution mismatch with log-books

A key step in the production of aggregated spatial distributions of fishing effort, intensity, etc. is the matching and integration of tracking data (such as VMS, AIS) and logbook data. This is true of both low- and high-resolution data. However, one consideration of the ToR C subgroup was that the benefits of high-resolution data can often be limited/ constrained by the greater discrepancy in resolution between the tracking data and the logbook than for low resolution tracking data. This is particularly the case for high-resolution data in the SSF context. The required reporting frequency of logbooks for SSF fisheries can be low, e.g. weekly, and their format and required information fields simplistic with little development over time. Low resolution logbooks have a number of weaknesses:

- Data reliability issues – inaccuracies and / or incomplete data.
- Operational shortcomings – low uptake of digitalization and lack of real time validation and consequences of non-compliance.
- Governance gaps – limited guidance and / or feedback mechanisms.

These weaknesses compromise data quality and integration to support high-resolution analyses.

Low temporal frequency logbooks often report a single catch that is associated with multiple fishing trips and activities. This often results in under and inadequate reporting of activity on non-landing days. When integrating such logbooks with high-resolution data there can be a high degree of mismatch and where catches are assigned over multiple fishing trips / activities errors and biases associated with assumptions are propagated.

Given the increasing coverage of high-resolution tracking devices and increasing importance of high spatial accuracy, addressing weaknesses of logbooks for SSF is essential. There is broad agreement on the need for reform of non-digitalised logbooks and this is reflected in the EU control regulations revised requirements for electronic reporting by all vessels from 2028:

> **REGULATION (EU) 2023/2842 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL**
>
> (27) The submission of catch registration data in paper format has led to incomplete and unreliable reporting and ultimately to inadequate catch reporting, by operators to Member States and by Member States to the Commission, and has hampered the exchange of information between Member States. It is therefore considered necessary for masters to record data concerning catches in a digitalised way and submit them by electronic means, in particular the fishing logbooks, transhipment declarations and landing declarations.

While this issue may have a high impact on data quality and coverage currently relative to low-resolution spatial data the ToR C subgroup doesn’t anticipate that they can address this issue. However, the subgroup could create and monitor indicators relating to this issue at a national level and some subgroup members are quantifying this data gap within their own individual programs.

4.2.8 Challenges in vessel identification

Depending on the nature of the high spatial resolution data employed, identifying fishing vessels and linking these records to fisheries-dependent data, such as logbooks, can pose challenges.

This issue arises in the case of AIS (Automatic Identification System) data, which was developed for maritime safety and navigation. AIS messages include the Maritime Mobile Service Identity (MMSI), a unique identifier assigned to a vessel's radio equipment. This identifier may change over time and does not correspond directly to the identifiers used in fisheries management systems. To associate AIS records with specific fishing vessels - identified by their Common Fleet Register (CFR) codes - external data sources are required to establish the correspondence.

A commonly applied strategy involves MMSI identification by cross-referencing AIS records with EU Fleet Register (EUFR) data, which contains both MMSI and CFR codes. In cases where MMSI information is missing or ambiguous, manual verification is conducted using tools such as TrackIPi or MarineTraffic.

In the context of upcoming EU regulation, when using systems such as AIS to track fishing activity, vessel identifiers should be provided in a format that enables direct linkage with fisheries management systems. Otherwise, the cross-referencing strategy described above must be applied, which does not guarantee complete identification of all operating vessels.

In addition to the technical challenges associated with identifier matching, limitations also arise from the reliability and completeness of AIS data itself. Although AIS equipment may be officially reported as installed on a vessel, this does not guarantee that the system is operational or transmitting data. To assess the consistency of the information provided in the EU Fleet Register (EUFR), a comparison is conducted between the number of vessels officially reported as having AIS installed and the number of vessels for which AIS data have actually been recorded. For example, in Spain, 3595 vessels are listed as having AIS equipment, yet Global Fishing Watch (GFW) has recorded data for only 293 of them (4.7%). Similar discrepancies have been observed in other countries, including France, Portugal, and Romania (Table 3).

Table 3. Summary of the number of vessels reported in each segment, within the EUFR. Column SSF.AIS indicates the number of vessels officially carrying an AIS device, whereas the column SSF.AIS.GWF shows, from those vessels, how many are actually transmitting the signal, and thus have records of AIS data within the GFW database. N shows the total number of vessels, LSF and SSF, the number of vessels reported for each segment and SSF indicated the number of vessels below 9 m LOA. Per.SSF indicates the percentage of vessels within the SSF segment, SSF.VMS indicates the number of SSF vessels with a VMS system and SSF.AIS, the number SSF vessels with AIS system installed. SSF.ton represents the total tonnage (Tonnage.GT) in the fleet segment.

Country	N	LSF	SSF	SSF9	per.SSF	SSF.VMS	per.SSF.VMS	SSF.AIS	per.SSF.AIS	SSF.ton	SSF.AIS.GFW	per.SSF.AIS.GFW
BEL	60	60	0	0	0.0	0		0		0		
BGR	106	10	96	91	90.6	8	8.3	2	2.1	167	1	1.0
CYP	736	41	695	585	94.4	1	0.1	0	0.0	1671		
DEU	1084	217	867	754	80.0	1	0.1	8	0.9	2225	8	0.9
DNK	1768	287	1481	1227	83.8	5	0.3	4	0.3	4338	2	0.1
ESP	8461	2223	6238	5061	73.7	59	1.0	3595	57.6	14696	293	4.7
EST	2067	33	2034	1917	98.4	0	0.0	0	0.0	2336		
FIN	3257	54	3203	2914	98.3	0	0.0	17	0.5	7175		
FRA	5957	773	5184	3720	87.0	675	13.0	3735	72.1	23402	656	12.7
GBR	1089	472	617	326	56.7			0	0.0	4121		
GRC	11401	719	10682	9529	93.7	1488	13.9	115	1.1	22723		
HRV	6195	362	5833	5384	94.2	292	5.0	111	1.9	11170	24	0.4
IRL	1944	243	1701	1229	87.5	1	0.1	0	0.0	6075		
ITA	12277	3422	8855	7274	72.1	4	0.1	594	6.7	18328	27	0.3
LTU	108	19	89	79	82.4	1	1.1	0	0.0	201		
LVA	167	46	121	115	72.5	0	0.0	0	0.0	168		
MLT	821	56	765	683	93.2	45	5.9	1	0.1	1982		

NLD	763	418	345	256	45.2	0	0.0	50	14.5	898	45	13.0
POL	783	148	635	462	81.1	3	0.5	76	12.0	2875	64	10.1
PRT	3541	496	3045	2674	86.0	39	1.3	1570	51.6	8173	62	2.0
ROU	78	14	64	40	82.1	0	0.0	63	98.4	228		
SVN	131	15	116	102	88.6	8	6.9	2	1.7	295		
SWE	917	123	794	540	86.6	8	1.0	154	19.4	3632	159	20.0

4.3 Opportunities

The opportunities associated with the use of high-resolution spatial data for tracking fishing activity are currently being identified based on previous work, including the ICES WKSSFGEO2 workshop (ICES, 2023) and the MAP-SSF project. These initiatives focused on small-scale fisheries (SSF) and explored the application of spatial tracking technologies in the context of fisheries monitoring and management.

The following opportunities have been summarised:

- Generation of spatially and temporally explicit datasets that support the analysis of fishing effort and its interaction with marine ecosystems.
- Possibility to establish traceability of fishing operations through geolocation data.
- Validation of fishing activity for inclusion in marine spatial planning (MSP) processes and for resolving spatial conflicts between maritime sectors.
- Identification of fishing grounds to inform spatially explicit management measures and support scientific advice and stock assessments.
- Quantification of fishing effort within marine protected areas (MPAs), including Natura 2000 sites.
- Integration of spatial data into bioeconomic models and ecosystem service assessments.
- Availability of data within short timeframes, supported by recent developments in the regulatory framework.
- Reduction in data processing costs due to increased computing capacity.
- Facilitation of multi-sectoral data integration and improved coordination between fisheries and other maritime activities.
- The following opportunities have been identified in Rufino *et al.* (2025), focusing on the implications of temporal resolution in vessel tracking systems:
- The use of high-temporal resolution data improves the accuracy of fishing effort estimation and reduces bias in fisheries assessments.
- Tracking systems can be designed to combine real-time monitoring (VMS) with post-trip data upload (MTS), allowing flexible implementation without compromising data utility.
- Historical tracking data is sufficient for most applications, including compliance, reducing the need for real-time transmission and associated costs.
- The definition of minimum temporal resolution standards in legislation can support harmonised implementation across Member States.
- Insufficient temporal resolution may lead to indirect costs for stakeholders, such as restricted access to fishing grounds or exclusion from marine spatial planning processes.

4.4 Next steps

Considering the priorization done in Table 2, the group agrees on preparing a dataset before next year's meeting:

- Ask the plenary for validated data examples.
- Start from the database already used in WKSSFGEO2 and include it in an informal data-call, eventually.
- Upload it into ICES Data tools.
- Request for information of vessels < 12 m LOA received in the datacalls: In the context of HRD ToR and to assess the maturity of SSFD (under 12 m vessels data) and HRD already collected in the official data call. It is crucial to understand the significance of this data, the fleet coverage, their average frequency and other related information. This could

inform the official data call to propose a different data request format for high frequency or small-scale fisheries data, e.g. finer c-square sizes, etc. This also could help to prepare the official data-call to incorporate in the future high-resolution data independently of if it is provenient from small-scale fisheries fleets. Therefore, the sub-group intends to explore and analyse the submitted data in the official data call for under 12 m segment, and respective information, along with the average ping rate for each c-square, during the current year.

5 Other Business

5.1 ICES Annual Science Conference

The group discussed whether it could contribute to the ICES Annual Science Conference in 2027. Several members expressed interest, and it was agreed that a document should be created listing interested participants and possible contribution ideas.

5.2 Data Submission Gaps

In 2025, the Faroe Islands, Greenland, Portugal, and Norway did not submit data to WGSFD. This omission resulted in data gaps within the final products, consequently reducing their overall quality. The group discussed potential strategies to increase the likelihood of complete data submissions from all countries in the future. It was agreed that a recommendation should be made to ICES regarding the issue of missing data.

The possibility of incorporating publicly available Norwegian data into the products was considered; however, this approach was ultimately rejected. The group noted that using such data could introduce bias, as it would not have undergone validation through an official data provider. Furthermore, relying on publicly available data could reduce the incentive for Norway to submit data through the standard channels in the future.

5.3 Quality Control Procedures

The quality control procedures applied after national data submissions were discussed, as the process has historically depended heavily on the efforts of the current and former chairs. It was proposed that a dedicated subgroup be established to manage this aspect of the workflow in a more structured and sustainable manner.

Concerns were raised regarding data confidentiality, given that such a group would require access to aggregated datasets and potentially sensitive information related to data quality issues at the national level. This matter is closely linked to the long-standing and unresolved discussions surrounding data confidentiality within the group. No consensus was reached on an appropriate approach to address this issue.

It was discussed whether a subgroup could be formed to coordinate the quality control process with ICES. It would require three to five people who could allocate two to three days of work after the data call is completed each year, around June. The placement of such a subgroup under WGSFDGOV or WGSFD was discussed. Some members showed interest, but a formal agreement was not reached.

5.4 Planned Hackathon

A hackathon involving all group members will be organised towards the end of 2025. The event will focus on the processing and analysis of `splitamongpings` functionality, trip assignment procedures, SAR (Swept Area Ratio) calculations, and associated dependencies such as port information.

6 References

Eigaard, O. R., Bastardie, F., Breen, M., Dinesen, G. E., Hintzen, N. T., Laffargue, P., Mortensen, L. O., Nielsen, J. R., Nilsson, H. C., O'Neill, F. G., Polet, H., Reid, D. G., Sala, A., Sköld, M., Smith, C., Sørensen, T. K., Tully, O., Zengin, M., & Rijnsdorp, A. D. 2016. Estimating seabed pressure from demersal trawls, seines, and dredges based on gear design and dimensions. *ICES Journal of Marine Science*, 73(suppl_1), i27–i43. https://doi.org/10.1093/icesjms/fsv099

Ferrà, C., Tassetti, N., Armelloni, E. N., Galdelli, A., Scarcella, G., Fabi, G. 2020. Using AIS to attempt a quantitative evaluation of unobserved trawling activity in the Mediterranean Sea. *Frontiers in Marine Sciences*, 7, https://doi.org/10.3389/fmars.2020.580612.

ICES. 2023. Workshop on Small Scale Fisheries and Geo-Spatial Data 2 (WKSSFGEO2). *ICES Scientific Reports*. 5:49. 105 pp. https://doi.org/10.17895/ices.pub.22789475.

Henriques, N. S., Erzini, K, Gonçalves, J. M. S., Russo, T. 2024. Let's measure it: An approach of high-resolution estimates of bottom fixed net fishing effort at national level. *Fisheries Research*, 278: 107118, https://doi.org/10.1016/j.fishres.2024.107118.

Mendo, T., Glemarec, G., Mendo, J., Hjorleifsson, E., Smout, S., Northridge, S., Rodriguez, J., Mujal-Colilles, A., James, M. 2023. Estimating fishing effort from highly resolved geospatial data: Focusing on passive gears. *Ecological Indicators*. 154. 110822 (9p.). https://doi.org/10.1016/j.ecolind.2023.110822.

Mendo, T., Mujal-Colilles, A., Stounberg, J., Glemarec, G., Egekvist, J., Mugerza, E., Rufino, M., Swift, R., James, M. 2024. A workflow for standardizing the analysis of highly resolved vessel tracking data. *ICES Journal of Marine Science*. 81: 2, 390–401, https://doi.org/10.1093/icesjms/fsad209.

Rodriguez, J., 2023. Iapesca, an R-package for manipulating and interpretating high resolution geospatial data from fishing vessels. https://doi.org/10.13155/93094.

Rufino, M. M., Mendo, T., Samarão, J., Gaspar, M. B. 2023. Estimating fishing effort in small-scale fisheries using high-resolution spatio-temporal tracking data (an implementation framework illustrated with case studies from Portugal). *Ecological Indicators*, 154: 110628, https://doi.org/10.1016/j.ecolind.2023.110628.

Rufino, M. M., Mujal-Colilles, A., Russo, T., Stelzenmüller, V., Gaspar, M., Rodríguez-Gutiérrez, J., Fernández, D. C., Ruiz, M. S., Egekvist, J., Rodriguez, J., Martinez, R., von Dorrien, C., Jonsson, P., Mateo, M., Schulze, T., Mendo, T. 2025. Implications of low temporal resolution of vessel tracking systems. *ICES Journal of Marine Science*, *82*(8), fsaf123.

Samarão, J., Moreno, A., Gaspar, M. B., Rufino, M. M. 2025. Improving machine learning predictions to estimate fishing effort using vessel's tracking data. Ecological Informatics, 85: 102953, https://doi.org/10.1016/j.ecoinf.2024.102953.

Sans Mathurin, Rodriguez Julien. 2023. Development and application of a machine-learning and geocomputation workflow for assessing the gear effort of gillnetters operating in the Bay of Biscay. Ref. 52p. Ifremer, https://doi.org/10.13155/97561.

Sharma, A., Tang, X., Gupta, J., Farhadloo, M., Shekhar, S. 2025. Analyzing Trajectory Gaps for Possible Rendezvous: A Summary of Results. In 11th International Conference on Geographic Information Science (GIScience 2021) - Part I. *Leibniz International Proceedings in Informatics (LIPIcs)*, 177, 13:1-13:16, Schloss Dagstuhl – Leibniz-Zentrum für Informatik, https://doi.org/10.4230/LIPIcs.GIScience.2021.I.13.

Tassetti, N., Ferrà, C., Fabi, G. 2019. Rating the effectiveness of fishery-regulated with AIS data. *Ocean & Coastal Management*, 175: 90-97, https://doi.org/10.1016/j.ocecoaman.2019.04.005.

Yildiz, T., Cömert, N., Ferrà, C., Şaşmaz, U., Galdelli, A., Tassetti, N. 2025. Environmental and behavioral drivers of Automatic Identification System gaps of Turkish trawlers in the Balck Sea. *Frontiers in Marine Sciences*, 12, https://doi.org/10.3389/fmars.2025.1647930.

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Annex 2: WGSFD resolution

The **Working Group on Spatial Fisheries Data** (WGSFD), chaired by Jeppe Olsen, Denmark; and Jose Rodriguez Gutierrez, Spain; will work on ToRs and generate deliverables as listed in the Table below.

	Meeting dates	Venue	Reporting details
2025	6–10 October	Malaga, Spain	
2026			
2027			

ToR descriptors

ToR	Description	Background	[Science Plan Codes]	Year	Expected Deliverables
a	Deliver an aggregated data product showing fishing effort and estimates of its impact for fisheries throughout the ICES area.	The provision of spatial fisheries data is fundamental to ICES evidence-based marine spatial planning and ecosystem-based management advice processes. This ToR addresses the need for standardised, quality-assured data products on fishing activity that can inform marine management decisions, environmental impact assessments (including an assessment of the social and economic impacts), and conservation measures across the ICES area.	2.1, 2.2, 2.3, 2.6	2025 - 2027	• Report chapter • Quality-assured data product for use in provision of advice by other groups.
b	Support the maintenance and update of the VMS data call workflow to ensure it is adequate for the existing data requirements	Members of WGSFD developed a workflow to process the ICES VMS and logbook data call. The workflow needs regular revisions to update with changing data call requirements.	2.1, 2.2, 2.3, 2.6	2025 - 2027	• Report chapter. • Github repository with well-maintained code for use in the data call.
c	Develop methods to work with high resolution spatial data and implement these in the WGSFD workflow	Continue the progress on implementing methods and workflow developed within SSF context	2.1, 2.2, 2.3, 2.6	2027	• Report chapter.

d	Improve the utility of WGSFD outputs to the ICES community and other potential users	Investigate and suggest changes of or new variables in the data call or aggregation method to meet increased demand for more refined data.	6.3, 6.4, 6.5, 6.8	2027	• Report chatper. • WGSFD contributions to other WGs/WKs reports.
e	Establish a method to represent and present fleet coverage of the VMS data.	Propose methods to regularly assess the quality and coverage of the high resolution data in relation to other fisheries related information (e.g., logbook data and landing declarations)	2.1, 2.2, 2.3, 2.6		• Report chapter. • Peer-reviewed publication.
f	Further investigate a common spatial temporal framework representing data at ICES	Expert groups and data users within ICES currently use varying spatial and temporal frameworks for data representation, leading to potential inefficiencies and difficulties in cross-referencing analyses. A common framework would improve interoperability of datasets, enhance consistency in advice, and facilitate more effective data sharing between expert groups and external partners.	3.1, 4.1, 4.5, 4.6		Report chapter. Conceptual framework document outlining the proposed structure for a common spatial-temporal system Proof-of-concept demonstration using a subset of fisheries data Guidelines for future implementation across ICES expert groups

Supporting information

Priority	The activities of this Working Group are considered of very high priority for ICES as they provide essential spatial information on fishing activities needed for multiple advisory processes. The group's outputs directly support the implementation of ecosystem-based fisheries management, marine spatial planning initiatives, and assessments of fishing impacts on seabed habitats and sensitive marine ecosystems. The standardised data products developed by WGSFD are critical inputs to numerous ICES expert groups and advice requests from ICES clients.
Resource requirements	The group requires continued access to VMS and logbook data submitted through the ICES data call, alongside appropriate data processing and storage facilities. Technical support from the ICES Data Centre is essential, particularly for data call coordination and management of the resulting datasets. Additional resources may be required to develop and maintain the common spatial-temporal framework (ToR e).

Linkages to ICES committees or groups	WGSFD has direct linkages to the Working Group on Fisheries Benthic Impact and Trade-offs (WGFBIT), Working Group on Marine Habitat Mapping (WGMHM), Working Group on Deepwater Ecosystems (WGDEC), Working Group on Bycatch (WGBYC), Working Group on Marine Protected Areas (WGMPAS), Working Group on Spatial Fisheries Data Governance (WGSFDgov), Working Group on Social Indicators (WGSOCIAL), and Working Group on Economics (WGECON). The group also supports the work of the Advice Drafting Groups on Fisheries and Ecosystem Overviews and various workshops addressing marine spatial planning and human activities. WGSFD outputs contribute directly to ICES advice on the impacts of fishing on the seabed and wider ecosystem.
Linkages to other organizations	The work of WGSFD is relevant to OSPAR, HELCOM, NEAFC, NAFO, and the European Commission, particularly in relation to the Marine Strategy Framework Directive, Maritime Spatial Planning Directive, and Common Fisheries Policy.