Paper

Innovation in fisheries monitoring science – Fisheries dependent data as a tool for real-time advice

SCAR-Fish, the Strategic Working group on Fisheries and Aquaculture Research

SCAR
Standing Committee on Agricultural Research
FISH Fisheries and Aquaculture Research

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Foreword

This Document is comprised of an original and updated text. The original document was presented to SCARFish in 2022, the updated document is a follow up to the initial paper, which was required because of developments in the subject area (including the publication of the Control regulation) since the original document was completed and before it was published through SCARFish. The original text is presented first, and the updated text can be found on from page 20. The updated recommendations from SCARFish have been brought forward to the recommendations section on Page 5 so that reader can access the updated conclusions of this work without having to read both texts.

Background

Under FP7 and EU H2020, a high number of projects have been funded where technological advances were used in the development of tools for monitoring marine ecosystems and fisheries activities in particular. Funded projects also touched upon many aspects of results-based management, social and economic factors and participatory approaches. Additionally, DG MARE funded several studies dealing with similar aspects. The extent to which such aspects have been covered at the scope of these projects was discussed in the Workshop on Research Gaps in Fisheries Topics, held in Brussels in March 2018, where scientific, economic, industrial and societal gaps, as well as research gaps in support to policies, were highlighted. Research on spatio-temporal dynamics of fisheries as a basis for Marine Spatial Planning (MSP), ecosystem and fisheries management was recommended as a priority, along with stakeholders' involvement in fisheries management and policy development. A main conclusion from this workshop was the need of changing the fisheries management paradigm towards a more flexible one, where a new set of rules is developed, adapted to a more diverse and regional structure in the fishing activities. This new paradigm calls for a bottom-up management, with real-time assessment of fishing activities, requiring active involvement of fishers in data collection and advice.

As a result of the discussions about technological advances in fisheries monitoring science, during the meetings of the Strategic Working Group on Fisheries and Aquaculture Research of the Standing Committee on Agricultural Research (SCAR-Fish), it was agreed that such advances are currently not fully used as a tool in support of fisheries advice. To propose R&I priorities in the EU, and strengthen this topic, an ad-hoc working group was formed in the frame of SCAR-Fish at the 31st SCAR-Fish Meeting on 29 September 2020. This group was tasked to identify gaps and propose research on the use of fisheries-dependent data usually collected during fishing operations (FDD) to support near-realtime advice and management. The focus is on better use of existing data and the further development of tools to improve the data collection and provision of this data for advice and management. In the EU, fisheries data is collected under the DCF (Data Collection Framework), which establishes a set of rules governing the collection of biological, environmental and socio-economic data on the fishing sector. It is important to note that, for the purpose of this group, the term "fisheries-dependent data" is used under a narrower scope, being defined as data that are already collected during fishing operations by the fishing industry. It does not include data collected through sampling of catches that are either sampled at sea through scientific observers on commercial vessels, or by scientists in harbours, when the fish are landed. Data from the Automatic Identification System (AIS), are also not considered in this document as fisheries-dependent data, despite their usefulness as a complementary source of geo-

referenced data for fishing vessels. The group mainly looked at a better usage of already existing technologies rather than the development of new technologies for data collection as well as data use.

Conclusions and recommendations

This section contains the recommendations arising from the updated review of the original document. There were 6 recommendations made in the original text, below is an update on those recommendations in the context of developments since 2022.

SCAR-Fish recommendation 1:

"To extend data collection (i.e. position and catch data) to small vessels involved in local fisheries, by promoting user-friendly technologies and reducing the costs of using these technologies. Small-scale fleets represent around 86% of all vessels in EU waters"

Update:

This recommendation is no longer required since the amended EU Control Regulation will extend electronic logbooks, declarations and vessel position data systems to all sizes of fishing vessels. The 2023 amendment of the EU Control Regulation defines the legal requirements for fisheries dependent data collection and a summary of the different types of data which must be collected by vessel length is shown below and included in the annex.

	Data collection required?				
Vessel length	**0 - 9m**	**9 - 12m**	**12 - 15m**	**15 - 18m**	**18m +**
Electronic Logbooks data	Y (by day)	Y (by day)	Y (by operation)	Y (by operation)	Y (by operation)
Landing Declarations data	Y	Y	Y	Y	Y
Vessel position data	Y* **	Y**	Y	Y	Y
*Can be exempted until 31/12/29 ** Vessel position system does not have to be fixed on board					
AIS data	N	N	N	Y	Y
Remote electronic monitoring (REM) data	N ^, ^^	N ^, ^^	N ^, ^^	N ^, ^^	Y (if high risk of non-compliance with the landing obligation) ^^
^ MS may require other vessels at high-risk of non-compliance. ^^ MS may provide incentives on a voluntary basis.					

Whilst for the smaller vessels (less than 12m) the temporal resolution of the logbooks will be coarser (per day rather than per fishing operation), and the position data may not be available in real-time, this will still be a big step forward in position and catch data provision from the small-scale fleet.

It's worth highlighting that vessels under 12m will be allowed to carry a vessel position device which does not have to be installed on board and can use other connections than satellite – this enables the option of using a mobile phone app as a vessel positioning data system on smaller vessels. How

reliable this system will be is not yet known e.g. there could be issues with skippers forgetting to start logging vessel position data during their trips.

Although the recommendation (to call for this data to be collected as part of the control regulation) is no longer required, as it is now in the revised regulation (albeit at a timeline up to 2030); it is worth noting that there might already be pilot schemes for enhanced data collection from small vessels that are already operating. Since it could be a number of years before all sizes of vessels are reporting data it is recommended that any already existing schemes continue to

be funded so that there isn't a break in data collection. Thought should be given to the transition between existing schemes and the requirements under the amended Control Regulation. The need for highly resolved spatial data on fishing activity is being driven not only by fisheries science requirements, but also by Marine spatial planning developments (e.g. Offshore Renewable Energy) and advances in socioeconomic assessments of fisheries.

SCAR-Fish recommendation 2:

"To enhance the vessel reporting capacity concerning the frequency of transmission of VMS positions."

Update:

In Article 9 of the amended Control Regulation it states that the Commission shall by means of implementing acts lay down detailed rules on the frequency of transmission of the data concerning the position and movement of fishing vessels, including in fishing restricted areas.

Generally, VMS pings are currently transmitted every 2 hours although there are instances where the minimum transmission rate is higher e.g. once every 30 minutes in protected areas. As vessel position data collection is expanded to all vessel length categories under the amended Control Regulation this transmission rate is unlikely to be high enough to accurately capture the small-scale fleet's activities. For comparison the transmission rates in the inshore VMS pilot run by the Marine Institute[1] varied from 1 ping every 10 minutes, to 1 ping every 1 minute.

Although this recommendation is valid in principle, it needs specificity from a regional level. This could be facilitated through the RCG's of the DCF and the High level Management groups implementing the regionalization of the CFP.

SCAR-Fish recommendation 3:

"To incorporate technology for automatic real-time data collection, including data on starting and ending time of individual hauls. This will allow the estimation of the effective fishing effort and its spatial component; and at the same time, will establish a knowledge base for documentation and traceability."

Update:

The amended Control Regulation requires vessels over 12m to record electronic logbook data per fishing operation.

There is limited support for Remote Electronic Monitoring (REM) systems under Article 13 of the amended Control Regulation – it is only required that vessels of 18m+ that are in a fleet segment deemed at a high risk of non-compliance with the landing obligation will need to have such a system.

Member states may extend this REM requirement to vessels under 18m that are also deemed to be at high risk of non-compliance. They may also provide incentives for vessels to use an REM system on a voluntary basis. Outside of the EU, Scotland has proposed to introduce mandatory REM requirements in the pelagic and scallop dredge sectors[2].

Given the limited requirement for REM within the EU Control Regulation it is likely that the majority of REM data collection will need to be undertaken on a voluntary basis - either incentivised under the Control Regulation, or voluntarily collected for other purposes.

Since there is unlikely to be a single source of REM data it is important that protocols and standards are clear to make the data collected fit for scientific use. It is also important to ensure that data agreements are in place before data is collected to ensure all parties know what can (and can't) be done with the data after collection[3].

There has been an increasing amount of work within ICES dedicated to looking at advances in electronic monitoring[4], and this topic is also being monitored by an intersessional sub-group on Electronic Monitoring Technologies within the fisheries DCF Regional Coordination Groups (RCGs). The RCG published an inventory on data collection technologies being used or piloted by different member states[5]. See summary section on recent developments in electronic monitoring below.

SCAR-Fish recommendation 4:

"To increase the number of existing datasets in fisheries dependent data. Data need to be collected on by-catch species, non-commercial species and discards."

Update:

Under article 14 of the amended Control Regulation vessels will be required to record the estimated quantities in live weight (or, where appropriate, the number of individuals) of each species retained on board, and estimated quantities of each species discarded, per fishing operation (or per day for vessels under 12m).

In the case of catches of sensitive fish and shellfish species, and marine mammals, seabirds and marine reptiles (defined in Article 10(1) and (2) and Article 11(1) of Regulation (EU) 2019/1241) it

is also required to record the quantities in live weight (or, where appropriate, the number of individuals) of the catches which are injured, dead or released alive.

However, although recording of discards has been required for many years the data that has been collected via fishing logbooks is not sufficient to enable analysis. Instead, scientific bodies run their own data collection programs to collect data on discarding practices and catches of Protected Endangered and Threated Species (PETS). These have predominantly involved sending scientific observers to sea on commercial fishing vessels to collect the required data during the trip – this sample of fishing trips is then used to create estimates for the overall fleet. In recent years more self-sampling schemes have also been introduced, partly triggered by the need to still collect data during the Covid- 19 restrictions.

There is a need for more data on by-catch species, non-commercial species and discards to be collected. However, collecting this data during regular sampling programs can be challenging, particularly for rare events such as catching PETS. REM could have a key role to play through the use of cameras and automated species identification.

Steins et al.[6] stated that for future sustainable management of fisheries they anticipate that deeper and more diverse information will be needed. This could include not only biological data, but also information such as real-time 'early warning' indicators of changes at sea, socio-economic data and fishing strategies.

SCAR-Fish recommendation 5:

"To implement procedures and quality control for collecting and processing data with a view to using this information in fisheries management and improve the reliability of scientific advice."

Update:

Quality assurance procedures are already in place for both control data and scientific data[7] but they should continue to be improved. As it stands this recommendation is vague and needs to be made more specific if it is to be acted on. For example, are there some specific areas where the quality control has been observed to be insufficient?

A further issue is that the data quality issues that are of most concern to control agencies are often different to those that matter to scientific bodies. Control agencies are often more interested in the most recent data since that relates to current activities whilst scientific bodies will often perform analyses which use many years' worth of data – thus the quality of older data might be allocated a different priority in the different bodies.

SCAR-Fish recommendation 6:

"To improve the mechanisms for sharing fisheries dependent data among fisheries management authorities and institutions formally charged with provision of scientific advice."

Update:

It needs to be noted here that the term fisheries dependent data is referring primarily to fisheries control data. In addition to the "mechanisms" there are 2 other issues identified here: timeliness, and confidentiality.

1. Timeliness

For most current scientific needs, it is required to have a full, quality controlled data set of the previous year's data early in the current year. This is not always the case in every country. The update to the recommendation is that MS need to commit to and co-ordinate the timeliness of control data sharing with the scientific community. The recommendation therefore here would not be a research or innovation action but rather an operational consideration for MS interacting at the regional level.

2. Data suppression due to confidentiality

Under Article 110 of the amended Control Regulation data collected may, where necessary, be provided to independent scientific bodies that are recognised at Union, national or international level. (Although Member States shall consider whether the scientific research can be conducted on the basis of pseudonymised or anonymised data.)

Early in the year ICES issues a data call for provisional nominal catches for selected species within fishing area 27 from the previous year[8] – the aim is to provide the latest catch data for fish stock assessments conducted by ICES Expert Groups. As well as this restricted use data set, ICES also compiles the official catch statistics in collaboration with Eurostat[9]. In the latest version available it is noted that "Eurostat data accessed 3rd July 2023. Ireland and Latvia have reported several confidential data to Eurostat, reflected in the present dataset with the flag '0 c'." Eurostat's dissemination database blocks all data marked as confidential from being disseminated (where relevant, aggregates are also not calculated). This limits the data's further use.

It is recognised that data collected under the control regulation may contain both personal and confidential data and the detailed data needs to be treated appropriately. However, the flagging of data that is quite coarsely aggregated (by year, species, and ICES division) as being confidential has the impact that the data cannot be made publicly available which affects the

science and advice which use the data. The update to the recommendation is that MS need to harmonise their interpretation of the confidentiality of control data such that the visibility of data reported to Eurostat meets the needs of fisheries scientists. Again the recommendation here would not be a research or innovation action but rather an operational consideration for MS interacting at the regional level.

A set of technological tools are now available to monitor the first link of the fish value chain – from sea to port. However, there is still a long way to go in exploring their potential, including the Vessel Monitoring Systems (VMS) and e-logbooks, transforming the data generated by these systems into useful information complying with the general time frame needed for scientific advice and in particular near-real time advice and management. The main focus of this document is on fishing operations/fish capture. This is the link which needs most attention concerning fisheries governance.

The document "Science in support of the European fisheries and aquaculture policy", produced by SCAR-Fish in 2013, is a very relevant document, mainly in its conclusions and recommendations regarding the challenges in fisheries management. The importance of a decentralized fisheries management is emphasized, enabling decision making to be made at a more regional level. In that document, the innovation of methods and technology in fisheries which can facilitate sampling and utilization of data from commercial vessels for scientific purposes is pointed out as essential for a transition to the new Common Fisheries Policy (CFP). However, the document does not point out any directions in this line.

With the present document, our objective is to complement this former SCAR-Fish exercise, raising awareness, near the Commission, Member States and Associated Countries, fisheries research organisations and platforms within SCAR-Fish, of the integration and operationalization of technological developments in fisheries monitoring in order to help shaping the toolbox of fisheries management and advice. Our objective is to guide the R&I agenda to the need of new studies addressing challenges for improving Fisheries Spatial Management in line with the CFP and the Marine Strategy Framework Directive (MSFD).

For this purpose, SCAR-Fish recommends:

- To extend data collection (i.e. position and catch data) to small vessels involved in local fisheries, by promoting user-friendly technologies and reducing the costs of using these technologies. Small-scale fleets represent around 86% of all vessels in EU waters;
- To enhance the vessel reporting capacity concerning the frequency of transmission of VMS positions;

- To incorporate technology for automatic real-time data collection, including data on starting and ending time of individual hauls. This will allow the estimation of the effective fishing effort and its spatial component; and at the same time, will establish a knowledge base for documentation and traceability;
- To increase the number of existing datasets in fisheries dependent data. Data need to be collected on by-catch species, non-commercial species and discards;
- To implement procedures and quality control for collecting and processing data with a view to using this information in fisheries management and improve the reliability of scientific advice.
- To improve the mechanisms for sharing fisheries dependent data among fisheries management authorities and institutions formally charged with provision of scientific advice.

1. The importance of fisheries-dependent data in support to scientific advice

Within the current CFP, which has become effective from 1 January 2014, fisheries are recognized to be heavily dependent on healthy marine ecosystems and were integrated into other policies related to the broader marine environment, such as the Integrated Maritime Policy (IMP) and the MSFD. The relevance of the implementation of an Ecosystem-Based Fisheries Management (EBFM) was recognized as a central element of fisheries governance under the third CFP reform.

A full implementation of EBFM requires the consideration of the effect of the multitude of human activities and their individual and cumulative effects on the marine environment and the effect of changes of the marine environment, particularly under climate change, on the human activities, specifically fisheries. The EBFM implementation implies a regionalized approach to fisheries management, increasing stakeholders' participation with the establishment of fishery-based plans and mitigation measures to be tailored to specific fisheries. This places heavy demands on data collection, in which fishers already have a central role; and at the same time it requires that the fishing industry should receive more responsibility in implementing conservation and control, advocating participatory management or co-management as a second central element of fisheries governance.

While EBFM was proposed under the last CFP reform, almost ten years ago, discussions on strengthened participation in fisheries governance date back from the second CFP reform in 2002. In the Green Paper on the CFP (Anonymous 2009) a generalized support for decision-making is expressed focusing on core long-term principles and increased regionalization, with

mechanisms for monitoring and auditing of policy development and decisions by either the EC and/or at regional level. However, the operationalization of EBFM and participatory management require additional effort.

Fisheries-dependent data (FDD) have been systematically collected since decades through paper logbooks and sales notes, and more recently, through the development of tools such as Vessel Monitoring Systems (VMS) and e-logbooks. Conceived for the purpose of fisheries control, the utility of these FDD sources, providing geo-referenced data from the fishing vessels activity, can be explored to a high extent in support of scientific advice.

VMS is a tool used by Member States (MS) and already accepted by the industry for more than two decades. Since 2012, VMS is used with e-logbooks, in all vessels above 12 metres. The data generated by these systems can give a picture of the spatial distribution of the fishing activity in marine ecosystems, allowing the analysis of the fishers' behaviour and fleets dynamics. When coupled with catch reporting data in logbooks, they can give a proxy of fishing effort distribution and species abundance.

Despite the importance of both VMS and e-logbooks in terms of data collection, their potential is far from being explored to this purpose. There is a need to integrate and operationalize these systems in order to help shaping the toolbox of fisheries advice.

2. Needs on how to use FDD in a meaningful way for management

2.1 Existing data

FDD are retrieved for fisheries management purposes through data calls issued by the end users, such as DGMARE, the International Council for Exploration of the Sea (ICES), regional fisheries management organisations (RFMOs) and regional coordination groups (RCGs), comprising data on vessel activity and commercial catches gathered by the fishing industry and shared with the fisheries control agencies. ICES is the prime source of scientific advice on the marine ecosystem to governments and international regulatory bodies that manage the North Atlantic Ocean and adjacent seas, providing advice on fisheries issues to the EU and maintaining a large database on FDD. These data, containing detailed vessel movements and commercial information about catches for vessels over 12 metres in length, are provided in an anonymized format from national database systems of a high number of countries. As they are considered confidential data, they are used in an aggregate manner and are not publicly accessible under the general ICES Data Policy. DG MARE is responsible for launching the data

calls of the Mediterranean and the Black Sea and fisheries dependent information (FDI), among others, for EU Member States.

These systems generate big data streams. To organise this information, a new governance for marine data is required. There is a need to document data gaps by area and vessel type, in order to estimate the likely level of under-reporting of fishing effort. There is also the need to have standardization on how data are collected and harmonisation of procedures across MS, as well as on new methods to handle these data. The Quality Assurance Framework in Member States' DCF Work Plans and Annual Reports provides relevant information of the work done at national level. ICES implemented procedures and methods for quality control and assurance of data. For VMS data this is the Working Group on Spatial Fisheries Data Governance (WGSFDGOV) and for catch data the Working Group on Governance of the Regional Database & Estimation System (WGRDBESGOV). ICES also explores the development of new tools, e.g. in the Working Group on Technology Integration for Fishery-Dependent Data (WGTIFD) and other groups under the Data Science and Technology Steering Group (DSTSG[10]).

2.2 Extra data needs

2.2.1 Small scale vessels data

VMS is currently operating in vessels with overall length of 12 metres or more. However, vessels between 12 and 15 metres may be exempted of this obligation either if they operate exclusively within the territorial seas of the flag MS or never spend more than 24 hours at sea from the time of departure to the return to port. This universe comprises the vast majority of the deep-sea fishing fleets and a significant percentage of the units in the coastal fleets but does not cover small-scale fleets. However, the increased computing power of handheld devices facilitates their expansion to small vessels involved in local fisheries. In some MS, examples of this expansion have been implemented in small vessels from coastal fleets that are now collecting their own data. This is the case of the Portuguese bivalve dredge fleet where high spatio-temporal resolution data are collected through real-time GPS tracking devices installed on fishing vessels. This allows to identify the main bivalve fishing grounds, assess the spatio-temporal distribution of the fishing effort, and contributes to the sustainable management of the fishery.

(https://play.google.com/store/apps/details?id=pt.ipma.bivalvesipma).

2.2.2 Resolution of spatial data to the fishing haul

Although the combination of VMS data, logbooks and landings data is quite insightful and is widely used for fisheries research and fisheries management purposes, including modelling, its usefulness in ecosystem-based fisheries management depends on data quality. In what concerns VMS, data quality depends on the frequency of the registers regarding the vessel position during the fishing activities. Until 2004, VMS data were received with a resolution of one point every 10 minutes; however, due to the high

costs of communications, EC regulations set a minimum rate of transmission of only one position every two hours, whenever the monitoring centre has the ability to control the actual vessel position (EC, 2003). The analysis of geo- referenced data from 2 to 2 hours, while allowing the identification of fishing trips, undermines the spatial definition of the fishing events, and thus the estimation of the effective fishing effort and its spatial component. Increase in transmission rate from 2 to 1 hour was proposed by the Commission in the Revision of the EU Fisheries Control System and presently, different VMS rates of transmission are in place, including 30 min in fishing restricted areas (cf. Art 50 (3) Control Regulation. However, independent of the transmission rate, these data can be recorded at a high frequency, allowing their use for a better definition of the fishing operations within each trip. On the other hand, logbook data and sales notes are produced once each fishing trip; e-logbooks, that must be completed and transmitted on a daily basis, are required to provide georeferenced information at haul level regarding setting and hauling operations, soak time, and gear attributes such as gear length, mesh size or hook size, along with catches and main discards, allowing the definition of métiers. However, as they are manually filled, in practice this is not observed in many situations, in particular in mixed fisheries, where many species are captured simultaneously and the same vessel can operate different gears. In order to take the next step towards true EBFM, fisheries data collection will need to innovate and increase its resolution to the fishing haul. Innovative data collection should record the geographical details of the fishing track and the associated composition of the catch. The challenge remains in interconnecting VMS and e- logbooks, making them interoperable, and expand their use in SSF. Several MS are already exploring this interoperability for fisheries control purposes.

2.2.3 Increase the reporting capacity of the CME

The reporting capacity of the VMS Continuous Monitoring Equipment (CME) can be enhanced by developing and testing solutions to enable CME data transmission modules through alternative communications systems to the satellite, lowering transmission costs. Due to the specific requirements of geolocation and data transmission of the CME, but also, to its supervisory nature and inviolability mechanisms, the CME can also be developed towards an integrated technological system to gather information about fishing operations in real time. It can be developed to be used in combination with remote electronic monitoring, including CCTVs, and with multiple sensors collecting data on human activities and environmental parameters, complementing and communicating with each other, improved with innovative technological solutions such as machine learning and artificial intelligence, transforming fishing boats into platforms for collecting fisheries data as well as data on the observation of the marine environment.

Vistools is a Belgian project where all instruments on board that produce data are connected to a data concentrator that uploads the data real-time to the cloud. As such, detailed fish tracks and landings data at haul level are made available to the fisheries institute to be used in modelling exercises supporting the development of an EBFM. One vessel has been fully operational for over two years, in the summer of 2022 four vessels have been made operational.

Considering, on the one hand, the effort currently expended in on-board sampling, both in human and financial terms, and the limitations to have observers in smaller vessels, for instance in the multi-gear

coastal fleet, it is of great interest to invest in the development of new technologies, including remote electronic monitoring, aimed at automatic monitoring of fishing activities.

2.2.4 Increase the number of fisheries- dependent datasets

In addition to the landings data as recorded today, discards of commercial and non- commercial species need to be recorded as well. As such, mortality and fisheries impact can be allocated to habitats and marine communities in high resolution. The technology to obtain these data, including remote electronic monitoring, is available or is being developed and should be also considered as a priority. Fishing tracks are recorded routinely and for the analysis of fisheries catches, self-sampling and image analysis technology is innovating in a way to be applicable in the near future. As these data, however, are quite sensitive in the fishing industry, sufficient attention should be given to stakeholders involvement and potential benefits for the fishery of this data collection.

2.2.5 Alternative applications of fisheries-dependent data – Development of software tools in support of spatial fisheries management

Several tools have been developed for the exploration and visualization of spatial information on fisheries, including maps of fishing intensity, landings, catch rates and environmental characterization. They use vessel position, speed and course data from VMS/AIS, combined with catch data (sales and logbook records), to estimate and map fishing effort and catch rates. Fishing Trips and Trawl Hauls identification routines are also developed and the identification procedure automated through the inclusion of artificial intelligent algorithms. Fishing trip landings and logbook catch records are used as a proxy of catch, and when crossed with fishing effort allow the calculation of catch rates (catch per unit effort, CPUE), by region or fishing ground.

GeoCrust software, a pioneering application developed to map fishing effort and CPUE information for the Portuguese crustacean trawl fleet, operating off the Portuguese coast. The data available for this study included GPS vessels' geographical positions and speed, transmitted via satellite to the Portuguese fisheries inspection authorities, and their catch reported to the Portuguese Directorate-General of Fisheries. The application includes several modules allowing to map and edit the original VMS data for a single vessel or group of vessels, for different periods of time; to define fishing grounds; to identify and define the trawl hauls; to issue maps of fishing effort and CPUE; to recreate the activity of a single vessel, group of vessels or the total fleet, for a fixed period of time, among others.

VMStools is a package of open-source software, built using the freeware environment R, specifically developed for the processing, analysis and visualisation of landings (logbooks) and vessel location data (VMS) from commercial fisheries. Embedded functionality handles erroneous data point detection and removal, métier identification through the use of clustering techniques, linking logbook and VMS data together in order to distinguish fishing from other activities, provide high-resolution maps of both fishing *effort and landings*.

VMSbase is an R package devised to manage, process and visualize information about fishing vessels' activity provided by the VMS, and catches/landings, as reported in the logbooks. *VMSbase* is primarily conceived to be user-friendly; to this end, a suite of state-of-the-art analyses is accessible via a graphical interface. In addition, the package uses a database platform allowing large datasets to be stored, managed and processed very efficiently. Methodologies include data cleaning, and data enhancing, that is interpolation and merging with external data sources. Standard analyses comprise: 1) métier identification; 2) linkage between VMS and Logbook records, with the former organized into fishing trips; 3) discrimination between steaming and fishing points; 4) computation of spatial effort with respect to user-selected grids; 5) calculation of standard fishing effort indicators.

3. From real-time monitoring to (near) real-time advice

ICES advice provides catch limits (TACs and quotas) for a high number of stocks shared between ICES countries. However, the general time frame of scientific advice and resulting management actions does not generally comply with management needs of real-time advice. This has generally been a lengthy process and typically there is a two-year time lag between fisheries observations and management actions. This is problematic, particularly for short-lived species.

Today, it is possible to integrate these fishery-dependent data sources, in the generation of real-time advice. With increasing capacity for "big data" storage, sharing, and analysis, the conditions are now being created to implement dynamic, decentralized advice, adaptive, operating at a much finer spatial and temporal scale; increasing participatory decision-making.

Presently, real-time advice is already used to avoid regions of high juvenile or sensitive species bycatch, e.g., in the North Atlantic region (Iceland, Norway, EU), through real- time closures. A further step has been taken with "Real-time incentives" (RTI), a novel management concept capable of responding to species distributions, and biological and ecological knowledge. RTI can operate at a much finer spatial and temporal scale than traditional management approaches, and can be updated in close to real-time (e.g. weekly), through harnessing modern satellite and digital technology. This system, under development, can in the future partially replace or complement traditional management measures such as catch/landing quotas and effort limitations.

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14th October 2022

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Innovation in fisheries monitoring science

– Fisheries dependent data as a tool for real-time advice

Follow up to SCAR-Fish document of October 2022

SCAR-Fish, the Strategic Working group on Fisheries and Aquaculture Research

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Update February 2024

Background

In late 2022 SCAR fish produced a document titled "*Innovation in fisheries monitoring science – Fisheries dependent data as a tool for real-time advice*" which was edited by Aida Campos (this document is referred to as "the document" in this text). The document was tabled for discussion by SCAR-Fish in 2022, and circulated to DGMARE for feedback. However, by the time of agreed adoption of the document by SCAR-Fish a response to the DGMARE comments was not incorporated. Since then further discussions were held by SCAR-Fish to try to update the work and it was noted that several initiatives on this work were underway in other fora such as EFARO & ICES; so there was an agreement to discuss the setting up of a joint EFARO-ICES-SCAR-Fish workshop to bring the recommendations from the document up to date. Discussions between these 3 groups did not result in a successful workshop development mainly due to timing and the broadening of scope of the terms of the workshop. The idea was finally abandoned at the last discussion between the 3 groups in November 2023 when it emerged that the whole area had moved on significantly both in the legislative and scientific domains.

This paper sets out to conclude the SCAR-Fish work in this area, by addressing the initial comments by DGMARE, and by looking at the recommendations from the original document and assessing these against the current landscape. Following this review salient points are highlighted and suggested as amended recommendations from SCAR-Fish on this area. A short review of the current developments mainly through work at ICES is also provided to bring the information up to date.

DGMARE comments

DGMARE provided some useful background references, sought clarification on some aspects and made an important point about the purpose of scientific development of fisheries dependent data (FDD), which has relevance for the context of future scientific endeavor in this area.

In the first instance DGMARE pointed out that the definition of FDD is narrower in this document than generally understood by the Commission. This is noted, and the salient point is that the full suite of FDD which is collected under the DCF is not the focus of the document, rather the use of real time operational data is the focus of the document, this is potentially control data. DGMARE go on to reference the means by which DCF and control data are collected stored and analysed, noting that the control data is already part of the fisheries assessment process, and that current best practice is that this control data is cross checked through other FDD such as observer data. DGMARE further comment on factual errors in the document e.g. vessels <15m exempted from

VMS (DGMARE point out this is not entirely true) and VMS pings rate only 2 hourly (DGMARE point out this is not entirely true). The comments of the Commission are correct.

In relation to the documents focus on tools to support Ecosystem based Approach to Fisheries Management (EAFM), DGMARE comments then speak to the detailed process of how fisheries science supports fishery management, outlining participatory management, governance and regionalisation aspects not considered by the document. The crux of this point is that the current system of fisheries management in the EU is primarily based on fisheries science supporting the development of advice, rather than the development of tools for the implementation of real time fisheries management. The intent of the document and the observation of the Commission may be at cross purposes here. The Commissions observations are factually correct, however in the document, despite the use of examples which are fisheries management tools (i.e. RTI), the intent was to cite examples of how control data could be used to support (smaller scale) fisheries management decision making in a shorter time frame, and not to suggest an alternative paradigm to the current TAC based management.

Original recommendations review

There were 6 recommendations made in "Innovation in fisheries monitoring science – Fisheries dependent data as a tool for real-time advice"[1] below is an update on those recommendations in the context of developments since 2022.

SCAR-Fish recommendation 1:

"To extend data collection (i.e. position and catch data) to small vessels involved in local fisheries, by promoting user-friendly technologies and reducing the costs of using these technologies. Small-scale fleets represent around 86% of all vessels in EU waters"

Update:

This recommendation is no longer required since the amended EU Control Regulation will extend electronic logbooks, declarations and vessel position data systems to all sizes of fishing vessels. The 2023 amendment of the EU Control Regulation defines the legal requirements for fisheries dependent data collection and a summary of the different types of data which must be collected by vessel length is shown below and included in the annex.

	Data collection required?				
Vessel length	**0 - 9m**	**9 - 12m**	**12 - 15m**	**15 - 18m**	**18m +**
Electronic Logbooks data	Y (by day)	Y (by day)	Y (by operation)	Y (by operation)	Y (by operation)
Landing Declarations data	Y	Y	Y	Y	Y
Vessel position data	Y* **	Y**	Y	Y	Y
*Can be exempted until 31/12/29 ** Vessel position system does not have to be fixed on board					
AIS data	N	N	N	Y	Y
Remote electronic monitoring (REM) data	N ^, ^^	N ^, ^^	N ^, ^^	N ^, ^^	Y (if high risk of non-compliance with the landing obligation) ^^
^ MS may require other vessels at high-risk of non-compliance. ^^ MS may provide incentives on a voluntary basis.					

Whilst for the smaller vessels (less than 12m) the temporal resolution of the logbooks will be coarser (per day rather than per fishing operation), and the position data may not be available in real-time, this will still be a big step forward in position and catch data provision from the small-scale fleet.

It's worth highlighting that vessels under 12m will be allowed to carry a vessel position device which does not have to be installed on board and can use other connections than satellite – this enables the option of using a mobile phone app as a vessel positioning data system on smaller vessels. How reliable this system will be is not yet known e.g. there could be issues with skippers forgetting to start logging vessel position data during their trips.

Although the recommendation (to call for this data to be collected as part of the control regulation) is no longer required, as it is now in the revised regulation (albeit at a timeline up to 2030); it is worth noting that there might already be pilot schemes for enhanced data collection from small vessels that are already operating. Since it could be a number of years before all sizes of vessels are reporting data it is recommended that any already existing schemes continue to be funded so that there isn't a break in data collection. Thought should be given to the transition

between existing schemes and the requirements under the amended Control Regulation. The need for highly resolved spatial data on fishing activity is being driven not only by fisheries science requirements, but also by Marine spatial planning developments (e.g. Offshore Renewable Energy) and advances in socioeconomic assessments of fisheries.

SCAR-Fish recommendation 2:

"To enhance the vessel reporting capacity concerning the frequency of transmission of VMS positions."

Update:

In Article 9 of the amended Control Regulation it states that the Commission shall by means of implementing acts lay down detailed rules on the frequency of transmission of the data concerning the position and movement of fishing vessels, including in fishing restricted areas.

Generally, VMS pings are currently transmitted every 2 hours although there are instances where the minimum transmission rate is higher e.g. once every 30 minutes in protected areas. As vessel position data collection is expanded to all vessel length categories under the amended Control Regulation this transmission rate is unlikely to be high enough to accurately capture the small-scale fleet's activities. For comparison the transmission rates in the inshore VMS pilot run by the Marine Institute[2] varied from 1 ping every 10 minutes, to 1 ping every 1 minute.

Although this recommendation is valid in principle, it needs specificity from a regional level. This could be facilitated through the RCG's of the DCF and the High level Management groups implementing the regionalization of the CFP.

SCAR-Fish recommendation 3:

"To incorporate technology for automatic real-time data collection, including data on starting and ending time of individual hauls. This will allow the estimation of the effective fishing effort and its spatial component; and at the same time, will establish a knowledge base for documentation and traceability."

Update:

The amended Control Regulation requires vessels over 12m to record electronic logbook data per fishing operation.

There is limited support for Remote Electronic Monitoring (REM) systems under Article 13 of the amended Control Regulation – it is only required that vessels of 18m+ that are in a fleet segment deemed at a high risk of non-compliance with the landing obligation will need to have such a

system.

Member states may extend this REM requirement to vessels under 18m that are also deemed to be at high risk of non-compliance. They may also provide incentives for vessels to use an REM system on a voluntary basis. Outside of the EU, Scotland has proposed to introduce mandatory REM requirements in the pelagic and scallop dredge sectors[3].

Given the limited requirement for REM within the EU Control Regulation it is likely that the majority of REM data collection will need to be undertaken on a voluntary basis - either incentivised under the Control Regulation, or voluntarily collected for other purposes.

Since there is unlikely to be a single source of REM data it is important that protocols and standards are clear to make the data collected fit for scientific use. It is also important to ensure that data agreements are in place before data is collected to ensure all parties know what can (and can't) be done with the data after collection.

There has been an increasing amount of work within ICES dedicated to looking at advances in electronic monitoring5, and this topic is also being monitored by an intersessional sub-group on Electronic Monitoring Technologies within the fisheries DCF Regional Coordination Groups (RCGs). The RCG published an inventory on data collection technologies being used or piloted by different member states[6]. See summary section on recent developments in electronic monitoring below.

SCAR-Fish recommendation 4:

"To increase the number of existing datasets in fisheries dependent data. Data need to be collected on by-catch species, non-commercial species and discards."

Update:

Under article 14 of the amended Control Regulation vessels will be required to record the estimated quantities in live weight (or, where appropriate, the number of individuals) of each species retained on board, and estimated quantities of each species discarded, per fishing operation (or per day for vessels under 12m).

In the case of catches of sensitive fish and shellfish species, and marine mammals, seabirds and marine reptiles (defined in Article 10(1) and (2) and Article 11(1) of Regulation (EU) 2019/1241) it is also required to record the quantities in live weight (or, where appropriate, the number of individuals) of the catches which are injured, dead or released alive.

However, although recording of discards has been required for many years the data that has been collected via fishing logbooks is not sufficient to enable analysis. Instead, scientific bodies

run their own data collection programs to collect data on discarding practices and catches of Protected Endangered and Threated Species (PETS). These have predominantly involved sending scientific observers to sea on commercial fishing vessels to collect the required data during the trip – this sample of fishing trips is then used to create estimates for the overall fleet. In recent years more self-sampling schemes have also been introduced, partly triggered by the need to still collect data during the Covid- 19 restrictions.

There is a need for more data on by-catch species, non-commercial species and discards to be collected. However, collecting this data during regular sampling programs can be challenging, particularly for rare events such as catching PETS. REM could have a key role to play through the use of cameras and automated species identification.

Steins et al. stated that for future sustainable management of fisheries they anticipate that deeper and more diverse information will be needed. This could include not only biological data, but also information such as real-time 'early warning' indicators of changes at sea, socio-economic data and fishing strategies.

SCAR-Fish recommendation 5:

"To implement procedures and quality control for collecting and processing data with a view to using this information in fisheries management and improve the reliability of scientific advice."

Update:

Quality assurance procedures are already in place for both control data and scientific data8 but they should continue to be improved. As it stands this recommendation is vague and needs to be made more specific if it is to be acted on. For example, are there some specific areas where the quality control has been observed to be insufficient?

A further issue is that the data quality issues that are of most concern to control agencies are often different to those that matter to scientific bodies. Control agencies are often more interested in the most recent data since that relates to current activities whilst scientific bodies will often perform analyses which use many years' worth of data – thus the quality of older data might be allocated a different priority in the different bodies.

SCAR-Fish recommendation 6:

"To improve the mechanisms for sharing fisheries dependent data among fisheries management authorities and institutions formally charged with provision of scientific advice."

Update:

It needs to be noted here that the term fisheries dependent data is referring primarily to fisheries control data. In addition to the "mechanisms" there are 2 other issues identified here: timeliness, and confidentiality.

Timeliness

For most current scientific needs, it is required to have a full, quality controlled data set of the previous year's data early in the current year. This is not always the case in every country. The update to the

recommendation is that MS need to commit to and co-ordinate the timeliness of control data sharing with the scientific community. The recommendation therefore here would not be a research or innovation action but rather an operational consideration for MS interacting at the regional level.

Data suppression due to confidentiality

Under Article 110 of the amended Control Regulation data collected may, where necessary, be provided to independent scientific bodies that are recognised at Union, national or international level. (Although Member States shall consider whether the scientific research can be conducted on the basis of pseudonymised or anonymised data.)

Early in the year ICES issues a data call for provisional nominal catches for selected species within fishing area 27 from the previous year[9] – the aim is to provide the latest catch data for fish stock assessments conducted by ICES Expert Groups. As well as this restricted use data set, ICES also compiles the official catch statistics in collaboration with Eurostat[10]. In the latest version available it is noted that "Eurostat data accessed 3rd July 2023. Ireland and Latvia have reported several confidential data to Eurostat, reflected in the present dataset with the flag '0 c'." Eurostat's dissemination database blocks all data marked as confidential from being disseminated (where relevant, aggregates are also not calculated). This limits the data's further use.

It is recognised that data collected under the control regulation may contain both personal and confidential data and the detailed data needs to be treated appropriately. However, the flagging of data that is quite coarsely aggregated (by year, species, and ICES division) as being confidential has the impact that the data cannot be made publicly available which affects the

science and advice which use the data. The update to the recommendation is that MS need to harmonise their interpretation of the confidentiality of control data such that the visibility of data reported to Eurostat meets the needs of fisheries scientists. Again the recommendation here would not be a research or innovation action but rather an operational consideration for MS interacting at the regional level.

Electronic monitoring derived fisheries dependent data- updates from ICES research

Traditionally CCTV video footage was considered the main Electronic Monitoring (EM) data source outside the tradition GPS location transmission systems aboard vessels, but with modern advances in sensor technology, multiple integrated sensor technology on gear and mechanical equipment are also included in the EM suite of tools. In more recent times the use of eDNA to detect the presence/absence of a species is also being added to the EM suite of tools. In many jurisdictions EM sources are being looked at mainly to aid with control and enforcement as a tool to enhance compliance of the vessels with regulations. These sources of data may additionally be used to increase the flow of fisheries dependant data once the EM system is set up in a way that ensures the possibilities of system bias have been mitigated and accounted for.

One particular area where EM is being actively cited as a potential source of useful data is in assessing "slippage". The monitoring of high-volume fisheries often includes oversight on catch retention. Catch retention can be defined as the ability of the fishing vessel to retain full possession of the contents within the net, once fished. Typically, catch volumes for high volume fisheries can reach tens of thousands of kilos of fish per trip and therefore, the monitoring of catch retention in these fisheries is often a provision of management. On occasion, vessels release a portion or all of the contents of the net in the water for a variety of reasons. The release or discarding of catch prior to being brought on board is referred to as "slippage" and generally includes large volumes of released fish. Reasons for slippage can be intentional or unintentional and can include; safety concerns (too much volume for the vessel, inclement weather), unwanted catch (undesired, nonmarket, or bycatch), mechanical failure (damage to the gear resulting in disruption or loss in fishing activities) or catch restrictions/regulations (vessel has exceeded its quota for a certain species or area). The monitoring of slippage in high volume fisheries or fisheries with discard prohibitions is a critical component of fisheries management. EM is increasingly being used as a tool for catch monitoring and reporting compliance in fisheries around the world. Specifically, in the United States the Northeast Region is pursing EM to support additional monitoring initiatives for the herring fishery. EM has proven to be an effective tool in detecting and categorizing slippage events. The following are

recommendations to promote a successful EM program in the herring midwater trawl fishery as it relates to documenting slippage.

- EM system reliability: Power interruptions associated with high volume vessels to the EM system can cause incidences of data loss. The use of voltage conditioners and uninterruptible power supplies (UPS) decreased the risk of power loss to the EM system. Camera connectivity issues can be caused by high vibrations on the rail mounted cameras. Vibration resistant cameras are recommended for boom mounted cameras in this fishery.
- Camera set-up: To maximize the ability of EM reviewers to view all discards, cameras should be installed to capture all possible discard locations as listed below; o Fish pumping o Dewatering box o Full deck o Stern Not each view will require a distinct camera, often one camera can cover multiple areas depending on the vessel set-up and operations. These views can generally be captured by three properly placed cameras. On most vessels, getting the required views will require the installation of a boom arm mount.
- Data retrieval: in fisheries with complex logistics where the vessels are not all located in the same port, in person data retrieval can be costly and logistically complicated. Mailing EM data to the review centre can simplify this process and result in cost savings.
- In a fleet that makes frequent, short trips and is somewhat migratory, sufficient spare hard drives should be made available to the vessels to ensure data collection is not hindered due to HDD resource limitations.
- Slippage detection: while EM is effective in the detection of discard events, reviewers had some difficulty in differentiating between categories of slippage events consistently. Incorporating a mechanism which allows vessel operators to provide information regarding discard events throughout the trip may further aid when distinguishing among these events.

The above example on slippage shows the advantages and disadvantages of using EM to gather raw fisheries dependent data. Any scheme designed to collect fisheries dependent EM data will require careful consideration of the delivered product and how it can be collected in an unbiased manner. While modern advances in satellite and 5G communications may assist with data transmission this also comes with a cost associated with the large volumes of data transmitted and associated storage costs. With the use of EM fishery dependent data, the collection and transmission of the data is only the first step.

The next step the review of video footage is fundamental to any EM program. It is often the most labour intensive and costly component of an EM program. Reducing video review below 100% in suitable situations provides a mechanism to reduce EM program costs while meeting monitoring objectives. Video review rates are primarily dictated by the type of EM program and

its specific monitoring goals. Generally, EM programs fall into two broad categories: (1) compliance, or (2) audit. Compliance based programs tend to have higher review rates, up to 100% because they are designed to verify compliance with specific fisheries management provisions (ex. slippage detection). Conversely, audit-based EM programs that compare independently reported data (ex. catch) with annotated video review data can offer more flexibility when setting video review rates depending upon the degree of error tolerance and reporting accuracy. Review rates can also be modulated depending upon specific needs like enforcement interest, catch handling verification, retention verification, area/behaviour of interest, etc. A key component of audit-based EM programs is the requirement for a complimentary data source (typically the vessel logbook) that is independent of the EM system in order to provide the necessary data for comparison. Future EM programs designed to assess events such as interactions with protected endangered and threatened species (PET) which have a low incident rate will by definition require a high review rate.

Most European countries report bycatch data through non-dedicated programs and in most regions, incidental catches are only sporadically monitored via independent on-board observer programs which are limited in time and space. EM represents an opportunity to increase observation coverage at a regional level to gain knowledge of the impact of fishing on bycatch and (PET) Species populations including marine mammals, sharks, turtles, rays and seabirds. Ideally, EM should be able to collect bycatch events in the same way as on board observation with appropriate regional database standards. On-board observers usually register information on number, length, (derived weight) and fate of bycatch individuals that can be collected most of the time via EM (with appropriate configurations) and registered in a common database. However, some information such as species ID (for lookalike species), conditions at release (dead, alive, injured) or sex can be sometimes difficult to collect via cameras (too far from individuals) but might be important for stock assessment studies, and should be reported whenever possible with associated quality flags. Note that the quality of these data could be increased by adding more cameras, using recorded footage of a higher resolution or placing cameras closer to the main catch sorting and discarding areas within each national program. In parallel, the development of a standardized bycatch labelled images database from major European fisheries combined with AI might also help to automate the collection of bycatch data (species identification and quantification) obtained from EM systems and reinforce EM programs at national and regional levels.

Traditionally EM has focused on collecting and analysing data associated with fisheries catch and effort data. This has been achieved by utilizing video capture along with positional GPS/time-date data and gear parameter data such as motion sensors. As EM systems develop, fisheries scientists are looking to increase the available data collected. The integration of the vessel's own sensors such as sonar and sounder into the EM systems is seen as an opportunity to maximize data collection aboard. The addition of extra sensors such as flow through monitors

on fish pumping devices in pelagic fisheries have been mooted as methods to get independent estimates of catch on such vessels. EM coupled with extra sensors is expected to increase the accuracy of both catch and effort estimates.

The coupling of EM and new oceanographic sensors is leading to the leveraging of fishing vessels to vessels of opportunity for oceanographic monitoring. Oceanographic sensors that collect data on temperature, depth, salinity (CTD's) can be deployed on fishing gear such as otter boards to collect a CTD profile of the water column every time the net is deployed and hauled back, resulting in a profile from each location where the vessel fishes. In the Bering Sea temperature sensors integrated into mooring buoys from static fisheries are already sending real-time sea surface temperature and positional data to the fishers that use such systems – allowing fishers to monitor the ice coverage relative to the gear.

As with all data the legal implications of the EM collected fisheries dependent must also be carefully considered. Questions of ownership and stewardship of the data are critical to the scientific usage/utility of these data sets. For example; EM compliance derived data may be required for in year for legal purposes but may enhance the scientific data set by collection and retention over many years/decades. The legal implications of such large datasets are intrinsically linked with the associated storage costs, where one entity may save on costs by simply deleting datasets no longer required. It is also important for partnership, collaboration and transparency that the issue of ownership and stewardship of the fisheries dependent data is agreed from the start of any data collection program.

With the collection of data from pilot studies a lot of work is ongoing in different EU Member States (MS) to automate the identification of catches from annotated video/images using machine learning algorithms (i.e. computer vision). Such models require a large amount of training data to reach acceptable levels of accuracy and the cost to produce such massive training datasets may be prohibitive for individual MS. The development of an appropriate platform to promote a future development of a shared database of annotated data between participating MS that respects intellectual property rights would allow the rapid development of machine learning models tailored to the monitoring/assessment of fisheries.

While the use of EM can greatly enhance the flow of fisheries dependent data it is important to state that a scattergun approach will lead to deficiencies in the quality and usefulness of the data collected. Careful consideration must be given to the required outputs and the standards at which those outputs are transmitted, the focusing on the desired outputs will allow the technology to advance and evolve to deliver the required data products. The Workshop on Standards and Guidelines for fisheries dependent data WKDSG and Working Group on Technology Integration for Fishery-Dependent Data (WGTIFD) have both been actively looking at how electronic monitoring (EM) data can be effectively and efficiently used to contribute to the stock assessment process and provide greater detail at the links below.

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- COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL The common fisheries policy today and tomorrow: a Fisheries and Oceans Pact towards sustainable, science-based, innovative and inclusive fisheries management EUR-Lex - 52023DC0103 - EN - EUR-Lex (europa.eu)

Annex 1

EU Legislation

Data collected under fisheries control regulations is essential for scientific analysis of fishing activity and is routinely used by Member States (MS) for this purpose. Generally, the data required by the recast fisheries Data Collection Framework (DCF)[11] will be a combination of sampled data (e.g. biological data or socio-economic data) and transversal data (census data about the activities of the fishing fleet including fishing logbooks, VMS, and sales notes data). The sampled data is collected directly under the DCF legislation but the transversal data is typically collected under the recently amended EU Control Regulation[12.] Article 110 of that legalisation explicitly states "For the purpose of performing scientific research or provide scientific advice, data … may, where necessary, be provided to independent scientific bodies that are recognised at Union, national or international level."

Under the previous Control Regulation only a small amount of transversal data was collected from vessels under 10m – typically just sales notes. Methods such as surveys are then required to complement that data and make estimates of the small-scale fleet's activities.

The 2023 amendment of the EU Control Regulation defines the legal requirements for fisheries dependent data collection and a summary of the different types of data which must be collected by vessel length is shown below.

	Data collection required?				
Vessel length	**0 - 9m**	**9 - 12m**	**12 - 15m**	**15 - 18m**	**18m +**
Electronic Logbooks data	Y (by day)	Y (by day)	Y (by operation)	Y (by operation)	Y (by operation)
Landing Declarations data	Y	Y	Y	Y	Y
Vessel position data	Y* **	Y**	Y	Y	Y
*Can be exempted until 31/12/29 ** Vessel position system does not have to be fixed on board					
AIS data	N	N	N	Y	Y
Remote electronic monitoring (REM) data	N ^, ^^	N ^, ^^	N ^, ^^	N ^, ^^	Y (if high risk of non-compliance with the landing obligation) ^^
^ MS may require other vessels at high-risk of non-compliance. ^^ MS may provide incentives on a voluntary basis.					

Electronic logbooks data

- As specified in Article 14 the master of each Union fishing vessel must keep an electronic logbook recording their fishing activity, the relevant geographical area in which the catches were taken, and estimated quantities of species retained on board and discarded. For vessels 12m and greater this information must be recorded per fishing operation, whilst smaller vessels can record it as a daily summary.
- Vessels 12m and over need to submit their electronic logbooks (a) at least once a day; (b) after the last fishing operation and before entering a port or a landing site. However, vessels of less than 12m are only required to submit the electronic logbook after the last fishing operation has been completed and before the landing starts.

Landing Declarations data

- As specified in Articles 23 and 24 Union vessels are required to submit an electronic landing delegation within 24 hours after the completion of landing. This declaration must include the species, the relevant geographical area in which the catches were taken, and the quantities (landed and live weight).
- Sales Notes data
- As specified in Articles 62 and 64 registered buyers, registered auctions or producer organisations authorised by Member States shall record by electronic means sales notes data and shall submit it by electronic means, within 48 hours after the first sale. Sales notes data should include the unique fishing trip identification number; the CFR number; the quantity of each species and the relevant geographical area in which the catches were taken; and the price.
- Vessel position data
- "Vessel position data" means data on the fishing vessel identification, geographical position, date, time, course and speed transmitted by tracking devices on board fishing vessels to the fisheries monitoring centre of the flag Member State. Under the previous Control Regulation this was provided by satellite-based vessel monitoring systems (VMS).
- Under Article 9 all Union vessels shall have installed on board a fully functioning tracking device which allows that vessel to be automatically located and identified by a vessel monitoring system through transmitting automatically the vessel position data. However, fishing vessels of less than 12 metres in length overall may carry a device which does not have to be installed on board. This can use other connections than satellite. In the event that the device is not within reach of a network, the vessel position data shall be recorded during that period of time and shall be transmitted automatically as soon as the vessel is in reach of such network.
- Vessels under 9m may be exempted from the requirement to record and transmit vessel position data until 31/12/2029.

AIS data

- Under Article 10 Union fishing vessels exceeding 15m shall be fitted with and maintain in continuous operation an automatic identification system (AIS).

Remote electronic monitoring (REM) data

- As specified in Article 13 Union catching vessels of 18m+ which pose a high risk of non-compliance with the landing obligation should have installed on board an operating REM system. The REM system shall be able to effectively monitor and control compliance with the landing obligation, shall include CCTV and may include other instruments and/or equipment.
  -(The Commission, by means of implementing acts, shall determine the fleet segments of Union catching vessels to which the obligation to have installed on board the REM system shall apply, based on the assessment of the risk of non-compliance with the landing obligation.)
- Member States may provide that certain fleet segments of Union catching vessels of less than 18 metres in length overall flying their flag shall have on board an operating REM system, based on the risk of non-compliance with the landing obligation.
- Member States may provide incentives for vessels not required to be equipped with an REM system under paragraphs 2 and 4 but which use such a system for control of the landing obligation on a voluntary basis.
- Member states may provide for the use of REM systems for the control of compliance with the rules of the common fisheries policy other than the landing obligation.

National legislation

Under the Common Fisheries Policy[13] (CFP) MS may take measures for the conservation and management of fish stocks and the maintenance or improvement of the conservation status of marine ecosystems within 12 nautical miles of its baselines. This can mean that vessels are required to collect more data when fishing in these waters. For example Ireland's S.I. No. 206/2015[14] requires that all vessels fishing for Razor clams must have a functioning high frequency position data ("inshore VMS") system. Outside of the EU, Scotland has also proposed to introduce mandatory REM requirements in the pelagic and scallop dredge sectors[15].