The fishPi 2 Project
Regional co-operation in fisheries data collection

STRENGTHENING REGIONAL CO-ORDINATION IN FISHERIES DATA COLLECTION

The fishPi^2 Project Summary Report

MARE/2016/22

Project funded by the European Union

Disclaimer

This report was prepared for

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Contents

Glossary, Vessel Flag and Landed Codes

Acronym	Full wording
AIS	Automatic Identification System
CCTV	Closed Circuit Television
CFP	Common Fisheries Policy
CLEF RDB	Core Library for Ecosystem and Fisheries Regional Data Base
COI	Country of interest
EM	Electronic Monitoring
ERS	Electronic Recording and Reporting Systems
EU	European Union
EU-MAP	European Union Multi-Annual Plan
FAO	Food and Agriculture Organization of the United Nations
FOI	Fish species of interest
FU	Nephrops Functional Unit
GNSS	Global Navigation Satellite System
GPS	Global Position System
GT	Gross Tonnage
IBTS	International Bottom Trawl Surveys
ICES	International Council of the Exploration of the Sea
IESSN	International Ecosystem Summer Surveys in the Nordic Seas
IFCA	Inshore Fisheries and Conservation Authorities
IRCS	International Radio Call Sign
ISSCAAP	International Standard Statistical Classification of Aquatic Animals and Plants
kg	kilogram
LSF	Large Scale Fisheries
MB	Megabyte
MMO	Marine Management Organization
MRF	Marine Recreational Fisheries
MS	Member State
MSAR	Monthly Shellfish Activity Returns
MSE	Management Startegy Evaluation
NA	North Atlantic
NC	National Correspondent
NSEA	North Sea and Eastern Arctic
NWP	National Work Programmes
PETS	Protected Endangered and Threatened Species
PGCCDBS	Planning Group on Commercial Catches, Discards and Biological Sampling
PGDATA	Planning Group on Data Needs for Assessment and Advice
PSU	Primary Sampling Unit
R	Free software for statistical analysis
RCG	Regional Coordination Groups
RDBES	Regional DataBase and Estimation System
RSE	Relative standard error
SC RDB	Steering Committee of the Regional Data Base

SRS	Simple random sampling
SSF	Small scale fishereis
SSU	Secondary Sampling Unit
STECF	Scientific Technical and Economic Committee for Fisheries
STECF EWG	Scientific Technical and Economic Committee for Fisheries Expert Working Group
SWOT	Stregnth Weakness Opportunities Threats
UK	United Kingdom
UN	United Nations
UN/LOCODE	United Nations location code
VMS	Vessel Monitoring System
WGBFAS	ICES Baltic Fisheries Assessment Working Group
WGCATCH	Working Group on Commercial Catches
WGECO	ICES Working Group on Ecosystem Effects of Fishing
WGMIXFISH	ICES Working Group on Mixed Fsiheries Advice
WGNSSK	ICES Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak
WGRFS	Working Group on Recreational Fisheries Surveys
WGSAM	ICES Working Group on Multispecies Assessment Methods
WKMERGE	Workshop on methods for merging metiers for fishery based sampling
WKPICS	Workshop on Practical Implementation of Statistical Sound Catch Sampling Programs
WKPRECISE,	Workshop on methods to evaluate and estimate the precision of fisheries data used for assessment
WKTARGET	ICES/Probyfish Workshop on identification of target and bycatch
WoRMS	World Register of Marine Species
WP	Work Package

Vessel Flag Code	**Member State (UK and France split)**
BEL	Belgium
DEU	Germany
DNK	Denmark
ENG	UK-England & Wales
ESP	Spain
FRA	France-Mainland
GBC	UK-Channel Islands[1]
GBI	UK-Isle of Man[2]

Land Code	**Member State (UK and France split) and non-EU countries**
BEL	Belgium
DEU	Germany
DNK	Denmark
FRA	France-Mainland
FRO	Faroe Islands
GBC	UK-Channel Islands
GBE	UK-England
GBI	UK-Isle of Man

[1] As included in the "UK sea fisheries annual statistics report 2018" https://www.gov.uk/government/statistics/uk-sea-fisheries-annual-statistics-report-2018

[2] Idem

IRL	Ireland
NIR	UK-Northern Ireland
NLD	The Netherlands
PRT	Portugal
SCT	UK-Scotland
SWE	Sweden
WLS	UK-Wales

GBN	UK-Northern Ireland
GBS	UK-Scotland
GBW	UK-Wales
GUF	France-French Guiana
IRL	Ireland
NLD	The Netherlands
NOR	Norway
SWE	Sweden

General Introduction

The fishPi^2 project was one of four projects funded under the call for proposals MARE/2016/22: *Strengthening regional cooperation in the area of fisheries data collection. Annex 1, biological data collection in EU waters.* The call was launched in May 2017 with an original indicative maximum amount per project of €500,000. The final report was submitted in July 2019 and the timeseries data used in the study were mainly from 2015 and 2016.

This project has brought together over 50 scientists from 14 institutes, from 10 Member States in work package teams, to address Biological data collection in EU waters. The project consortium spans the basins of the North Sea and Eastern Arctic and the North Atlantic. The project consortium reunited many of the participants of the fishPi project (MARE 2014/19) with additional participation from Regional Co-ordination Meeting North Atlantic (RCM NA) institutions. The project has built on the work achieved in the fishPi project, further strengthening regional cooperation, and has provided some clear guidance on the implementation phase of regional sampling. Work packages have specifically addressed the operation of putative Regional Co-ordination Groups (RCGs) (WP1); sets out scoping of regional fisheries (WP2); and proposes regional sampling plans for commercial fisheries (WP3). Other work packages have addressed stomach and incidental bycatch sampling (WP4); small scale and recreational fisheries sampling (WP5); and national and regional data quality (WP6). The project outcomes have been disseminated to the North Sea and Eastern Arctic, North Atlantic, and Baltic RCGs in 2018 (WP7). The feedback from these interactions led to a dissemination workshop with National Correspondents and DG MARE representatives in February 2019 (WP8). The project team established close links with other successful consortia and the STREAM project in particular, thus building both within region expertise and facilitating pan-regional cooperation.

This report which documents the work conducted under the fishPi^2 project is divided into a Summary Report and a series of related Annexes which contain more detailed material relevant to each Work Package.

The Summary Report and Annexes can be found at the following URLs:

https://datacollection.jrc.ec.europa.eu/docs/regional-grants
https://www.masts.ac.uk/research/

The Summary Report and Annexes together with ancillary R code can be found at:
https://github.com/ices-tools-dev/FishPi2/tree/master/

Work Package 1 – Prerequisites for the functioning of Regional Coordination Groups (RCGs)

1.0 Aim

The aim of fishPi^2 WP1 is to propose a set of prerequisites for the functioning of the Regional Coordination Groups (RCGs).

1.1 Methodology

The work was predominantly carried out in a face-to-face meetings (14th-16th March 2018) with the core team. The results from the core team meeting were followed up in presentations and discussions within RCG North Sea &Eastern Arctic (NS&EA), RCG North Atlantic (NA) and RCG Baltic 2018 and in the fishPi^2 Work Package 8 consultation meeting in February 2019. The work was completed in two web meetings during early spring 2019.

The face-to-face meeting began with a brainstorming exercise aiming to identify and analyse possible objectives and tasks for the RCG. We then discussed how well these tasks and objectives are fulfilled today, the desired future situation, needs and actions allowing us to move towards the desired future situation and obstacles to overcome. We also considered the hypothetic possibility of fulfilling these tasks/objectives in the absence of RCGs. The objectives identified include development and establishment of regional workplans and regional sampling plans, cost-effective end-user driven data collection and transparent quality assurance and assessment of collected data. There are a substantial array of tasks to fulfill these objectives. A table with the full results from the brainstorming exercise is found in Annex 1.1. This exercise was used as a basis for the discussions on prerequisites for effective RCG work and, in particular, for the suggestion for more permanent intersessional subgroups with more structured working procedures (Annex 1.2). The suggested new structure and working procedures for subgroups was presented at RCG NS&EA, RCG NA and RCG Baltic in their 2018 meetings. The suggestion was well received and implemented.

1.2 Main conclusions from the analysis and discussions

The RCGs constitute a very important platform for regional coordination and cooperation. The Member States (MS) participating in the RCGs and their predecessors the Regional Co-ordination Meetings (RCM) have, over time, built a common understanding of fisheries and sampling in the regions as well as trust. This is described in the report from fishPi (MARE/2014/19). The risk of uncoordinated national sampling, money wasted on duplicated processes and structures would increase without the RCGs.

The written consultation process in fishPi (MARE/2014/19) showed that there is a strong agreement between MS on the objectives of the RCGs. MS consider that they have expertise to fulfill the tasks needed to meet the objectives of the RCGs and are in many cases willing to prioritize regional work. In reality, however, the RCG work competes with other obligations at the level of the institutes

charged with fulfilling the RCG objectives. These include, for example, national tasks and priorities, ICES work and science which might be more career promoting for experts and institutes. **A key challenge and pre-requisite for well-functioning RCGs is that MS/institutes prioritize regional work and that the right experts can be attracted.** A key question therefore is how we can make RCG work more attractive for experts and institutes? There is no simple answer to this question but a first step would be to increase the visibility of the work done within the RCGs to make it more career promoting. This could for example be done through publically available **traceable reports with authors from the RCG subgroups**. (see Annex 1.2).

The core team discussed how the intersessional work in the RCG subgroups could be strengthened. It is important to realize that intersessional subgroup work is complex management of time and resources across an array of individuals and institutes. This is challenging. It is usually individuals, not institutes, that take on tasks in the RCGs. This might end up in situations where, on the individual level, it is difficult to prioritize regional tasks if there are time constrains and if national tasks are better recognised at institutional level. **Intersessional RCG work needs to be better planned and institutes/MS** (in contrast to individuals) **need to make resources available** in accordance with the plan to improve the situation (see Annex 1.2). WP1 further suggests that sub-groups need to be more structured and permanent to be effective (it takes time to start up new groups). The subgroups should, were possible, be pan-regional for the RCG NS&EA, RCG NA and RCG Baltic (and where relevant other RCGs) to avoid scattering of expertise.

One of the main tasks for the RCGs is agreement on and preparation of regional workplans. As far as the WP1 core team understands, no such plans have been put forward. WP1 discussed why. To some extent this might be explained by the fact that a regional workplan has been considered equal to a regional sampling plan, which requires a high level of cooperation. WP1 realizes that there are elements in the national workplans that could be regionalized. Such elements could, for example, be otolith exchanges and workshops or documentation and implementation of a Quality Assessment Framework (QAF). An obstacle for a region to submit a regional workplan is that there is no common format or understanding of how this should be achieved. A template for a regional workplan that could complement the national workplans needs to be developed. If agreements can be made it is suggested that the RCGs create limited regional workplan(s) covering just one (or a few) element(s) of data collection to test how it can work. The idea was picked up by the RCGs (NS&EA, NA and Baltic) during the 2018 meeting were they established an intersessional subgroup on this topic.

The RCGs are presently lead by chairperson(s) that, according to the established Rules and Procedures for the RCG, have extensive responsibilities. These include planning for the meeting (venue, participants, terms of reference, agenda), reporting the meeting and to keep track of work going on between meetings. The workload between meetings will increase with the new structure of subgroup work proposed by WP1. Chairs are elected for 2 years. This means that there is a risk of inconsistency over time as different Chairs might have different levels of ambition. The RCGs have repeatedly suggested the **establishment of a secretariat** to support the Chairs and to add continuity in the working procedures when Chairs are changing. Such a function would also help to ensure a more consistent approach towards regionalization and would facilitate a more stable quality of RCG

work independent of the Chair. WP1 discussed potential tasks for the secretariat and resources needed. The results are presented in Annex 1.3.

The RCGs are the main hub for regional coordination and cooperation in data collection within the different regions. The RCGs are, in accordance with regulation (EU) 2017/1004 (Article 9(7)) and with the newly established rules of procedures, supposed to interact with end-users and invite observers (eg. regional fisheries management organizations, Advisory Councils and third countries), to the meetings when necessary. This requires that end-users and stakeholders are aware of the RCGs and the work carried out within them. The problem is that the RCGs are currently more or less invisible for most people and organizations not directly involved. This is considered a problem both internally, as it might contribute to problems allocating resources and expertise to regional work, as well as externally as stakeholders and end-users are not aware of the work done in the RCGs. **Improved outreach is therefore a key priority and pre-requisite to improve the effectiveness of the RCG work.** WP1 thereby suggest the **establishment of pan-RCG website**, managed by the RCGs. Each region would have a specific part of the website if this is needed. The website would serve both the internal needs (eg. communication between RCGs) but also contribute to outreach and increased visibility. WP1 discussed content and management of the suggested website. The result is presented in Annex 1.4.

WP1 further concluded that the RCGs need a logo. This is an easy way to "trademark" work done by the RCGs or in the contexts of the RCGs. The logo was developed by ILVO, Belgium shortly after the WP1 core group meeting (Figure 1.1). The logo was used by the RCGs (NS&EA, NA and Baltic) in 2018.

Regional Coordination Group
North Sea & Eastern Artic

Figure 1.1 showing the logo for RCG North Sea and Eastern Arctic. Same logo, but with name adapted is used by RCG NA and RCG Baltic.

A final but important challenge for effective future RCG work is the ability to secure long-term robust funding for regional tools and resources required for effective RCG work. This includes (but might not be exclusive to) further development and maintenance of the regional database, development and maintenance of the website and support to the RCG chairs from a secretariat. Funding might come from the Commission or it can be shared between MS. **The routes for funding depends on what is possible in EMFF and this needs to be examined and then discussed, tentatively between the Commission and the NCs.** A starting point would be to estimate the total (yearly) cost for these tools and resources. To initiate the process WP1 created an estimate for the costs for a secretariat (included in Annex 1.3).

1.3 Prerequisites for the functioning of RCGs.

1.3.1 Rules of Procedures

Rules of Procedures (RoP) for RCG NS&EA and RCG NA have already been developed by the RCGs and endorsed by the NCs. The RoP are found in the reports from the 2018 RCG meetings and on the Commission website for data collection. The RoP differ slightly between the RCG NA and the RCG NS&EA. Both cover aspects such as:

- Scope
- Working language
- Meetings of the RCG
- RCG groups
- RCG recommendations for further work, work plans and preparation of a draft regional work plan in accordance with the Article 9 of the Regulation 2017/1004
- Decision making on a draft regional work plan
- Cooperation between RCGs and the European Commission and other relevant bodies
- Observer participation to the RCG meetings in accordance with Article 9(7) of Regulation 2017/1004
- Terms of Reference for the RCG
- Agenda and submission of documents
- Election of the RCG Chairperson(s)
- The Chairperson(s) responsibilities and agenda
- Reporting from a RCG meeting
- Amending rules of procedure

FishPi[2] WP1 recognise that the working procedures described in the RoPs imply increased administrative responsibilities (including deadlines for documents, reports etc) for the Chair. **This highlights the need for Secretariat support (Annex 1.3).**

1.3.2 Mechanisms for communication within and between RCGs

Formal communication between RCGs does presently occur in the liaison meeting. Informally the Chairs of RCG NA, RCG NS&EA and RCG Baltic cooperate extensively on aspects such as data calls and terms of reference for meetings. There is also a considerable overlap in participants between the three groups that facilitates communication. Internally the RCGs primarily communicate through the SharePoint system (hosted by ICES) and by mail. The present communication system works fairly well for the present working procedures with some exceptions.

A current problem is the communication of results from the yearly meetings as all work is presented together in a long report. This means that discussions, decisions, recommendations and reference material are found in the same document. In the short term, this is not an issue as participants know what to look for. In the longer term this will become an issue as participants (or end-user / stakeholder) need to remember the year a decision was taken / a topic discussed / reference material produced and then go and look for it. This constitutes a risk of old work being overlooked. It also makes it unnecessarily difficult for new participants to join the RCGs. The situation would improve if the outcome from the RCGs to a larger extent were reported in topic specific, standalone documents that then, where relevant, were made public in a structured manner. The proposal for new working

procedures for subgroups (Annex 1.2) and the proposal for a RCG website (Annex 1.4) are aiming to achieve this.

The RoP and the by fishPi^2 proposed working procedures for subgroups, imply a need for stronger leadership of the RCGs, in particular, between meetings. This increases the responsibilities for Chairs who will need to communicate more frequently with the subgroups to ensure that; documents needed for meetings are provided in a timely manner, plans needed work in the different subgroups and different deadlines are met. This highlights the need for a Secretariat (Annex 1.3) to support the Chair in this communication.

The liaison meeting (for communication between RCGs) and the SharePoint system (for internal communication within the RCG) is highly appreciated by the RCG members and needs to be retained.

1.3.3 Identification of subgroups (regional and/or pan-regional) needed

A substantial part of the work in the RCGs is presently carried out in subgroups between meetings. FishPi^2 WP1 suggests that this work is strengthened by the establishment of more permanent subgroups and more structured working procedures within these subgroups (Annex 1.2). The subgroups should, as far as possible, be pan-regional for the RCG NS&EA, RCG NA and RCG Baltic, and others, to avoid scattering of expertise. The pan-regional groups can, however, have regional tasks.
FishPi^2 WP1 suggest in their March meeting, the establishment of seven topic specific subgroups. These were presented and discussed in the RCG NA, NS&EA and Baltic during the 2018 meetings. The RCGs were in agreement with fishPi^2 WP1 but added some extra subgroups. One of the suggested subgroups was put on hold. The suggested subgroups are presented below.

1. **Subgroup on implication of management measures on data collection**
   The objective for this subgroup is to evaluate measures in fisheries management impact data collection and suggest suitable actions. The primary task for this subgroup is to understand consequences of the landing obligation for the data collection. There are other management and control regulations that impact data collection and the scope for the subgroup might be extended in the future. This subgroup was supported by the RCGs.

2. **Subgroup on effective interaction between end-users and RCGs**
   The objective for this subgroup is to review and streamline dialogue between data providers (RCGs) and end-users (presently ICES, but can be extended to other end-users as well) in order to identify effective processes to meet end-user needs and allow the RCG to prioritize its activity relating to future data collection, storage and transmission functions. This subgroup was supported by the RCGs.

3. **Subgroup on data analysis to support RCG work**
   This suggested subgroup has a broad scope dealing with everything that has to do with data analysis and data quality for the RCGs internal needs, for harmonization between MS and for interaction with end-users. The work is dependent on the regional database. This subgroup was supported by the RCGs but they suggested it to be split it in four parts allowing the tasks to be more manageable. The four suggested parts are:

a) Continued development and production of regional overviews of fisheries and sampling, for internal needs and for interaction with end-users.
b) Continued development of codes and tools to support harmonization in reporting to COM, across MS
c) Métier issues – harmonization of assignment of métiers and transversal variables
d) Facilitation of quality assurance of data and sampling programmes

4. **Subgroup on design and implementation of regional sampling plans**
The objective for this subgroup is to do all the preparatory work for the establishment for regional sampling plans. The outcome of fishPi[2] will have an impact on the working procedures for the group. Outcomes of fishPi, such as the data sharing agreement and data format, are supporting this work. This subgroup was supported by the RCGs but the work will, as the objective has a strong regional component, be carried out in regional groups instead of pan-regional. There are presently two regional initiatives "Towards a regional sampling plan for the freezer trawler fleet exploiting pelagic fisheries in the Northeast Atlantic" (RCG NA) and "Towards a regional sampling programme – Case study of fisheries for small pelagics in the Baltic" (RCG Baltic).

5. **Subgroup on surveys**
The objective for this subgroup is to deal with everything that relates to surveys. This includes regional preparatory work for survey evaluations, naming issues, issues related to survey manuals that need to be discussed with survey groups and/or end-users, new types of data (eg. stomachs) to be collected in surveys that need to be discussed with survey groups. This subgroup was supported by the RCGs but it is presently on hold awaiting the outcome of the survey evaluation made by the Scientific, Technical and Economic Committee for Fisheries (STECF EWG 19-05).

6. **Subgroup on diadromous species**
The overall task for this subgroup is to progress development of the regional work and sampling plans for data collection and quality assurance for diadromous species (in particular, eel and salmon). The subgroup was supported by the RCGs.

7. **Subgroup on regional database**
The regional database is hosted by ICES. The objective of this subgroup is to govern content of the regional database (RDB), and to indicate priority areas for development, reports and data requirements. The work is primarily carried out within the ICES Steering Committee of the Regional Fisheries Database (SCRDB) in which the subgroup members represent the RCGs. This subgroup was supported by the RCGs

Two more pan-regional subgroups were added by the RCGs:

8. **Subgroup on development of Draft Regional work plan.**
The objective for this subgroup is to draft a regional work plan with limited elements and to develop format and content for proposed submission.

9. **Subgroup on revision of EUMAP**
The objective of this subgroup is to review current EUMAP legislation and propose required amendments for EUMAP 2020 and beyond with particular focus on issues relating to regional coordination.

1.3.4 Mechanisms for formal communication with end-users

ICES, being the body carrying out stock assessments and providing advice for fisheries management, is a key end-user in the regions covered by RCG NS&EA, RCG NA and RCG Baltic. There is a lot of interaction between the work carried out in the RCGs and ICES as ICES is the host of the Regional Database (RDB), ICES provides the framework for data quality, ICES have planning groups for surveys etc. Many members of the RCGs also participate in the ICES work. ICES have, in accordance with the RoP, a standing invitation to the RCG meetings and can participate in subgroups.

The set up in EU-MAP (2016/1251) with end-user driven data collection implies that end-users need to identify what they need. It is also important to realize that needs might be endless. As funding for data collection is constrained End-user driven data collection requires clever prioritization and optimization between different data collection activities as funding for data collection, although obliged for MS, to some extent always will be limited. This has given rise to a new set of challenges. These include a better understanding of data collected and data used in the region as well as the quality associated to that data; a better understanding of the data needed to support fisheries management in the region and the quality needed; and more formal communication with end-users.

The RCGs are presently working with these challenges in several different ways:

- Fisheries and sampling overviews are developed and produced by the sub-group on data analysis. The aim is to increase the knowledge of collected data and make this knowledge available. This is particularly important prior to benchmarks of stock-assessments.
- Support in the development of the regional database into the regional database and estimation system (RDBES) to the ICES Data Centre by the SCRDB (subgroup on regional database). This new system would support transparent and statistically sound processing of data for a variety of different sampling schemes. The aim is to have transparent ways to process data from the detailed level to estimates entering stock-assessment models. This will support transparent assessments of data quality within regions and across MS. This is essential for understanding how much data needs to be collected and a prerequisite for future prioritization between data needs.
- A yearly meeting with the ICES Secretariat (subgroup on end-user needs) was initiated by the RCM NS&EA in 2016 and has been held annually since that time. The purpose of the meeting is to establish a collaboration between the ICES Secretariat and the RCGs to identify processes for identification of data needs. This is predominantly carried out through ICES databases and through the benchmark process.

The work is ongoing and needs to be developed further before a more formal mechanism of communication between the RCGs and ICES can be established. Formal communication with ICES presently occurs through data calls to MS.

1.3.5 Mechanisms for communication to stakeholders

A mechanism for communication with stakeholders is stated in Regulation 2017/1004 (Article 9(7)). RCG shall, invite as observers, relevant end users of scientific data, regional fisheries management organizations, Advisory Councils and third countries, when necessary. The process for this invitation is clearly described in the RoP.

Improved communication with stakeholders would also include making results of the RCG work easier to access. The website (Annex 1.4) that is proposed by fishPi[2] WP1 is essential in this process.

1.3.6 Identification of expertise needed

Expertise needed was identified in the fishPi (MARE/2014/19) project. MS were asked in the written consultation process if they have the right expertise in the following areas:

- IT (i.e. database development and database management)
- statistical expertise in sampling design and estimation
- large scale commercial fisheries
- small scale commercial fisheries
- recreational fisheries surveys
- running sampling programmes
- "R" programming
- systematic quality assurance work
- surveying bycatch /Protected Endangered and Threatened Species (PETS)

MS considered that they have the right expertise in all or most areas and were in many cases willing to prioritize regional work when utilizing this expertise. In reality, however, the RCG work competes with other obligations at institute level that may also be more career promoting. **A key challenge and pre-requisite for well-functioning RCGs is that MS/institutes prioritize regional work and that the right experts can be attracted.** This require organization and recognition of the experts/institutes that carry out the work (Annex 1.2).

1.3.7 Storage of and access to data (RDB)

RCG NA, RCG NS&EA and RCG Baltic have been utilizing the RDB since 2012 when ICES became the host for the database. The RDB is the hub of all analytical work carried out in the RCGs and thereby a crucial prerequisite for a lot of the work done. The database is populated through a yearly data call sent out by the RCG chairs. The database is presently under development into a regional database and estimation system (RDBES). The main difference from the old system is that the new system will embrace estimation procedures as well. This will result in transparent and statistically sound processing of data from the detailed level to the final estimates going into stock assessment. This is a crucial point for quality assurance, and consistency of quality assurance across MS, as good or bad quality can originate from the estimation procedures and not only from the data itself. The new system is a prerequisite for processing and estimation of data originating from future regional sampling plans (as data might be scattered over databases in several MS). The system is fairly complex as it needs to cover a multitude of different sampling designs and schemes. A road-map for its completion is found in the report from the steering committee fort he RDBES 2018 (https://www.ices.dk/publications/library/Pages/default.aspx#k=SCRDBES).

1.4 Recommendations

- A key challenge and pre-requisite for well-functioning RCGs is that MS/institutes prioritize regional work and that the right experts can be attracted. This require organization and recognition of the experts/institutes that carry out the work.

- The RCGs should produce traceable published reports acknowledging the authors from the RCG subgroups.
- Intersessional RCG work needs to be better planned and institutes/MS (in contrast to individuals) need to make resources available.
- Improved outreach is a key priority and pre-requisite to improve the effectiveness of RCG work and to help address this a pan-RCG website should be establishment and managed by the RCGs.
- The RCGs need a common logo to help build a sense of identity and increase recognition.
- For future RCG work there is a need to secure long-term robust funding for regional tools and resources required for effective RCG operation.
- The potential for EMFF needs to be examined and then discussed between the Commission and the NCs.
- The working procedures described in the Rules of Procedures for the RCGs imply increased administrative responsibilities for the RCG Chairs and it is recommended that dedicated Secretariat support for the operation of the RCGs is established.
- Identification of RCG subgroups (regional and/or pan-regional) has been identified by WP1 and already implemented by the RCGs.

Work Package 2 - Suitability for regional sampling

2.0 Overview

This work-package considers how to distinguish between fisheries suitable for regional sampling and those suitable for national sampling. It creates tools in the form of an R-package to graphically explore fisheries data with the aim of identifying fisheries suitable for regional sampling.

The deliverables for this work-package are as follows:

- Text providing guidelines for defining regional fisheries and a checklist of criteria to be met for determining suitable regional fisheries. This is below and is also available at: https://github.com/ices-tools-dev/FishPi2/tree/master/WP2
- Analytical tools to be applied to regional data sets to provide objective measures of suitable regional fisheries. These have been compiled into an R-package which is available at: https://github.com/ices-tools-dev/FishPi2/tree/master/WP2
- Example analyses of regional data sets with a view to identification of fisheries suitable for regional sampling plans. These are available at: https://github.com/ices-tools-dev/FishPi2/tree/master/WP2

2.1 Criteria for suitability for regional sampling

The work-package considered the criteria for fisheries suitable for regional sampling designs. It was agreed that whilst "regional" could be applied to any sampling plan, here the focus would be on those that involved more than one Member State. A regional sampling design is required for stocks that are either fished by fleets from more than one Member State (landings shared between MS) or landed in more than one MS, and for which the landings are not dominated by a single MS. Stocks will need to be considered together in the same sampling design if they are caught together, and the stocks focussed on would be commercially important to these MS.

The working definitions of stock, fleet and fishery are:

- Stock – species in certain areas as defined by ICES.
- Fleet – a list of vessels with certain characteristics that are stable over time.
- Fishery – interaction of fleet and stock(s) (along the lines defined by FAO).

Analysis of landings data (e.g. logbook and sales notes) can be used to address the following questions:

- Are the stocks landed by more than one country, and to what extent is the stock shared between those countries?
- Are the stocks commercially important? (Do the landings have a relatively high value?)
- Which groups of vessel are fishing these stocks?
- Which stocks are caught together?
- Are the groups of vessels fishing these stocks, and/or the landings from these groups suitable for a regional sampling plan?

2.2 Analytical tools

The analytical tools are mainly based on landings (logbook and sales notes) and use the data format as specified in the data call for WPs 2 & 3, described in WP3. The tools have been developed as functions in the statistical package R, and have been compiled into an R-package, called fishPi2WP2.

The R-package contains the following functions:

- heatmap
  Function which aims to visualize the consequences of selecting a case study limited by area and/or gear.
- stocks_diversity
  This function estimates some diversity indices to help characterise how some variable is shared over some other variable (e.g. stocks in terms of landed weight among countries).
- map_pie_landings
  The function allows the user to map selected stocks per ICES square, by plotting a pie-chart of the required variable for each ICES square.
- plot_stock_data
  A function to create barplots for visualisation of stock data, for example a barplot of landed weight by Member State, for a particular stock.
- stock_landings_by_id
  This function builds data frames of landings and proportions of landings of different stocks by a given grouping variable.

Some examples of the graphical output from these functions are shown in Figure 2.2.1.

2.3 Case studies

The tools in this package have been used in 3 short case studies, Celtic Sea, North Sea and Iberian waters, the first to identify fisheries suitable for regional sampling, and the latter two to confirm the choice of fisheries chosen for case studies in the work-package on regional sampling designs for commercial fisheries (WP3). These case studies are summarised here and are available in Annex 2 of this report and at:

https://github.com/ices-tools-dev/FishPi2/tree/master/WP2

Celtic Sea

This case study considered fisheries in the Celtic Sea (ICES divisions 7b-k), and focussed on the stocks for which at least 50% of the landings (in 2015 and 2016 combined) were taken from areas 7b-k. Several stocks, Celtic Sea/Biscay anglerfish and megrim, Celtic Sea whiting and pilchard and pollack, were identified as having several Member States landing but with no Member State having more than 60% of the landings. Of these stocks, pilchard is a targeted fishery, whilst the other stocks are caught in a mixed demersal fisheries, and so a regional sampling plan would need to include all the (main) stocks caught in the demersal fisheries in the Celtic Sea. Celtic Sea herring, boarfish and cuttlefish were identified as mostly being taken by a single Member State and therefore not suitable for a regional sampling design.

Wider North Sea

This case study considered fisheries in ICES divisions and subareas 3a, 4, and 7d, hereafter called the wider North Sea. The otter trawl, seine and beam trawl fisheries, are all mixed fisheries prosecuted by all Member States surrounding the wider North Sea, landing a wide range of stocks, including cod, haddock, plaice and sole. These fisheries were therefore grouped together into a single regional sampling design. Several Member States have vessels fishing in more than one area (UK-England, France, Belgium and Denmark in particular). In addition, UK-England and Germany land the bulk of their demersal catch into other Member States, making the wider North Sea mixed demersal fisheries an interesting case study.

Iberian Waters

The case study considered the demersal trawl fishery in ICES divisions 8c and 9a. Almost all the landings are from Spanish and Portuguese vessels, mainly landing into their national ports, but with some landings into Spain from Portuguese vessels. Around 60% of the vessels are Spanish, and they land about 60% of the landings. There are 5 level 6 metiers[3] used in this fishery, of which two are used exclusively by Portugal, two by Spain, and the main metier, OTB_DEF_>=55_0_0, which accounts for almost 50% of the landings, is used by both Member States. This fishery has several commercially important shared stocks, and the main species with shared stocks identified as being of key interest to the case study were anglerfish, black-bellied anglerfish, hake, megrim, four spot megrim, horse mackerel, blue whiting, Nephrops, mackerel and deep water rose shrimp.

[3] See Commission Decision 2008/949/EC Appendix IV: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:346:0037:0088:EN:PDF

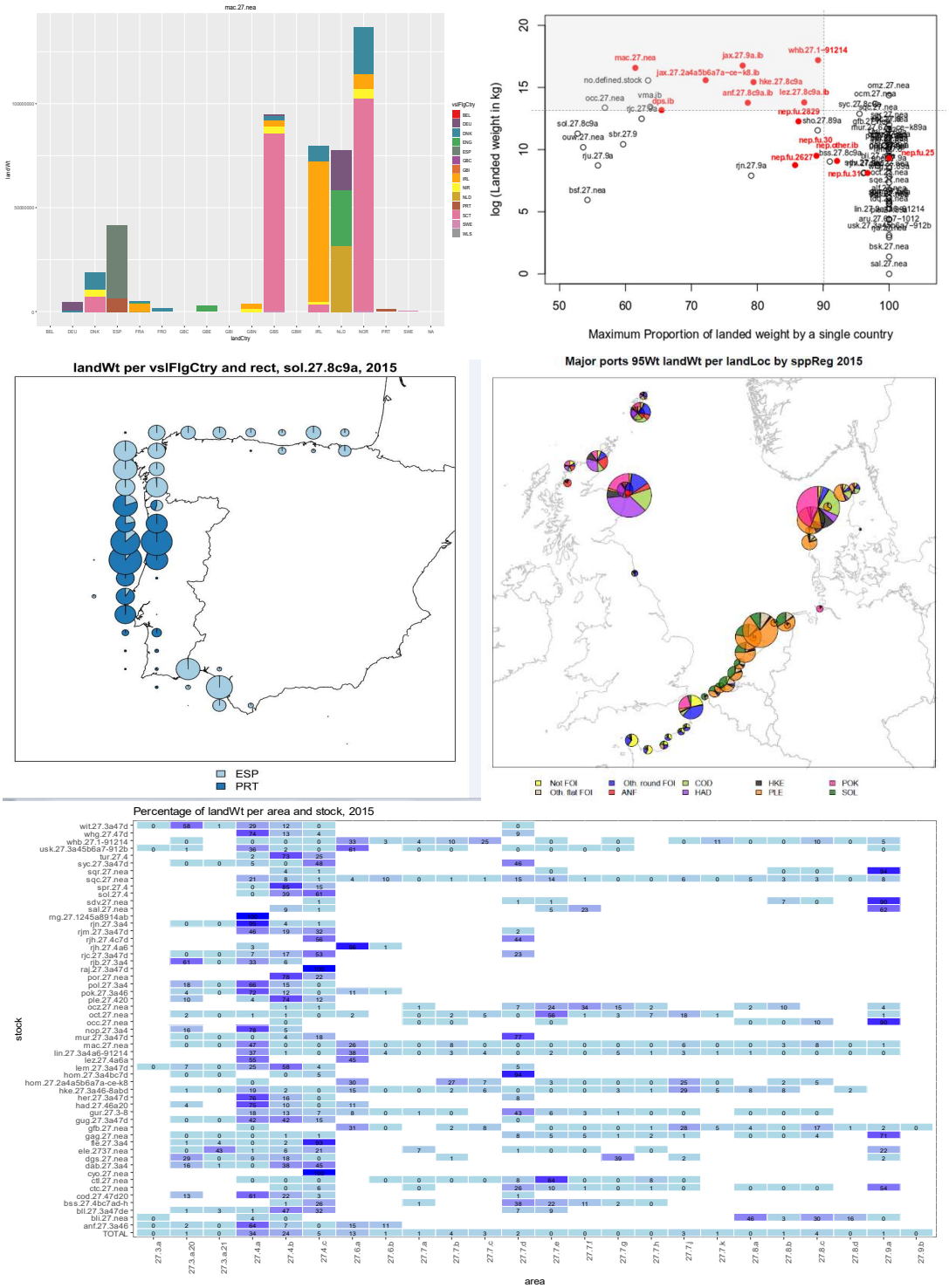


Figure 2.2.1 Example output from the functions in the fishPi2WP2 package. Top left: a barplot of mackerel landed weight by country of landing, coloured by vessel flag. Top right: log-landed weight against maximum proportion of landings from one Member State, for several Iberian stocks. The red coloured stocks indicate those chosen in the Iberian case study in WP3. Middle left: pie-charts of landed weight by vessel flag for each ICES rectangle for the sole stock in Iberian waters. Middle right: pie-charts of landed weight by species for major landing ports in the North Sea, English Channel, Skagerrak and Kattegat. Bottom: a heatmap showing percentage landed weight for North Sea stocks by area, indicating which areas are most important for the stock. For code key see: Glossary, Vessel Flag and Landed Codes at the start of this document.

Work Package 3 - Regional sampling designs

3.0 Background and context

It is generally accepted that the biological sampling of commercial fisheries acting on regional stocks should be coordinated regionally. This will ensure effort is targeted at the most important sectors, and will improve both the transparency and efficiency of the design and resulting estimates. Currently most catch sampling programmes within the EU are organised nationally, with no coordination of stratification or effort.

WP3 provides a framework and tools to specify a regional sampling plan through the sharing of a regional data set and generic simulation code to test potential sampling designs. This allows Member States to draw up work plans that include regional, as well as national, commitments.

The required deliverables from this WP are firstly, a proposed sampling design to put forward for further consideration by the relevant RCGs and RCG subgroups (deliverable 3.1), and secondly, a repository of tools required to set up a simulation scheme to test and develop sampling designs, such as the one proposed (deliverable 3.2). These are described below.

We present the sampling design as a regional work plan, adapting the template provided for the EU Multi-Annual Programme (EU-MAP; Regulation (EU) No 2017/1004) where required (Annex 3.1). The repository of tools is publically available at:
https://github.com/ices-tools-dev/FishPi2/tree/master/WP3

and includes statistical principles, protocols, code-lists, and R scripts and packages to simulate and test sampling designs. The repository also includes step by step guidelines for the development of regional sampling designs and for the transition from a national to a regional sampling design. These tools can be used by individual Member States both within and outwith the regions to test and improve national sampling designs within the framework of statistically sound sampling, building up expertise in this area.

The work package includes two case studies – North Sea demersal fisheries and Iberian trawl fisheries. In each case study, a regional sampling design for on-shore sampling at landing locations was developed using computer simulations on landings data (obtained from logbooks and sales notes) supplied by each participating institute. These case studies confirm that regionally stratified sampling designs with proportional effort allocation perform better than the status-quo.

The original aim of this work package was to agree a regional sampling design to implement, but it was agreed at the interim meeting that as the participants in the work package did not have the authority within institutes to agree to increasing or reducing staff resources or budgets, the move from theory to implementation should be taken forward through RCGs and RCG subgroups and not through fishPi^2. The project therefore focussed on improving tools to simulation test sampling

designs. This involved creating documented code and functions, a step-wise process and graphical means to compare designs, and detailed output to allow consideration of the implications of the sampling design for each Member State. Furthermore, this led to the development of adaptations to annual work-plan tables that incorporate all stages of the sampling design.

Thus the key outcomes are of this work package are: i) a clear framework to develop regional sampling designs; ii) tools for simulation testing of sampling designs, in the form of documented R-packages and scripts for both reported landings data and biological data; iii) proposals of regional on-shore sampling designs to take forward to RCGs for further consideration; and iv) proposed adaptations to the EU-MAP Annual Work-Plan templates which incorporate all aspects of a catch sampling designs in a self-contained set of tables.

3.1 Example Regional Sampling Designs

The output of each of the case studies includes an example regional sampling plan for the on-shore sampling of the chosen fisheries for 2019 for the Member States participating in the consortium. These use modified tables and text-boxes from the existing Work Plan template. The relevant tables are Annual WorkPlan Tables 4 and Text Box 4A. Text box 4A describes the sampling design in around 400 words. The requirements of this text box are well-specified and did not require adaptation.

3.1.1 Annual WorkPlan Tables 4

The original Annual Work Plan tables 4A-D have been adapted to include pertinent information about sampling designs that is required to fully assess a sampling design and its expected outcomes. These adaptations are proposed as a result of the output required from the simulation studies to compare sampling designs, and much of the information in the proposed tables can be obtained as output from the simulation code. Proposed annual work plan table templates and guidelines are included in the repository of tools described below. Here we include a brief comparison of the original and adapted work plan tables. Details can be found in Annex 3.1.1.

The original work-plan tables for catch sampling schemes are as follows:

- Table 4A: Sampling plan description
- Table 4B: Sampling frame description
- Table 4C: Data on the fisheries
- Table 4D: Landings locations

Tables 4A and 4B are appropriate for both on-shore and at-sea designs, where at-sea designs focus on fleets, and on-shore designs focus on landing (or sales or processing) locations, and give an overview of the design, including sampling effort and stratification and sampling frames for the primary sampling unit (e.g. port-days, or fishing trips). Table 4B only contains 3 additional columns compared to table 4A, and the two can easily be amalgamated to better understand the sampling design. The rationale for Tables 4C and 4D were to provide an overview of the populations being sampled by the at-sea and on-shore sampling designs described in 4A and 4B, with totals of landed tonnage, trips, etc by fleet or groups of landing locations. However, if the fleets and locations in

Tables 4C and 4D are not grouped into the same strata as used for the sampled fleets and locations in Tables 4A and 4B, comparison between the population and sampling design is difficult.

The proposed new set of tables covers all aspects of the sampling designs for commercial catch, starting with a list of catch sampling schemes for each MS (Table 4a), before describing each scheme in more detail (Tables 4b-4f). These tables include extra information to describe the planned sampling design, amalgamate the sampling designs and overviews of the populations into separate tables for at-sea and on-shore designs, and include additional new tables on biological sampling and expected outcomes.

The adapted work-plan tables are as follows:

- Table 4a: List of catch surveys
- Table 4b: Sampling hierarchies
- Table 4c: On-shore schemes
- Table 4d: At-sea schemes
- Table 4e: Biological sampling
- Table 4f: Expected outcomes by domain

Table 4a is the equivalent list of commercial catch sampling schemes to the list of research vessel surveys in Table 1G. Table 4b adapts the original Table 4B to include the sampling hierarchy at all levels (4b), and whilst this is not necessary for evaluating the schemes, it aids clarity and therefore understanding. Table 4c amalgamates Tables 4A, 4B, and 4C to provide a single overview of the population with the design and effort allocation for at-sea schemes, whilst Table 4d amalgamates Tables 4A, 4B and 4D to provide a single overview of the population with the design and effort allocation for on-shore schemes. This allows the stratification in each design to be set in context. Table 4e contains information regarding the biological sampling for each design, and is the equivalent of Table 1C "Sampling intensity" but is specific to the commercial catch sampling designs in Tables 4. Table 4f gives an overview of the expected sampling outcomes, in terms of numbers of trips sampled by stock, area and metier. Much of this new information in Table 4f can be obtained as output from simulation studies to test sampling designs, such as the ones used in this work-package.

By collating information on proposed commercial catch sampling designs in the same place, and by including additional information on expected outcomes of the schemes, this proposed new table structure will aid clarity and understanding, and will thus improve evaluations of such plans.

3.1.2 North Sea Demersal Fisheries Case Study

The sampling design proposed for further consideration by NSEA RCG and RCG subgroups is a multi-stage stratified design of on-shore landing locations, in which landing locations are stratified into regionally important ports (major ports) and less important ports (minor ports), before being further separated by sampling administration[4]. . This results in 15 strata, two for each participating sampling

[4] The UK is an EU Member State that made up of four constituent countries. The sampling for these countries is currently independtly organised by three sampling administrations, with the sampling

administration , apart from Sweden, which only has a minor port stratum. Sixty percent of the total regional effort is allocated to the regional sampling design. The regional effort is allocated to the major ports using proportional allocation, in which the effort allocated is proportional to the number of port-days in that stratum. Nominal effort of four port-days is allocated to each of the minor ports strata. The annual work-plan tables for the North Sea case study are available in Annex 3.1.2 of this report and at:
https://github.com/ices-tools-dev/FishPi2/tree/master/WP3

The sampling effort by Member State (with the UK split into two sampling administrations) resulting from this design is summarised in Table 3.1.2.1. The sampling effort overall remains approximately the same, with 60% effort from each Member State involved being allocated to a regional sampling design, and 40% being retained for national use. Although there is a substantial effect on the effort of some Member States, overall it brings the sampling effort more in line with the Member States' relative contributions to the fisheries.

Table 3.1.2.1 Sampling effort by Member State (UK split into two sampling administrations) – current effort and with the proposed design, potential change in effort and indicative changes in cost (see section 3.5 for estimation of costs). For code key see: Glossary, Vessel Flag and Landed Codes at the start of this document.

	BEL	DEU	DNK	FRA	GBE	GBS	NLD	SWE	Total
Current total effort (port days)	0	0	112	80	180	117	120	102	711
Proposed regional effort	25	6	109	114	15	76	82	4	431
40% current effort (port days)	0	0	45	32	72	47	48	41	284
Proposed total effort (port days)	25	6	154	146	87	123	130	45	715
Change in effort (port days)	25	6	42	66	-93	5	10	57	4
Change in effort (%)			37%	83%	-52%	5%	8%	-56%	1%
Change in cost (%)			37%	83%	-52%	5%	8%	-56%	15%

3.1.3 Iberian Case Study

The sampling design proposed for further consideration by NA RCG and RCG subgroups is a multi-stage stratified design of on-shore landing locations, in which landing locations are stratified into regionally important ports (major ports) and less important ports (minor ports). Here major ports included the 22 ports accounting for both 90% of the landings and 90% of the total fishing trips. Eighty

designs being compiled into a single work plan for the UK. These sampling administrations are Northern Ireland, England & Wales and Scotland, however for the purposes of the North Sea case study, only Scotland and England are relevant. Because the sampling designs for these constituent UK countries are organised independently, the North Sea case study considers them as separate entities. For the avoidance of confusions, the word sampling admininstrations is used to indicate the EU Member States and the two UK constitutent countries which independently organise sampling of North Sea fisheries.

percent of the total regional effort is allocated to the regional sampling design. The regional effort is allocated to the two port strata using proportional allocation, in which the effort allocated is proportional to the number of port-days in that stratum.

3.2 Repository of Tools

Deliverable 3.2 is a repository containing the tools required in the process of designing the regional sampling plan such as the ones described in deliverable 3.1. The repository can be found at: https://github.com/ices-tools-dev/FishPi2/tree/master/WP2

It includes:

3.2.a Data sharing

Deliverable 3.2.a is the data sharing agreement drawn up by the University of St Andrews and signed by the signatories of each institute prior to the data request in March 2018. The agreement ensures secure storage of the data on a password protected limited access area on the project SharePoint, and limit the duration of the storage and the use and publication of the data.
The data request, including data format and code lists, for the logbook and sales note data, was circulated in March 2018, whilst the request for biological data was circulated in July 2018. The data requests and formats were standardised to cover the requirements of both case studies, taking into account lessons learnt from the previous fishPi project.

The data sharing agreement and data requests are available in Annex 3.2 of this report and at: https://github.com/ices-tools-dev/FishPi2/tree/master/WP3

3.2.b Guidelines

Deliverable 3.2.b is a document describing the principles of the implementation of a sampling design. This is available in Annex 3.3 of this report and at: https://github.com/ices-tools-dev/FishPi2/tree/master/WP3

3.2.c fishPiCodes package

Deliverable 3.2.c is the fishPiCodes R-package, which includes look up tables for: species, including FAO and WoRMS codes; UN location codes; ICES areas and rectangles, metier codes accepted by the RDB; ICES stock codes, defined by FAO species codes and ICES area codes; vessel types and gear codes, as used in EU-MAP. It also includes two functions which act on the look-up tables: whatFish, which given an English name, scientific name or species codes, will return the full information for that species; and getStock, which returns the ICES stock code (if one exists) for the species and area combinations within the dataset.

The fishPiCodes package is available at:
https://github.com/ices-tools-dev/FishPi2/tree/master/WP3

3.2.d Simulation study

Deliverable 3.2.d is a simulation study including both logbook and biological elements. This includes:

- A report for each case study:
    a) North Sea demersal fisheries
    b) Iberian demersal trawlers
    c) Biological data

These are summarised in sections 3.3.1 to 3.3.3 of the present document and are available in Annexes 3.4, 3.5 and 3.6 respectively of this report and at:
https://github.com/ices-tools-dev/FishPi2/tree/master/WP3

An R-package and scripts containing relevant functions and documentation for checking and compiling the data described in the data call in deliverable 3.2.a, and carrying out the simulation study. These are available at: https://github.com/ices-tools-dev/FishPi2/tree/master/WP3

3.2.e Effort allocation rules

Deliverable 3.2.e is a brief text outlining proposed rules for the allocation of effort across regional strata. This is included as section 3.4 of this document and is also available at:
https://github.com/ices-tools-dev/FishPi2/tree/master/WP3

3.2.f Cost Implications

Deliverable 3.2.f is a brief text outlining possible cost implications if the regional sampling plan was introduced. It is included as section 3.5 and is also available at:
https://github.com/ices-tools-dev/FishPi2/tree/master/WP3

3.2.g Moving from a national to a regional scheme

Deliverable 3.2.g is an outline text of the necessary steps and stages to be considered in moving from a national to a regional sampling scheme. This is included as section 3.7 and is also available at: https://github.com/ices-tools-dev/FishPi2/tree/master/WP3

3.2.h Regional data storage and estimation

Deliverable 3.2.h is a brief text outlining possible regional data storage systems and estimation approaches is included as section 3.8 and is also available at:
https://github.com/ices-tools-dev/FishPi2/tree/master/WP3

3.2.i Agreed protocols

Deliverable 3.2.i is a brief text outlining either agreed regional protocols or issues to be addressed to agree regional protocols for the collection of data on catches and biological variables. This is included in section 3.9 and is also available at:
https://github.com/ices-tools-dev/FishPi2/tree/master/WP3

3.2.j Establishment of future regional sampling designs

Deliverable 3.2.j is a brief text outlining rules and recommendations to be used as reference in the establishment of future regional sampling plans. This is summarised in section 3.10 and is available at: https://github.com/ices-tools-dev/FishPi2/tree/master/WP3

3.3 Simulation Studies

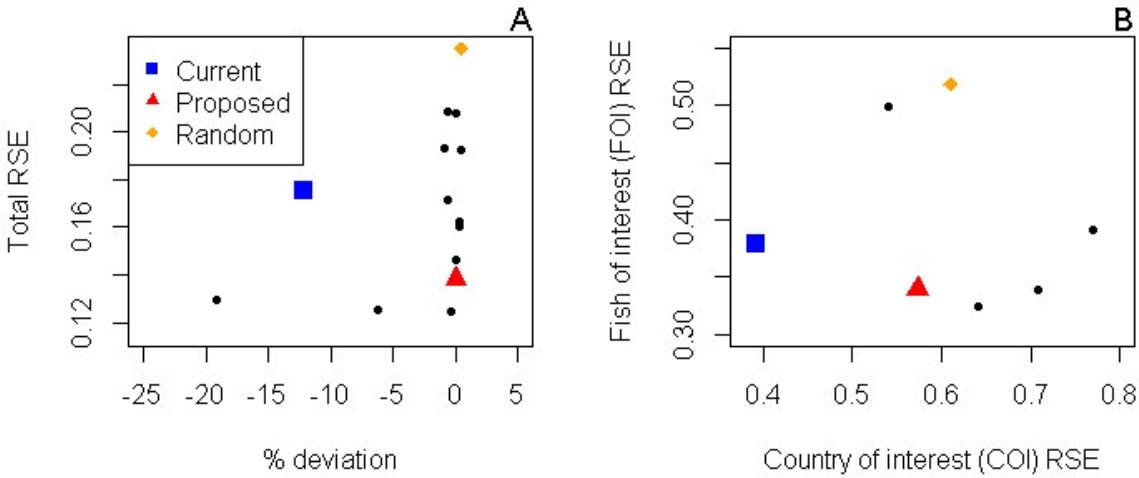
3.3.1 North Sea Case Study

The North Sea case study used computer simulations to test different regional sampling designs for the on-shore sampling by eight sampling Member States, of demersal landings from fisheries in the ICES Subarea 4 and Divisions 3a and 7d (referred to hereafter as the "wider North Sea"). Different sampling designs scenarios were tested using simulated sampling of a dataset of reported landings (compiled from logbook and sales notes) to estimate total landed weight by species. The designs were then compared using summary statistics such as sampling frame coverage, sample size, and bias and variability of the estimates. The tests mainly focussed on comparing different stratification of the on-shore locations and allocation of sampling effort to those strata. Due to the large number of comparisons required, comparisons were carried out using graphical methods, such as those used in Figure 3.3.1.1. The total sampling effort by each Member State was compiled and re-distributed across the design strata using different effort allocation methods.

Regional sampling effort

The current total sampling effort by each sampling Member State for each area within the region, in terms of visits to ports on different days is 711 (Table 3.1.2.1). A regional sampling design has the ability to reallocate sampling effort from one Member State to another. However, individual Member States may wish to maintain some autonomy over their sampling schemes in order to focus on certain issues of national, rather than regional, importance. Therefore we propose to take 60% of the total regional sampling effort in the regional design (430 port-days) leaving the remainder for national allocation. Simulation results showed that, for a simple random sampling design, where all species on a trip are sampled, variability of estimates does not substantially reduce when sample size increases beyond 400 or 500 port-days.

Figure 3.3.1.1 Graphical method for regional sampling design selection, showing the expected A) percent deviation and total relative standard error (RSE), and B) the RSE of estimates of the fish species of interest (FOI) and the countries of interest (COI) resulting from simulations of the current (blue square), proposed (red triangle), random (orange diamond) and other tested design scenarios (black dots). To select the best performing on-shore sample design, summary statistics generated from each simulated scenario were plotted to assess the relative effect on the bias and precision of results. Departure from zero in percent deviation indicates bias, while higher RSE values indicate greater variation in estimated values.



Stratification & effort allocation

Stratification, whether by regional port type (regionally important (major ports) or minor ports), sampling administration or area, or a combination of the three, improves the efficiency of the sampling design compared to both simple random sample and the current design. Of these, stratification by regional port type and sampling administration , with the total regional effort allocated to these strata proportionally by total number of port-days, proved to be both unbiased and, overall, the most efficient, with low relative standard errors of estimates compared to other designs. In addition, effort allocation by sampling administration Member State simplifies the logistics of a regional sampling design and increases autonomy for the participating Member States.

Proposed design

Thus the chosen regional sampling design to take forward for further consideration is of stratification by port-type and sampling administration , with proportional effort allocation of 60% of the total regional effort. This clearly has some repercussions in terms of substantial changes to on-shore sampling effort for several Member States (Table 3.1.2.1), and this is discussed in more detail in Sections 3.4, 3.5 and 3.6.

3.3.2 Iberian Case Study

The aim of the fishPi^2 Iberian case study was to design a regional on-shore sampling plan for landings of the Iberian trawl fleet. The Iberian trawl fishery is a good candidate for regional sampling as it is a multi-specific fishery with catches of targeted stocks shared (in relevant proportions) by more than one Member State.

A simulation study, using real data (logbook and sales notes for 2015-2016) principally from Portugal and Spain, was used to select the most efficient sampling plan by assessing the bias and precision of results, as well as the cost and feasibility. The simulation considered all species simultaneously, but the analysis of simulation results focused on nine species or group of species that are of major interest.

In the case study, we compared alternative designs for on-shore sampling of landings of the Iberian trawl fleet. One scenario simulated the current sampling schemes, which was used as the baseline. Various scenarios were used to evaluate the effects of different stratification, coverage of ports/trips, and sampling effort. The different stratifications considered were: no stratification; by Member State; by institute; by major ports; by major and minor ports (with different thresholds of separation of major and minor ports: 80%, 85% or 90% of landings, trips, and both combined). These scenarios were then compared with and without sampling of foreign landings, as well as applying current total sampling effort or a reduced percentage of that effort.

A work flow was developed in which scenarios were compared in a sequential manner with each step selecting a subset of scenarios to be passed to the next step. The comparison was first based on statistical metrics, then cost and feasibility/suitability issues:

- Statistical metrics: bias, precision and overall deviation.
- Cost: each scenario has an associated cost defined by the port-specific cost per primary sampling unit and by the port-specific sampling effort.
- Feasibility: such as the risk of having zero samples when visiting a port, and other logistic and accessibility issues.
- Suitability: checking that all relevant ports have samples assigned.

The first steps (1,2) compared designs that differed in stratification and the following steps (3,4) considered differences in sampling effort as well (Figure 3.3.2.1).

The first step compared the effect of different scenarios on bias and precision of estimated landed weight of the main species of interest landed by this fleet, and the second step compared the effect on the species overall deviation. Subsequently, the third step compared each scenario of full effort with its counterpart scenario of reduced effort (80%) and since in all cases there was no relevant deterioration of bias and precision scenarios were compared in terms of costs. In the final fourth step we considered feasibility and suitability issues and selected two scenarios among the five scenarios of reduced effort with lower cost.

During the process of comparing several scenarios, it became evident that there was a trade-off between bias and precision of estimated landed weight among scenarios (step 1 & 2). Bias and precision from current scenario were better than in many of the alternative simulated scenarios tested. Only scenarios which improved these two metrics were selected. However, there was no way to evaluate the meaning of differences in absolute bias and precision values.

Although there were no large differences in cost between statistically selected scenarios, some scenarios (that included sampling of minor ports) involve higher workload and would likely incur spending on unsuccessful sampling events. We found insufficient statistical advantage in sampling the minor ports to justify the increased costs.

The case study identified the two scenarios (S35 and S55) which best improved bias and precision and reduced effort and cost in comparison with current sampling. In both of these scenarios, stratification was defined by major ports (with a threshold of 90% of landings and trips) with 80% of sampling effort, with the difference between the two being that S35 included sampling of foreign landings and S55 did not.

In the selection process, there were some feasibility and suitability issues that should be taken into account that could not be adequately addressed by any of the proposed scenarios. For example, the lack of sampling of Portuguese ports with landings of crustaceans was an issue that applied to all scenarios, and would need to be circumvented by assigning an additional number of samples to these ports. The feasibility issues derived from accessing new ports not currently sampled would also need to be further assessed.

It is important to highlight that the present case study is a simulation study using effects on landed weight as a proxy for the effect on actual parameters of interest (length/age distribution). Therefore, before any implementation of a regional sampling scheme (such as the final scenarios selected here) it is necessary to perform a pilot study simultaneously with the current national schemes to assess/compare the effects on length and age distributions. Before implementing such a pilot study it is necessary to consider the cost implications especially if the pilot study is to be implemented in the current EU-MAP where such a pilot study was not planned and budgeted. To make an efficient use of resources, data (PSUs) from the national sampling schemes will be used simultaneously for the pilot study, and only additional sampling PSUs needed specifically for the pilot will bring additional costs.

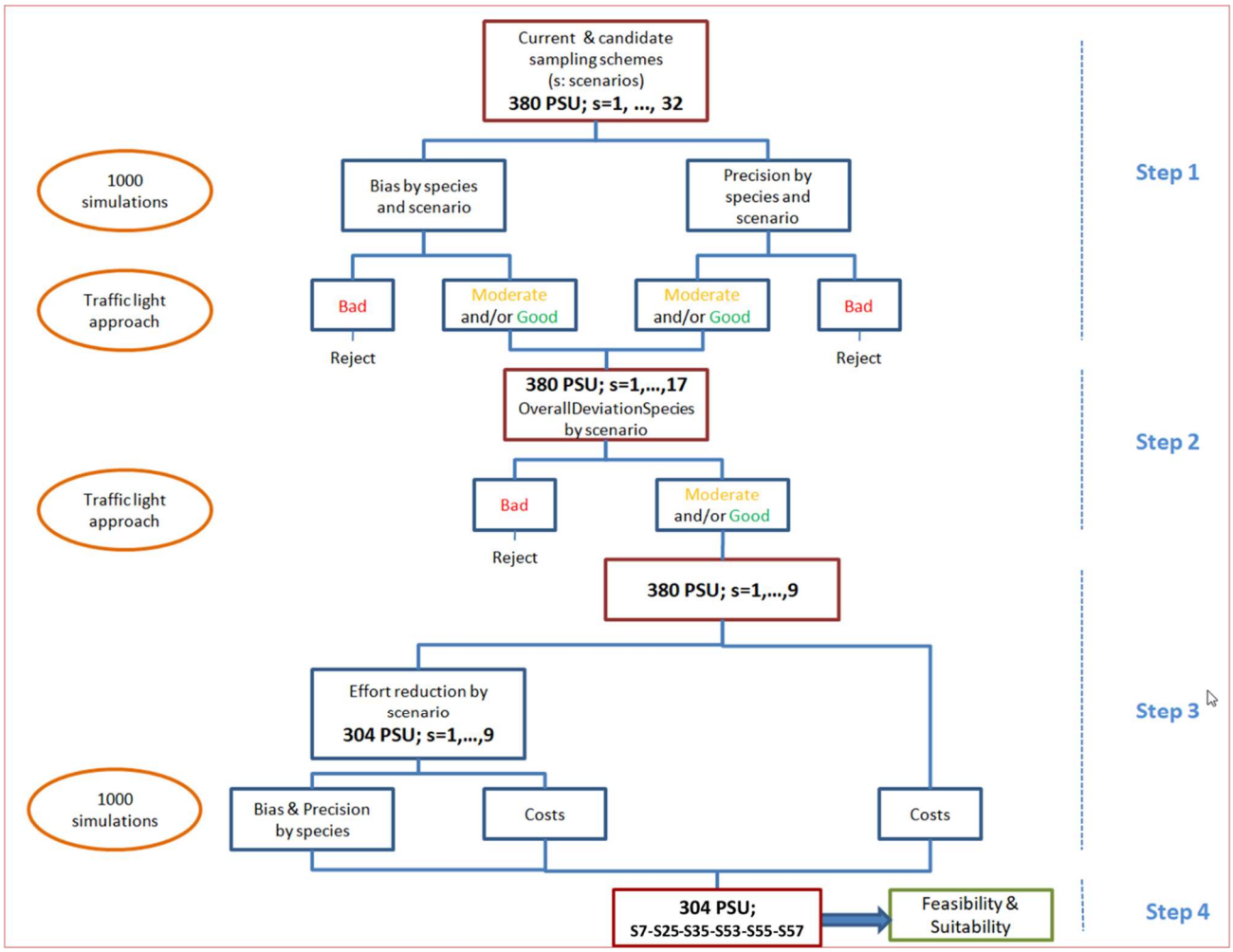


Figure 3.3.2.1 A schematic diagram of the workflow to compare scenarios in a sequential manner.

A main output of this study is the methodology developed for the simulation testing and comparison of sampling designs, which provides a framework for designing a sampling regional sampling plan that takes into consideration multiple aspects: statistical quality of the data obtained, cost as well as feasibility and suitability issues. The framework was developed for the case study of the Iberian trawl fisheries but can be applied to other fisheries and regions.

3.3.3 Biological Case Study

The biological case study considered length data, raised to trip level, within the areas of interest, for a selection of species. Data were provided for both case studies, but only the North Sea data were analysed and reported on. For the North Sea case study, the species chosen were cod, plaice and grey gurnard, i.e. covering two commercially important and one less common species. Functions very similar to the ones in the R-package developed in WP2 were used to explore, describe and select a suitable case study. These outputs are presented in annex of the simulations.

A simulation framework, similar to the simulation framework developed for the logbook data, was used to assess sample sizes by domain of interest, using mean length as the parameter of interest. The results presented in the case study are an illustration of this simulation framework. This

framework was written to work on a species-by-species basis, acknowledging that the original biological dataset is not from concurrent sampling so only positive trips are reported. This is the most common approach currently taken for biological parameters. Un-sampled domains and low sample sizes were found to be the main constraints for simulation studies such as this. Strategies to increase sample size, i.e. options for combining metiers, are discussed in the annex alongside the data exploration. Details can be found in Annex 3.6.

3.4 Effort Allocation Rules

We recommend the use of a stratified design with proportional effort allocation. This is a well-recognised and statistically robust method in which the effort allocated to strata is proportional to the relative number of primary sampling units in each stratum (the size of the stratum), and within each stratum, the sample is a simple random sample. Estimates from stratified samples with proportional allocation almost always have lower variance than a simple random sample. This method is used in the proposed designs for each of the case studies. We do not advocate the use of more complex effort allocation rules such as Neyman's allocation, which allocates more sampling effort to strata with greater variability in the parameter of interest, as we consider that in multi-variate situations such as these, where the parameters of interest are biological, it would be difficult to apply such methods appropriately without experience, and therefore could lead to poorer outcomes than proportional allocation.

3.5 Costs

In each of the case studies, an indicative relative cost of the current scheme and the proposed scheme were calculated.

In the North Sea Case Study, the costs of the proposed scheme were estimated with a broad brush approach using a mean cost of sampling per port-day for each institute involved, and the costs of the two schemes compared. For Member States that do not currently carry out on-shore sampling, indicative costs per port-day were calculated as the mean of the port-day costs of the sampling sampling administration. These indicative costs were used to calculate an approximate cost of on-shore sampling for these Member States if they were to commence on-shore sampling in accordance with the proposed design. Hence the indicative total cost of the proposed scheme includes all Member States in the design. The total sampling effort remains approximately constant between the two schemes, however the reallocation of effort between Member States increases the overall cost compared to the current scheme by 15% (Table 3.1.2.1). Furthermore, the cost to each Member State differs substantially for most of them, with two sampling administration potentially losing around 50% of effort, and 2 Member States potentially increasing effort by a similar amount.

In the Iberian Case Study, port-specific costs were calculated and used to calculate the costs for each proposed design. As the proposed designs have reduced effort (80%) compared to the current design, the relative costs of these are reduced compared to the current design. However, the increased costs of sampling ports not previously sampled resulted in 87% of current overall costs for the design which

sampled national and foreign vessels and 85% of current overall costs for the design which only samples landings of national vessels.

3.6 Considerations

In these simulations, regional designs that reallocate the current national sampling effort according to a regional stratification into major and minor ports perform better than a design replicating the status-quo, in terms of increased efficiency and better estimates. This is compelling evidence to take these designs forward. However, there are still several practical and pragmatic issues to take into account before these designs can be implemented in practice, and these can be considered within the framework of the RCG subgroup on Regional Sampling Designs.

Firstly, the reallocation of effort, whilst maintaining the sampling effort overall, can have a substantial effect on the sampling plans for some Member States. This is the case for the North Sea Case Study, where the ratio of sampling effort to landings, which have been set nationally according to national interests, varies considerably across Member States. The regional design allocates the sampling effort consistently across sampling administrations , which results in a robustly defensible and more efficient design, but potentially at the cost of national interests. At the same time, there are practical issues to be resolved, for example, the commitment to a Multi-Annual Work Plan, and institutional budgets and staffing issues related to changes in sampling requirements, can slow movement towards changes in design. Furthermore, some Member States do not currently carry out on-shore sampling for logistical reasons, and so the effect of using at-sea designs for sampling landings from these Member States need to be considered before on-shore designs are introduced in these Member States. In general, at-sea samples are more costly than on-shore samples and so if increased sampling effort is required, on-shore sampling is likely to be most cost-effective. Finally, the re-allocation of effort has been considered between EU Member States, and will improve the efficiency of the sampling design for the EU Member States. However, in the North Sea, other non-EU countries have substantial fisheries and these should also be considered in a truly regional sampling design.

Secondly, the inclusion of all ports in the sampling frame will, in practice, cause logistical and efficiency issues, since many of the minor ports having landings on only a few days of the year. The pragmatic approach is not to sample these ports, as currently occurs in most national sampling designs, which tend to focus on nationally important ports. However, this could result in a sector of the population not being sampled at all and, as these simulations highlight, this could potentially cause bias if the landings of the unsampled ports are biologically different to those in the sampled ports. Careful consideration of all these issues is required when deciding on the best approach to be taken forward. Pilot studies, as proposed by the Iberian case study, can test out the feasibility of including previously unsampled ports in a new sampling design.

Thirdly, although fishPi^2 has started to address the issues related to biological sampling, it was difficult to develop this work in depth in the short time available within the project, and the decisions regarding sampling designs are driven by the results of the simulation study based on reported landings. Whilst there is a clear correlation between landed weight and numbers of fish, there are

limitations to the use of proxy variables and restricted datasets. Although the principles and code have been set up for the biological simulation studies, more species need to be considered to demonstrate that the regional sampling design will produce estimates at least as robust as those currently available.

Fourthly, the designs implemented in both case-studies involved sampling all species from a landing (so-called concurrent sampling). Whilst concurrent sampling is carried out in practice in Iberian Member States, in those surrounding the North Sea, it is generally found that it is not possible to sample all species landed. Some Member States (e.g. UK-Scotland) have implemented random species selection methods, whilst others implement species specific sampling. The simulation studies should include species selection within the sampling designs, but this has not yet been implemented as part of the code.

In conclusion, although the rationale for employing regional sampling schemes for regional fisheries is compelling, for a Member State to make substantial changes to their sampling design, they need solid evidence that the proposed changes will indeed result in improved estimates for the regional stocks, without their national estimates being too adversely affected. This requires careful scrutiny of the detailed results of the simulations and the effect on national sampling designs and estimates, and this process is expanded on in Section 3.7. By necessity, comparison of designs has involved comparison of broad summary statistics for each design. However, the implications for each Member State can be assessed using more detailed outputs. In addition, the feasibility of implementation of the proposed design, for example introducing previously unsampled ports, has to be assessed. The acceptance stage of the process is still evolving and is likely to involve trade-offs between pragmatic solutions and statistical ideals. In addition, whilst the replication of the upper levels of the sampling hierarchy have now been well-tested, the simulation testing now needs to replicate the estimation of biological parameters in more depth, and for more species, than has been included in fishPi^2. To this aim, generalised code has been developed, which is now freely available as part of the deliverables of fishPi^2, and so this can be taken forward through the work of the RCG subgroup on regional sampling designs which has access to the full set of regional sampling data.

3.7 Steps and stages

The move from a national to a regional design is likely to be an iterative process as Member States assess the design and identify issues to be addressed. Steps to be considered when moving from a national design to a regional design are as follows:

1) Consideration of proposed on-shore sampling locations (for on-shore designs) or fleets (for at-sea designs), in particular the feasibility of sampling at these locations. Pilot trials of sampling at these locations should be considered. Feedback agreement or concerns.
2) Consideration and acceptance of proposed sampling effort. Consideration as to whether national effort is required in addition to regional design. (This is particularly relevant if the regional design requires a substantial increase in effort.) Feedback agreement or concerns.
3) Consideration of regional protocols. Feedback agreement or concerns.

4) Adaptation and resubmission of annual work-plan and proposed budget. This could delay implementation of a regional design if multi-annual plans and budgets are already agreed.
5) Possible recruitment or re-assignment of sampling staff if effort allocation has considerably changed. This is likely to take time and could delay implementation of a regional design.

Once the above issues have been agreed between Member States, the regional design is ready to be implemented. It should be noted however, that aspects of the regional design can be implemented by individual Member States as progress is made, for example, changes in sampling effort, including new locations, altering sampling frequency at some locations etc.

It was not possible to follow all of these steps within the timescales of the fishPi^2 project, and in general it was considered that this process should be taken forward within RCGs and RCG subgroups on regional sampling designs.

3.8 Regional data storage and estimation

A new system for regional data storage, RDBES: Regional DataBase and Estimation System (https://github.com/ices-tools-dev/RDBES/) is in the process of development by a core group of members of the EU and ICES catch sampling community, in close consultation with the wider sampling community. It is being developed to provide the requirements for data storage of the developing statistically sound catch sampling schemes within the EU & ICES fishPi^2 recommends that the estimation methods should take into account the sampling design and the use of the widely accepted Horvitz-Thompson estimators which were used in this simulation study. The RDBES intends to implement these methods through the use of open-source R code, developed by members of the EU & ICES catch sampling community.

In summary, RDBES will fulfil the requirements of statistically sound catch sampling and estimation proposed here, and thus RDBES is the data storage and estimation system recommended by fishPi^2.

3.9 Agreed protocols

Protocols were compared between Member States for each stage of the sampling. Currently the port-days to be sampled tend to be assigned on an *ad-hoc* basis and it is clear that a protocol to randomly assign port-days needs to be agreed. In addition, the attempted sampling of designated port-days which have no landings or market could make sampling at the less busy ports quite inefficient, and a protocol for this eventuality needs to be determined. Most Member States currently carry out random selection of vessels at the market, mainly through vessel selection forms that are filled in on the market. Denmark samples size categories rather than vessels because of the way the fish market is laid out, and this needs to be accounted for in the protocol. The Iberian Member States practise concurrent sampling, whilst in the North Sea, two Member States employ species selection forms, and several do not. Finally, only one Member State employs random selection of boxes of fish within size categories, the rest leaving the decision to the samplers. Although the sample selection methods do not necessarily need to be aligned across Member States within a sampling scheme, protocols do

need to be agreed so that they can be taken account of at both the simulation testing and eventual data analysis and estimation stage.

3.10 Steps in the development of a regional sampling design

Deliverable 3.2.a, "Principles in the Implementation of a sampling design", explains the principles and aspects to consider in the development and implementation of a regional sampling design. These include the definition of the study population and associated sampling frame, the purpose of the data collection and the information to be collected, the sampling design, including hierarchy, stratification and effort allocation, protocols, non-response and refusal rates, data storage, and estimation.

Deliverable 3.2.j provides step-by-step guidelines to develop a regional sampling design using simulation models to explore different alternatives. These include the definition of the study population, collection of data, data cleaning, fisheries description, choice of scenarios, and interpretation of results. Details can be found in Annex 3.7.

Both documents can be found at:
https://github.com/ices-tools-dev/FishPi2/tree/master/WP3

3.11 Recommendations

fishPi^2 recommends that:

- Fisheries sampling schemes, both regional and national, should follow statistical principles of randomised sample selection and associated estimation methods that take the sampling design into account. (See Deliverable 3.2.b for more details.)
- Proportional effort allocation should be used for a regionally stratified design to improve efficiency. (See previous section 3.4 of this document for more details.)
- A regional sampling design should be tested before implementation through simulation studies such as those presented here, using code provided by fishPi^2 (Deliverables 2.2, 3.2.c and 3.2.d).These simulation studies are likely to involve the sharing of landings data, and will therefore need a data sharing agreement of the type used in this study, data call and an agreed set of code-list, such as those available in fishPiCodes. The study should apply an objective method of selecting designs based on summary statistics as described in Deliverable 3.2.j.
- Sampling Member States should work closely together to agree a regional design, considering feasibility and scrutinising proposed changes to ports sampled. A pilot study should be considered to test the feasibility of new sampling locations prior to implementation of a regional sampling design.

Work Package 4 - Regional sampling plan for 2019 covering the collection of data on fisheries impacts on the ecosystem.

4.0 Specific areas of regional cooperation, additional requirements and possible trade-offs

Ecosystem components and species for which information would be particularly important to obtain, a complete overview of available data for bycatch of Protected, Endangered and Threatened Species (PETS) and detailed methods to identify priority species (both PETS and fish predators) has been collected (Deliverable 4.1, Annex 4.1).

The work towards identifying which type of data to collect for different multispecies models concluded that the data types needed were broadly the same for the models capable of producing natural mortalities or growth estimates for stock assessment: Information on length, stanza and/or age of prey for all stocks, proportion of the prey of interest in the diet of major predators and the biomass of the given prey and predator. To improve knowledge on prey mortality, priority should be given to sampling diets and populations of predators which have a high potential impact on total mortality of the stock. To improve knowledge on prey dependent predator growth, priority should be given to prey which make up a large proportion of the food in at least some life stages and has demonstrated links to growth. Priority can also be given to prey and predator species where the interaction is high in only part of time series or only in some years. The methods were applied to six different ecosystems producing a list of priority species for cost estimation. The likely effects of high priority predators on prey natural mortality are given for the Baltic Sea, Bay of Biscay, Irish Sea, Kattegat and the North Sea including Skagerrak, encompassing a total of 26 predatory species affecting 22 prey species. The likely effects of prey on high priority predator growth are given for the Celtic Sea, Eastern English Channel and the North Sea for a total of 10 predatory species affected by seven commercially exploited prey species. Further details are given in Annex 4.1.

On by-catch of protected, endangered or threatened species, a table was completed to provide an overview of the information available. A total of 74 case studies by Germany, Greece, Iceland, Ireland, Netherlands, Spain, Sweden and the UK were included in the table, covering six types of case study (e.g. pilot study, habitat directive study). Several methods to assess risk of protected species bycatch, including risk maps or risk analyses, were considered (Annex 4.1), all of which require three key types of information: fishing effort, bycatch per unit of fishing effort and population abundance. The approach adopted by the ICES Working Group on Bycatch of Protected Species (WGBYC). This addresses the management question: “given current knowledge, where <u>might</u> the greatest number of bycaught animals be found, and is this number <u>likely</u> to exceed some reference level”. In selected cases, observed bycatch rates are available for key species from dedicated surveys (see table in Annex 4.1). However, where bycatch rate estimates are absent or limited, inferences can be made either by expert judgement, by assuming the rates are similar to those found elsewhere, or by using an estimate of density as a proxy for relative bycatch rate. For example, by assuming that bycatch rates

are twice as high in areas where animal density is twice as high. This can be used to identify cases where pilot studies are specifically needed to confirm or reject the suspected level of risk.
This method is continued in WGBYC, which under fishPi[2] has expanded the evaluation to cover the Baltic Sea. As an example, risk factors above 50 were used to rank the top 5 risk gear types. Note that this method identifies gear types posing a risk to several species group but does not identify where one gear is a major threat to a single species. From the analysis, set longlines, bottom otter trawl, trammel net and set gillnet seem to pose the greatest risk in ascending order. Set longlines, pots and traps, fyke nets, multi-rig otter trawl, bottom pair trawl, midwater otter trawl, pelagic pair trawl, hand and pole lines and purse-seine were all in the top five risk gears in at least one area.
.
The list of species to be recorded as PETS was discussed. The potential list includes all species of reptiles, mammals and seabirds as these are listed in either in the Habitat or Bird Directives. However, the case is less clear for fish. The directives tend to list diadromous species which have decreased as their freshwater habitat was impacted, and therefore do not provide a good overview of species sensitive to marine fishing. Lists of species considered sensitive to marine fishing are available from the literature for the North Sea (Greenstreet et al. 2012) and from subsequent work in ICES Working group on ecosystem effects of fishing (WGECO), which continues to work on identifying sensitive fish species throughout the EU waters. It was agreed to suggest that ICES attempts to coordinate and prioritise species on these lists as input to RCGs which can then coordinate sampling accordingly.

The most reliable approach to estimating total bycatch relative to population size require three steps: An estimate of fishing effort by metier, if possible adjusted to reflect changes in gear dimensions, an estimate of bycatch rate by metier and an estimate of population abundance. It is not possible with the current level of knowledge to conclude that specific not yet sampled metier do not pose a risk to PETS. However, it is possible to use current information to identify metiers which are very likely to pose a risk. To allow regional estimates of bycatch relative to population abundance and a fully statistical based method for scaling results from observations to populations, data collection must be harmonised and data on bycatch of protected species collected and stored in commonly agreed and understood formats. The subsequent tasks address these requirements.

4.1 Methodologies/collection protocols

4.1.1 Stomach contents sampling

An updated manual with best practices in stomach contents sampling based on the 'Manual for ICES Stomach sampling projects in the North Sea and Baltic Sea' (ICES, 2010) was produced (Annex 4.2.1). The protocol has been used in a trial sampling on the 2018 International Ecosystem Summer Survey in the North Seas for mackerel. To facilitate work on board the survey vessels, it is recommended to take stomach samples from fish already sampled for otoliths etc. up to the limit given in the manual. Species can be sampled in different years in a rolling scheme, ensuring that at least one species for which biological samples are taken (e.g. maturity and/or otoliths) and one species for which this is not the case (and which hence provides a greater increase in work load) is sampled every year and that a maximum of five years passes between the sampling of any one species.

The potential use of modern meta-genomic techniques to identify stomach contents to species was also investigated (Annex 4.2.1). This has the potential to drastically reduce the analysis costs, but currently works on a presence/absence basis only.

4.1.2 Spatial distribution of demersal fish

Spatial distribution of demersal fish is sampled by demersal bottom and beam trawl surveys. However, some (pelagic) fish species are not well sampled by these gear types. Among the most important poorly sampled predator species are mackerel and horse mackerel and for prey species, sandeel and coastal sprat. An overview of the surveys available for mackerel and horsemackerel has been produced and used as a basis for estimating distribution of these species (Annex 4.2.2). Sandeel are monitored by dedicated trawl (Shetland), dredge (North Sea) or acoustic (Norwegian waters) surveys, commercial catches or catch rates, delivery rates of seabirds to chicks and presence/absence in International Bottom Trawl Surveys (IBTS) trawl surveys. The dedicated surveys provide the most precise estimates at a substantially higher cost.

4.1.3 PETS

An appropriate format for recording bycatch of especially large PETS (mammals and sharks) was discussed in the recent RCG meetings. It was suggested that observers should note down how large a fraction of the hauling process was observed and animals observed before the sorting area should be recorded as slipping (lost before the gear is on deck) or hauling (discarded from deck). It is not yet clear if the observers find it possible to estimate the fraction of the haul observed. The experience from pilot studies shows that the bycatch of large fish and mammals is discarded before entering the sorting area, and hence observing in the sorting area should not be recorded as having sampled these species. It was considered and advantage if live escapes are noted.

It is recommended that the observer brings a camera to take photos when the observer perceives a risk of potential misidentification (and always for birds). If more than 20 specimens of in any of the groups mammals, seabirds and elasmobranchs are recorded, subsampling can be used if scaling factors are noted (preferably an estimate of the total number caught). Note that many mammal and seabirds species occur in groups or families, and in this case, the total hauls should not be scaled up assuming the same catch rates in e.g. all of the haul time.

Possible observation methods discussed included piggybacking on discard observers, dedicated observers, interviews, self-sampling, strandings, camera and Remote Electronic Monitoring (REM). Among these, interviews, self-sampling and unverified reports from e-log were not considered sufficiently accurate to estimate number caught, but can potentially be used to identify high risk fisheries which can then be selected for pilot studies. Strandings can potentially be used to distribute mortality to sources for large (mammal) species, but are not appropriate for estimating total number bycaught. The remaining methods were selected for production of a draft sampling manual (Annex 4.2.3).

4.1.4 Allocating tasks to Member States for the collection and analysis of these data

The allocation of tasks to Member States (MS) for the collection of stomach data could follow the allocation of tasks for the specific surveys to be used (bottom trawl, beam trawl, pelagic trawl etc). However, the analysis of stomachs collected on surveys requires substantial expertise, and it would be preferable to allocate the analysis of all stomachs of a specific species to one MS, while costs can still be allocated to a range of Member States or MS. The cost associated with the analysis could follow the Total Allowable Catch (TAC) distribution of the particular species. After entering all data in the common format into the ICES stomach data base, the cost of the analyses of data can be shared in the same way.

The principles behind the distribution of sampling tasks for PETS among MS should ideally mirror the expected risk. This could be obtained by MS following the fishing effort in high risk fisheries, areas and seasons. However, due to lack of data on the actual effort (e.g. soak time and length in gillnet fisheries), landings of fish (total across all species targeted in gillnets) can be used to allocate sampling requirements proportionally.

4.2 Solutions for regional storage systems, data processing, management and raising of data

4.2.1 Stomach data

ICES is already hosting a large database allowing easy access to stomach data. The ICES stomach database provides information on the weight, size and species or species group in stomachs of predators of selected sizes and species. It is recommended that new data collected continue to be stored in the ICES database.

Based on the methods currently used by the ICES Working Group on Multispecies Assessment Methods (WGSAM) to raise stomach data to population level, a roadmap for using stomach data was produced including methods to raise information on consumption, to stock based estimates based on species distribution (See Annex 4.2.4).

A possible timeline for the collection of data and entering of data for the five surveys are:

Bottom trawl surveys in Q1
February: Collect stomachs
August: Completion of stomach analysis and upload of stomach data to ICES data base
September: Data screening and quality assurance completed
October: Update of estimated natural mortalities with data from previous years

Pelagic trawl surveys in Q2
July: Collect stomachs
December: Completion of stomach analysis and upload of stomach data to ICES data base
September: Data screening and quality assurance completed
October: Update of estimated natural mortalities with data from previous years

Bottom trawl and beam trawl surveys in Q3

September: Collect stomachs
February: Completion of stomach analysis and upload of stomach data to ICES data base
September: Data screening and quality assurance completed
October: Update of estimated natural mortalities with data from previous years

Bottom trawl surveys in Q4
November: Collect stomachs
June: Completion of stomach analysis and upload of stomach data to ICES data base
September: Data screening and quality assurance completed
October: Update of estimated natural mortalities with data from previous years

Currently, some trawl data and some acoustic data are stored in the ICES databases. However, surveys such as the pelagic trawl survey for mackerel is not currently available in the public ICES database. This should be a priority for the future.

4.2.2 Spatial distribution

ICES already hosts DATRAS for survey catches. It should be a priority also to include data from the International Ecosystem Summer Surveys in the Nordic Seas (IESSNS) in the DATRAS database. Catches are already available at STECF (https://stecf.jrc.ec.europa.eu/web/stecf/dd/effort/graphs-quarter).

4.2.3 PETS

WGBYC produced scaled up bycatch estimates where the data are sufficient to do so. It is suggested that the protocols to do this are revised as more data become available in a standardized format as the method used to upscale data from observers to fleet level would be strengthened by analyses of additional data from several fleets/areas/Member States. A first step towards performing these analyses is a wider collection of data combined with joint analyses of the data, either based on a joint database or on a joint data format confronted with an agreed analysis.

An estimate of a realistic timeline for inclusion of data in advice is:
Data call: 15 January
Data submission: 15 March
Data validation: 15-31 March
WGBYC assessment: 1-7 April
Possibly inclusion in forecasts of the ICES Working Group on Mixed Fsiheries Advice (WGMIXFISH) or ICES Fisheries overview: after 21 April.

4.3 Evaluation of cost implications

4.3.1 Stomach sampling and spatial distribution

When fish selected for biology (maturity, age etc.) sampling are used for collection of stomach as well, it takes less than a minute to remove the stomach, fill-in the label and bag the stomach with label if all other information on the fish already has been acquired and recorded. When the fish is

used exclusively for stomach sampling, the time spent is accordingly longer because weighing and length measuring of the fish, opening of the body cavity, and basic data recording is needed. The entire procedure may then take up to five minutes per stomach. In total, this corresponds to a maximum number of 1 to 7 minutes per 5 cm group per haul for the combinations of species suggested above to be sampled in a given year (least where one species is sampled which is already investigated for biology, most when three species are sampled of which only two are sampled for biology). Assuming that most predators are in the length range 15-50 cm, this corresponds to 7 to 49 minutes per haul if all species and length groups are caught in the haul (corresponding to 7 length groups sampled for each species). Generally, this will not be the case and hence the time allocation at sea will be less.

The subsequent processing of stomachs in the laboratory is more time consuming. A skilled technician with a good taxonomic knowledge should be able to work up 30–100 stomachs per workday depending on the size of the predator and the stomach content composition. Generally, stomach contents from smaller predator individuals and predators that prey on relatively small prey items (e.g. mackerel) are more time consuming, as are stomachs containing a large proportion of invertebrates. This is because it takes more time to disentangle and identify the different prey. However, the suggested, coarse categorization of invertebrate prey helps to reduce the overall time consumption.

With a sampled number of seven for each species and haul on average, the maximum cost in days of working up all stomachs are given in the table below. Values before and after – denotes the number when sampling 1 and 3 predators, respectively.

Cost in working days				
Number of hauls	Number of stomachs	Number of workdays used to collect stomachs	Number of workdays used to analyse stomachs at 30 stomachs per day	Number of workdays used to compile data
1	7-21	0.02-0.11	0.23-0.70	5-15
100	700-2100	1.6-11	23-70	5-15
200	1400-4200	3.2-22	47-140	5-15
400	2800-8400	6.3-44	93-280	5-15

Depending on the number of predators sampled, the total number of workdays spent as a function of number of hauls in the survey is given in the table below.

Total number of workdays spent		
Number of hauls	1 predator, 30 samples worked up per day	3 predators, 30 samples worked up per day
1	15	16
100	47	96
200	79	177

400	143	339

4.3.2 PETS

The three approaches which use camera surveillance have comparable costs, precision and accuracy for a specific trip. The working days are around a third of that used when observing in a dedicated survey, and the work requires a minimum of education. The cost of these working days is therefore substantially less than that of the working days on board which must include allowance and typically involves more educated staff.

It is very cost efficient to monitor fishing trips by requiring DCF observers to monitor bycatch also of PET species by using a portable camera. Without the use of cameras, DCF observers introduce a bias due to the PETS often not reaching the sorting area and hence, these observers can only provide a minimum estimate of actual bycatch. However, for the bycatch which is observed, observers provide the opportunity to measure and sex the bycaught animals and take other samples as requested. The method can only be based on the coverage of fleets already required in the DCF, and hence the sampling effort for high risk bycatch fleets is likely to be less than that required to monitor bycatch of rare species. A combination of this method with camera based methods not requiring on board observers may therefore be necessary to achieve an acceptable accuracy of bycatch estimates of high risk fleets.

The camera options (portable camera used by observers, portable camera used by fishers, fixed CCTV) differ in the coverage they will provide of the fishery: observers will provide the widest coverage across years whereas the other methods are limited to fewer vessels thereby reducing the coverage of the fleet. Using one or a few vessels minimizes the impact of vessel differences on identification of e.g. seasonal and spatial hot spots for bycatch but increases the impact of vessel differences on the average bycatch at fleet level. It is also possible that the concept of all vessels requiring for example a 10% camera coverage of trips differs in social acceptability from requiring 10% of the vessels to have a 100% camera coverage.

In addition to differences in coverage, the methods differ in the extent to which they have been used to date in pilot projects, and hence the likely accuracy of the cost estimates. Observer costs and costs of CCTV have been estimated based on experience from long term projects, whereas the option to cost-efficiently use portable cameras has just emerged with the decrease in price of these units, and hence there is less knowledge to support the estimates of cost using this method. These methods would benefit from further pilot studies to investigate their long term benefits, challenges and costs more accurately.

On land or on board	Dedicated survey	Additional when piggy bagging on fishery surveys	Portable camera used by fishers First year	Portable camera used by fishers following years	Portable cameras combined with fisheries observers	CCTV/REM First year	CCTV/REM Second to fourth year
On land*	41 days	13 days	1000 euro+102 days on land	500 euro+88 days on land	1000 euro+ 99 days on land	9706 euro+ 98 days on land	1990 euro+ 85 days on land
On board**	300 days	0	0	0	0	0	0
Total 200 trips	**41* days on land + 300** days on board**	**13* days on land**	**1000 euro+102 days on land**	**500 euro+88 days on land**	**1000 euro+ 99* days on land**	**9706 euro+ 98* days on land**	**1990 euro+ 85* days on land**
Total per trip	**0.205* days on land + 1.5** days on board**	**0.065* days on land**	**5 euro+ 0.50 days on land**	**2.5 euro+ 0.44 days on land**	**5 euro+ 0.50* days on land**	**48.5 euro+ 0.49* days on land**	**10.0 euro+ 0.43* days on land**

*work requiring a minimum of education

**working days on board which must include allowance and typically involves more educated staff.

4.4 Lessons learned

Under fishPi[2], a method has been developed to prioritize fish predators according to their relevance for determining species interaction (Annex 4.1). The method developed under fishPi to identify high risk gear types has been applied to Baltic fisheries and the highest risk gear types identified for all regions. Manuals have been developed for sampling stomach data and distributional data as well as methods by which these data should be combined to determine consumption by fish predators as well as manuals for sampling PETS bycatch on board commercial fishing vessels. In both cases, tentative timelines for data delivery and initial sampling levels are provided. It is suggested that there should be an evaluation of the appropriateness of the manuals and sampling levels after five years of sampling.

4.5 Recommendations

Recommendations for immediate actions

- To allow regional estimates of bycatch relative to population abundance and a fully statistical based method for scaling results from observations to populations, data collection must be harmonised and data on bycatch of protected species collected and stored in commonly agreed and understood formats, an effort initiated in the ICES working Group on Bycatch of protected species (WGBYC).
- We recommend commence stomach sampling of the prioritised predator species immediately.
- It should be a priority also to include data from the International Ecosystem Summer Surveys in the Nordic Seas (IESSNS) in the DATRAS database.
- It is suggested that there should be an evaluation of the appropriateness of the manuals and sampling levels for PETS bycatch on board commercial fishing vessels immediately and again after 3-5 years.
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Recommendations for future projects

- Further analyses of bycatch data should be performed to identify the most appropriate sampling level for different fleets
- Methods for observer and CCTV data collection would benefit from further studies to investigate cost efficient methods to analyse video data and based on this, long term benefits, challenges and costs more accurately.
- The information available for some predators and prey combinations was insufficient to recommend full sampling, in particular in areas outside the North Sea. We recommend conducting pilot studies for these predator species to allow further prioritisation of species to sample, in particular outside the North Sea.

Work Package 5 - Small Scale Fisheries and Recreational Fisheries

5.0 Background and context

Small scale fisheries and marine recreational fisheries (SSF and MRF) are an important economic and social activity in many European inshore coastal areas. Despite the differences, these fisheries can be considered analogous in some aspects which may justify similar approaches to data collection and management: both fisheries have low mobility, which makes them dependent on local and regional ecosystems, and both fisheries impacts are principally borne by coastal fish and shellfish resources and habitats.

Catches, effort and geospatial data are therefore dependent on fisheries dependent and fisheries independent sampling if there are no census data, which has traditionally hampered the understanding of these fisheries, and underestimated their impacts. SSF and MRFrequire methodological approaches that are different from the ones commonly used in European Large Scale Fisheries (LSF) due to some specific features such as the use of different gears to target multiple species, and highly variable seasonal distribution of fishing effort, etc.

This report is comprised of two main sections, SSF and MRF, covering different issues related to the data collection of these fisheries, highlighting main outputs but also main recommendations to be considered specially by the Commission and the RCGs.

5.1 Small Scale Fisheries (SSF): Review of current data collection approaches

Preliminary results and several recent projects (Chuenpagdee et al., 2006[5]; Salas et al., 2007[6]; Chuenpagdee Ed., 2011[7], Guyader O. et al., 2013[8]; FAO, 2015) highlight the need to improve SSF knowledge in order to secure their sustainable development. However, SSF appear to be trapped in a vicious cycle where due to the existing data being incomplete and of lower quality, lower

[5]Chuenpagdee, R., Liguori, L., Palomares, M.D., Pauly, D. 2006. Bottom-up, global estimates of small-scale fisheries catches. Fisheries Centre Research Reports. 14(8), 112 (available at http://www.fisheries.ubc.ca/publications/).
[6]Salas, S., Chuenpagdee, R., Seijo, J.C., Charles, A. 2007. Challenges in the assessment and management of small-scale fisheries in Latin America and the Caribbean. Fisheries Research. 87, 5-16.
[7]Chuenpagdee, R. (Ed.) 2011. World Small Scale Fisheries Contemporary Visions, Eburon Academic Publishers, Delft, 400 p.
[8]Guyader Olivier, Berthou Patrick, Koutsikopoulos Constantin, Alban Frederique, Demaneche Sebastien, Gaspar M. B., Eschbaum R., Fahy E., Tully O., Reynal Lionel, Curtil Olivier, Frangoudes Katia, Maynou F. (2013). Small scale fisheries in Europe: A comparative analysis based on a selection of case studies. Fisheries Research, 140, 1-13. Publisher's official version : http://dx.doi.org/10.1016/j.fishres.2012.11.008 , Open Access version : http://archimer.ifremer.fr/doc/00118/22934/

importance is assigned to their characterization and sampling when compared to larger scale fleets (Figure 1).

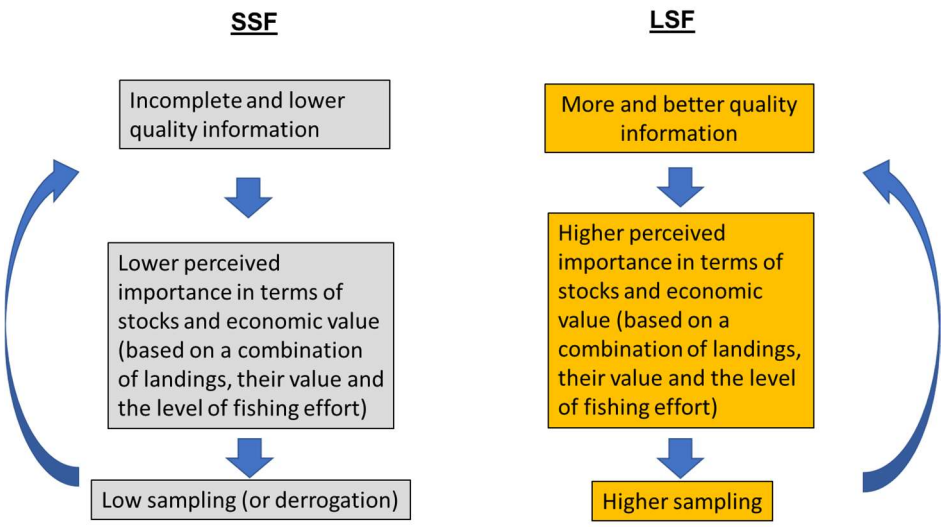


Figure 1. SSF vicious cycle

Under this WP, a review of the current methodologies used by different Member States (MS) and institutes to collect SSF data was made. Alternatives based on new technologies (AIS, mobile Applications, etc.) were also assessed based on available information and considered as potential tools to improve the data collection for these fisheries.

5.1.1 Data collection methodologies

Two different approaches are applied for the collection of fishing activity data in SSF: Census or Sampling. Census approaches based on sales notes could be used but are insufficient as evidence of landing. Census approaches using landing declaration forms should be used, but the accuracy/reliability/completeness of such data has to be assessed. Issues related to sampling approaches are mainly related to the statistical soundness of the sampling design and assessment of accuracy/reliability of self-reported data.

A review of **biological SSF data** collection (on-shore and on-board sampling), showed that it is mainly included in a general (across all vessel size) sampling scheme, but there are some specific issues for SSF linked to safety and space for observers for on-board sampling. These limitations challenge assessment of the overall SSF discard rate and incidental catches of PETS (Protected, Endangered and Threatened Species) even though SSF may have a significant contribution.

The experts involved in this Work Package, created a matrix to evaluate the potential use of different methodologies and approaches, considering the quality of the data obtained and the cost of implementing these methods. The details of this matrix are explained in Annex 5.1 (Supp. Mat 1).

The main objective of this matrix is to provide a useful tool for different RCGs when SSF data collection is discussed. The matrix could provide guidelines for the methodology to be used once the

end user's needs are identified. Depending on the information required, its quality, resolution etc., different alternatives should be considered, taking into account the cost of implementation.

5.1.2 Case studies

Four case studies were considered in which SSF monitoring has been implemented. The case studies were from Portugal (IPMA), France (IFREMER), UK (CEFAS) and Spain (AZTI).

Based on the experience of these institutes, all issues related to the implementation of these programmes were systematically reviewed.

Detailed information of each of the case studies is provided in Annex 5.1. The main outputs of these case studies were:

- All case studies highlighted the need and importance of **calculating good quality estimates** of the **SSF activity variables** (effort, catches etc.)
- The need for an **assessment of the coverage/completeness** and the **quality/reliability representativeness/precision** of the data collected
- **SSF have to be monitored** by census or sampling approaches **adapted to their specific features**
- **Transversal (logbook, sale notes) data** coming from the current Control Regulation (Council Regulation (EC) No 1224/2009 of 20 November 2009) is **not well adapted or insufficient** to analyze SSF
- Lack or **scarce information on other biological variables** (length distributions, discards, PETS bycatch etc.)
- **Considerable differences between official and scientific estimates** (i.e. 2-40 % catch and effort, depending on the species, region, etc.)
- Finally, all case studies highlighted the **difficulties of implementing these programmes** due to the specific characteristics and behavior of SSF.

The **high level of uncertainty** with respect to the collection of relevant data for SFF was highlighted by all case studies.

5.2 New technologies. Progress, challenges, and data gaps: towards standardization of electronic reporting in small scale fisheries in Europe

New technologies offer significant opportunities to improve SSF monitoring and data collection, providing a cost-effective means of collecting highly spatially and temporally resolved data. These data can provide reliable assessments of fishing activity such as measures of fishing effort and distribution. In particular, these technologies can provide detailed information on the spatial footprint of SSF activity which is of increasing importance in informing compliance under the Common Fisheries Policy (Regulation (EU) No 1380/2013) and decision making in Marine Spatial Planning. New technologies also provide a good opportunity to collect catch (landings + discards + PETS) data and effort data for SSF. In some cases, due to the size of many of these vessels and for safety reasons, it could be the only way to collect this information. More generally, new technologies constitute a way to improve SSF data collection. The last EU special report "EU fisheries control: more effort needed" (EU 2017) highlighted the need to improve the data collection of the SSF and their

reliability using these new technologies, due to the weakness in the current reporting systems (paper based catch reports, incomplete sale notes, etc.).
In fishPi^2 a review of different Electronic Recording and Reporting systems (ERS) and Electronic Monitoring (EM) systems for the SSF was undertaken. Manufacturers of systems currently available on the commercial market were interviewed. Fifteen manufacturers were contacted and replied to the request to participate in an online or telephone interview about their systems. A total of 11 consented interviews discussing 15 systems were conducted and included in the analysis.

Fourteen scientists currently using these systems were also interviewed. The interview consisted of questions on the study rationale, specific characteristics of the fleet, fisher's uptake, the spatial distribution of fleets equipped with ERS, how the data acquired could be aligned with data requirements, and a Strength, Weakness, Opportunities, Threats (SWOT) analysis. The details of the results of these interviews are explained in Annex 5.2.

The review identified a number of ERS and EM approaches that could be used to improve SSF data collection, but also identified challenges in relation to: the cost of some systems relative to the value of SSF and income of some fishers; technical limitations dictated by the size and operational characteristics of the vessel and; data handling and analysis of large volumes of data. Taking into account these issues, in fishPi2 proposes a possible approach to follow when considering which devices should be installed. This approach is based on a "Risk Assessment". Gear types used by a given SSF are identified and their possible impacts (e.g. impact on the seabed, bycatch rate, PETS bycatch etc.). Fleets operating in specific areas or fishing grounds could also be identified (e.g. fishing grounds close to MPA or restricted areas etc.). Based on this information, experts could score and rank relative risks against defined objectives. Depending on the risk category, the level of compliance and data needed from the fleet, different devices would be installed. This could for example, range from simple tracking devices to more complex systems capable of detecting gear use and, for the highest risk vessels video equipment.

It would seem likely that for the majority of static gear SSF operating in non-sensitive areas, all that would be required would be track data collected at sufficient resolution to allow fishing activity to be inferred with a high degree of statistical confidence. Recent research indicates that vessel track data alone, collected at an appropriate resolution, can be used to estimate the spatial distribution of fishing activities, fishing intensity and fishing effort. Coupled to verifiable landings declarations these data could provide an effective means of informing compliance, fisheries management and marine spatial planning requirements.

5.3 Standardized workflow for SSF geospatial and catch data

fishPi^2 recommends a workflow (Figure 2) adapted to SSF data and makes a summary of the main issues encountered when working with geospatial and sales notes data in SSF, together with some conclusions and recommendations. Two case studies are presented as examples of the results that can be obtained with this kind of data.

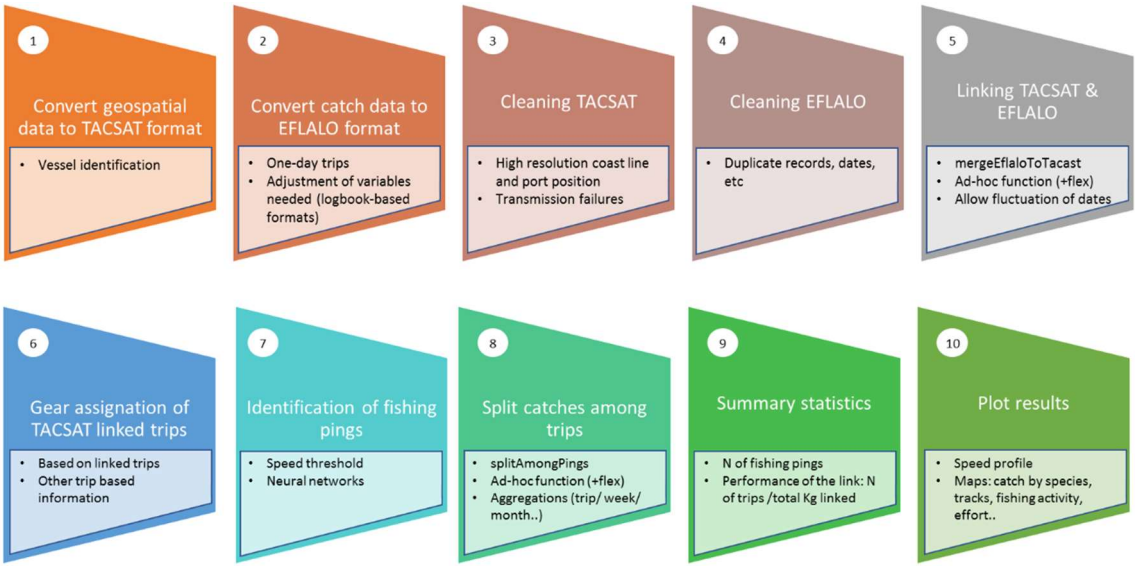


Figure 2. Workflow to link geospatial with catch data.

The list of steps in the proposed workflow, should be adapted to the specific characteristics of national data. In some cases, additional analysis may be needed, or some of the steps described here may not be relevant.

The workflow is based on the EFLALO and TACSAT data formats used by the R package VMStools (Hintzen et al. 2012). These formats build on work undertaken and agreements made during previous EU funded scientific projects such as TECTAC, CAFÉ, AFRAME and "Development of tools for logbook and VMS data analysis (Mare 2008/10 Lot 2)" and are well known within the International Council for the Exploration of the Sea (ICES) community. A description can be found in: https://github.com/nielshintzen/vmstools/releases/download/0.0/Exchange_EFLALO2_v2-1.doc. The workflow is explained in detail in Annex 5.3 and the code produced in R following the workflow is included in fishPi^2 project GitHub: https://github.com/ices-tools-dev/FishPi2/tree/master/WP5

5.4 Marine Recreational fisheries (MRF)

Marine recreational fisheries could represent a significant source of fishing mortality, have impact on ecosystems, and interact with commercial fisheries and users of the marine environment. However, the evidence needed to manage these fisheries is often limited and difficult to collect, because of the large numbers of widely-distributed small fishing vessels and individuals on the shore, exploiting highly mixed fisheries using a variety of gear types. These challenges mean that significant components of fishing mortality are not well described, which may affect our ability to manage fisheries to achieve conservation targets. Moreover, marine recreational fisheries can have a high economic value, but this is not taken into account in management and allocation decisions within European fisheries management.

5.4.1 Seabass case study

Developing a management strategy evaluation to assess the impact of recreational data on the performance of the assessment for the seabass Northern stock.

The European seabass is widely distributed in the Northeast Atlantic shelf waters, with the Northern stock unit covering the North Sea, Channel, Celtic Sea and Irish Sea. Over that past 10 years, the northern stock has declined rapidly due to a combination of poor recruitment and increasing fishing mortality, leading to management measures for both commercial and recreational fisheries. Recreational catches of seabass are a large proportion of total removals, representing at least 25%. However, recreational data are limited with only a single estimate from 2012 used in the assessment. Hence, there is a need to understand how uncertainty and bias in recreational fisheries catches impact the assessment, the advice and ultimately the status of the stock.

For this case study, a management strategy evaluation (MSE) framework was developed to highlight the potential of using an MSE to test scenarios of data quality in recreational catches. Here, details of the approach and decisions made to develop the framework are provided (Annex 5.4). The MSE, or closed loop simulation framework, was developed for Stock Synthesis based on the current assessment and advice approaches. Comparison of the performance of the assessment and harvest rules were made for different scenarios for the quality of recreational data, expressed as bias and precision. This performance was measured using indicators such as the risk of falling below reference points and analysing recovery trajectory trends.

The outcomes were used to test and validate the potential of the tool for assessing implications of recreational data quality for management and inform regional sampling. Due to the time constraints of the project, the results are mainly illustrative. The highest long-term risk to the stock was if the recreational sector caught more than the catch advice, compared to catching the advised limit with some level of noise. The scenario where catch observations were systematically under-estimated was not run here. In situations where the realised recreational catches varied around the advice but remained unbiased, results did not suggest an advantage of collecting noisy data over assuming that the recreational sector caught the advised quota. However, this implied knowledge of non-bias which can only be known in the real world with existing data. Assuming that recreational catches follow management advice is a risk to the stock. Further simulations remain needed to assess the impact of a broader range of uncertainty.

Several assumptions were made to build the MSE framework, to check that it performed as expected and to generate results. Firstly, recruitment was assumed to be at a historical average, when recruitment is known to be variable and driven by environmental conditions. It was also assumed that the commercial catch data quality was high (while studies have shown that the UK under 10 m fleet landings is likely to be underestimated), that the commercial fleet complied with quotas, the recreational fishers caught up to 50% of the total, and F varied between years depending on the harvest rules and without restrictions on yearly rates of increase or decrease. These assumptions can be relaxed in future scenarios, where necessary. Before the framework can be used to support advice, further model development is needed. This should include more work on the conditioning the operating model, to ensure that it is fully informed by the data and exclude any unrealistic combination of parameters such as mortality and steepness of the stock-recruitment relationship. Further, the main challenge remains computational time and it would be worth investigating the

possibility of using a more efficient framework and estimation model, a4a for example might offer this possibility in order to reduce expensive runtimes.

5.4.2 Pilot studies

Under the project it was decided to review the outcomes from the MRF pilot studies carried out by different MS under the EU MAP in the period of 2017-2019. With this aim in mind, all the information reported from these studies coming from MS Annual reports were reviewed. Existing pilot studies showed a large variety of objectives at a MS level (e.g. target population, target species, period, duration etc.). However, no results from the pilots are available yet, but the pilot studies still need to be evaluated to improve knowledge of MRF at the EU level. In addition, it will also demonstrate where routine MRF data collection will be required during the period of the next EU MAP.

Therefore, a scientific evaluation of these MRF pilots is required under the umbrella of the STECF that would provide a robust assessment of the validity of the pilots and the need for future MRF monitoring under NWPs. The evaluation of pilots should be initiated as soon as the pilot period has finalized. A detailed report of these studies should be provided to this expert group. This evaluation will allow the European Commission to assess the need for MRF surveys at a MS level by 2019 to be ready for the start of the next EU MAP period in 2020.

5.5 Recommendations

In this section, based on the main outputs of the work carried out in this WP some key recommendations are compiled to improve the data collection of SSF and MRF at regional level. The potential subgroups established by the RCGs to cover these recommendations are also identified:

5.5.1 SSF Recommendations

1. Given the high uncertainty of the quality of the data collected for the SSF, a rigorous evaluation of this fleet data at EU level is required. RCGs could be the responsible of this evaluation by region through experts in this fleet (Regional sampling plans + Data Analysis and Quality “Pan regional subgroup”)
2. Although the SSF are part of the commercial fleet, they should be considered as a specific section when revising EU MAP. The fleet segments to be considered: <10/10-12/12-15 fleet segments. (EU MAP revision subgroup “Governance Pan regional group”)
3. Data collection on biological data (length frequencies, Discards, PETS bycatch etc.) and methodologies to collect these data need to be evaluated based on end-users needs. (End users and RCGs “Pan regional subgroup”)
    a. Catches made by SSF may present a different size structure than catches made by LSF
    b. SSF can contribute significantly to the overall discard (e.g. nursery areas in coastal areas) rate and amount depending on gear type
    c. PETS bycatch could be relevant (i.e. gillnets and cetaceans, longlines and seabirds, turtles)
4. The challenges of storing, applying quality control filters, querying and mapping large volumes of positional data that are likely to be produced by the large number of SSF vessels in Europe

have thus far not been adequately addressed. There is a need to develop procedures to manage and integrate vessel movement data sets and link these data with relevant effort metrics to inform fisheries management

5. New technologies offer a significant opportunity to improve SSF monitoring and data collection. A risk based approach is proposed to determine the type and resolution of data required to meet defined objectives for a given SSF. This approach will then inform the type of ERS and EM equipment required for different fleet segments.

5.5.2 MRF Recommendations

1. A scientific evaluation of the outcomes of the pilot studies should be undertaken (STECF, conducted by experts on MRF sampling programmes) to assess the potential impact on stocks and facilitate the design of the future routine data collection on MRF. Outputs evaluated by the RCGs (Regional sampling plans Pan regional subgroup).
2. Multispecies surveys are needed to provide data on level of catches and releases of all species and allow the impact of MRF on stocks to be assessed (EU MAP revision subgroup "Governance Pan regional group")

5.5.3 Common recommendation for both fisheries

1. Complete SSF and MRF data needs to be included in European databases (such us the RDBES which is being developed by ICES) to ensure that it is available and utilized by end users including stock assessors, RCGs, etc.
    a. There is a need for a regional database adapted to the specificities of SSF and MRF.
    b. fishPi^2 in parallel with WGRFS made a proposal to ICES Data Centre (SHORT AND LONG TERM proposal considering the inclusion of this data in the RDBES)
    c. Proposal presented to the SC RDB (Annex 5.5)

Work Package 6 – Data Quality

6.0 Background and context

The work package aimed at developing operational procedures and tools for the evaluation of the quality of biological datasets at the regional level. Concretely, this involved agreeing on reference lists with standard codes on e.g. harbours, species and metiers, to ensure that Member States in a region would report in a standardized way on their data collection.

WP6 added value to long standing suggestions and recommendations from the former fishPi project and STREAM project, ICES/PGCCDBS, ICES/PGDATA, ICES/WK on data quality (WKPRECISE, WKMERGE, WKPICS). The RCGs and STECF-EWG were to come up with an operational tool applying all the principles detailed in the above mentioned fora. The R library developed was planned to be tested on a real regional dataset, and improved to be an official R CRAN library.

The initial proposal for WP6 mentioned the need to tackle the issue of sensitivity of input parameters to stock assessment in order to further improve sampling optimization, and following the latest development of ICES/WKBIOPTIM and ICES/WKSDEC. WP6 had also to demonstrate novelty of approach and guarantee that the tools proposed follow the most advanced theory and development in the quality domain. In essence, this means the development of an integrated means to streamline the process of making available the objectives to be achieved, to assist with data monitoring and communicate on quality indicators.

During the kick-off meeting, DG MARE emphasised the added value that fishPi^2 would bring through a combination of a detailed user manual making the use of the code library more accessible to non-specialists and the development of reporting functions that could make the use of the database more attractive to end users. In the subsequent inception report, fishPi^2 planned to develop further the library for quality checking and make it available on the R CRAN repository. It was also mentioned that a user manual would be developed to help all national data managers to run the code on their own datasets, and new fields of work would be developed, taking advantage of data being provided in the RDB, i.e. quality evaluation and reporting. Eventually, a framework for quality assurance was planned to address all issues from the collection of the data to its use, via follow-up for the collection and data processing, and that fishPi^2 would propose the structure of a comprehensive framework for quality assurance.

6.1 Setting up a roadmap

A WP6 meeting was held in Port-en-Bessin (France) from 8 to 10 October 2018, and was attended by 8 experts (Annex 6.1). The meeting was postponed from the initial plan in July, because most of the experts named for the WP6 were still busy in responding to data calls for their own Member States, and RDBES was still working on its data structure. The latter issue was not fully resolved at the moment of the meeting, but the experts were of the opinion that sufficient progress had been made on the data structure to use it for further development of methods.

The meeting focused on a roadmap to deliver the expected products (deliverables) on data quality for the fishPi^2 project. The WP followed up on the fishPi project initial development of an R library (https://github.com/ldbk/fishPifct) serving as a tool to quality check the data at national and regional level. The participants of the meeting decided to put all efforts to develop further the library for quality checking and make it available on the R CRAN repository. Since the library was to be developed based on any data format, including the one structuring the RDBES, the finalisation of the library was regarded as the major goal of the WP. It was decided that only basic functions for handling the data should be included in the R package, and examples of use (vignettes) would be provided to illustrate the potential of the library. The work on manuals and more advanced functions had to be halted whilst awaiting the necessary library. This information was passed to the STREAM project as expectations to include their work in the library could not be achieved at this stage.

Renewed objective of the WP: develop a stable package which will contain the basic structure of the RDB and the main methods to handle the data. The group agreed on:

- 2 formats of dataset - RDB FishFrame and RDB-ES;
- embed into the library some simulated data, known to better perform with bias testing (outputs of methods vs controlled parameters);
- develop core objects and classes (COSTcore like + integrity checks embedded + update basic methods with the structures);
- vignettes : helping users how to use the objects with examples lines of scripts;
- name of the library : **CLEF-RDB** standing for Core Library for Ecosystem and Fisheries data in the RDB.

All the graphs and tables linked to quality evaluation would not be developed in the library, except if there is the potential to create them with simple lines of codes, then it will be described in the vignettes. The basic reporting will also be given in the vignettes.

For the development of outputs, it was agreed to setup a fishPi^2 repository https://github.com/ices-tools-dev/FishPi2/tree/master/WP6 and then request to specific technical groups or convene dedicated workshops to progress further, including experts from the STREAM project.

6.2 CLEFRDB package

6.2.1 An introduction to the package

The CLEFRDB R package is dedicated to facilitate data handling, based on the construction of fishery-dependent data container objects, with an embedded quality check. The mechanism to build up such containers is generic in order to accommodate any data structure for the entry data and facilitate the provision as an output to an RDB or as an answer to fishery-dependent data calls, with the aim of tackling the issue of providing the same information in different formats to different end-users. The construction ensures intrinsically the quality of the data these objects contain. In this framework, we address the definition of data quality in the first part of this document. The document provides some practical examples of the construction of specific data containers. The CLEFRDB package can be found at: https://github.com/ices-tools-dev/FishPi2/tree/master/WP6

6.2.2 Framework

Fishery data are usually collected at the national level, following national work plans and using *ad-hoc* infrastructure and database format. Upon agreement, these data are then transmitted to the Regional Fishery Management organizations (RFMO). RFMO's data calls define the type of data Member States have to provide, the format and the way the data are to be transmitted and the deadlines.

6.2.3 Fishery-dependent data

This document focus only on fishery-dependent data: data that are collected from the fishery, not the one collected during the scientific surveys or other activities not based on fishermen activities. This document will focus mainly on fishery characteristics (vessels characteristics, fishing areas, period of fishing, metiers used, fishing effort), the catches (landings and discards of the species), and the population descriptors of the catches: the numbers at length, the numbers at age and some biological parameters (maturity, sex…) by species.

6.2.4 Data call

The fishery-dependent data are those used as inputs to stock assessment models. Besides this critical use, these data by themselves provide information about the fisheries states and behaviours: a standard prerequisite to the understanding of the fishing pressures on the stock and its influence on the dynamics of the stock. The demands on fishery-dependent data by RFMO has increased in the past few years. For example, the data calls issuing by the International Council of the Exploration of the Seas (ICES) have increased threefold for the stocks identified as data-limited in 2016 and 2017. For such stocks, the data provided has to cover three years instead of one, logically multiplying the processing time of the information by three. Moreover, different RFMOs can ask for the same information in different formats. It is the case for the EU Member States having fishing fleets in the Mediterranean Sea: both the General Fishery Commission of the Mediterranean (GFCM) and the Joint Research Center (JRC, a research institution belonging to the European Union) request the same fishery-dependent data for these Member States but follow different data calls (deadline and file formats differ profoundly).

6.2.5 Data quality

The quality of a dataset is a vague concept. A definition of this concept has to mix philosophical and practical considerations. Philosophy helps to understand the link between reality (the fishery activities and its impact on stocks) and the data representing this process. Floridi's paper (2005)[9] discuss the link between semantic information and meaningful data in a general way, with first practical considerations on the real use of the data collected. Wang and Strong (1996)[10] define "data quality" as data that are fit for use by data consumers. Between these two extremes views, this document relies on the data quality framework proposed by the STECF report on quality assurance for DCF data (STECF, 2017)[11], which synthesized the quality indicators already implemented in

[9] Floridi, L. (2005). Is semantical information meaningful data? Philosophy and Phenomenological Research, LXX, pp. 351-370.

[10] Wang, R. Y., and Strong, D. M. (1996) Beyond Accuracy: What Data Quality Means to Data Consumers. Journal of Management Information Systems, Vol. 12, No. 4 (Spring, 1996), pp. 5-33Published by: M.E. Sharpe, Inc. Stable URL: http://www.jstor.org/stable/40398176

[11] STECF Report (2017). Scientific, Technical and Economic Committee for Fisheries (STECF) – Quality Assurance for DCF data (STECF 17-11). Publications Office of the European Union, Luxembourg, 2017, ISBN 978-92-79-67483-9, doi:10.2760/680253, JRC107587

different end-users such GFCM, JRC, ICES and STECF. For the purpose of this work, the set of data quality indicators, their definitions and the corresponding practical implementation are taken from the GFCM document (GFCM, 2019)[12] and are defined as follows in a broader sense:

- timeliness: data transmission meets the deadlines set by the RFMO;
- completeness: all data transmitted contain all mandatory information as required under relevant data calls;
- conformity: the data transmitted adhere to RFMOs standards (codification and format),
- stability: the data transmitted vary within acceptable limits compared with the values of the same variables in the recent past;
- consistency: the data transmitted are coherent with the values of similar variables reported in different data tables for the same reference year;
- accuracy: the data transmitted are close to a realistic or expected value (sampling coverage, precision and bias checks, outliers detection, change in methodology);
- adequacy: the data transmitted allow relevant RFMO subsidiary bodies to provide scientific advice related to the stocks under consideration.

The timeliness, completeness and adequacy indicators will be not considered for this work. Their assessments are particular to the data calls and ask for extra information not belonging to the construction of the data container. However, considering the "fit for use" proposed by Wand and Strong (1996)[13], they are probably the most important in term of quality: if no, partial or inadequate data are provided to answer a data call, what is the meaning of the related data collection? These indicators will deserve further thoughts and developments.

The conformity, stability, consistency and accuracy indicators are data quality indicators which can be verified during the realization of the data collection at the national level. The conformity is an indicator intrinsically linked to the data container. For example, the conformity data quality indicators which checks if a landing value is a positive number, means that the column of the data table containing the landing value has to be defined as a positive number. If the data container of this data table is well defined, nothing else than a positive number can be entered by the user for this variable. This document will focus on the construction of data containers confirmed by definition. Shorter examples will illustrate the implementation of some of the three other indicators (stability, consistency and accuracy). These indicators are less critical in terms of data quality. A stability indicator signals a drastic change of a parameter, but this change can be a real change in the fishery dynamic. This indication can be interesting to point out for the end-user, as stock assessments models can be sensitive to a significant variation in their input, but *per se* we consider stability as a secondary step in data quality assessment. The consistency indicator is dependent on the format of

[12] GFCM (General Fishery Commission for the Mediterranean), 2019. GFCM Data Collection Reference Framework (DCRF). Version: 2019.1. http://www.fao.org/gfcm/data/dcrf/

[13] Wang, R. Y., and Strong, D. M. (1996) Beyond Accuracy: What Data Quality Means to Data Consumers. Journal of Management Information Systems, Vol. 12, No. 4 (Spring, 1996), pp. 5-33Published by: M.E. Sharpe, Inc. Stable URL: http://www.jstor.org/stable/40398176

the data calls. It has to be checked in the data calls where redundant information is requested. For example, if catches, landings and discards are all requested, the total catches have to be equal to the sum of the total landings and the total discards. This example seems to be trivial, but at the national level, the data calls answers can involve different institutes (to complete the previous example, institute A providing the discards estimates, and institute B the census of the landings), and this kind of check is rarely done across different institutes. The accuracy indicator covers a large body of practice in statistics. As the stability indicator, its implementation can lead to false positive, because the definition of what is a realistic value of fishery parameters in the context of a given data call is open to discussion. However, like stability, this indicator can inform the user to some errors or change in the fishery or stock dynamic, but *per se* we consider accuracy as a secondary step in data quality assessment.

6.2.6 Data format in fishery science

The need to have a versatile tool able to build different data container for the same information relies on the multiplicity of the data format requested by the RFMOs. A data format is a formal definition of how the data are transmitted to the RFMOs. The definition includes the files format and the codification of the data in these files. For EU Member States, according to the distribution of the stock their fleets target, a short list could be:

- ICES Fishframe format, ICES Intercatch format, JRC Fishery Dependent Information (FDI) for North-Atlantic stocks;
- GFCM data format, JRC Fishery Dependent Information (FDI) format for Mediterranean stocks;
- ICCAT data format for Atlantic tunas stocks;
- IOTC data format for Indian Ocean tunas stocks;
- FAO data format for fishery data production.

Other RFMOs exist (CCAMLR, SPF…) and are not considered here, as they are less concerned by European fleets. The main end-users (ICES, DG MARE through JRC, GFCM) for the EU Member States lead to the manipulation of at least 4 data format to answer the regular data call. All these formats are documented:

- RDB Fishframe: Jansen et al. (2009) [14] then ICESb (2018) [15];
- Intercatch: ICES (2018c) [16];
- FDI: JRC (2019) [17];

[14] Jansen, T., Degel, H., Vigneau, J. and Jardim, E. 2009. Definition of Standard Data-Exchange Format for Sampling, Landings, and Effort Data from Commercial Fisheries. ICES Cooperative Research ReportNo. 296. 43 pp.
[15] ICES (International Council for the Exploration of the Seas), 2018b. The Regional DataBase (RDB) Exchange Format. Version 1.314-August-2018. https://www.ices.dk/marine-data/data-portals/Pages/RDB-FishFrame.aspx
[16] ICES (International Council for the Exploration of the Seas), 2018c. InterCatch Exchange Format. Version 1.0. Document version 1.11. http://www.ices.dk/marine-data/data-portals/Pages/InterCatch.aspx
[17] Data Collection Framework website, co-managed DG MARE - JRC (DG Maritime Affairs and Fisheries and Joint Research Center, European Commission,), 2019. https://datacollection.jrc.ec.europa.eu/dc/fdi

- DCRF GFCM: GFCM (2019) [18];

An interesting common feature of these documents is their evolution in time. All of them have experienced during the past three years (FDI, GFCM) or are experiencing, significant changes (ICES). These significant changes are in regard of the basic structure of the files exchanged with the Member States, and on a less critical level, these changes also concern the definitions of the reference list of some individual parameters. As an example, the interested reader can compare the data structure described in Jansen et al. (2016) with the one in development in ICES (2018a) [19].

To conclude this short review on the fishery-dependent data, the increasing number of data calls and the instability on the data formats requested by the RFMO highlights the need to develop a tool able to cope with these constraints, with the guarantee of ensuring the quality of the data transmitted to all end-users. The construction principle of fishery-dependent data containers is illustrated using the Fishframe data format (see Fig. 1 from Jansen et al. 2009).

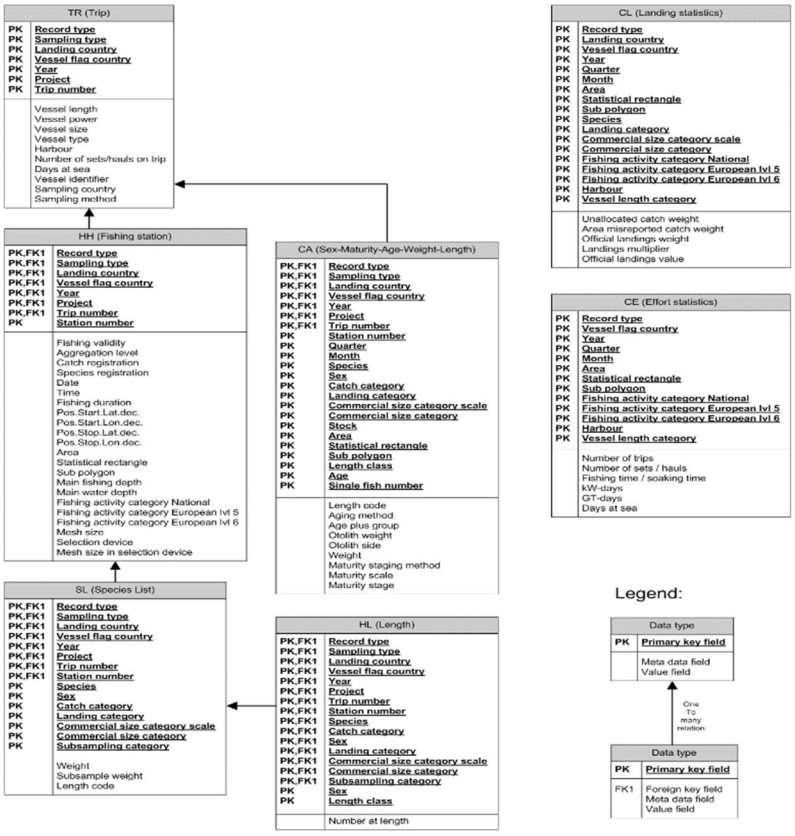
The careful inspection of this current format highlights essential properties:

- the information is often located in space: the table trip locates the trips in their landing harbours (variable harbour), the table haul locates the fishing haul three times (by its geographical coordinates, the ICES Statistical rectangle and the ICES Area)…;
- the information is located in time: fishing trips by year, fishing stations by year, date and time, landings statistics by year, quarter, month…;
- Some fishery objects have their own coherency: a fishing vessel is defined by its flag (this information is repeated in all the commercial sampling tables in our example), its physical properties (length, size…). A fishing station is defined by the metier referenced three times in the fishing station tables

[18] GFCM (General Fishery Commission for the Mediterranean), 2019. GFCM Data Collection Reference Framework (DCRF). Version: 2019.1. http://www.fao.org/gfcm/data/dcrf/

[19] ICES (International Council for the Exploration of the Seas), 2018a. Workshop on new data model for the Regional Database (WKRDB-MODEL), 15 –18 January
2018. http://www.ices.dk/sites/pub/Publication%20Reports/Expert%20Group%20Report/acom/2018/WKRDB/wkrdb-model_2018.pdf

- **Figure 1:** Fishframe data format



These comments apply to other RFMOs data formats. In summary, time and space references are essential information, and other fishery objects information (fishing vessel description, characteristics of a haul, sampling reference) are requested by all the data calls. Inside each data calls, the labelling and the aggregation of the information can change. For example, the temporal unit of GFCM data call is the year, while for ICES Intercatch related data it can be the month, the quarter or the year. For fixed information, the codification can change while the parameter conveys the same information. The metier lists are not the same for ICES, GFCM or FDI data call but a trawler of 25 meters long remains the same trawler even if its name is OTB_DEF_70-99_0 for ICES, T12 for GFCM and TRAWL/OTB/70D100 for the FDI data call.

Considering these properties, the main task to translate national data to data calls (apart from the estimation work that this document does not address) is a translation work in time and space plus a renaming of the information properties using a different convention. To do this, this package provides some generic data containers for time, for space and for general fishery object. These data containers embed some strict definition of the data types and ensure the conformity of the information intrinsically.

6.2.7 Data containers and S4 R class

The data containers are build using S4 class objects. Advanced knowledge of R and an understanding of the oriented-object (OO) programming can be helpful to understand the way the data containers are built and translated into data files conform to the data-calls specification. The book of H. Wickham (2014) covers all these topics (https://www.jstatsoft.org/article/view/v059i10). The S4

objects in R have fundamental properties related to the fishery data container: they have a formal definition to ensure conformity and inheritance properties who simplify the construction of complex data containers.

Information

The data container has to record information at its smallest resolution. If a trip is located in space by the vessel trajectory, the data container will contain this trajectory. If for another trip, only the ICES division is known, then this information is recorded in the data container. This consideration is the same for the time, and for all the other fishery information: one record by parameters at the smallest resolution possible. The R classes and objects will then ensure the translation of the data into the data-calls requirements using methods and transparent reference lists and algorithms.

6.3 Conclusion

The CLEFRDB R library proposes an implementation of classes of objects currently used by fishery-dependent data. The definition of S4 classes and its strict validation mechanism lead to generating objects which strictly follow the conformity of their description (variable type, numerical range, compliance to a lookup table...). The inheritance among S4 objects gives to the user the ability to build more complex objects from smaller objects, preserving the conformity of these smaller objects. These objects have no prerequisite in term of format: they can be created from the national data available in each Member State. Then exporting these objects into the multiple formats requested by the different end-users is straightforward, and these objects, by construction, will pass the conformity checks implemented on the various upload facilities.

If the two examples presented in this document generate raw sampling dataset, other data-call request raised data at the population level (GFCM, ICCAT, ICES Intercatch). So there is a strong need for methods associated with these object to raise the sampling data to the population level. Future work will implement such methods including generic statistical sound sampling raising methods, from ratio-estimators to probability-based sampling estimators. The main difficulty will be to free the raising methods from any data format. A significant benefit should be the smooth transmission and adaptation of these methods to the RDBES format, and possibly to other fishery-dependent data formats.

Work Packages 7 – Training and 8 - Consultation

7.0 Background and context

The WPs in the fishPi^2 project were populated by members of the organisations that are primarily involved in data co-ordination at national and EU level. The process of participation in the project ensured that there was a focus on developing a common understanding of the challenges and help to build consensus towards the development of practical solutions. The value of this experiential learning through participation formed part of the dissemination and to some extent, the training element of the project.

The outputs from WPs 1- 6 are available in summary and more detailed form including raw R code to cater for the needs of different user groups ranging from those working at a strategic decision making level (the Summary), those engaged in RCG Working Groups (Summary and Annexes), and those who work at a hands on level with statistical code (R Libraries).

Whilst WP7 was to focus on training, WP8 was to undertake a consultation to engage the National Correspondents and seek their feedback on the outputs of fishPi^2.

The outputs from this project were presented at relevant ICES Working Groups and the Regional Co-ordination Group meetings (RCG) which took place in September 2018. Feedback from the RCG meetings informed revision of the proposed deliverables for WPs 7 and 8.

7.1 Revision of deliverables

A stated deliverable of the project was a dedicated training workshop to take place over a two-day period will be scheduled to take place in month 13 of the project. However, after specific feedback from the RCG fishPi^2 presentations made to the NS&EA and NA RCGs in September 2018, the requirement for a training workshop was revised. The consensus view was that the majority of MS institutions had the necessary expertise in place or were in a position to access this expertise (subject to the caveats noted in WP1 regarding National vs Regional priorities for sampling and allocation of staff resources, together with incentives related to career progression). In addition, specialist training is already provided by ICES as required. The view that sufficient expertise exists was further supported by the survey conducted under the original fishPi project and provide again here for information (see Table: 7.1). The original request for response was sent to all National Correspondents. The responses recorded in the table reflect the feedback provided by the organisations within any given MS who were presumably directed to do so by their respective National Correspondents. Not all responded, but the majority did so and subsequently none of the Member States who did not respond have objected to the overall conclusion that they have sufficient expertise.

Table 7.1: Showing a summary of available expertise within key areas for the development and implementation of regional plans. First answer relates to "**Currently available in your institute (or institute(s) involved in the data collection**". Second answer relates to "**Are you willing to prioritise regional work within your institute to make expertise available for design and management of regional data collection plans?**" Y = Yes, N = No and "-"= No response

Respondent	IT expertise i.e. database development and database management	Statistical expertise in sampling design and estimation.	Expertise in large scale commercial fisheries	Expertise in small scale commercial fisheries	Expertise in recreational fisheries surveys	Expertise in running sampling programmes	"R" programmers	Expertise in systematic quality assurance work	Expertise in surveying bycatch /PETS
Estonia (NC)	N / N	Y / N	Y / Y	Y / Y	Y / Y	Y / N	Y / N	N / N	Y / Y
Portugal (NC)	Y / -	Y / -	Y / -	Y / -	Y / -	Y / -	Y / -	Y / -	Y / -
France (IFREMER)									
Denmark (NC)	Y / Y	N / Y	Y / Y	N / Y	Y / Y	Y / Y	Y / Y	Y / Y	N / NA
Sweden (SLU)	Y	Y / Y	Y / Y	Y / Y	Y	Y / Y	Y / Y	Y / Y	Y / Y
Sweden (NC)	Y / Y	Y / Y	Y / Y	Y / Y	Y / -	Y / Y	Y / Y	Y / Y	Y / Y
Netherlands	Y / Y	Y / Y	Y / Y	Y / Y	Y / Y	Y / Y	Y / Y	Y / Y	Y / Y
Finland (NC)	Y / Y	Y / Y	Y / Y	Y / Y	Y / Y	Y / Y	Y / Y	Y / Y	Y / Y
Ireland (NC)	Y / Y	Y / Y	Y / Y	Y / -	Limited	Y / Y	Y / Y	Y / TBD	Y / TBD
EU									
Spain (IEO)	Y / N	Y / N	Y / N	Y / N	N / N	Y / N	Y / N	Y / N	N / N
Ireland (MI)	Y / N	Y / Y	Y / Y	Y / Y	Y / Y	Y / Y	Y / Y	Y / Y	Y / Y
Germany (NC)	Y / N	Y / Y	Y / Y	Y / Y	Y / Y	Y / Y	Y / Y	N / N	Y / Y
Belgium (NC)	Y / Partly	Y / Y	Y / Y	N / -	Partly / Y	Y / Y	Y /Partly	Y / Y	N / -
Poland	Y / Y	Not yet / N	Y / Y	Y / Y	Y / Y	Y / Y	Y / Y		Y / Y
ICES	Y / Y	Y / Y	Y / Y	Y / Y	Y / Y	Y / Y	Y / Y	Y / Y	Y / Y
Belgium	Y / Y	N / N	Y / P	Y / P	Y / P	Y / P	Y / N	Y / Y	N / -
Spain (AZTI)	Y / -	Y / -	Y / -	Y / -	Y / -	Y / -	Y / -	Y / -	Y / -
UK (MSS)	Y / Y	Y / Y	Y / Y	Y / Y	N / N	Y / Y	Y / Y	Y / Y	Y / Y
UK (MMO)	Y / -	Y / -	Y / -	Y / -	Y / -	Y / -	Y / -	Y / -	Y / -
UK (CEFAS)	Y / -	Y / -	Y / -	Y / -	Y / -	Y / -	Y / -	Y / -	Y / -

The main requirement for dissemination and "training" beyond the RCGs was identified as the National Correspondents, RCG Chairs and related decision makers whose understanding and commitment would be required to ensure that the necessary priority and resources be made available to deliver Regional Co-ordination in their respective national contexts. This requirement overlapped with the proposed consultation under WP8 and therefore a revised approach was agreed.

Subject to discussion at the Interim Project meeting with DG MARE on 27-09-18, it was agreed that WP7 would deliver a Knowledge Exchange (KE) Workshop designed to share the outputs of fishPi[2].

7.2 Knowledge Exchange Event – for RCG Chairs and National Correspondents

The Knowledge Exchange event took place in Brussels, 20th February 2019. The Commission issued invitations to attend this event to RCG Chairs and National Correspondents. Subject to space availability representatives from the Baltic RCG and STREAM project were also invited to attend (List of invited attendees and attendees provided in Annex 7.1 – also see Figure 7.1).

Name	Job Title	Company
Adrian Antonescu	Programme manager	DG MARE
Cannelle Beauchesne	Policy Assistant	European Commission- DG MARE
Eleni Bintoudi	Blue Book Stagiaire	European Commission - DG MARE
Anna Cheilari	Policy officer	European Commission

Blanca Garcia Alvarez	MARE-C3 Data Collection	European Commission
Stanislovas Jonusas	Policy officer	European Commission
Venetia Kostopoulou	Policy officer	DG MARE
Vedran Nikolic	Policy officer - Nature protection	European Commission
Joana Patricio	Fisheries Inspector	European Commission, DG MARE
Kenneth Patterson	Senior Expert	European Commission
Oana Surdu	Policy officer	European Commission - DG MARE
Javier Villar Burke	Economic Analyst	European Commission - DG MARE
Belgium		
Els Torreele	Scientist	ILVO
Denmark		
Marie Storr-Paulson	Head of Monitoring section	DTU Aqua
Estonia		
Elo Rasmann	Senior officer	Ministry of Environment
Finland		
Heikki Lehtinen	Ministerial Adviser	Ministry of Agriculture and Forestry
France		
Camille Dross	National Correspondent	France / Directorate for marine fisheries and aquaculture
Germany		
Matthias Bernreuther	Fisheries Biologist	Thuenen Institute of Sea Fisheries
Christoph Stransky	DCF National Correspondent	Thuenen Institute of Sea Fisheries
Ireland		
Andrew Campbell	Team Leader	Marine Institute
Leonie O'Dowd	Section Manager	Marine Institute
Italy		
Alessandro Ligas	Researcher	CIBM
Latvia		
Didzis Ustups	National Correspondent	Institute of Food Safety, Animal Health and Environment "BIOR"
Lithuania		
Remigijus Sakas	Researcher	Klaipeda University
Antanas Kontautas	Researcher	Klaipeda University
Juranda Savukyniene	DCF LTU National Correspondent	Ministry of Agriculture Lithuania
The Netherlands		
Sieto Verver	Programme Leader Statutory Tasks	Centre for Fisheries Research
Poland		
Irek Wojcik	National Correspondent	National Marine Fisheries Research Institute
Portugal		
Emilia Batista	National Correspondent	DGRM-Directorate General for Natural Resources, Safety and Maritime Services
Suzana Faria Cano	Data Analyst	DGRM-Directorate General for Natural Resources, Safety and Maritime Services
Spain		
María Moset	Technical Advicer	Ministerio de Agricultura, Pesca y Alimentación
Jon Ruiz	Researcher	AZTI-Tecnalia
Sweden		
Maria Hansson	Environmental analyst	SLU aqua
UK		
Matthew Elliott	DCF National Correspondent	Marine management Organisation

Matthew Gubbins	Fisheries Data Programme Manager	Marine Scotland

Figure: 7.1 Table and map showing delegates and Member States represented at the fishPi^2 Knowledge Exchange Workshop (those in red registered to attend, but did not join the workshop on the day).

Presentations designed to inform the target audience were delivered by the respective Work Package Leaders followed by a question and answer session related to each presentation. In addition, an open panel discussion between the attendees and the Work Package Leaders was facilitated.

The intention was to introduced as part of the Knowledge Exchange event the WP8 consultation process, as it would ultimately be targeted at National Correspondents, Heads of Laboratories and RCG Chairs. Initially this was conceived as of a series of "proposals" derived from WP1-6, with responses to be collated and analysed semi-quantitatively manner. However, the feedback from the Knowledge Exchange event attendees was that there was no requirement for a separate consultation exercise given the level of detail provided during the event and subject to ongoing dissemination and sharing of project outputs across the relevant RCGs.

7.3 Project legacy dissemination and implementation

Members of all of the fishPI2 Work Packages are also party to RCG Meetings. In 2018 the fishPi2 WP progress and outputs were presented, discussed and are reported in the relevent RCG Reports which can be downloaded at https://datacollection.jrc.ec.europa.eu/docs/rcg

- 2018_RCG Baltic
- 2018_RCG NA
- 2018_RCG NSEA

Given the timing of RCG meetings planned for May-June 2019, together with other relevant RCG Sub-Group meetings, it was agreed, with both DG MARE and the RCG Chairs that the final outputs of the fishPi^2 project would be shared with the RCGs and actively presented at the RCG meetings. This process would take place prior to final sign-off of the final fishPi^2 report by DG MARE which would occur after the scheduled RCG meetings.

It is clear from the feedback received from the Brussels Knowledge Exchange event and feedback from the RCG Chairs that the many of the outputs from fishPi^2 are already being implemented and some of the key recommendations noted in this report are under active consideration by the RCGs and formed a substantive part of the RCG Agendas in 2019.

The fishPi² Project
Regional co-operation in fisheries data collection

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