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Report of the Working Group on Recreational Fisheries Surveys (WGRFS)

12–16 June 2017

Azores, Portugal

ICES International Council for the Exploration of the Sea
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Executive Summary

The ICES Working Group on Recreational Fisheries Surveys (WGRFS) role is to summarise and quality assure recreational fishery data collected in European countries, and provide advice for ICES on recreational fishing issues. In 2017, 31 scientists from 17 countries attended the WGRFS to: share and evaluate current national surveys; assess the validity of new survey designs; provide support on the use of survey data in stock assessment; review national and regional data plans; review novel survey methods; highlight new work on post-release mortality; assess the potential for research on human dimensions; and review the treatment of outliers. The terms of reference and agenda for the working group are provided in Section 1.

WGRFS compiled and assessed the quality of recreational harvest and release data collected within Europe for use in stock assessment (Section 2). These were summarised by country for four major sea areas (Baltic Sea, North Sea and Eastern Arctic, North Atlantic, and Mediterranean and Black Seas) and species (European sea bass, cod, pollack, elasmobranchs, salmon, eels, and tuna).

The design, quality and analysis of marine recreational fisheries surveys was investigated (Section 3). A summary of the experience of marine recreational fisheries surveys in New Zealand and Canada was provided (Section 3.1). The identification and treatment of outliers in the analyses of recreational fishing surveys was investigated, with several methodologies highlighted (e.g. hotdeck imputation, trimmed means) (Section 3.2). However, there was rarely evidence that datapoints are incorrect, so care was needed when deciding treatment of outliers. In general, where outlier or imputation procedures were used, the sensitivity of the results to the approach should be investigated. In addition, a more comprehensive assessment was needed of the methods and proposals for robust approaches, and should be done at a future WGRFS meeting. The quality of national recreational catch sampling schemes in Belgium, Norway, and Sweden were assessed using the WGRFS Quality Assessment Tool (QAT) (Section 3.3). It was only possible to assess the design of these surveys, as the analysis was not complete, with the designs considered appropriate in all cases.

The interactions between marine recreational fisheries surveys and data and the EU-MAP and regional coordination were discussed (Section 4). Several WGRFS members were involved in the review of the National Work Plans (NWP), so feedback was provided to the STECF on the process. The main challenges were the mismatch between the evaluation criteria and template, lack of feedback to MSs on the evaluation, identification of experts, timely requests for expert input, and evaluation of national surveys during the WGRFS. The European Parliament study, EURecFish that builds on the WGRFS analysis, and estimated numbers, participation, effort and expenditure by recreational fishers in Europe, was discussed. The storage of recreational fisheries data was assessed and it was agreed that processed recreational fisheries data should be stored in regional databases, and that WGRFS should work with ICES to develop a plan and time-scale for delivery of this solution.

The use of recreational fishing catches in stock assessment was reviewed for western Baltic cod, European sea bass, and Baltic salmon and sea trout (Section 5). For sea bass, all recreational data were delivered through a data call and the WGRFS assessed how to provide appropriate data for use in stock assessment. Recreational catches and post-release mortality should be included in the assessment. The lack of survey data made removals after the introduction of management measures difficult to estimate, but in

the short term should be based on data from the UK and Netherlands alongside extrapolation for France, with new data from France and Belgium included as soon as available. It is very important that time-series are collected for sea bass and that new methods for reconstructing time-series of catches are developed to improve the accuracy of assessments of stocks with significant recreational components. There is an urgent need to include Danish and Swedish recreational catches of western Baltic cod in the assessment. This includes exploratory stock assessment runs to test the effect of including all recreational data on SSB and F, possibly by pooling total recreational catch. Regional cooperation and sharing of data (e.g. biological) across subdivisions should be further explored to fill data gaps. There is also a need to observe recreational fishing effort dynamics in response to the introduced management measures. Recreational catches of salmon and sea trout were included in the assessments, but marine recreational catches were not well defined. In the case of Baltic salmon, expert judgement was used to develop understanding of the trolling fishery that demonstrated the importance of this fishery. Coverage of marine catches of sea trout were poor, so better data were needed to reduce the uncertainty in the assessments. There was an urgent need for the collection of more robust catch, effort, post-release mortality, and socio-economic data for recreational Baltic Sea trout and salmon fisheries.

To estimate fishery-specific mortality, WGRFS collected information on recreational fishing practices in different European marine recreational fisheries during two workshops conducted in 2015 and 2016. A practical implementation of this was shown and proposals made on how to proceed with post-release mortality (Section 6). It was agreed that recreational fishery characteristics for certain target species should be collected to enable extrapolation between stocks and fisheries, and sublethal impacts of catch and release investigated.

Novel approaches for data collection were reviewed including smartphone apps and webcams (Section 7). WGRFS assessed the information that needs to be collected from apps and the challenges with using app-derived data. The potential of smartphone apps was clear, but so were the challenges in using the data. The extent and direction of biases could be addressed through comparison of app data with onsite data, such as creel or access point surveys. Due to the broad range of apps available, data collection standards should be developed by a collaboration of app companies and end-users. Two examples of the use of webcams in New Zealand and Germany were presented and opportunities discussed.

The application opportunities of human dimension research in recreational fisheries were explored and several methods presented. Understanding anglers' reactions to recreational fisheries regulations help to predict changes in fishing effort dynamics and welfare. Further human dimension research will provide recommendations for allocation decisions between sectors and optimum co-management of commercial and recreational fisheries. To facilitate comparisons between different countries the experimental design (e.g. choice experiments) should be harmonized.

1 Background and Terms of Reference (ToRs)

The ICES Working Group on Recreational Fishing Surveys (WGRFS) meeting took place between the 12 and 16 June 2017, at the Department for Oceanography and Fisheries in Horta, Azores, Portugal. A total of 31 scientists from 17 countries contributed to the meeting, which was chaired by Kieran Hyder (see Annex 1 for list of participants). The agenda was agreed and followed, although some changes were made to timings to complete discussions, and was as follows:

Day	Session
12 June 2017	Introduction and ToRs Country updates (ToR a)
13 June 2017	Survey design, quality and analysis (ToRs a&b, and WP4): assessment of new survey designs, learning from other parts of the world, treatment of outliers, and quality assessment of Norwegian, Swedish and Belgian survey programmes. EU MAP and regional coordination (ToRs c&d): review of national workplan process, ongoing European studies, and storage of data.
14 June 2017	Collation and use of data in stock assessments (ToR d): update on methods and investigation of how to use data to support stock assessments for sea bass and Western Baltic cod. Post-release mortality (WP2) Novel methods for data collection (ToR b and WP1)
15 June 2017	Mini workshop on human dimensions (WP3)
16 June 2017	ToRs for next three years

The ToRs for the 2017 WGRFS meeting and how they fit into the ICES science plan is provided below.

ToR	Description	Background	Science Plan topics addressed	Duration	Expected Deliverables
a	Collate and review quality of national estimates of recreational catch, activity, and socio-economic values for candidate stocks, and identify significant data gaps in coverage and species.	Advisory need and requests by other WGS.	27, 30	Regular activity in each year	Report in annex to interim report each year
b	Assess the validity of new survey designs for data collection, including the sampling efficiency, cost of delivery, and levels of accuracy and precision.	Scientific need for efficient evidence production and feed to other working groups	25, 26, 28, 31	Regular activity in each year	Report in annex to interim report each year
c	Provide advice to ICES and European Commission on the availability of data, use of data in assessments, and design of future data collection programs as requested.	Advisory need and response to specific requests from the EC.	25, 26, 28, 31	Regular activity in each year, and reponse to *ad hoc* requests	Report in annex to interim report each year
d	Review and assess regional data collection programmes for the Regional Coordination Groups to deliver end-user needs and provide recommendations for additional data collection (e.g. species, areas, sectors, uses).	Advisory need and response to specific requests from the RCGs and ACs.	25, 26, 28, 31	Regular activity in each year	Report in annex to interim report each year

Summary of the Workplan

Year 1	Critically review the potential of novel survey methods to deliver recreational fisheries data (e.g. citizen science approaches using smartphone apps). Identify new post-release mortality estimates, potential sublethal effects, and reasonable extrapolations across species and fisheries for inclusion in stock assessments. Mini workshop on human dimensions: reviewing and collecting available information on the compliance and response of recreational fishers to different management measures. Review the treatment of outliers in survey data analysis.
Year 2	To be reviewed and confirmed after the WGRFS 2017 meeting.
Year 3	To be reviewed and confirmed after the WGRFS 2018 meeting.

All ToRs and items in the workplan were addressed through a mixture of plenary sessions and break-out groups. The relevant ToRs and workplan items are identified in the section heading.

2 Recreational fishing surveys across Europe (ToR a)

Recreational fishing surveys are carried out across Europe covering a range of species and areas. In EU member states, all species and areas required under the DCF (EC 199/2008, 2010/93/EU, 2016/1251/EU, 2016/1701/EU) and control regulations (EC 1224/2009) are covered.

The tables in Annex 2 provide an overview of the current/most recent surveys countries have in place to estimate marine recreational catches and Annex 3 gives the most recent harvest/release estimates for the relevant species. The tables cover four major sea areas as defined by the current DCF:

- Baltic Sea (ICES Subdivisions (SD) 22–32);
- North Sea (ICES Areas 3.a, 4 and 7.d) and Eastern Arctic (Areas 1 and 2);
- North Atlantic (ICES Areas 5–14 and NAFO areas);
- Mediterranean Sea and Black Sea.

These tables relate solely to surveys of recreational fishing defined by WGRFS (ICES 2013a) as:

"Recreational fishing is the capture or attempted capture of living aquatic resources mainly for leisure and/or personal consumption. This covers active fishing methods including line, spear, and hand–gathering and passive fishing methods including nets, traps, pots, and set–lines".

The table in Annex 4 provides an overview of economic evaluation of recreational sea fishing.

3 Survey design, quality, and analysis (ToR b, and WP4)

3.1 New experiences from outside Europe (ToR b)

3.1.1 Development of a national offsite survey in New Zealand

The National Panel Survey (NPS) method, currently used in New Zealand to estimate recreational harvests taken from all fish stocks, has been developed through trial and error over a 20-year period. Previous offsite surveys conducted during the 1990s were based on a white pages telephone number list sampling frame, but the estimates provided by these surveys are no longer considered reliable, and the phone list frame has become increasingly incomplete and demographically biased. Similar declines in the coverage of landline phone listings have occurred in Australia and USA.

The NPS follows a two-phase sampling design. The first phase is a screening survey that is based on a national database on the location of all dwellings in New Zealand, which is updated and maintained by Statistics NZ every five years when a national census survey is conducted. This database is available in a GIS format, in which all inhabited areas are subdivided into around 46 000 spatial strata (called mesh blocks) containing up to 80 dwellings. Maps of the location of each dwelling in each mesh block can be generated from this GIS database. This sample frame can therefore be used to sample the entire resident population in a random probabilistic manner, with known selection probabilities for each household, given national census data on its inhabitants. A sample of 1000 mesh blocks were selected for the screening survey, from which up to 30 dwellings are selected at random. In 2011–2012, this led to the selection of 30 390 dwellings, where face-to-face interviews were conducted over a six-week period. Up to seven visits are made to each dwelling, which resulted in an 86% contact response rate. During each interview, data are collected on the number of inhabitants in each dwelling, their demographic characteristics, who had gone fishing in the last 12 months, and their claimed avidity. The interviewer uses a Kish grid to select one fisher from each household, to avoid any bias towards self-selection or proxy selection. The selected fishers are asked if they are willing to be enrolled into a 12-month panel survey, with 90.8% agreeing to do so in 2011–2012. This response rate, coupled with the 86% contact response rate, yielded a 78% response rate for the screening survey.

As a result of the first phase screening survey in 2011–2012, 7013 fishers were enrolled into a second phase 12-month panel survey, so that they could report their catch and effort on a regular basis. Catch and effort data were collected by interviewers using a Computer Assisted Telephone Interview (CATI) programme, so that data were collected in a complete and consistent manner. The most avid (recall claimed) fishers were contacted once a week, and the least avid once a month. Contact was initially made via SMS texting to see if they had been fishing and a phone interview was warranted. These high contact rates were adopted to minimise the incidence of recall bias, and panellists were also given a memory jogger diary to help with recall when the interviewer phoned them. A random sample of 3000 individuals who claimed not to have fished during the first phase screening survey were also contacted every six months, to gauge the catch and effort of drop-in fishers.

Panellist attrition rates reached 10% by the end of the survey, with higher rates occurring for avid fishers. Attrition occurs for a variety of reasons, and different methods were used to adjust estimates for this sample loss. Some panellists were lost from the survey because they died, emigrated, or were unable to go fishing any longer for other reasons. No adjustment was made to their reported data as they had genuinely stopped

fishing. Some resigned from the panel almost as soon as the survey started, so their data were ignored and the selection weights for remaining panellists were recalculated. Others stopped reporting during the last couple of months, and their data were treated as complete, as these months coincided with winter when relatively little fishing usually occurs. Nearest neighbour methods were used to account for incomplete reporting by the remaining panellists who dropped out of the survey, but this imputation made almost no difference to the estimates or their estimated variance, given the data they had already provided, and high response rates overall.

The National Panel Survey has been designed to directly address sources of bias detected in previous offsite surveys, but the accuracy of a single survey can only be assessed in terms of plausibility if concurrent estimates are not available from another independent survey. Two other smaller scale onsite surveys were therefore conducted alongside the 2011–2012 National Panel Survey (and aerial-access survey and a smaller scale census creel survey) and the estimates provided by these independent surveys suggest that the NPS approach provides reasonably accurate recreational harvest estimates for all substantive inshore fish stocks in New Zealand. Another direct comparison of offsite NPS and onsite aerial-access estimates will take place in 2017–2018, which is intended to be a final validation of the NPS method. NPS surveys will then be conducted every 5–6 years, and web camera/creel survey monitoring used to monitor relative trends in catch and effort during intermediate years, for key fish stocks.

3.1.2 The Canadian experience

The survey of recreational fishing in Canada reports the most comprehensive information on recreational fishing activities and harvest in all regions of the country. The survey is the most relevant and up to date source of statistics on the economic contribution made by anglers and informs decisions made in a broad cross section of sectors including non-governmental organisations, academia, and tourism entities, and underpins government fisheries management policy and governance decisions.

The survey is jointly implemented by federal and provincial governments, was first initiated in 1975, and has been carried out every five years since. The survey covers the activity of a stratified random sample of recreational license holders from 14 different Canadian jurisdictions, including the federal marine fishery in the Pacific region. However, there is currently no marine recreational licensing system elsewhere in Canada. Region and waterbody coding was employed in the data collection. Due to the differences in jurisdictional fisheries management regimes, the national survey is essentially a compilation of 14 different surveys with slight differences in methodology and weighting. For example, in two jurisdictions, a pre-screen telephone survey of households is used to establish the sample due to the lack of a comprehensive licence database.

Up until 2010, the survey has been delivered by paper-mail starting in January of the year following the survey period covered. Paper reminders were sent subsequently from the jurisdiction that holds the delegated responsibility for fisheries management and administers the associated database of license holders. The future intent for the survey is to move to an electronic platform. The 2015 survey was implemented as dual-mode (paper/electronic) and all invitations were delivered by paper-mail with half of the sample receiving a paper survey and the other half receiving a URL and instructions to complete the survey online. Care was taken in designing and testing an electronic survey that most resembled the paper survey and to minimise the differences in

treatment of the two sample groups, to minimise bias between the groups. Upon request, respondents could change their response mode, in which case the sample sizes were adjusted accordingly. A summary of the headline results from the 2010 and 2015 surveys is provided in Table 3.2.1.1.

Table 3.2.1.1. Headline results from the Canadian recreational fishing surveys in 2010 and 2015.

Measure	2010	2005
Fish caught per angler	~58.8	~66.5
Average days fished	~13.2	~13.3
Number of active resident anglers	2.73 m	2.46 m
Contribution to the economy	~C$8.3b	~C$7.5b

The next steps for the Canadian survey are:

- To improve the multi-jurisdictional project charter, survey governance, and data processes.
- To design and implement an electronic survey for the next iteration that meets the needs of anglers and each fisheries management jurisdiction.

3.2 Analyses of survey data: treatment of outliers and missing data, and imputation procedures (WP4)

To assess the treatment of outliers, the approach used in the Netherlands was assessed as a case study, and to develop a discussion about how other countries deal with outliers.

3.2.1 Hotdeck imputation used for missing data in the Netherlands

The Netherlands carried out an online logbook (diary) survey, where participants transferred their paper logbooks to an online system each month. To minimise non-response, regular reminders were sent to the participants. Most participants responded every month, but some participants did not, resulting in partial non-response (Figure 3.2.1). To obtain information about the fishing activity of the partial respondents in months where no data were reported, a non-response follow-up survey was sent out as an additional online questionnaire each month. In this non-response survey, partial respondents were asked whether they had fished in the months for which data were missing and, if they had, the number of fishing trips (not catch) made in each of the missing months. Data were then imputed for the months where trips had been made, but not reported.

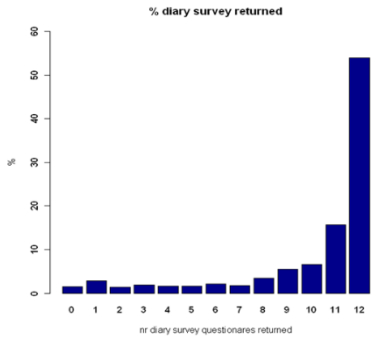

Figure 3.2.1. Logbook response rates as the percentage of users that returned logbooks for the total number of months given.

The non-response follow-up survey was designed to collect information about the number of fishing trips undertaken in each month rather than catch information. In these cases, data for the missing catches were imputed in the following manner. Respondents who indicated that they had not fished in a specific month were assigned zero catch and effort, and treated as having fully responded in that month. For respondents that indicated they had fished in each month, their fishing activity for the missing month was imputed using the hotdeck approach. Hotdecking is a method to replace missing values with observed values from a respondent (the donor), that are similar to the non-respondent in characteristics (e.g. demographics and avidity). The strengths of the hotdeck method are that imputed values come from observed responses so are realistic, the method can be applied independently of the distribution of the data, and the correlation structure is preserved. The donor values were chosen from respondents within the same avidity class (and waterbody type) who had the same number of freshwater or marine fishing trips in the month as the recipient. Hence, avidity was used to match donors with recipients, and stated avidity was used to classify each respondent into an 'avidity' group. Stated avidity was not used as a measure of effort in any of the calculations. Donors came from the same stated avidity group, because stated avidity was expected to influence catch rates as more avid fishers were likely to be more experienced and skilled fishers, and the month was expected to affect the species targeted.

Participants who completed logbook questionnaires, supplemented with the non-response follow-up, less than eight times (eight months) were treated as non-respondents and excluded from the final analysis. This meant that there were participants with between one and four months of missing data, with no follow-up fishing information available. For these missing months, the same hotdeck imputation procedure was followed, but with the difference that all information was imputed from a randomly selected donor from the same (marine of freshwater) stated avidity class and month as the missing record. The information was imputed from the reported number of fishing trips and catches. This meant that donors were chosen from the same stated avidity group, but that the realised number of fishing trips from the donor were used to impute the missing month. This resulted in zero fishing trips if the donor indicated no fishing in the missing month. To test the effect of imputing data, catches were estimated including respondents with different participation rates (Figure 3.2.2). The response rate was high and the same dataset was used, so little difference was found (Figure 3.2.2). If respondents that completed eight monthly diaries were included in the analysis, the total amount of data that was imputed was 3% for marine and 4.7% for freshwater (Table 3.2.1).

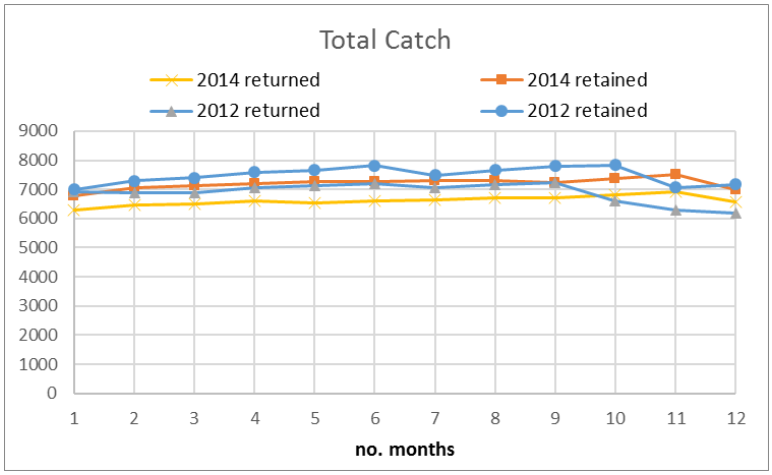

Figure 3.2.2. Effect of number respondents included in the analysis on the total amount of marine catches.

Table 3.2.1. Total number of monthly angler catch diaries imputed.

Data	Marine	Freshwater
Not Imputed	14 373	22 882
Imputed	439	1127
Total % data imputed	3.0%	4.7%

3.2.2 Methods used in other countries

Several different approaches have been used in other countries to deal with missing data and outliers. Generally, in the case of outliers, it is very difficult to define what constitutes an outlier. Statistical approaches for the identification of outliers are available, but these are usually based on a distributional assumption, so they are very sensitive to the choice of underlying distribution. From a statistical perspective, datapoints should only be excluded if there is good evidence that they are a mistake (e.g. a 5 m long cod), but this evidence rarely exists, so these 'outliers' should be included in the analysis and will be captured in the error. Trimmed means have been used to reduce the impact of extreme values where an equal number of points are removed from the top and bottom of the distribution (e.g. economics in Armstrong *et al.*, 2013), but this is not an approach that WGRFS would recommend broadly. Practically, a single value from a survey should not drive the estimates, so sensitivity of the estimates to the extreme value could be assessed by computing estimates with and without the datapoint. Imputation methods to account for missing data have been tested in several countries and the cut-off in number of months for inclusion in the analysis of offsite surveys, but experience from these countries is that a cut-off of around eight months has little impact on the estimates and imputation also makes little difference (Figure 3.3.2). A similar approach is recommended for assessment of imputation approaches to outliers, where the sensitivity of the result to the choice of imputation method and selection criteria should be done. However, a more rigorous assessment of outlier and imputation approaches should be done by the WGRFS to develop these ideas further.

WGRFS proposes that where outlier or imputation procedures are used, the sensitivity of the results to the approach should be investigated. In addition, the WGRFS

plans to do a more comprehensive assessment of the methods used and propose robust approaches at a future meeting.

3.3 Assessing the quality of survey data (Tor b)

3.3.1 Belgium

Belgium is carrying out a pilot study to assess recreational fishing effort, catches, and economic value. The study is ongoing and the WGRFS Quality Assessment for this pilot focused mainly on survey design, as the analysis is not yet complete (see Annex 5.1). Belgium has a very low angler participation rate, making national screening (especially for some rare fishing modes) rather challenging. An online omnibus survey was conducted in 2016 that had an initial sample size of 117 434, and identified 400 anglers, but had a large non-response (103 584). As a result, the WGRFS felt that this would not give a robust estimate of effort, and should not be used. Belgium has a coastline of only 65 km, so a roving creel survey is included in the pilot study with an aerial component monitoring the entire shoreline. The aerial component together with onshore observations for a random section of 5 km of beach is used to estimate total fishing effort in fishing hours for the different land-based fishing techniques in each of the four strata (weekdays / weekends and national holidays; on- / off- season). For the total effort of boats, all four marinas are visited on random days. Currently, Belgium is considering using cameras for observing the harbours. Random interviews on beaches and in marinas are used to estimate avidity. WGRFS experts highlighted issues with the use of stated avidity in the raising of the catch data, so these should be used with caution. In addition, more effort should be put into sampling weekends compared to the weekdays to maximise the variability captured. Finally, the WGRFS advised collaboration with Germany on the use of cameras in marinas.

WGRFS concludes that the Belgian survey has a reasonable design, but the group could not assess the validity of the analysis at this stage.

3.3.2 Norway

Norway is conducting a study funded by the Norwegian Research Council from 2017–2019, where the primary objective is to increase knowledge of the extent and development of the marine recreational fishery in Norway with respect to catch, effort, and the cultural and provisioning ecosystem services provided by the sector. The aim is to estimate participation, activity, catches and releases, and expenditure for resident recreational anglers nationally, and to develop methods for studying non-resident anglers that cannot be accessed via telephone registries.

The project aims at developing cost-effective off-site and on-site probability-based survey sampling methods with multiple sampling frames to improve sampling coverage of resident and non-resident recreational fishers. The national phone-survey to be conducted in spring 2018 aims to estimate the percentage of the Norwegian population that participates in recreational sea fishing, demographics and the different fishing methods used. The phone survey will be used to recruit diarists, and a year-long diary survey will be conducted from April 2018–April 2019, where a subsample of resident recreational fishers record their fishing trips (fishing mode, catches and releases of selected species, expenditures, etc.). In Troms and Hordaland Counties, and in the Oslofjord region, on-site methods will be used to provide data on catches, releases of key species, and biological data for cod. The on-site survey will also be used to quantify the proportion of anglers in the informal tourist fishery sector that cannot be intercepted trough the coming registry of fish camps or through the telephone survey. This

study will be completed by spring 2019, and the full analysis cannot start until data collection is complete. The study is ongoing and the WGRFS Quality Assessment for this study focused mainly on survey design, as the analysis is not yet complete (see Annex 5.2).

WGRFS concludes that the Norwegian survey has a reasonable design, but the group could not assess the validity of the analysis at this stage.

3.3.3 Sweden

A pilot marine recreational fisheries survey is being carried out to estimate recreational fishing effort and catches in Sweden. The survey targets fishing trips carried out by residents and non-residents in Sweden in ICES subdivisions (SD) 23 and 24. Separate sampling of tour boats (on-board) and private boats (onshore) is being done, with additional information collected on shore fishing to inform future surveys. The pilot survey was designed in the second semester of 2016 and started on 1 January 2017. Two 2-spatial strata (southwest and south coasts) and four temporal strata (Quarter 1 to Quarter 4) were considered for both components of the fishery. The sampling frame for the tour boat included a total of ten companies and 17 tour boats. The sampling frame of the private boat component include a total of 12 municipalities and 83 marinas/ramps (Figure 3.3.3.1). Sample size was defined based on staff availability, funding availability, and *a priori* knowledge of geographical importance of the different components for the recreational catches of cod.

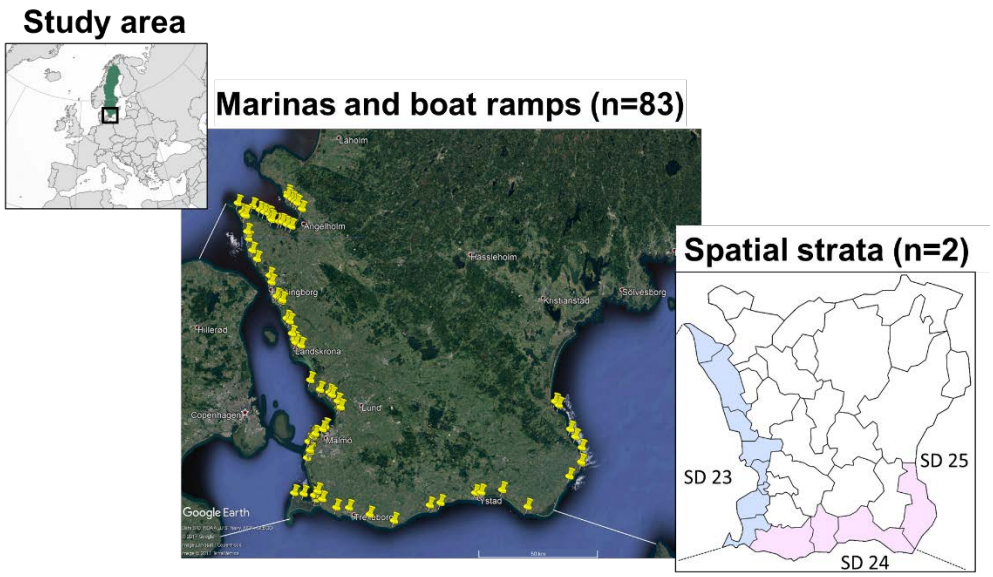

Figure 3.3.3.1. Study area, spatial strata, and geographical distribution of marinas and boat ramps surveyed in the Swedish pilot survey of ICES SD23 and 24.

The study is ongoing and the WGRFS Quality Assessment for this study focused mainly on survey design, as the analysis is not yet complete (see Annex 5.3). The WGRFS identified that the on-site survey required a lot of sampling to estimate effort. There was a lot of variability between days, so four-hour shifts instead of eight-hour shifts should be considered, as it would double the number of days sampled and cover more variability. Approaches to increase the number of sampling days will be assessed including: port masters (e.g. ramp usage, catch information, number of active boats,

etc.) and cameras/automatic registration. Scaling effort based on weather information would also be possible.

WGRFS proposes: the Swedish survey has a reasonable design, but could not assess the validity of the analysis at this stage.

4 EU MAP and regional coordination (ToRs c&d)

4.1 National workplans for EU-MAP

Some members of the group had been involved in pre-screening and evaluation of the quality of National Work Plans (NWP) for marine recreational fishing data collection under the DCF. The core evaluation criteria for these specific NWPs consisted of a review of all aspects of the sampling programme against documented standards (best practice guidelines) and quality assessment tools. The critical requirement was to have accurate and complete documentation of all components of the programme. The experiences of the reviewers were discussed and challenges highlighted, then proposals were made of how the process could be improved in future. To improve the quality of the pre-screening process and NWPs, the WGRFS felt the following were needed:

- **Evaluation criteria should be defined by WGRFS.** The evaluation process revealed a mismatch between the evaluation criteria and the evaluation template. In many cases the evaluation questions, which originated from the WGRFS quality assurance tool (QAT), were too detailed to be answered using information in the NWPs. In addition, there was a mismatch between the design and implementation stage of the NWPs and the evaluation criteria. As a result, evaluation criteria should be developed with the WGRFS to ensure correct scrutiny.
- **Feedback of evaluation outcome to Member States (MS).** The evaluators of the NWPs often provided detailed comments during the pre-screening process. Unfortunately, these were not made available to MS, instead only brief explanations were shared. The detailed reviews should be made available to enable MS to redesign or amend NWPs where necessary.
- **List of experts for recreational fisheries should be supplied by WGRFS.** There was some effort to identify knowledgeable experts to evaluate NWPs for recreational fisheries. The WGRFS is willing to provide a list of experts across Europe and the broader scientific community to facilitate this process.
- **Timely notification of evaluation experts.** Several experts could not contribute to the evaluation because they were contacted just before the deadline, and the evaluation had to be done in a specific week. To secure the most appropriate experts, earlier notification is required, ideally at least two months in advance.
- **Regular evaluation of NWP during WGRFS.** Given the complexity of recreational fisheries surveys, MSs should have their national surveys reviewed at regular intervals by WGRFS using the WGRFS QAT.

WGRFS proposes that feedback is sent to the STECF about the evaluation process that includes the issues identified and that the WGRFS should be integrated into the review of NWPs.

4.2 European marine recreational fishing studies

The European Parliament Committee on Fisheries requested a study to evaluate the relative value and impact of recreational and semi-subsistence fishing within different regions of the EU and funded a consortium of Cefas, AZTI, and Thünen-OF to deliver

the EURecFish project. EURecFish builds on the WGRFS analysis that estimated numbers, participation, effort and expenditure by recreational fishers in Europe (Hyder *et al*., in press). EURecFish examined the social benefits, economic value, and environmental impact of marine recreational and semi-subsistence fisheries in six marine regions of Europe. Five questions were addressed:

1) What is recreational and semi-subsistence fishing, and where do they occur?
2) What is the value of recreational and semi-subsistence fishing?
3) How much fish is caught by recreational and semi-subsistence fisheries and how does this compare to commercial fisheries?
4) What other impacts of recreational and semi-subsistence fishing exist?
5) What needs to be done in future to monitor, assess, and manage recreational and semi-subsistence fisheries?

The report is complete and was released in September 2017, so should be consulted for full details on the methods and outcomes (Hyder *et al*., 2017). Definitions were identified for marine recreational fisheries (ICES, WGRFS) and semi-subsistence fishing. Defining semi-subsistence fisheries was challenging and it was not possible to estimate value or impact. However, it was felt that semi-subsistence fisheries would be captured in either commercial or recreational surveys, so an additional category should not be created. There was significant total economic impact of marine recreational fisheries, so this should be considered as a sector and developed alongside commercial fisheries and aquaculture under the CFP. Comparisons of commercial and recreational removals showed that recreational removals could be significant, but data were lacking for many stocks. Hence, additional data were needed to inform assessment and multi-species surveys should be done. The European Parliament Committee on Fisheries will be developing a position paper on recreational fisheries.

WGRFS proposes: the outcomes from the EURecFish project are reasonable. Support should be provided by the WGRFS to the European Parliament to develop their position paper on recreational fisheries.

4.3 Regional data collection and storage

The data collected on marine recreational fisheries are collated by Joint Research Centre of the European Commission, but the WGRFS highlighted significant issues with the way that the data are stored (ICES, 2014). In addition, recreational fisheries data are stored in a separate database to the rest of the catch data, making the compilation of data for assessment challenging. At present, the most accurate approach to collating recreational fisheries data is either through a data call or from the tables in the annexes of the WGRFS report. However, these tables only contain the latest estimates, so it is necessary to look through all the reports to collect a time-series. This is not a sensible or efficient approach to data provision, so a database that contains recreational fisheries data should be developed. Regional databases (RDBs) are being developed for commercial survey data at present, so it would make sense to consider if recreational survey data could also be included.

Commercial fisheries survey raw data will be contained in the RDB, with raising procedures coded into the RBD to provide estimates. However, the varied nature of the recreational fishery and culture differences in responses to survey instruments mean that a single design is not possible or efficient to deploy across Europe. Instead, the focus has been on assuring the quality of each individual survey and understanding

how the data can be used alongside other estimates in stock assessment. As a result, there is a large variety of different designs that include on-site and off-site methods with different designs and raising procedures. Hence, the commercial approach to include raw data and raising will not work, as a bespoke coded procedure would be needed for each survey. This would be very inefficient and subject to large potential errors unless done by the national expert in recreational fisheries. Instead, raised tonnages and numbers of fish caught and released should be captured by area and year, alongside length–frequency distributions. In addition, a short description of the survey is needed and an assessment of the quality (e.g. biases, design, missing platforms and methods, etc.). The principal focus of any database at this stage should be to ensure that data from national surveys of different types are properly archived and subjected to appropriate QA/QC procedures. In addition, the full process from survey design, implementation, data archiving and quality control, data analysis and reporting is documented and transparent for each country contributing to a regionally coordinated recreational survey program.

Different options to store recreational fisheries data were considered, with two potential solutions: 1. improve the JRC database; or 2. engage with the RDB system being developed by ICES called Regional Estimation System (RES). RES will initially contain commercial fisheries landings and sample data and raising/estimation methods, but the plan is that this system should cover all fisheries data. The system should include bycatch, recreational fisheries, and diadromous fish, but these will need their own structure so will not be developed in the first iteration of RES. The end-users include: ICES expert groups, the Regional Coordination Groups (RCGs), and STECF.

Given the nature of the RES and the set of end-users, WGRFS felt that storage of recreational data in RES would maximise uptake and use. WGRFS provided a summary of the data fields needed to be included in RES, and agreed to work with ICES to identify the possible options for the incorporation of recreational fishing data and the timescales over which this could happen.

WGRFS proposes that processed recreational fisheries data should be stored in regional databases and that WGRFS should work with ICES to develop a plan and time-scale for delivery of this solution.

5 Collation and use of data in stock assessments (ToR d)

5.1 Sea bass

The trends and status of the sea bass stock in the North Sea, Channel, Celtic Sea and Irish Sea (ICES areas 4 b, c and 7 a, d–h) have been estimated since 2012 using an integrated analytical assessment framework (Stock Synthesis 3). This was first developed for sea bass by ICES IBP-NEW in 2012 (ICES, 2012), then further developed by IBP-Bass in 2014 (ICES, 2014) and by IBP-Bass2 in 2016 (ICES, 2016a). The IBP-Bass2 assessment was carried forward to an update assessment in 2016 providing management advice for 2017 (ICES, 2016b). WKBASS was tasked with benchmarking an analytical stock assessment method for the northern stock (ICES areas 4.b&c, 6.a, 7.d–h) and the Biscay stock (ICES areas 8.a&b) stocks. A data evaluation workshop was held in January 2017 and an assessment workshop in March 2017. Advice for the Iberian Coast (ICES, 2017a) and West of Scotland and Ireland (ICES, 2017b) was released at the end of June 2017. However, for the Northern and Biscay stocks, the final assessment was delayed, and advice was released in October 2017 (ICES, 2017c; 2017d).

Since 2014, ICES have used an assessment approach for sea bass that allows inclusion of an estimate of recreational fishery removals derived from surveys carried out in Europe over the period 2009–2013. Recent estimates of total recreational harvests of sea bass for France, the Netherlands, England and Belgium (data supplied informally by Belgium) in subareas 4 and 7 amounted to 1400–1500 t. With no direct knowledge of post-release mortality of sea bass, WGCSE previously reviewed studies on similar species such as striped bass in the USA, but did not include a value in the assessment along with estimates of released fish, and assumed the total recreational landings were approximately 1500 t in 2012. ICES therefore considered it desirable to have the recreational fishery F represented in the assessment and forecast, so that impacts of measures on either fishery could be evaluated. The method used to reconstruct a time-series of recreational landings assumed that the recreational fishery F in all years of the assessment was the same as that given by the estimated recreational harvest of 1500 t in 2012. This was considered more feasible and defensible than assuming the same harvest of 1500 t in all years, or the same proportion of total fishery harvest each year (e.g. 25% as in 2012) given the large changes in biomass and the growth of commercial fishing over time.

An update of the recreational data was provided for WKBASS. Several challenges were identified with the compilation and use of recreational fisheries data in the assessment. There were surveys spanning different years and regions that could be used in the assessment (Table 5.1.1), but it was unclear which years should be selected. In addition, no data were available after the introduction of management measures in 2015, so estimation of the changes in exploitation was difficult. The implementation of a suite of management measures including a larger MCRS of 42 cm, closed season, bag limits for recreational fishers, and boat and unavoidable bycatch limits for commercial fishers, meant that post-release mortality and discards are an important component of fishing mortality and should therefore be included in the assessment. As a result, an estimate of post-release mortality was needed for the recreational fishery. Finally, the selectivity by recreational fisheries will have changed in response to the management measures, so selectivity curves were needed for both the kept and the dead release pre- and post-implementation of management.

New studies of sea bass post-release mortality have been done (Lewin *et al.*, submitted; Ruiz *et al.*, 2015). A combination of these studies with reanalysis of striped bass studies

in marine systems, suggested that post-release mortality of sea bass should be set at 15%. However, it is clear from sea bass studies that gear used has a large impact on post-release mortality with mortality higher for bait than lure caught fish (Lewin *et al*., submitted; Ruiz *et al*., 2015). Hence, it may be possible in future to estimate post-release mortality for each stock using information on the methods used to catch sea bass (Lewin *et al*., submitted; Section 6).

An additional data call was made by ICES asking countries to submit all national recreational fishing survey data on sea bass catches and length–frequency distributions. These data were provided to the WGRFS with a request for a proposal of how best to use the data in an assessment. Data were submitted by the Netherland and UK (Table 5.1.1), and France and Belgium presented plans for new surveys.

Table 5.1.1. Sea bass catches and releases in both numbers of fish (A) and tonnages (B) for France, the Netherlands, and the UK. Preliminary data for 2016 also provided to WGRFS, but are not included in this table.

A. Numbers (thousands)

Country	Year	Area	Retained	RSE	Relased	RSE	Total	RSE	% released
France	2009-11	IV & VII	781		796		1578	>26	50
	2009-11	Biscay	1168		1190		2357	>26	50
	2009-11	All	1949		1986		3935	26	50
	2011-12	IV & VII	2043		1581		3624		44
	2011-12	Biscay	572		281		852		33
	2011-12	All	2615		1861		3935		47
Netherlands	2010-11	Southern North Sea	234	38	131	27	366	30	36
	2012-13	Southern North Sea	335	26	332	21	667		50
	2014-15	Southern North Sea	176	19	499	20	675		74
UK	2012-13	IV & VII	367		576		943		61

B. Weight (tonnes)

Country	Year	Area	Retained	RSE	Relased	RSE	Total	RSE	% released
France	2009-11	IV & VII	940		332		1272	>26	26
	2009-11	Biscay	1405		496		1901	>26	26
	2009-11	All	2345		828		3173	26	26
	2011-12	IV & VII	2458		659		3117		21
	2011-12	Biscay	688		117		805		15
	2011-12	All	3146		776		3922		20
Netherlands	2010-11	Southern North Sea	138	37					
	2012-13	Southern North Sea	229	26					
	2014-15	Southern North Sea	138	20					
UK	2012-13	IV & VII	230-440		150-250		380-690	26-38	36-39

The reference year 2012 was still used as the point estimate for recreational fishing for the northern stock, and the catch for Belgium was excluded as no reference for this amount could be found. The 2009–2011 data were used for France, as partitioning between the northern and Biscay stock was possible (Rocklin *et al*., 2014). A reanalysis of the 2011–2012 study (Levrel *et al*., 2013) provided separate estimates for the Biscay and northern stocks, but there was a large difference form the 2009–2011 (Table 5.1.1). This may be due to the different survey design or low sampling effort in Biscay, so the 2009–2011 study was selected. The 2010–2011 survey for the Netherlands was selected and combined with 2012 UK data and the 2009–2011 French data. Using a post-release mortality of 15%, the total removal in 2012 was 1501 tonnes (Table 5.1.2).

Table 5.1.2. Sea bass catches in tonnes for France, the Netherlands, and the UK using 2012 as a reference year.

Country	Year	Area	Retained	Released	Dead Rel	Total
France	2009-11	IV & VII	940	332	50	990
Netherlands	2010-11	Southern North Sea	138	56	8	146
Belgium	----	----	----	----	----	----
UK	2012	IV & VII	335	200	30	365
Total	2012	IV & VII	1413	588	88	1501

A single selectivity was estimated for the northern and Biscay stocks based on the French and English length–frequency distribution from surveys (Armstrong *et al.*, 2013; Rocklin *et al.*, 2014). The raised length–frequency distributions for each country were subsequently binned into 2 cm lengths and summed for the kept and released components for the purpose of inclusion in the stock assessment. Then a post-release mortality of 15% was applied to the released component before adding to the kept fish to give the recreational fishery selectivity (Figure 5.1.1).

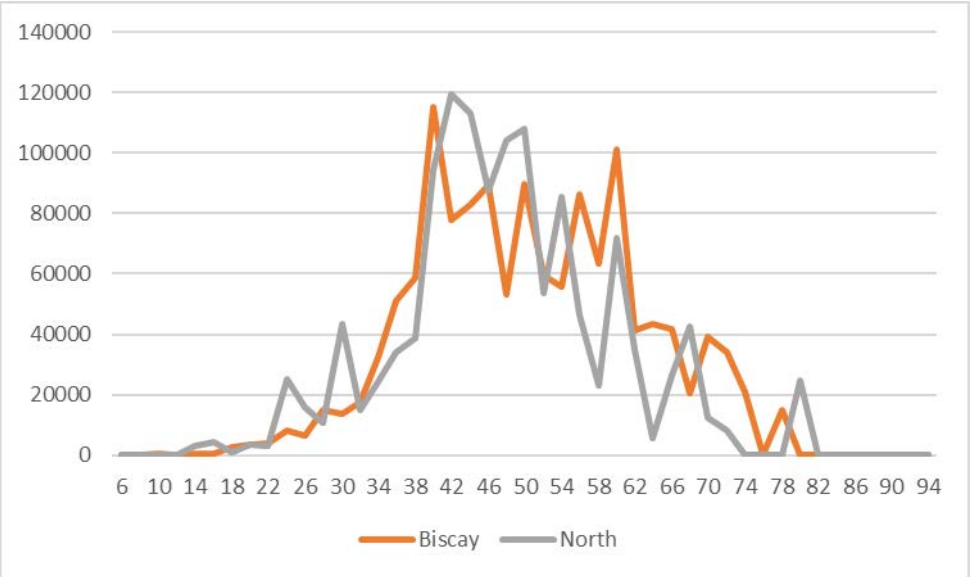

Figure 5.1.1. Sea bass selectivity by recreational fisheries for the northern and Biscay stocks.

Given the current dataset, the WGRFS proposed that sea bass removals must be included in the assessment, and that the kept and released component should be accounted for. The assessment should have two sets of recreational data from the reference year 2012 (Table 5.2.2) and a second set for 2016 after the management measures were introduced. Management measures included an increase in the MCRS to 42 cm, closed season, and bag limits. These have a large impact on both removals and selectivity, so survey data after the introduction of measures should be included in the assessment. However, only the UK and Netherlands provided data for 2016, with Belgium and UK collecting data in 2017, Netherlands and France in 2018. As a result, sea bass removals after management measures were introduced should be based on UK and Netherlands, alongside extrapolation from the French 2009–2011 data for the 2017 assessment, and length–frequency distributions from the UK.

Several ways of generating these numbers were suggested including extrapolation and correction of 2012 data. The most appropriate was the use of the Netherlands data to correct French recreational catches from the 2009–2011 survey. This led to higher removals in 2016 than 2012 (~8%) due to increased release rates for the Netherlands (extrapolated to France) and large UK releases from the 2016 survey. This increase could be the result of any combination of the following: change in survey methods, error associated with the estimates, methods used to estimate French catches in 2016 from 2012, changes in availability of fish for recreational fishers, or interannual variability of catch or catch per unit of effort (cpue) of recreational fishers. Given the uncertainty in the reconstructions of recreational catches for 2016, it would be prudent to assess the sensitivity of the assessment and projections to the 2016 recreational removals, and test additional scenarios.

Recreational removals survey data from all countries that catch sea bass are needed in order to improve these estimates, and a continuous time-series of data is required to improve the stock assessment model and projections. Additional data should be included in the assessment as soon as they become available for Belgium (2017), France (2018) and Netherland (2018). In addition, UK surveys for 2017 will provide further information on the levels of catches and releases that will allow review of the large levels of release of sea bass observed in 2016, and should be included in the next assessment as soon as the data become available.

WGRFS proposes that recreational catches and post-release mortality should be included in the assessment for two reference periods: before management measure (2012) and after management measures were introduced (2016). There was a lack of survey data for several countries making removals post-management measures difficult to estimate, but in the short term should be based on data from the UK and Netherlands alongside extrapolation from the French 2009–2011 data. The removals in 2016 are slightly higher than 2012 due to higher release rates and large UK releases in 2016. This could result in additional uncertainty in the assessment, so the sensitivity of the assessment and forecasts to 2016 recreational removals should be tested. Additional data from Netherlands, France, Belgium, and UK should be included in the assessments as soon as they become available, and time-series included in the assessment as they are generated.

5.2 Western Baltic cod

The 2015 ICES Benchmark Workshop on Baltic Cod Stocks evaluated the appropriateness of data and methods to determine stock status for the cod stocks in SD 22–24 (western) and SD 25–32 (eastern) (ICES, 2015). Stock identification based on otolith shape analysis showed a high degree of stock mixing in SD 24, so the catch was split into two stocks with the eastern cod representing around 65% of the current total removals. The proportions of eastern and western cod in SD 24 was reconstructed back to the mid-1990s and landings-at-age were obtained using the age structure from SD 22 (ICES, 2015). A stochastic state–space model (SAM) is used to estimate trends and status.

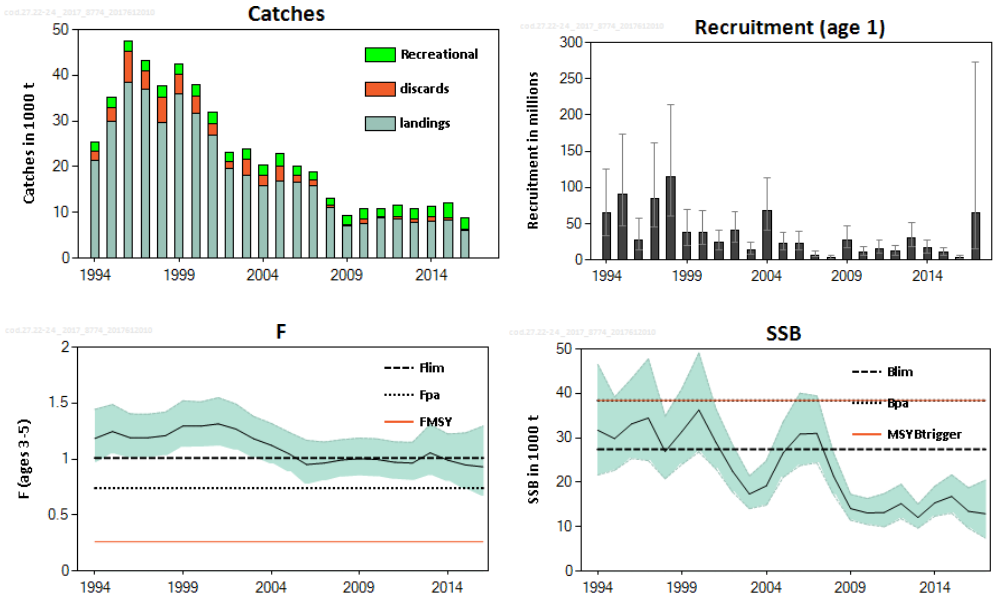

Figure 5.1.1. Cod in subdivisions 22–24 (western Baltic cod). Summary of stock assessment (weights in thousand tonnes). Recruitment, F, and SSB have confidence intervals (95%) in the plot. The EU landing obligation started in 2015; therefore, landings in 2015 include fish above and below the minimum conservation reference size (MCRS).

The spawning–stock biomass (SSB) has been below the limit reference point B_{lim} since 2008 (Figure 5.1.1), while fishing mortality (F) is above F_{MSY} and recruitment (R) has been low since 1999, however, recruitment in 2017 is estimated to be the highest since 2005 (ICES, 2017e).

Commercial catches are mainly taken by trawlers and to a lesser degree by gillnetters in subdivisions 22–24. There is a trawling ban in place for the largest part of subdivision 23, so gillnetters take the largest share of the commercial catches in this area. Overall catches are mainly Danish, German, and Swedish. Since 2015, the EU landing obligation obliges the fishery to land all catches of cod, making discarding an illegal activity. In this context, the minimum conservation reference size (MCRS) was reduced to 35 cm.

Recreational catches are mainly taken by private and charter boats and, to a small degree, by land-based fishing methods. Overall catches are mainly Danish, German and Swedish. However, only German recreational catches are included in the 2017 assessment, so represent a large underestimation of recreational removals. (ICES, 2017a). The lack of Danish and Swedish recreational fishery removals adds to the uncertainty of the assessment, and it is unknown when these data will be included. Preliminary estimates of Danish and Swedish recreational catches in 2015 were 1250 t and 215 t respectively (ICES, 2016c).

ICES provided information on catch opportunities for the commercial sector; this was implemented assuming a recreational catch of 1754 t in 2017. This corresponded to the observed average of the last three years (2014–2016) of recreational catch (2654 t) minus the estimated reduction (900 t) due to the introduction of the bag limit in 2017. This gave catch advice of between 1376 t and 3541 t total commercial catch in 2018 for western Baltic cod, corresponding to the F ranges in the plan. (ICES, 2017f).

The council of ministers decided on catch limits for 2017 in the Baltic Sea reducing the total allowable catch for western Baltic cod by 56% and introducing bag limits for recreational fisheries of five cod per fisher and day, and three cod per fisher and day during the spawning closure in February and March. The introduction of the bag limit has had strong effects on the German recreational fishing sector in 2017 with reported declines in numbers of charter boat anglers between 30–50%. The deterring effect of the bag limit is further enforced by declining catches due to the poor stock status. This means that catches are reduced through declining effort independent of the current bag limit. The estimated 900 t cod catch reduction (used by ICES for 2018 advice) is based on the assumption of constant recreational fishing effort. Accordingly, the actual catch reduction could be higher, but cannot be quantified at present.

WGRFS proposes the inclusion of Danish, German, and Swedish recreational catch data of western Baltic cod in the assessment. This includes exploratory stock assessment runs to test the effect of including all recreational data on SSB and F, possibly by pooling total recreational catch. Regional cooperation and sharing of data (e.g. biological) across subdivisions should be further explored to fill data gaps. There is also a need to observe recreational fishing effort dynamics in response to the introduced management measures.

5.3 Baltic salmon and sea trout

To evaluate the status of wild Baltic salmon stocks, the ICES Baltic Salmon and Trout Assessment Working Group uses smolt production relative to the potential smolt production capacity (PSPC) on a river-by-river basis (ICES, 2017g). Time-series indicate that the status for most stocks has improved over the last five years. The natural salmon smolt production has gradually increased in the Gulf of Bothnia rivers, and in the Main Basin and Gulf of Finland in recent years. Continued increase of smolt production is predicted in 2017–2018 for most rivers, mainly because of good spawning runs in 2013–2016 (ICES, 2017g). An increasing proportion of the assessed river stocks have reached 75% of PSPC with high or very high certainty, especially in the north. At current fishing pressure and natural mortalities, a continued positive status development is predicted. As previously, most weak salmon rivers are in the Main Basin and Gulf of Finland, but status has improved in these southern stocks. Wild Estonian (Gulf of Finland) stocks show recovery (ICES, 2017g). The exploitation rate of Baltic salmon in the sea fisheries has been reduced to such a low level that most stocks are predicted to recover. However, weak stocks also need long-term stock-specific rebuilding including fisheries restrictions in estuaries and rivers, habitat restoration, and removal of migration obstacles (ICES, 2017g).

The total salmon catch in 2016 (excluding recent estimates of trolling catches; see below) was the second lowest in the time-series since the 1970s, although the level has been similar in recent years. Efforts in several important commercial fisheries decreased to their lowest recorded. The total share of recreational (non-commercial) catches in the sea and rivers continues to increase (Figure 5.3.1). The offshore trolling fishery has developed rapidly (ICES, 2017g).

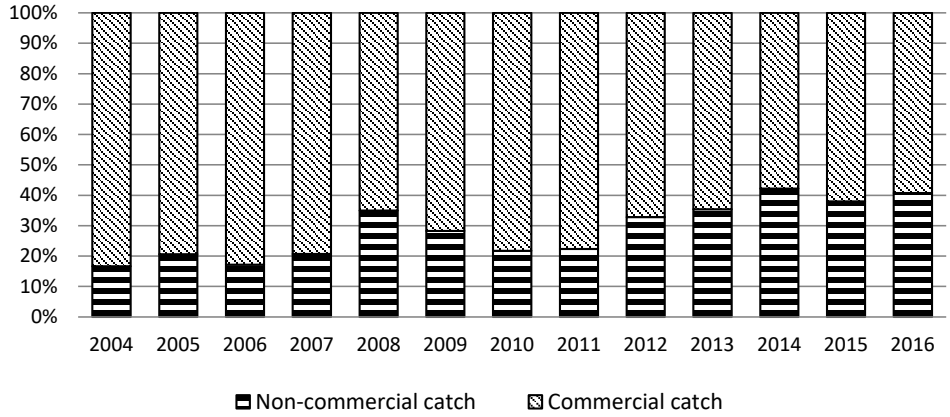

Figure 5.3.1. Commercial and non-commercial catches in percent (weight) in 2004–2016 in subdivisions 22–32 (total catches from sea, coast and rivers; derived from ICES, 2017).

Recreational trolling is an increasingly common and popular fishing method to catch salmonids in the Baltic Sea. Trolling is practised by private anglers and professional guides. The recreational salmon fishery, including the trolling sector, supports an industry in structurally and economically weak regions that provides jobs involved in manufacture, sale, or provision of tackle, boats, professional guide services, hotels, restaurants and more (ICES, 2017g). Recent survey estimates from Germany revealed that trolling anglers spend on average €3500 annually (Kaiser, 2016).

Recreational fishers troll several fishing lines, baited with lures or natural bait through the water. Fishing lines are spread horizontally with help of planer boards and vertically using downriggers. Common trolling speeds vary from 1.5 to 3 knots. Small boats used for trolling vary between 3 and 8 meters. Fishing grounds are usually over deeper water, and boats may venture more than 20 nautical miles offshore. Therefore, weather conditions have a strong impact on the trolling effort, and bad weather conditions may prevent trolling boats leaving port. The season varies between the different sea areas and depends on the feeding and spawning migration of salmon and/or seasonal closures. In the western Baltic and the Main Basin, it typically starts in late fall and ends in May, whereas in the Åland Sea and Gulf of Bothnia it starts at the end of May and ends in late summer (ICES, 2017g).

Recreational salmon trolling has been practised in the Baltic Sea for more than 30 years, however, catch data from individual countries are still incomplete or missing (ICES, 2017g). One reason for this is that trolling data collection is often not included or sufficiently covered in national recreational catch sampling schemes. The magnitude of this fishery also varies between countries, and while in some countries trolling effort has levelled off (e.g. Sweden), it is developing in others (e.g. Poland and Lithuania).

To account for this source of fishing mortality and to facilitate the inclusion of trolling data in the Baltic salmon stock assessment, a time-series comprising both retained and released components was developed as part of a recent benchmark (ICES, 2017g). National experts were asked to reconstruct time-series of the number of retained and released salmon caught in the recreational trolling fishery, starting from 1987, by using quantitative data from surveys (if available) and/or qualitative inquiry of stakeholders (e.g. experienced trolling fishers, local authorities, fishing guides, and angler associations). In addition to providing a mode number of retained and released salmon for each year and area, national experts were also asked to provide a minimum and maximum value as a measure of uncertainty. National estimates were asked for to cover

the three main areas with feeding or spawning migrating salmon (i.e. SD 22–28, SD 29–31 and SD 32). The triangular probability distributions per year and area collected from national experts (min-mode-max) were combined into joint medians (with 90% probability limits) using the same transformation as applied to similar expert estimates of discarding and underreporting (ICES, 2016d). The total number of retained salmon includes an assumed post-release mortality rate of 25% for troll-caught released salmon. As no post-release mortality estimates for troll-caught Atlantic or Baltic salmon in marine waters exist, the 25% mortality rate was derived from a review of studies of troll-caught Pacific salmon (Parker *et al*., 1959; Butler and Loeffel, 1972; Wertheimer, 1988; Wertheimer *et al*., 1989; Gjernes *et al*., 1993; Orsi *et al*., 1993).

The resulting joint expert estimates for trolling catches in SD 22–28, SD 29–31 and SD 32 over time are depicted in Figure 5.3.2. This preliminary evaluation suggested that the true recreational catch at sea has potentially been 20 000–30 000 salmon larger than assumed in the assessment period 2010–2016. Exploratory model runs were planned to evaluate the response of the assessment and the sensitivity to the stock size (ICES, 2017g). Unfortunately, fitting the model to data was a challenge, so no scenario could therefore be run including these recreational trolling catches. This will instead be assessed by intersessional work.

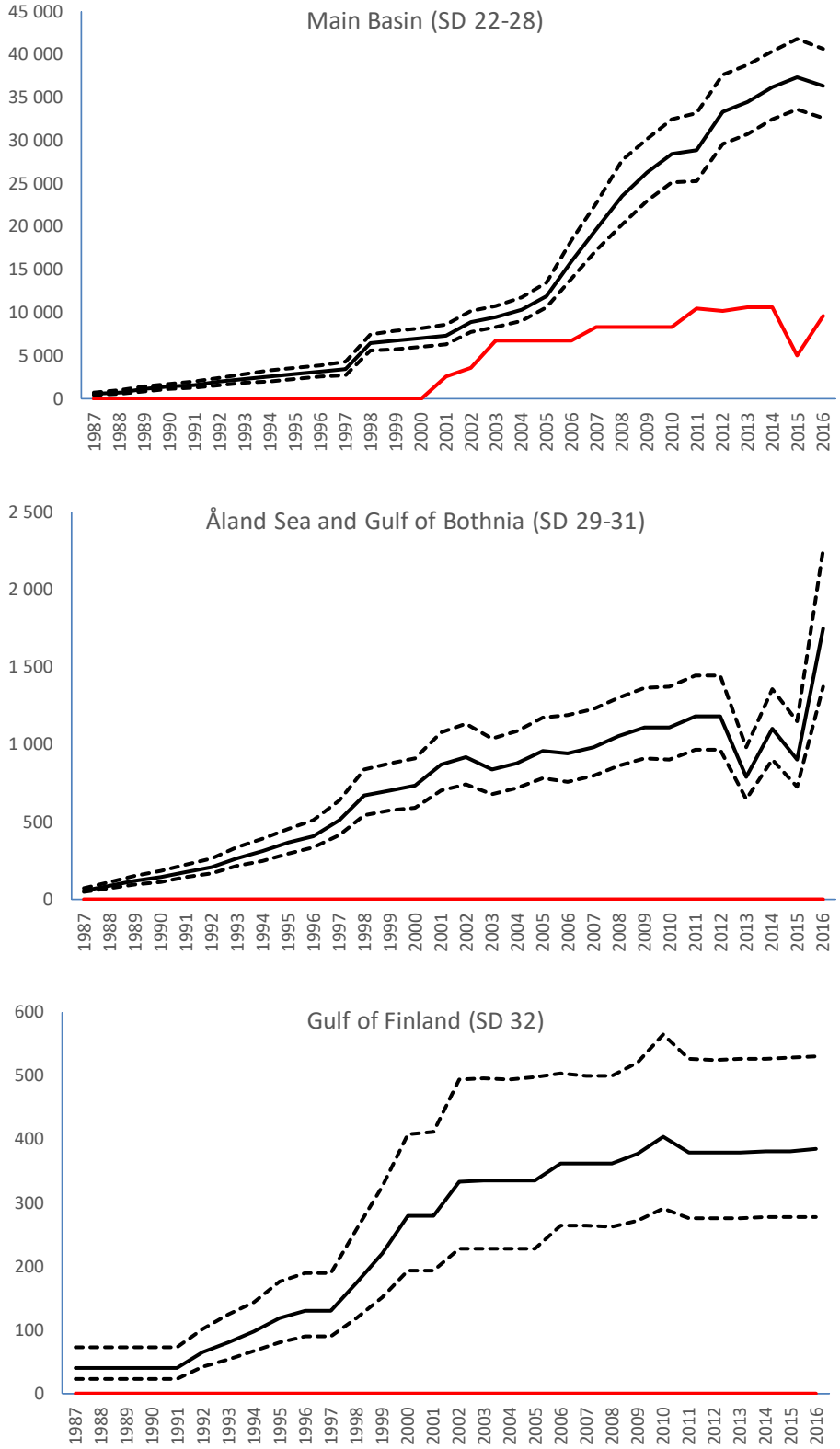

Figure 5.3.2. Combined expert estimates of total trolling catches (dead fish) for Baltic salmon, 1987–2016 (medians with 90% p.i.). Red lines show previous estimates of trolling catches. Note the different scales (derived from ICES, 2017g).

However, according to the nature of the Baltic salmon assessment model, the underestimated trolling catches are currently most likely included as a component of natural mortality leading to an overestimate of post-smolt mortality (ICES, 2017g).

Recreational sea trout fishing in the Baltic is very diverse with different fishing methods from shore and boat in the sea and in rivers. Recreational sea trout catches are substantial compared to the commercial fishery in particular in the western Baltic Sea. The coverage and data quality of the recreational freshwater catches is good due to mandatory catch reporting in several countries, but some gaps remain. However, the data quality and coverage of marine catches are poor and there is a need for better and more data to reduce this uncertainty in the assessment. Some positive signs can be seen for sea trout in the Baltic Sea, but many populations are still considered vulnerable. Stocks in the Gulf of Bothnia are particularly weak, although spawning numbers are improving. In general, stock status is higher in the Main Basin and in the southern Gulf of Finland (ICES, 2017g). However, exploitation rates in most fisheries that catch sea trout in the Baltic Sea area need to be reduced. This also includes fisheries for other species where sea trout is caught as bycatch. In areas where stock status is good, existing fishing restrictions should be maintained in order to retain the present situation (ICES, 2017g).

WGRFS proposes that there is an urgent need for the collection of more robust data (catch, effort, post-release mortality, socio-economic importance) for the Baltic Sea recreational salmon fishery, in particular, from the trolling fishery. If catch estimates are not available or if there is a need for reconstruction of time-series using the approach developed for the trolling fishery by WGBAST is recommended to close existing data gaps. There is also an urgent need to collect information (catch, effort, post-release mortality, socio-economic importance) from the recreational sea trout fishery in the Baltic Sea.

6 Post-release mortality (WP2)

To estimate fishery-specific mortality, WGRFS collected information on recreational fishing practices in different European marine recreational fisheries, e.g. commonly used bait and lure types, capture depths and water temperature ranges during two workshops conducted in 2015 and 2016. One focus species was European sea bass as recreational release rates are high and fishery-specific post-release mortality estimates are needed for stock assessment. During this year's workshop, fishery-specific mortality estimates for European sea bass based on a post-release mortality experiment and fishery-specific information were presented and discussed. In the post-release mortality experiment, no mortality was observed for sea bass captured on artificial lures. However, the use of natural baits resulted in a mortality of 13.9%. Significant mortality factors were deep hooking, hooking injuries and prolonged handling times. Survival probability increased when artificial lures were used and air exposure duration was limited. Deep hooking resulted in 76.5% mortality. Post-release mortality estimates ranged from 2.8–9.1% in Belgium, England, France, and the Netherlands considering country-specific sea bass angling practices (Lewin *et al*., submitted). This approach was deemed sensible and useful by WGRFS when fishery-specific post-release mortality estimates are not available.

Apart from post-release mortality, sublethal impacts can occur. This has been discussed at previous WGRFS meetings, but the topic was highlighted again. Animal welfare discussion are arising in several countries (e.g. Norway and Denmark) due to the potential negative impacts of catch-and-release on the fish. Sublethal impacts can be minimised by best practice guidelines developed based on experimental results.

WGRFS proposes to continue collecting recreational fishery characteristics target species (e.g. Atlantic cod, European sea bass, and European eel) to enable extrapolation between stocks and fisheries. Furthermore, WGRFS proposes that sublethal impacts of C&R are investigated for relevant target species to develop best practice guidelines and to evaluate C&R regulations from a fish welfare perspective.

7 Novel methods for collection and analysis of data (ToR b and WP1)

7.1 Smartphone apps and standards

This session critically reviewed the potential of novel survey methods to deliver recreational fisheries data. The focus was on smartphone apps where recreational fishers report information, for example, about fishing trips including trip and catch information. Angler apps (fisheries apps hereafter) are a potential new tool for efficiently collecting conventional and novel fisheries data, and have the potential to fundamentally change how fishers interact with the resource and management approaches (Venturelli *et al*., 2017). However, the fisheries app market is very diverse, competitive, and unpredictable, and apps collect a variety of different data. Therefore, it is important to develop standards that ensure that apps both individually and as a sector, generate large and reliable data streams that support existing data collection under the DCF. One challenge is to understand the biases associated with app-derived data, as this will maximise the utility of the data collected.

To understand biases and develop standards, a workshop was run that focused on two important aspects of fisheries apps: 1. defining and prioritising data collection standards; and 2. identifying challenges and suggestions to solutions. To achieve this a short introduction to fisher apps was provided, and then breakout sessions addressed the following questions:

- What information should be collected by the apps?
- What are the challenges of using app-derived data and are there potential solutions?

Two groups listed the standard information the fisheries apps could provide and then ranked them by level of important to scientists (essential, important, useful) and anglers. The focus was on catch and effort, but other information was also identified that could be of use. Summary of the outputs for the two groups is provided in Table 7.1.1. There were differences in the rankings between the groups, for example demographic information was viewed as important or essential, but agreement on many of the required fields (Table 7.1.1). Further work is needed with the app developers to identify how standards can work, especially the balance between amount of information provided and likelihood of the information be completed by users.

The challenges and potential solutions of using app-derived data were discussed and summary of the outcomes from the groups is provided in Table 7.1.2. The use of app data to support analyses and understanding of recreational fishing leads to many challenges that need to be resolved. In general, challenges can be (partially) solved through comparisons with traditional surveys as a reality check. Challenges such as self-selection and user retention could be partly addressed by demonstrating the benefits of the app for the user (e.g. tailor-made overview of legislation based on specific coordinates, etc.), making the app attractive, or by the introduction of mandatory catch reporting. Other challenges include demographic bias (no Internet access, no cell phone), data confidentiality (potential users do not trust the system), and the high response burden for average fishers. The extent of non-reporting, including zero catch trips, could possibly be assessed by identification of when the user is at fishing locations. Incorrect reporting is also a challenge, and could be the result of both intentionally (gaming the system) and unintentionally actions (reporting catches of colleagues on the same boat,

unreliable fish sizes, incorrect species identification, typing errors). New innovative technologies might allow weighing fish with smartphones or measuring fish from photographs, but simple actions including providing measurement stickers for fishermen or taking photos of fish that include a scale. The problem of unambiguous time measurement can be solved by explicitly distinguishing the 'no fishing/fishing' hours on the base of an individual trip. Recall bias was considered as less important in this case, but users may delay the upload of their trip, and could result in non-reported catches.

WGRFS recognises fisher apps as a potential new source of data for fisheries management, but there are significant challenges in using the data. The extent and direction of biases could be addressed through comparison of app data with onsite data, such as creel or access point surveys. Due to the broad range of apps available, data collection standards should be developed by a collaboration of app companies and end-users.

Table 7.1.1. Lists of standards for fisher apps and ranking in importance by two groups.

PRIORITY	BREAKOUT GROUP 1	BREAKOUT GROUP 2
Essentials	Place – coordinates or with OK resolution	Species ID
	Date	Catch (numbers/lengths) (maybe weight)
	Target species	Releases (numbers/lengths) (maybe weight)
	Fish harvested	
	Fish released	
	Fishing mode	
	Gear type	
	Demographic variables such as address, age, gender	
Important	Effort (Start time fishing)	Effort (time/how long trip) and number of persons using the app
	Effort (Stop time fishing)	Basic demographics (personal data + area specific) to scope the population
	Break (time not fishing during trip)	
Useful	Length/weight	Avidity

PRIORITY	BREAKOUT GROUP 1	BREAKOUT GROUP 2
	Reason for release of fish –	Area (grid) (no coordinate) (map is always useful)
	State of fish released	Trustworthiness check
	How many in your group?	Recording zero trip
	Other fishers observed (number?)	What are your target species for today?
	Contest/competition/recreational	Fishing type (sea, shore, freshwater etc.)
	GPS-tracker	Gear type (passive or sport fishing)
	Socio-economics (many levels)	Lure type
	Photo	Expenditure per trip
	Membership in organisations	Anglers opinions about regulations (feed-back loop)
	Experience level	
For anglers	Social group networks	Weather and environmental data
	Possibilities to chat with other anglers	
	Fisheries regulations based on your GPS	
	Angler comments/notebook	

Table 7.1.2. The challenges of using app derived data and potential solutions.

Challenges	Breakout Group 1	Breakout Group 2
Self-selection	Post-stratify and correct for bias (e.g. avidity, expertise) using existing knowledge of the population from national surveys.	Use diary panels as a test to look at the levels of reporting. Attempt to find a diverse user group.
Retention	Demonstrating the app benefits, making app attractive, mandatory reporting	Obligatory reporting of fishing trips and catches.
Demography	Post-stratify and correct.	
Privacy	Data confidentiality.	
Incorrect reporting	Mandatory reporting and controls.	Buy-in and establish conscience towards sustainability.
Non-reporting	Reward systems and check if catch is reported after phone is located onshore or offshore.	Motivate people using rewards.
Effort	Ask to partition fishing trip into hours fished and hours travelling or not fished.	Provision for gear types in user profile and select each time fish. Build in value of complete reporting through logbook functionality.
Blank trip		Underreporting of zero catches and overreporting of large fish. Motivation to report all trips as this maximises the benefit of the logbook functionality.
Recall	App gives insight in avidity and adapt recall to avidity.	
Locations		Fishers are unwilling to give away location information. Fisher's locations not shared with other users. Use GPS to record location and movement.
Gear used		Gear type clearly stated, as very different information required (e.g. passive rearvs.angling). Challenge for single app to capture diversity, so may not be possible for rare activities and gear.
Fish species	Use photographs.	Take photographs and develop look ups for identification.

Challenges	Breakout Group 1	Breakout Group 2
Fish size	Giving scale for fishermen in combination with photographs. In future, measurements or weighing scales that link to phones.	Get super users to quality check that data from others - particularly where known fishing locations.

7.2 Webcams

Different survey and sampling techniques for marine recreational fishing activities have been developed over the past decades. Many of these survey techniques have been applied successfully and are under constant improvement (Steffe *et al*., 2008). Especially, integrated systems using a combination of multiple surveys are being tested (Ryan *et al*., 2013). Although, many of which proved to be successful, there is still room for improvement for the level of accuracy in estimating effort catches and the cost-effectiveness of survey strategies (Ryan *et al*., 2013). Additionally, many surveys focus on relatively large recreational fisheries targeting multiple species (Smallwood *et al*., 2011). Attaining viable data from small, specialised angler populations is particularly challenging using commonly used survey methods.

The use of remote cameras offers a potentially accurate and cost-efficient way of continuously monitoring levels of recreational fishing effort (Hartill *et al*., 2012; Smallwood *et al*., 2012; Hartill *et al*., 2016; Keller *et al*., 2016). This approach has already been successfully utilised in different fishing locations, including freshwater (Patterson and Sullivan, 2013) and coastal marine fisheries (Parnell *et al*., 2010; Smallwood *et al*., 2012) and has been under constant improvement ever since (Van Poorten, *et al*., 2015). Preliminary results showed that only costs of the data analysis are high when using cameras as monitoring tools (Smallwood *et al*., 2011). Although, interactive database software can lower these costs by a considerable amount (Greenberg and Godin, 2015), selecting a suitable frequency at which images are taken and then subsampled for interpretation is still crucial to the effectiveness of the survey (Hartill *et al*., 2016). Only a few studies have been conducted testing the long-term use of remote cameras. This methodology is still relatively new and the involved components should be improved to produce viable and cost-effective data (Ryan *et al*., 2013). If camera monitoring is optimised, it has the potential of providing accurate fishing effort estimates at comparatively low cost. Two case studies are presented from Germany and New Zealand showing different applications of remote cameras in recreational fisheries monitoring.

7.2.1 Web camera monitoring in Germany

In 2014/2015, a nationwide telephone–diary survey was conducted to collect representative data on catch and effort, and social, economic and demographic parameters for the German marine recreational fishery. However, this survey resulted in very small numbers of panellists for some small, but, in terms of stock exploitation, important and highly specialized fisheries, e.g. the recreational Atlantic salmon (*Salmo salar*) fishery in the Baltic Sea. Using the German recreational salmon-trolling fishery as a case study, we tested the long-term use of remote cameras in harbours to monitor boat fishing effort. Remote cameras have been installed in three important salmon trolling harbours to count boats leaving for fishing with recording time restricted to the period in which trolling boats are known to leave the harbour. Depending on location, the cameras took 12–30 pictures per minute. Picture analysis and boat counting was conducted via visual inspection of the pictures in quick motion. The camera monitoring was complemented by on-site interviews to estimate catch per unit of effort and

to collect biological catch data and socio-economic information. Preliminary results revealed that remote cameras proved to be a cost-efficient method providing accurate fishing effort estimates helping to reduce bias in recreational catch estimates. Several potential advantages and disadvantages of using cameras to monitor recreational fisheries have been identified. Advantages include time- and cost-efficiency, low bias (census possible), high temporal resolution of data, broad application range, storage of data allows reanalysis, and easy installation with little infrastructure needs. Disadvantages comprise legal issues (e.g. potential violation of privacy rights), weather, theft, and vandalism related outages and accumulation of large amounts of data that need to be handled and analysed hampering the use of cameras for broad-scale monitoring at present. The results help to increase the accuracy of the Baltic salmon stock assessment, and the methodology may also help to monitor other recreational boat fisheries or small-scale commercial fisheries, which operate like recreational boat fisheries.

7.2.2 Web camera monitoring in NZ

Web cameras have been used to monitor recreational traffic at high traffic boat ramps in New Zealand since 2004–2005, where they provide a means of monitoring relative trends in effort on an ongoing basis. Each camera collects a time-stamped image of the ramp every 60 seconds, but the resources required to manually interpret all the images collected is prohibitive, so images are only interpreted from a random stratified sample of 60 days per year. The allocation of 60 days across four temporal strata (combinations two seasonal and two-day type strata) per year was informed by an analysis of daily traffic counts from each of four boat ramps spread across 600 km of coastline from 365 days in 2004–2005. Traffic counts at all four ramps showed similar fluctuations in effort over this 12-month period, with effort being higher during weekends and in summer. The optimal allocation of sampling effort was 24 days during summer weekend days, 20 days during summer midweek days, and eight days for each of the winter strata. This optimisation across temporal strata produced CVs in the order of 10%, and all subsampling in following years has followed this design. Daily traffic counts only provide limited insights into changes in recreational harvest, however, and addition creel surveys has been conducted during the same 60 days per year, to collect data on the proportion of observed boats that were used for fishing, and on the average catch landed per fishing boat. These data can be combined to produce an ongoing relative harvest index, which can be used to estimate changes in levels of harvesting between five yearly national offsite surveys (which produce absolute harvest estimates). One key finding from this work is that interannually, fluctuations in catch recreational catch rates (and hence total harvest) are far greater than previously thought, and recreational fisheries are far more dynamic than their commercial counterparts are. Some challenges with this approach are verifying that patterns seen at one ramp are representative of those seen elsewhere, dealing with systems outages, and verifying that ramp usage is not constrained by other factors such as available parking.

8 Human dimension (WP3)

Managing fisheries is ultimately managing peoples' behaviour. Human dimension research aims to understand human behaviour and the connections and feedbacks between the human and biological components of recreational fisheries systems (Hunt *et al*., 2013). For a better understanding, the natural resource system may be viewed as a complex social-ecological system (SES) showing the links and interactions between social, governance, and ecological systems (Ostrom, 2009). In recent years, the SES model has been adopted and modified to recreational fisheries to improve our understanding of the interactions between humans and nature (Arlinghaus *et al*., 2016; Hunt *et al*., 2013; Arlinghaus *et al*., 2013).

One application of human dimension research is understanding how recreational fisheries regulations (size limits, seasonal closures, bag limits) affect recreational fishermen, and how they will influence angler participation and recreational fishing mortality (Lee *et al*., 2017). A practical example is the introduction of a bag limit for recreational cod catches in the Baltic Sea in 2017, three cod per day and angler during the spawning closure from February–March (eight weeks) and five cod per day during the rest of the year, to reduce recreational fishing mortality and contribute to the rebuilding efforts of the western Baltic cod stock. In reality, a decline in fishing effort was noticed in 2017 (HVS, personal observation), i.e. less anglers going fishing at the coast, mainly due to the deterring effect of the bag limit but also due to declining catches because of the poor stock status. This means that the actual catch reduction could be higher through a decline in fishing effort independent of the current bag limit. That harvest restrictions might have strong negative effects on anglers' behaviour independent of fishing opportunities has been shown by Johnston *et al*. (2011) where fishing effort (number of anglers) had dropped considerably 3–10-fold lower despite a 28-fold increase in stock abundance over a period of ten years.

Studying angler reactions to management interventions is possible from observation (ideally before and after implementation, and with controls) applying qualitative or quantitative surveys. Alternatively and additionally, one can use stated-choice experiments to foresee likely behavioural reactions of anglers to novel policy interventions (e.g. Dorow *et al*., 2010). This empirical data can be used to model angler behaviour and generate predictions of mean responses to policy scenarios (Johnston *et al*., 2010; Fenichel *et al*., 2013). The integration of social and ecological models and their underlying theories have been summarized in Cooke *et al*. (2009). Choice experiments can be used to estimate monetary values of all kind of preferred alternatives to forecast changes in fishing effort dynamics and welfare (Parkkila *et al*., 2010) but also to identify behavioural aspects (e.g. noncompliance) equally important to predict optimal regulations (Johnston *et al*., 2015). Bioeconomic models link the ecological, socio-economic, and management components to examine the effects on fishing mortality, angler welfare, and fish stocks. Some good examples for application can be found here: Lee *et al*. (2017) and Johnston *et al*. (2010). Johnston *et al*. (2010) reminds us to be aware of not only dynamic angler behaviour but also angler heterogeneity (the average angler does not exist), i.e. the traditional assumption of only catch-based behaviour results in misleading predictions, e.g. underestimating the impacts of exploitation.

There are many more methods and tools to assess the human dimension and a wide range of application, e.g. allocation of resources, stakeholder involvement and the implementation of the ecosystem approach to management only to name a few (see Parkkila *et al*. (2010) for a comprehensive collection).

WGRFS proposes to investigate and develop thinking on human dimension research further as these data will provide recommendations for allocation decisions between sectors and optimum co-management of commercial and recreational fisheries. To facilitate comparisons between different countries the experimental design (e.g. choice experiments) should be harmonized.

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Annex 2: Current/most recent marine recreational fishing surveys

A2.1. Baltic Sea (ICES Subdivisions 22–32)

Table A2.1. Most recently carried out, ongoing and/or planned marine recreational fishing surveys.

COUNTRY	COD	EEL	SALMON	SHARKS	COMMENTS
Denmark	A combined telephone and Internet survey was designed together with Statistic Denmark. Two recall surveys, with their own questionnaires and group of respondents, were carried out. The first survey, the "licence list survey", specifically targeted that part of the Danish population with a valid annual fishing licence. When a licence is issued, the Danish social security number of the purchaser is registered, providing an efficient way to contact these persons. However, the list does not cover: (i) tourists (since they do not have a Danish social security number), (ii) those fishing without a valid licence, and (iii) people with a valid reason not to have a licence. The second survey, the "omnibus survey", targeted a subsample of the entire Danish population. This survey was intended to estimate the number and effort of fishers who fished without a valid licence. In this survey, no questions concerning their harvest were asked. Data on average size of eel, cod and seatrout are obtained by a reference panel of 75 fishers. No data on average size of catches are available.	Sampled similar to cod.	Baltic salmon is mainly caught by trolling. The harvest is not monitored but guestimated e.g. from surveing the catches during the major trolling competitions in the Baltic. Catch is set to be around 3000 individuals including recreational fishing with longlines.	For 2014 respondents were asked about their catches of shark (only two respondents claimed to have caught sharks)	From 2010 catch of seatrout has also been estimated. From 2013 the annual licence list recall survey is webbased only. Catch estimates should therefore be interpreted with caution. No results are available in missing categories for the group of non-respondents as a consequence of the new approach. The data for 2014 are preliminary.

Country	Cod	Eel	Salmon	Sharks	Comments
Estonia	Main catch of cod in recreational fisheries comes from passive gears. The data are reported and stored in Estonian Fisheries Information System (EFIS).	Catch data are reported and stored in Estonian Fisheries Information System (EFIS) for passive gears (gillnets, longlines). Eel is mainly caught in inland waters.	Catch comes from gillnets and rod fishing in rivers. For recreational fishermen it is obligatory to report these data, which is stored in Estonian Fisheries Information System (EFIS).	There is no recreational fishery for sharks in Estonia.	Catch reporting has been mandatory since 2005. The data are reported and stored in Estonian Fisheries Information System (EFIS) for passive gears (gillnets, longlines) and salmon and sea trout rod fishing in rivers. Latest hobby fishery survey was carried out in 2016 and was based on phone call approach. Next recreational fishery survey is planned to be carried out in 2018.
Finland	Cod catch known to be very low. Catch estimate by postal survey of the whole Finnish population (see comments).	Catch estimate by postal survey of the whole Finnish population (see comments).	Catch estimate by postal survey of the whole Finnish population (see comments). For Salmon rivers there is an additional postal survey conducted on the basis of local fishing licenses.		A nationwide biennal recreational fishing survey is done for all species and gears. A stratified sample of about 6000 household-dwellings is done with response rates of around 40–45% after a maximum of three contacts. A telephone interview is done for a sample of the non-respondents. Harvested catch and released catch is measured separately by species.

Country	Cod	Eel	Salmon	Sharks	Comments
Germany	Cpue data from annual stratified random access point survey covering all access points along the Baltic coast. Effort estimates by postal survey from 2006–2007 will be replaced by effort data from a nationwide CATI-Bus telephone screening, followed by a 1-year telephone diary recall survey. Length distributions from on-board sampling of charter vessels by survey agents. Length–weight key from commercial sampling for conversion to weight. Releases are only dead releases, i.e. boat-based releases with an assumed post-release mortality of 11.2% and land-based releases with an assumed 100% post-release mortality.	A telephone–diary survey to estimate eel harvests of the recreational passive gear fishery was implemented in 2011–2012 as a pilot study. The panel consisted of 180 recreational passive gear fishers of which 120 have been recruited from the Baltic Sea across seven strata. Participants were called every four months to remind them to fill in the diary.	Derogation pending. A survey is planned for 2015.	Derogation requested, as there is no recreational fishery for sharks in German Baltic waters or from German vessels.	In 2014 a seatrout survey (1-year diary recall survey) was completed. During the spring season a bus route intercept survey was used to recruit diarists and collect biological samples (length, weight, scales, tissue samples). Alongside catch data, diarists collected biological samples themselves.
Latvia	In 2012 a survey of the recreational cod fishery from fishing vessel was conducted. Catches were vey low, more leisure than fishing trips.	Sampling on triennial basis in lakes and rivers - on-site survey. Available catch data from part of the recreational fishery (self consumption fishery) as well as from licensed fishery in several inland waterbodies.	The same as for eel. The catches from self consumption have to be reported and are available. Licensed angling is allowed in three rivers and catches could be estimated from the returned licenses.	There is no recreational shark fishery.	The catches taken in the recreational fishery with commercial gears (self consumption fishery) have to be reported and are added to the commercial catches.

Country	Cod	Eel	Salmon	Sharks	Comments
Lithuania	Small commercial angling boats are licensed. From 2013, Lithuania implemented a new system of data collection. Total number of charter vessels and boats enaged in recreational fishing can be obtained from daily reports of border police. The total catch and catch per boat is evaluated from the direct interviews.	Information on catch volumes can be obtained from the census, direct interviews and questionnaires only. Respondents selected by visiting known fishing spots where they come to fish from all parts of Lithuania.	All salmon catches have to be reported to the Ministry of Environment Protection but the number of reported fish isvery low. An online survey, a face-to-face interview survey and a personal interview survey was implemented in 2015 as a pilot study to estimate recreational salmon catches.	There is no recreational fishery for sharks in Lithuanian waters or from Lithuanian boats.	All recreational fishers are licensed.

Country	Cod	Eel	Salmon	Sharks	Comments
Poland	In 2016, 12 on-board observer trips were performed to collect biological data and nine harbour masters offices were visited to collect data on number of angling trips and number of anglers onboard charter vessels.	The recreational eel fishery will be investigated within the framework of the Polish Eel Management Plan following Council Regulation 1100/2007 adopting the Eel Management Plan (EMP).	On the Polish coast the increasing popularity of salmon trolling is observed each year with a particular emphasis on years 2010–2016. Baltic salmon is mainly caught by trolling. Harvest has not yet been monitored. For 2017–2018, a pilot study on salmon and sea trout recreational fishing in Polish Exclusive Economic Zone (EEZ) is planned. The aim of the pilot study is to gather necessary information and to identify potential issues to allow setting the program for monitoring the recreational salmon trolling catches and coastal recreational fisheries focused on sea trout.		

Sweden	National survey supported by regional studies (see comments).	It is prohibited to fish for eel - additional information to RCM.	Trolling fishery was surveyed in 2015 with catch reports collected with a combination of onsite and online (web). Recreational fishing with passive gear was also surveyed in 2015 with a total census of gear. New studies are planned for 2019 (trolling) and 2020 (passive gear). In addition recreational catches in the rivers are surveyed every year.	It is prohibited to fish for sharks (additional information to RCM).	A national annual recreational fishing survey (mail), including all species, subareas and all gears has been done. However, a new improved design was implemented during 2013, but results are not yet available only preliminary results for years 2013, 2014, 2015 and 2016. The national survey is supported by a regioinal study on cod (tourboat fishing) that has been done for the last six years in the Sound (SD 23) between Sweden and Denmark (2011–2016) and continued in 2017. This is the most important area in Swedish waters for recreational cod fishing.

A2.2. North Sea (ICES 3.a, 4 and 7.d) and Eastern Arctic (ICES 1 and 2)

Table A2.2. Most recently carried out, ongoing and/or planned marine recreational fishing surveys.

Country	Cod	Eel	Sharks	Comments
Germany	According to a pilot study from 2004–2006, German recreational fishery cod catches in the North Sea have no impact on the stock. Annual cod catches from charter vessels amount to approximately 30 t. Other fishing techniques (e.g. boat angling, shore angling) as well as the recreational passive gear fishery have no further relevance concerning cod catches. A second pilot study was carried out in August 2011 to verify these findings. Results show that there has been no change and that catches have even declined.	A telephone–diary-recall survey to estimate eel harvests of the recreational passive gear fishery was implemented in 2011–2012 as a pilot study. The panel consisted of 180 recreational passive gear fishers of which 60 were recruited from the North Sea across two strata. Participants were recalled every four months to remind them to fill in the provided diary.	A pilot study was carried out in August 2011 to estimate recreational shark catches in the German North Sea. Findings show that recreational shark catches are negligible and have no impact on the stocks.	
Denmark	See the Baltic (Table A2.1).	See the Baltic (Table A2.1).	See the Baltic (Table A2.1).	See the Baltic (Table A2.1).
Sweden	See the Baltic (Table A2.1).	See the Baltic (Table A2.1).	See the Baltic (Table A2.1).	See the Baltic (Table A2.1).

Country	Cod	Eel	Sharks	Comments
Norway	Norway is conducting a study funded by the Norwegian research Council from 2017–2019 where the primary objective is to increase knowledge of the extent and development of the marine recreational fishery in Norway with respect to catch, effort. The aim is to estimate participation, activity,and catches and releases for resident recreational anglers nationally, and to develop methods for studying non-resident anglers that cannot be accessed via telephone registries. The project aims at developing cost-effective off-site and on-site probability-based survey sampling methods with multiple sampling frames to improve sampling coverage of resident and non-resident recreational fishers. The first results will be available in 2019.			

Country	Cod	Eel	Sharks	Comments
UK	A new sampling survey was set up for 2016 which had three strands. 1. A national omnibus survey which randomly surveyed the population to get national participation rates. 2. An online survey which fishers completed as a pre-questionnaire to completing monthly diaries. 3. The monthly diaries which were completed throughout 2016 to record partcipation, gear, catches and spend throughout the year. Covers all species.	Marine recreational survey estimates as for cod	Marine recreational survey estimates as for cod	
France	A pilot study from 2010–2011 of French recreational cod catches in the North Sea showed no impact on the stock. In 2012, the French recreational cod catches in the North Sea were monitored through a national telephone and diary survey covering all species.	As for cod.	As for cod.	The National Survey covers cod, eel and sharks, but the marginal nature of these fisheries does not allow obtaining a reliable estimate of harvest for these species. The French recreational fisheries cod, eel, sharks and bluefin tuna catches have no (or low) impact on the stocks.

Country	Cod	Eel	Sharks	Comments
Belgium	The Belgian monitoring program (multi species approach) is currently running (2016–2021); first results expected by mid-2018. The monitoring program focuses on on-site observations to assess fishing effort (marinas, beaches), interviews and a logbook survey. An earlier DCF funded pilot study (ILVO, 2007) concluded that cod catches by recreational fishers in the Belgian coastal waters could amount to 100–200 tons annually; however, the sample was very limited. A DCF-funded pilot study was carried out in 2013 and 2014 to estimate catches of sea bass, cod and some main species targeted by the recreational fisheries in Belgium. Mail, e-mail and online surveys were used, and from the pilot study, for 2014 the catches for cod resulted in an estimate of 400 kg per person on annual basis. From the same pilot study, for sea bass the average total catch by recreational fisheries was estimated 172 kg per person. The different fishing techniques have been considered in the pilot study surveys. However, no data are available on total effort.			In Belgium, no permit for marine recreational fishing exists and there is no obligation to report catches. For recreational fishing in freshwater, a permit is obligatory. This results in additional challenges for gathering and analyse data on marine recreational fisheries for cod and sea bass.

Country	Cod	Eel	Sharks	Comments
Netherlands	The RECFISH programme consists of the following elements: **Online Screening Survey** (panel) to estimate the number of receational fishers (marine and freshwater). Surveys were carried out in 2009, 2011, 2013 and 2015. In 2013 a parallel online and random digit dialling survey was done. **Online monthly Logbook Survey** to estimate the annual catches. 12 month surveys were carried out starting in March 2010, March 2012, April 2014 and April 2016. **Onsite surveys** to determine length frequency of landed (marine) species.	As for cod.	As for cod, however the number of sharks in the logbooks is low, therefore the numbers are not very accurate.	Weight estimates can be based on lengths in the onsite survey or the logbook survey.

A2.3. North Atlantic (ICES Areas 5–14 and NAFO areas)

Table A2.3. Most recently carried out, ongoing and/or planned marine recreational fishing surveys in the sampling period 2014–2015.

Country	Sea bass	Salmon	Eel	Sharks	Comments
UK	See North Sea (Table A2.2).	Recreational fishing for salmon is almost entirely in inland waters and is monitored by the Environment Agency.	See North Sea (Table A2.2).	See North Sea (Table A2.2).	See North Sea (Table A2.2).
Ireland	Pilot study in 2011 found that median annual bass harvest by domestic shore anglers, the dominant angler category, was two fish per angler in 2010. Catch and release by this angler category was 79% of catch. No reliable estimate of bass angler numbers available for study. Charter angling boat catch (2007–2009) was negligible (no impact on stocks).	Recreational fishing (angling) is entirely in freshwater. Harvest permitted in freshwater where surplus over Conservation Limits exists. Carcass tagging scheme with mandatory reporting for anglers.	Eel is a protected species in Ireland since 2009. No fishing (commercial or angling) allowed in the Republic of Ireland. Various life stages being monitored annually (under EU Reg.1100/2007).	Negligible landings based on fisheries officers observations.	
France	See North Sea (Table A2.2).	n.a.	See North Sea (Table A2.2).	See North Sea (Table A2.2).	See North Sea (Table A2.2).

Country	Sea bass	Salmon	Eel	Sharks	Comments
Spain (Basque Country)	A DCF-funded pilot study was carried out in 2012 to estimate sea bass recreational catches in the Basque Country. E mail, telephone, and post surveys were carried out and resulted in estimates of 129, 156, and 351 tonnes respectively (Zarauz *et al*., 2015). A new survey was carried out in 2013 to estimate recreational catches in 2012 and 2013. The main species targeted by recreational fishers were included in the surveys apart from sea bass. These species were different depending on the fishing technique used (shore, boat, spear fishing). E-mail, telephone, and post surveys were used. Three independent surveys were carried out. The three diferent sampling frames were the list of surface licences (for shore fishing), the list of spearfishing licences (for spear fishing) and the list of registered recreational vessels (for boat fishing). Contact information is complete for post , but incomplete for e-mail (14% approx.) and telephone (19% approx.). Surveys were done in June 2013 and December 2013 (Ruiz *et al*., 2015).		A routine glass eel sampling has been carried out since 2004. Fishers have to fill in a diary logbook in order to obtain a fishing license. These logbooks are used to estimate total catches and cpues and the results ae presented in WGEEL.		
Portugal					

A2.4. Mediterranean Sea and Black Sea

Table A2.4. Most recently carried out, ongoing and/or planned marine recreational fishing surveys in the sampling period 2014–2015.

COUNTRY	BLUEFIN TUNA	EEL	SHARKS	COMMENTS
Spain	Reported to ICCAT collected by IEO.	Regional governments Valencia and Catalonia collect information provided to the DGFisheries.	Negligible catches.	No standard surveys are performed. Only in the framework of research projects. No current sampling since 2012.
France	See North Sea (Table A2.2).	See North Sea (Table A2.2).	See North Sea (Table A2.2).	See North Sea (Table A2.2).
Italy				
Greece	The fishery of tunas is practised only by professional fishers and is prohibited for receational fishers by the Ministerial Decision 170317/162669	The recreational fishery of eel is prohibited in the application of the framework of regulation EU/1100/07.	The recreational fishery of various species of sharks is prohibited according regulation EC.53/2010.	There are no standard surveys performed in Greece and the few data that exist are from research projects.

Annex 3: Most recent catch estimates for the relevant species

Harvest estimates are either provided in tonnes (t) or in numbers (#) the second figure indicates the year.

A3.1. Baltic Sea (ICES Subdivisions 22–32)

Table A3.1. Most recent marine recreational harvest estimates, in tonnes (t) or numbers (#); figures in brackets indicate differing years, in the sampling period 2014–2015.

	Cod		Eel		Salmon		Sharks		Comments
Country	HARVEST	RELEASE	HARVEST	RELEASE	HARVEST	RELEASE	HARVEST	RELEASE	
Denmark	1272 t (2015)	1 222 710 # (2015)	71.2 t (2015)	28 867 # (2015)	10 562 # (2015)	5,963 # (2015)	0	0	Harvest and release of Salmon based on only 37 and nine respondents respectively. Catches are in general liekly to be overestimates due to repsonse and recall bias. Estimates should therefore be interpreted with caution. Data are also available for seatrout.
Estonia	1.175 t (2015) 1.504 t (2016)	0 (2015) 0 (2016)	0.000 t (2015)* 0.001 t (2016)*		3.430 t (2015) 3.916 t (2016)		0	0	*Eel is mainly caught in inland waters, 0.744 t (2015) and 0.633 t (2016)

	Cod		Eel		Salmon		Sharks		Comments
Country	HARVEST	RELEASE	HARVEST	RELEASE	HARVEST	RELEASE	HARVEST	RELEASE	
Finland	0 t (2014)	0 t (2014)	9 t (2014)	0 t (2014)	62 t (2014)	0 t (2014)			Data from the nationwide biennal recreational fishing survey.
Germany	1 790 576 # 2238 t (2016)	222 017 # 78 t (2016)	4034 # 1,5 t (2012)	1577 # 0,1 t (2012)					
Latvia	0.1 t (2012)	0 (2012–2014)	0.1 t (2013) 0.1 t (2014)	1 386 200 (2014)	2.2 t (2013) 2.2 t (2014)				
Lithuania	30 t (2015)		4,9 t (2015)		10 t (2015)	3 t (2015)			
Poland	695 t (2016)								
Sweden	190 t (2016)		NP	NC	7300 # (2013)				Cod estimates are from tour boat fishing in the Sound 2016 (SD 23). Salmon estimates are based on regional surveys from coastal and offshore areas. Salmon catches from trolling survey that will be repeated in 2015.Recreational trap catches are only reported in the total catch in WGBAST report therefore not included here

A3.2. North Sea (ICES 3.a, 4 and 7.d) and Eastern Arctic (ICES 1 and 2)

Table A3.2. Most recent marine recreational harvest estimates, in tonnes (t) or numbers (#); figures in brackets indicate differing years, in the sampling period 2014–2015.

	Cod		Eel		Sharks		Comments
Country	Harvest	Release	Harvest	Release	Harvest	Release	
Germany	30 t (2007)		16 858 # 4 t (2012)	5534 # 0,4 t (2012)	50–100 # (2011)		Pilot survey for recreational eel catches initiated in August 2011 will end in July 2012 (1-year telephone–diary survey). Findings from a pilot study in 2011 show that recreational shark catches (mainly tope shark (*Galeorhinus galeus*)) are marginal and have no impact on the stocks.
Denmark	777 t (2015)	346 170 # (2015)	23.8 t (2015)	73 068 # (2015)	201# (2015)		Catch estimates of sharks based on only two respondents! Catches are in general likely to be overestimates due to repsonse and recall bias. Estimates should therefore be interpreted with caution! Data on seatrout are also available.
Sweden	250 t (avg 2013–2015)	275.9 t (2010)					National survey (harvest ref.year 2013–2015 plus releases 2010)

Country	Cod		Eel		Sharks		Comments
	Harvest	Release	Harvest	Release	Harvest	Release	
Norway	Marine angling tourists[1]: 1613 t (2009) 543 000 # (2009) (RSE 22%) Local Norwegian recreational fishery (all gear types, high potential for bias)[2]: 23 040 t (2003)	Marine angling tourists Northern Norway[3]: 66% (SE 4%) (2010–2011) Marine angling tourists Southern Norway: 62% (SE 8%) (2010–2011) Norwegian Skagerrak recreationl fishery[4]:55% (2012)	Eel is a protected species in Norway since 2010. No recreational harvest of this species is allowed. No recreational catch estimates are available.		Spiny dogfish, porbeagle, basking shark and silky shark are protected species. No targeted fishing is allowed. No recreational catch estimates are available for other shark species.		1. Vølstad *et al*. (2011) 2. Hallenstvedt and Wulff (2004) 3. Ferter *et al*. (2013a) 4. Kleiven *et al*. (2012)
UK	2241t (RSE 464%) (2016)	2016t (RSE 505%) (2016)	0 (RSE 0%) (2016)	46t (RSE 13%) (2016)	sharks, skates and rays: 566 t (all 2016)	sharks, skates and rays: 12 090 t (all 2016)	These results cover the catches for the whole of the UK including North Sea, Channel, Celtic Sea and Irish Sea.
France							The National Survey also covers cod, eel and sharks, but the marginal nature of these fisheries does not allow obtaining a reliable estimate of harvest for these species. The French recreational fisheries cod, eel, sharks and bluefin tuna catches have no (or low) impact on the stocks.
Belgium	100–200 t (2007), new data expected in 2018	data expected in 2018	data expected in 2018	data expected in 2018	data expected in 2018	data expected in 2018	The data for cod result from a pilot study in 2007. A Belgian monitoring program is ongoing to estimate the catches by Belgian recreational fishermen.

Country	Cod		Eel		Sharks		Comments
	Harvest	Release	Harvest	Release	Harvest	Release	
Netherlands	771 000 (23)# 945 (22) t	534 000 (29)#	220 000 (37) # fresh 30 (25) t fresh 193 000 (24) # marine 40 (29) t marine	1 936 000 (21)# fresh 247 000 (27)# marine			All data from April 2014–March 2015 and anglers only with RSE in parentheses. Numbers are more accurate than weights. Data from van der Hammen and de Graaf (2013; 2015; 2017). Weights of retained cod are based on lengths measured in an onsite survey. Other weight estimates are based on lengths in the logbook survey. In the 2014 survey no length measures of released fish were collected. Therefore only numbers are available.

A3.3. North Atlantic (ICES Areas 5–14 and NAFO areas)

Table A3.3. Most recent marine recreational harvest estimates, in tonnes (t) or numbers (#); figures in brackets indicate differing years, in the sampling period 2014–2015.

	HARVEST	RELEASE	HARVEST	RELEASE	HARVEST	RELEASE	HARVEST	RELEASE	
UK (Scotland)									
UK (England)	Sea bass 223 t (2016) (RSE 51%)	2944 t (2016) (RSE 49%)	Salmon No marine catches	No marine catches	0 (2016)	Eel 46t (RSE 13%) (2016)	Sharks, skates and rays 166 t	Sharks, skates and rays 12 090 t	These results cover the catches for the whole of England including North Sea, Channel, Celtic Sea and Irish Sea.
Ireland			No marine recreational catches	No marine recreational catches	No marine recreational catches	No marine recreational catches			see Table A 2.3.
France	3922 t (2012, provisional)	776 t(2012, provisional)							The National Survey also covers cod, eel and sharks, but the marginal nature of these fisheries does not allow obtaining a reliable estimate of harvest for these species. The French recreational fisheries cod, eel, sharks and bluefin tuna catches have no (or low) impact on the stocks.

	HARVEST	RELEASE	HARVEST	RELEASE	HARVEST	RELEASE	HARVEST	RELEASE	
Spain (Basque Country)	145 t [112–180] (2013)				1.5 t (2012–2013)				Reported eel catches correspond to glass eel.
Portugal									

A3.4. Mediterranean Sea and Black Sea

Table A3.4. Most recent marine recreational harvest/release estimates, in tonnes (t) or numbers (#); figures in brackets indicate differing years, in the sampling period 2014–2015.

Country	Bluefin tuna		Eel		Sharks		Comments
	HARVEST	RELEASE	HARVEST	RELEASE	HARVEST	RELEASE	
Spain							
France							The National Survey also covers cod, eel and sharks, but the marginal nature of these fisheries does not allow obtaining a reliable estimate of harvest for these species. The French recreational fisheries cod, eel, sharks and bluefin tuna catches have no (or low) impact on the stocks.
Italy							
Greece							

Annex 4: Economic information by country

Table A4.1. Most recent marine recreational economic information.

Country	Survey Methods (description of method, assumptions made, and applicable species)	Economic Value (direct, indirect & induced), trip spend, & willingness to pay estimates	Magnitude and direction of bias
Austria			
Belgium	The onsite interviews at the beaches and in the marinas, part of the current Belgian monitoring program, also include socio-economic questions which will provide first quantitative insights in the expenditures of Belgian recreational fishermen (expenses big material (rod, etc.), small material (bait, etc.), travelling costs, boat related costs).		
Bulgaria			
Croatia			
Cyprus			
Czech Republic			

Country	Survey Methods (description of method, assumptions made, and applicable species)	Economic Value (direct, indirect & induced), trip spend, & willingness to pay estimates	Magnitude and direction of bias
Denmark	1. Webpanel (1500 respondents (no tourism) Economic impact analysis (input/output) Jacobsen (2010); Ministry of Food, Agriculture and Fisheries of Denmark (2010); Jensen *et al*. (2010). 2. Tourism; Economic impact (input output). Unclear how number of tourists are found and how relative share of angling relateted economic acitivity is established (but see Jacobsen, 2010; Jensen *et al*., 2010). 3. CE analysis (DK angler= no distinction between marine and freshwater (Cowi, 2010), Webpanel 1500 respondents) 4. Tourism (German webpanel, not distinction between marine and freshwater fishing) CE analysis, (Jensen *et al*., 2010). (Table 6.1)	1. Economic impact: Total 388 536 824 Euro (2 900 000 000 DKR) Excluding taxes and leakages 147 376 037 Euro (1 100 000 000 DKR). An average angler spends 543 Euro (4051 DKR) per year, but specialized sea anglers (trolling fishermen) spend on average 3349 Euro (25 000 DKR). 2. Economic impact from Tourism: Total 50 241 830 Euro (375 000 000 DKR), excluding taxes, leakages 33 896 488 Euro (253 000 000 DKR) 3. CE Analysis: Average WTP is about 100 Euro (736 DKR) angler, but methodological very insecure estimate. Important WTP estimates (ranked from highest to lowest) 1) Nature component (beautiful scenery), 2) Water quality, 3) catch opportunity (numbers). Note that in a higher quality study (Toivonen 2000) WTP for Danish anglers was estimated to 82 Euros (616 DKR) in 1999/2000 prices. 4. Tourism CE analysis: WTP -34 to 59 Euro (-255 to 444 DKR); positive WTP for increased catch opportunity, Increased size of fish, Beautiful surroundings and improved water-quality. Negative WTP if distance to fishing water is increased and/or if number of other anglers increase.	
Estonia			

Country	Survey Methods (description of method, assumptions made, and applicable species)	Economic Value (direct, indirect & induced), trip spend, & willingness to pay estimates	Magnitude and direction of bias
Finland	A nubmer of surveys have been done in Nordic countries to evaluate the economic value of recreational fisheries including: Toivonen, A.-L., Appelblad, H., Bengtsson, B., Geertz-Hansen, P., Guðbergsson, G., Kristofersson, D., Kyrkjebø, H., Navrud, S., Roth, E., Tuunainen, P., Weissglas, G.In: TemaNord 6042000. 1–70 Toivonen, A.-L. In: Pitcher, T. J., Hollingworth, C. (eds). Recreational Fisheries: Ecological, Economic and Social Evaluation. Blackwell Science. 2002. p. 137–143 A coomparison of the economic effects of salmon fishing: commercial vs. recreational with input-output model (abstract in English) Lohenkalastuksen taloudellisten vaikutusten vertailua: lohen ammattikalastus Pohjanlahden maakunnissa ja vapaa-ajankalastus Torniojoella ja Simojoella. Storhammar E, Pakarinen T, Söderkultalahti P and Mäkinen T 2011. Riista- ja kalatalous – Tutkimuksia ja selvityksiä 13/2011. 35 p.	http://www.rktl.fi/www/uploads/pdf/uudet%20julkaisut/tutk_selv_13_2011_web.pdf	
France			
Germany	In 2014 a nationwide telephone–diary survey with quarterly follow-ups was initiated contacting 50 000 households. This survey will produce estimates of anglers, effort and expenditures per category for the North and Baltic Sea. During the screening survey respondents were asked to provide a 12-month recall estimate of annual expenditures for recreational sea angling.	There are 174 000 sea anglers in Germany, with the majority (161 000) going angling in the Baltic Sea (unpublished data). Average annual expenditure was 677 € per angler.	
Greece	Have not been performed similar studies in Greece and has not been estimated the total value of the catches of recreational fisheries	No data exist	
Hungary			

Country	Survey Methods (description of method, assumptions made, and applicable species)	Economic Value (direct, indirect & induced), trip spend, & willingness to pay estimates	Magnitude and direction of bias
Ireland	'Socio-economic Study of Recreational Angling in Ireland' (TDI, 2013), commissioned by IFI, was based on sample size of 903 participants (692 face to face interviews, 211 online). Findings include an estimated 406 000 individuals (aged 15+) participated in recreational angling in 2012 (252 000 domestic, 113 000 overseas, 41 000 Northern Irish). (http://www.fisheriesireland.ie/media/tdistudyonrecreationalangling.pdf).	Estimated value of angling to Irish economy in 2012 of €755 million revised up to €836 million in 2014. Using the contingent valuation method, Irish anglers were asked their Willingness To Pay to preserve Ireland's natural fish stocks and the current quality of Irish angling - WTP estimates of €67 per angler per annum (2012) were estimated. Study of Irish angling events (festivals/competitions) estimates a much higher CS for participants using travel cost method; results indicated a CS of up to €252 per angler per day (see below).	
	An omnibus survey was carried out in 2015 to estimate total domestic participation in angling (MB, 2015). Results indicate a total of 273 600 Irish individuals aged 15+ who consider themselves to be 'anglers'. Of these, approximately 4% consider themselves to be bass anglers (11 000) and a further 24% consider themselves to be sea anglers who target other sea species (65 600). Lower bound estimates for overseas anglers in 2014 are in the region of 132 000. These combined figures give a total value of angling in 2014 in the region of €836 million; of this approximately €71 million relates to bass angling and €158 million relates to angling for other sea species.	Per trip expenditure range of €858–€1027 per person for overseas anglers. Domestic anglers annual expenditure estimated at €1740. From the omnibus survey and an increase in overseas angling tourism the total value of angling in 2014 in the region of €836 million; of this approximately €71 million relates to bass angling and €158 million relates to angling for other sea species.	
	A study, 'Economic Impact of Irish Angling Events' (based on sample of 314 anglers in 2013) (IFI, 2013) found that competitive anglers fish more often, stay for longer and spend more money than 'ordinary' anglers. The travel cost model was used to estimate consumer surplus in this study.	Case study sea angling event with 124 participants was estimated to be worth nearly €200 000 to the host region in southwest Ireland. CS estimates of €252 per angler per day.	
Italy			
Latvia	Value of landings in self consumption fishery	9762 EUR	
Lithuania	Have not been performed similar studies in Lithuania	No data on economic value, no economic-social surveys have been done.	
Luxembourg			
Malta			

Country	Survey Methods (description of method, assumptions made, and applicable species)	Economic Value (direct, indirect & induced), trip spend, & willingness to pay estimates	Magnitude and direction of bias
Netherlands	Screening survey (50 000 households) followed by 12 month Diary Survey (2000 participants) (van der Hammen and de Graaf, 2013).	200 € per fisher per year, 341 € million (accommodation, travel, durable equipment, consumables, etc.)	
Norway	A probability-based survey using a sampling frame of 434 fishing tourism enterprises to compile data on fishing tourism season, capacity in number of beds and rental boats. Additional data on expenditure during a fishing tourism holiday in Norway as collected from 597 tourists (that had visited Norway to participate in tourist fishing the previous year).	Average daily expenditure by fishing tourists visiting Norway was 173 Euros and average length of stay 7,4 days (this implies that the total average expenditure on a fishing holiday in Norway is 1280 Euros). Total expenditure from fishing tourists that visiting the 434 enterprises in the year 2008 was 104 million Euros.	
Poland			
Portugal			
Romania			
Slovakia			
Slovenia			
Spain (Basque Country)	A postal survey was carried out during 2009 and 2010. The target population was the vessel owners and skippers of the recreational fleet, but shore anglers and spear fishers were not included in this study. The contact details for skippers could not be obtained because of confidentiality, so AZTI contacted recreational fisheries associations and federations in the Basque Country. Postal and face-to-face surveys were done with approximately 2000 surveys sent and 549 completed. More questionnaires were completed with face-to-face than postal surveys. The name of the vessel, registration number and the home port was obtained from Basque Country adminsitration and additional vessel information including length, vessel and mooring was obtained from field sampling and google Earth. Three categories of vessels were defined: sailing, txipironeras (typical Basque vessel), and motor vessels. For the economic survey the same methodology was used as described above.	Direct expenditure for the same sample. The raising was made using the statistically significant variables, such as port, and length of vessel and the category. The value of the catch was not used in the estimation of the total direct impact. The induced effect was calculated using the input-output tables of the Basque Country published by EUSTAT. The multipliers of the income, value added and employment were calculated. The direct impact was around 34 million €/year and the total impact including the induced effect was almost 54 million €, and maintaining 624 FTE/year. No survey on WTP has been carried out.	Only covers recreational boat owners. Spear fishing and shore fishing is not included.
Sweden	National survey	1.6 million Swedes (age 16–80) engaged in recreational fishing at least once during 2015. Total expenditures for recreational fishing during 2015 was 14.9 billion SEK.	

Country	Survey Methods (description of method, assumptions made, and applicable species)	Economic Value (direct, indirect & induced), trip spend, & willingness to pay estimates	Magnitude and direction of bias
UK	The economic value and social benefits of sea angling were estimated within Sea Angling 2012 to understand the importance of sea angling in England. This shows the pattern of direct spending by sea anglers and how this spending supports other economic activity in England through supply chains. We used the ONS household survey to estimate the total number of people who went sea angling in 2012, then ran a well-publicised online survey throughout 2012 to collect data on expenditure and social benefits from a representative sample of these anglers. Other surveys were carried out in face-to-face interviews with sea anglers at five case study locations and supporting data were collected from angling businesses. In establishing the economic value of recreational sea angling, we considered the following elements: The total spending in the English economy supported by sea anglers and covering the more explicit items (i.e. rods, reels, etc.) and the less explicit items of spending (food, petrol, etc.). How far this total spending is on goods and services that are imported into the economy. For example, the UK as a whole is home to relatively few domestic firms that manufacture rods and reels, such that domestic spending on these goods tends to support foreign manufacturers, but with domestic firms perhaps benefiting as distributors of goods. How far this total spending on recreational sea angling, once discounted for imports, supports gross value added and employment in the English economy. How spending on recreation sea angling supports activity in other sectors. Here for example, spending on accommodation might support employment in the hotel trade, but also jobs in the sectors that supply hotels. Data for estimating spend per angler were obtained from 2512 respondents to an online survey and from 340 face-to-face interviews at five case study locations (Weymouth, Deal, Liverpool, Northumberland and Lowestoft) where local businesses were also surveyed. The onsite	Angler spend: • Annual trip spend per angler - £761 • Annual spend on major items - £633 • Total annual spend per angler - £1,394 Direct spend in England: • Total spend = £1.23 billion (£831M excl. taxes and imports) • Supports over 10 000 FTEs • £358 million GVA Total value (direct, indirect and induced spend): • Total value = £2.10 billion • Supports over 23 000 FTEs • £978 million GVA Average trip spend at case study sites: • Deal = £46.2 • Liverpool = £43.7 • Lowestoft = 35.9 • Northumberland = £37.2 • Weymouth = £161.7	+

Country	Survey Methods (description of method, assumptions made, and applicable species)	Economic Value (direct, indirect & induced), trip spend, & willingness to pay estimates	Magnitude and direction of bias
	survey locations included a variety of rural-coastal (Northumberland, Deal), mid-sized (Lowestoft and Weymouth) and city/urban locations (Liverpool). Site based research was conducted throughout the period from March 2012 to February 2013. Site based research also allowed collection of data from some groups who were more likely to be underrepresented in the self-select online survey, such as occasional anglers and holidaymakers. The total annual spend in England was estimated by raising the mean spend per angler to the total number of sea anglers in England estimated from the Office of National Statistics Survey. All data were re-weighted using demographic and frequency-of-angling data from the surveys to reduce bias. An Input–Output framework was used to estimate the multiplier impacts of sea angling expenditure at the England level. This I–O framework enabled the effect of any spending or activity to be traced through the various supply chains, ultimately estimating indirect and induced-income effects. Average spend was also calculated for all respondents from the five case-study locations and showed spend was much higher at the charter boat location (Weymouth). The social benefits of sea angling were also assessed, with 47% of respondents said that 'being outdoors and active' was their main motivation for going sea angling, and 55% said it was to 'relax and get away from things'. Sea angling contributes to health and well-being with 69% of sea anglers saying it is their main way of 'experiencing nature' and 70% saying that it is important to their quality of life. Better fish stocks were cited most often as the factor that would increase participation, although cost, time and family commitments were also important. For more information see Armstrong *et al.*(2013).		

Country	Survey Methods (description of method, assumptions made, and applicable species)	Economic Value (direct, indirect & induced), trip spend, & willingness to pay estimates	Magnitude and direction of bias
US	In 2011, the National Marine Fisheries Service (NMFS) conducted the National Marine Recreational Fishing Expenditure Survey. The survey collected information from anglers on expenditures related to marine recreational fishing. Marine recreational fishing was defined as fishing for finfish in the open ocean or any body of water that is marine or brackish for sport or pleasure. The survey is the second nationwide survey conducted by NMFS to gather marine recreational fishing expenditures across the United States. The first nationwide survey was in 2006. Prior to that year, three regional surveys were conducted starting in 1998 with the Northeast Region, the Southeast Region in 1999, and the Pacific Region in 2000 (Steinback and Gentner, 2001; Gentner, Price, and Steinback, 2001a; Gentner, Price, and Steinback, 2001b). The target population for the 2011 NES was marine recreational anglers, 16 years of age and older, who fished in all coastal states and in Puerto Rico during 2011. Puerto Rico was a new addition to the survey in 2011. In this survey, the level of fishing expenditures for these anglers was quantified within each coastal state and the US as a whole. The primary objectives of the national expenditure surveys are to collect trip expenditures for an angler's most recent marine recreational fishing trip and to collect annual expenditures on durable goods used for marine recreational fishing. Additional objectives include obtaining a profile of the most recent marine recreational fishing trip and collecting demographic information on marine recreational anglers. The survey data are then used to estimate the economic contributions of marine recreational fishing to a state's economy via a regional input–output model. In the states where the NFMS MRIP angler intercept survey was conducted, a total of 108 820 economic add-ons were attempted with anglers. 89 384 interviews were conducted with anglers who were 16 years old or older. Overall, 78 780 eligible respondents (72.0%) agreed to the economic add-on survey and 18 921 of those (24%) supplied contact information for a follow-up survey on their durable expenses. The MRIP intercept frame sample and the licence frame samples in states without MRIP followed slightly different	Total angler expenditures : $23 billion Trip expenditures: $4.4 billion expenditures Durable goods expenditures: $19 billion. By type of trip: • For-hire expenditures: $1 billion • Private boat expenditures: $2 billion • Shore expenditures: $1.5 billion. Economic Contributions: • 364 000 jobs • $56 billion in output (sales impacts) • $29 billion to GDP • $18 billion in personal income. Trip expenditures generated approximately 66 thousand jobs and durable expenses generated 298 thousand jobs.	

Country	Survey Methods (description of method, assumptions made, and applicable species)	Economic Value (direct, indirect & induced), trip spend, & willingness to pay estimates	Magnitude and direction of bias
	survey protocols. For the MRIP intercept frame, anglers who provided contact information were sent a follow-up survey either by mail or e-mail that asked about their expenditures on marine fishing- related durable goods in the prior 12 months. For the licence frame samples, anglers were sent a complete version of the survey by mail or e-mail that included questions on their most recent marine fishing trip and questions on their purchases of durable goods. The trip related questions on the mail survey gathered the same information that was obtained in the economic add-on to the APAIS. A total of 43 472 surveys were sent to anglers across the US either via e-mail or postal mail. About 5.8% of the total surveys sent out were returned as being undeliverable by the postal service. Approximately (34%) of the surveys (14 782) were completed either online or returned in the mail. Response rates were fairly consistent across states. See Lovell *et al*. (2013) for full details. **Northeast US Recreational For-Hire (Charter and HeadBboats) Cost and Earnings and Economic Impacts** Voluntary mail, telephone, and in-person surveys were designed to collect information on annual costs, returns, business structure, effort, demographics, and attitudinal data from for-hire vessel owners in the Northeast from January 2011 through July 2011. Surveys were completed by 281 vessel owners who provided data on 332 distinct for-hire vessels in the Northeast. In addition to providing a detailed overview of the operating structure of the "average" Northeast for-hire head boat and charter boat, input-output model were constructed to estimate the economic activity that for-hire businesses contribute to the Northeast's economy as measured by total employment, labour income, and sales. Model results show that in 2010 the for-hire industry earned $140.3 million in revenue, generated $50.4 million in income to owners, hired captains, crew/mates, and office staff, and employed over 3200 individuals. The multiplier effects of this activity were substantial. An additional $193.7 million in sales, $66.5 million in income, and 1290 jobs	Economic Impact • $334 million in output (sales impacts) • $117 million in personal income • 7530 jobs	

Country	Survey Methods (description of method, assumptions made, and applicable species)	Economic Value (direct, indirect & induced), trip spend, & willingness to pay estimates	Magnitude and direction of bias
	in other Northeast businesses were supported by the for-hire industry through indirect and induced transactions. Service businesses (real estate, food services, marinas, repair shops, etc.), wholesale and retail trade businesses (sporting goods stores, bait shops, gas stations, etc.), and manufacturing businesses (fishing gear manufactures, fuel refineries, commercial fishermen [bait], etc.) were the enterprises most reliant on the for-hire fleet. Over 700 service sector jobs, 360 wholesale and retail trade jobs, and 63 manufacturing jobs were dependent upon the Northeast for-hire fleet in 2010. In total, an estimated 4500 jobs in the overall Northeast regional economy were supported by the active for-hire fleet in 2010. For full detials see Steinbeck and Brinson (2013). **An Assessment of Marine Recreational Fishing Values in Massachusetts** This study compared nonmarket values based on actual cash transactions to those estimated by inferring values from revealed behaviour and from responses to hypothetical questions. The nonmarket good that served as the subject matter of the study was early season 2012 saltwater sportfishing permits in Massachusetts. Three separate samples of anglers were randomly sampled. The first consisted of 500 anglers who received a short survey that collected avidity and demographic information, accompanied by an actual cash offer to relinquish their fishing permit and give up their right to fish in Massachusetts waters for the remainder of 2012. The offers varied across anglers starting at $15 (the permit cost $10) and increased to $500 in log-linear amounts. A second sample of 700 anglers was sent the same short survey, and offered similar but hypothetical payments. Members of a third sample of 700 anglers received the same survey and were asked to indicate if they would be willing to pay the hypothetical price specified for their 2012 Massachusetts fishing permit. The distribution of hypothetical prices matched the amounts offered for the	Economic Value • Mean Economic Value per Angler • Hypothetical WTA Estimate = $593 annually • Hypothetical WTP = $80 annually • Actual WTA = $317 annually	

Country	Survey Methods (description of method, assumptions made, and applicable species)	Economic Value (direct, indirect & induced), trip spend, & willingness to pay estimates	Magnitude and direction of bias
	simulated market sample and the hypothetical willingness to sell sample. **State Preference Valuation Survey of Recreational Groundfish Fishermen in the Northeast US** The stated preference conjoint survey was administered in conjunction with NMFS' Marine Recreational Information Program Survey (MRIP) along the coastal states of Maine through New Jersey during calendar year 2009. All anglers intercepted in Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, and New Jersey for the MRIP were asked to participate in a voluntary follow-up mail survey. Anglers that agreed to participate in the follow-up were sent mail questionnaires using a modified Dillman Tailored Design. A total of 4577 surveys were mailed outand 1491 completed mail surveys were returned for a response rate of 33%. However, this analysis focuses only on Gulf of Maine cod and haddock so surveys returned by anglers fishing in states south of Massachusetts were excluded. A total of 2039 surveys were mailed out in Maine, New Hampshire, and Massachusetts and 775 completed mail surveys were returned from those states for a response rate of 38%. Resulting survey data are being used in a bioeconomic to estimate changes in angler behaviour (effort and participation) and economic well-being from alternative possession and size limits.	Total Annual Massachusetts Access Value • Hypothetical WTA = $91 million annually • Hypothetical WTP = $12 million annually • Actual WTP = $49 million annually	

Annex 5: Quality assessment of national sampling schemes

A5.1. Belgium

DESIGN			
QUESTION		ANSWER	COMMENTS (INCLUDING MAGNITUDE AND DIRECTION OF BIAS)
Target population	Are all sectors contribution to the total catch, harvest or release well known and documented?	Yes / No / Unknown	Yes, Shore (angling, nets, shrimp fishing (with horse)) and boat (private and charter; trawling, passive anglers, active anglers)
	Is there illegal/tourist fishery, which is not accounted for?	Yes / No / Unknown	Yes, night fishing, grey market, trawlers underrepresented in logbooks, tourist not accounted for
	Are there elements of the target population that are not accessible?	Yes / No / Unknown	See above
Target frame	Is the PSU identified and documented?	Yes / No / Unknown	N.A. self-selection instead of random sample for logbook participants. PSU for effort estimation is days.
	Does the sampling frame fully cover the target population?	Yes / No / Unknown	Screening survey is not robust! Instead use Rover Creel Survey: Catch) Every group included Effort) Yes, stratified sampling scheme over the whole area
	Are there elements of the target population that are excluded from the frame (e.g. non-residents, private access sites)?	Yes / No / Unknown	Catch) Non-residents not included Effort) No, entire coastline and Belgium part of the North Sea
Stratification	Are the strata well defined, known in advance and stable?	Yes / No / Unknown	Catch) Yes: Fishing technique and avidity (avidity) Effort) Yes: Season, weekdays / weekends and holidays, Fishing technique (avidity is derived)

DESIGN			
QUESTION		ANSWER	COMMENTS (INCLUDING MAGNITUDE AND DIRECTION OF BIAS)
	Is there an overstratification leading to excessive imputation?	Yes / No / Unknown	No, minimum required strata, enough data (help on statistics of power for stratified sample is wanted).
Selection	Is sampling probability based (e.g. stratified random with spatial strata, PPS)?	Yes / No / Unknown	Effort) Yes Catch) No, purposeful sampling, in order to create a big enough sized sample

IMPLEMENTATION			
Question		Answer	Comments (including Magnitude and Direction of Bias)
Selection	Has the survey been designed to maximize precision?	Yes / No / Unknown	Yes, tweak the number of days within the strata.
	Are there protocols in place and have they been followed for subsamples (selection of individuals, times, boats, biological samples)?	Yes / No / Unknown	Yes, protocol in place with maximum coverage (100%)
	Are the right sites, times, respondents, biological data sampled?	Yes / No / Unknown	All sites, stratified over geolocation for beach surveys. All harbours
	Is there a language barrier (tourist fishery)?	Yes / No / Unknown	No, not much Francophone in logbook survey, tourists are excluded. Species names in logbooks are in both Dutch and French
	Is there a preference not to engage with illegal fishers (e.g. threatening behaviour)?	Yes / No / Unknown	Yes, self-selection. However, everything in place to encourage reporting of illegal catches.
	Has the assignment been completed?	Yes / No / Unknown	No
Nonresponse	Are response rates recorded and evaluated?	Yes / No / Unknown	Omnibus) N.A. (not used) On-site) No non-response Logbook) Purposeful sampling. Follow up on non-participation. But sample is not random
	Are refusal rates (e.g. according to spatial issues, fishing in MPAs or fishing for high value species) recorded and evaluated?	Yes / No / Unknown	Yes, recall bias mail and phone for non-reports and refusals

IMPLEMENTATION			
Question		Answer	Comments (including Magnitude and Direction of Bias)
	Have you re-evaluated refusals?	Yes / No / Unknown	Non-purposeful sampling of log-book. Omnibus is a bit of a mess. Question was put in.
	Have you accounted for not completed assignments (unobserved sample bias)?	Yes / No / Unknown	Unknown, not the case yet
Recall	Is the recall period appropriate?	Yes / No / Unknown	Yes, monthly. E-mail recall and then phone recall
	Does recall period match fishing season?	Yes / No / Unknown	NA
Effort	Is effort well-defined (unit, fishing mode, target species, location) and related to cpue measures?	Yes / No / Unknown	Yes, strata for fishing modes. Target species is well defined per fishing mode and where not, extra strata (boat angling). For effort estimation, no difference between the latter. Effort measured in both fishing days per fisher and fishing boat days. For shore fishing hours.
	Is the concept of effort understood by respondents?	Yes / No / Unknown	Unknown, explicitly asked for fishing hours excluding transit, but not sure that this is always understood.
	Is it possible to record incorrect fishing areas?	Yes / No / Unknown	Unknown
Catch	Is catch verified by surveyors (e.g. all filleted, don't show)?	Yes / No / Unknown	Yes, during interviews (shore and harbour)
	Is species identification and naming reliable?	Yes / No / Unknown	Unknown
	Is there a clear division between fish kept and fish released?	Yes / No / Unknown	Yes, fish kept in kg. Fish released distinction between 'oversized' and 'undersized'

IMPLEMENTATION			
Question		Answer	Comments (including Magnitude and Direction of Bias)
	Are there any high-valued/threatened species taken in the fishery that might be unreported?	Yes / No / Unknown	Unknown, illegal catch of sea bass is (in some instances) reported. Anonymity of the data handling is guaranteed to stimulate reporting of illegal catches.
	Is there a digit preference in the reports?	Yes / No / Unknown	Yes

ANALYSIS			
QUESTION		ANSWER	COMMENTS (INCLUDING MAGNITUDE AND DIRECTION OF BIAS)
General	Does the estimation procedure follow the survey design?	Yes / No / Unknown	Yes
	Has imputation been used to account for missing observations and, if so, is the procedure documented?	Yes / No / Unknown	Unknown, missing days for aerial survey may be imputed on the efflux data (beach)
	Has the precision of estimates been calculated and, if yes, where are the documented?	Yes / No / Unknown	Unknown, we have the interview data on catches to compare with the reported catches in the logbooks to estimate precision
	Has there been weighting to correct for nonresponses/avidity bias	Yes / No / Unknown	Yes, for avidity NA for nonresponse
	In panel surveys, have those selected changed their fishing pattern or activity?	Yes / No / Unknown	Unknown
	Is the bias caused by dropouts and drop-ins in a panel corrected for?	Yes / No / Unknown	Unknown

A5.2. Norway

DESIGN			
QUESTION		Answer	Comments (including Magnitude and Direction of Bias)
Target population	Are all sectors contributing to the total catch, harvest or release well known and documented?	Yes / No / Unknown	Not documented. All potential sectors are defined, and sampling frames are being developed in 2017. Some groups, e.g. guest workers, and tourist fishers in the informal sector (i.e. tourist fishers that do not stay at registered fish camps) can mainly be contacted using on-site methods. The informal sector may also be reached through social media groups, but such methods can introduce bias of unknown magnitude and direction.
	Is there illegal/tourist fishery, which is not accounted for?	Yes / No / Unknown	Active gear (angling): Some groups are not accounted for in the offsite (telephone) survey (anglers without a Norwegian telephone number), but all are included in the onsite survey. Passive gear (traps, gillnets, etc.): Some groups are not accounted for neither in the offsite survey (residents without Norwegian telephone number) nor in the onsite survey (unmarked fishing gear).
	Are there elements of the target population that are not accessible?	Yes / No / Unknown	All legal fishing is accessible, but illegal fishing (unmarked fishing gear) may not be accessible. Control institutions may estimate illegal activity (map illegal fishing gear), so in theory all elements are accessible.
Target frame	Is the PSU identified and documented?	Yes / No / Unknown	All PSUs are documented.
	Does the sampling frame fully cover the target population?	Yes / No / Unknown	Yes for legal fishing activity. People with Norwegian telephone number offsite, all legal recreational fishers onsite.
	Are there elements of the target population that are excluded from the frame (e.g. non-residents, private access sites)?	Yes / No / Unknown	Not in the onsite survey, but in the offsite survey (all fisheries without a Norwegian telephone number).
Stratification	Are the strata well defined, known in advance and stable?	Yes / No / Unknown	Will be defined before the survey starts.

	Is there an overstratification leading to excessive imputation?	Yes / No / Unknown	Action will be taken to avoid overstratification.
Selection	Is sampling probability-based (e.g. stratified random with spatial strata, PPS)?	Yes / No / Unknown	Selection probability will be specified before sampling.

IMPLEMENTATION			
QUESTION		Answer	Comments (including Magnitude and Direction of Bias)
Selection	Has the survey been designed to maximize precision?	Yes / No / Unknown	Work in progress. Pilot studies have been conducted in 2016 and 2017 to inform the design of the main survey in 2018.
	Are there protocols in place and have they been followed for subsamples (selection of individuals, times, boats, biological samples)?	Yes / No / Unknown	Will be developed based on experience from pilot studies. Biological data will be collected in the onsite survey.
	Are the right sites, times, respondents, biological data sampled?	Yes / No / Unknown	In development.
	Is there a language barrier (tourist fishery)?	Yes / No / Unknown	Yes. Over 50 nationalities were identified in the pilot survey.
	Is there a preference not to engage with illegal fishers (e.g. threatening behaviour)?	Yes / No / Unknown	Main focus on legal fishing.
	Has the assignment been completed?	Yes / No / Unknown	Survey design and instruments are being developed, and the survey will start during second quarter of 2018 and continue until second quarter of 2019. First results are expected in 2019.
Nonresponse	Are response rates recorded and evaluated?	Yes / No / Unknown	Response rates wll be recorded in the telephone screening area survey, and diary studies. Non-respondents in the offsite survey will be evaluated, and partly evaluated in the onsite survey (personal information cannot be collected, but some basic information will be recorded, e.g. gender, fishing method)
	Are refusal rates (e.g. according to spatial issues, fishing in MPAs or fishing for high value species) recorded and evaluated?	Yes / No / Unknown	N/A

	Have you re-evaluated refusals?	Yes / No / Unknown	Ongoing work.
	Have you accounted for not completed assignments (unobserved sample bias)?	Yes / No / Unknown	N/A will be attempted in main survey 2018/2019.
Recall	Is the recall period appropriate?	Yes / No / Unknown	One year in the screening survey (fished yes/no), but follow-up fishing days with shorter recall (max 2–3 months) on a subsample. Recall period for catch diaries will be <30 days, and onsite will be hours.
	Does recall period match fishing season?	Yes / No / Unknown	No defined fishing season.
Effort	Is effort well defined (unit, fishing mode, target species, location) and related to cpue measures?	Yes / No / Unknown	Need to define if data are collected per person, or per fishing group/trip.
	Is the concept of effort understood by respondents?	Yes / No / Unknown	
	Is it possible to record incorrect fishing areas?	Yes / No / Unknown	N/A
Catch	Is catch verified by surveyors (e.g. all filleted, don't show)?	Yes / No / Unknown	Yes, for a subsample of boats intercepted in the on-site survey, and for a subsample of sites/days in the study based on diaries in the survey sampling of fish-camps.
	Is species identification and naming reliable?	Yes / No / Unknown	Will be evaluated in on-site studies.
	Is there a clear division between fish kept and fish released?	Yes / No / Unknown	Will be clearly defined in diary studies and during interviews.
	Are there any high-valued/threatened species taken in the fishery that	Yes / No / Unknown	Since there are no bag limits, there is no reason for underreporting if fishery is legal.

might be unreported?		
Is there a digit preference in the reports?	Yes / No / Unknown	Unknown. Will be evaluated if relevant in the main survey.

ANALYSIS			
	QUESTION	Answer	Comments (including Magnitude and Direction of Bias)
General	Does the estimation procedure follow the survey design?	Yes / No / Unknown	The estimators to be used in the main survey will follow survey design.
	Has imputation been used to account for missing observations and, if so, is the procedure documented?	Yes / No / Unknown	To be assessed in 2019
	Has the precision of estimates been calculated and, if yes, where are the documented?	Yes / No / Unknown	Will be included in 2019 analysis.
	Has there been weighting to correct for nonresponses/avidity bias	Yes / No / Unknown	To be determined
	In panel surveys, have those selected changed their fishing pattern or activity?	Yes / No / Unknown	To be addressed in 2019 analysis if relevant
	Is the bias caused by dropouts and drop-ins in a panel corrected for?	Yes / No / Unknown	To be addressed in 2019 analysis if relevant

DESIGN			
QUESTION		Answer	Comments (including Magnitude and Direction of Bias)
Target population	Are all sectors contributing to the total catch, harvest or release well known and documented?	Yes / No / Unknown	Not documented. All potential sectors are defined, and sampling frames are being developed in 2017. Some groups, e.g. guest workers, and tourist fishers in the informal sector (i.e. tourist fishers that do not stay at registered fish camps) can mainly be contacted using on-site methods. The informal sector may also be reached through social media groups, but such methods can introduce bias of unknown magnitude and direction.
	Is there illegal/tourist fishery, which is not accounted for?	Yes / No / Unknown	Active gear (angling): Some groups are not accounted for in the offsite (telephone) survey (anglers without a Norwegian telephone number), but all are included in the onsite survey. Passive gear (traps, gillnets, etc.): Some groups are not accounted for neither in the offsite survey (residents without Norwegian telephone number) nor in the onsite survey (unmarked fishing gear).
	Are there elements of the target population that are not accessible?	Yes / No / Unknown	All legal fishing is accessible, but illegal fishing (unmarked fishing gear) may not be accessible. Control institutions may estimate illegal activity (map illegal fishing gear), so in theory all elements are accessible.
Target frame	Is the PSU identified and documented?	Yes / No / Unknown	All PSUs are documented.
	Does the sampling frame fully cover the target population?	Yes / No / Unknown	Yes for legal fishing activity. People with Norwegian telephone number offsite, all legal recreational fishers onsite.
	Are there elements of the target population that are excluded from the frame (e.g. non-residents, private access sites)?	Yes / No / Unknown	Not in the onsite survey, but in the offsite survey (all fisheries without a Norwegian telephone number).
Stratification	Are the strata well defined, known in advance and stable?	Yes / No / Unknown	Will be defined before the survey starts.
	Is there an overstratification leading to excessive	Yes / No	Action will be taken to avoid overstratification.

	imputation?	/ Unknown	
Selection	Is sampling probability-based (e.g. stratified random with spatial strata, PPS)?	Yes / No / Unknown	Selection probability will be specified before sampling.

IMPLEMENTATION			
QUESTION		Answer	Comments (including Magnitude and Direction of Bias)
Selection	Has the survey been designed to maximize precision?	Yes / No / Unknown	Work in progress. Pilot studies have been conducted in 2016 and 2017 to inform the design of the main survey in 2018.
	Are there protocols in place and have they been followed for subsamples (selection of individuals, times, boats, biological samples)?	Yes / No / Unknown	Will be developed based on experience from pilot studies. Biological data will be collected in the onsite survey.
	Are the right sites, times, respondents, biological data sampled?	Yes / No / Unknown	In development.
	Is there a language barrier (tourist fishery)?	Yes / No / Unknown	Yes. Over 50 nationalities were identified in the pilot survey.
	Is there a preference not to engage with illegal fishers (e.g. threatening behaviour)?	Yes / No / Unknown	Main focus on legal fishing.
	Has the assignment been completed?	Yes / No / Unknown	Survey design and instruments are being developed, and the survey will start during second quarter of 2018 and continue until second quarter of 2019. First results are expected in 2019.
Nonresponse	Are response rates recorded and evaluated?	Yes / No / Unknown	Response rates wll be recorded in the telephone screening area survey, and diary studies. Non-respondents in the offsite survey will be evaluated, and partly evaluated in the onsite survey (personal information cannot be collected, but some basic information will be recorded, e.g. gender, fishing method)
	Are refusal rates (e.g. according to spatial issues, fishing in MPAs or fishing for high value species) recorded and evaluated?	Yes / No / Unknown	N/A

	Have you re-evaluated refusals?	Yes / No / Unknown	Ongoing work.
	Have you accounted for not completed assignments (unobserved sample bias)?	Yes / No / Unknown	N/A will be attempted in main survey 2018/2019.
Recall	Is the recall period appropriate?	Yes / No / Unknown	One year in the screening survey (fished yes/no), but follow-up fishing days with shorter recall (max 2–3 months) on a subsample. Recall period for catch diaries will be <30 days, and onsite will be hours.
	Does recall period match fishing season?	Yes / No / Unknown	No defined fishing season.
Effort	Is effort well defined (unit, fishing mode, target species, location) and related to cpue measures?	Yes / No / Unknown	Need to define if data are collected per person, or per fishing group/trip.
	Is the concept of effort understood by respondents?	Yes / No / Unknown	
	Is it possible to record incorrect fishing areas?	Yes / No / Unknown	N/A
Catch	Is catch verified by surveyors (e.g. all filleted, don't show)?	Yes / No / Unknown	Yes, for a subsample of boats intercepted in the on-site survey, and for a subsample of sites/days in the study based on diaries in the survey sampling of fish-camps.
	Is species identification and naming reliable?	Yes / No / Unknown	Will be evaluated in on-site studies.
	Is there a clear division between fish kept and fish released?	Yes / No / Unknown	Will be clearly defined in diary studies and during interviews.
	Are there any high-valued/threatened species taken in the fishery that	Yes / No / Unknown	Since there are no bag limits, there is no reason for underreporting if fishery is legal.

might be unreported?		
Is there a digit preference in the reports?	Yes / No / Unknown	Unknown. Will be evaluated if relevant in the main survey.

ANALYSIS			
	QUESTION	Answer	Comments (including Magnitude and Direction of Bias)
General	Does the estimation procedure follow the survey design?	Yes / No / Unknown	The estimators to be used in the main survey will follow survey design.
	Has imputation been used to account for missing observations and, if so, is the procedure documented?	Yes / No / Unknown	To be assessed in 2019
	Has the precision of estimates been calculated and, if yes, where are the documented?	Yes / No / Unknown	Will be included in 2019 analysis.
	Has there been weighting to correct for nonresponses/avidity bias	Yes / No / Unknown	To be determined
	In panel surveys, have those selected changed their fishing pattern or activity?	Yes / No / Unknown	To be addressed in 2019 analysis if relevant
	Is the bias caused by dropouts and drop-ins in a panel corrected for?	Yes / No / Unknown	To be addressed in 2019 analysis if relevant

DESIGN			
QUESTION		Answer	Comments (including Magnitude and Direction of Bias)
Target population	Are all sectors contributing to the total catch, harvest or release well known and documented?	Yes / No / Unknown	Not documented. All potential sectors are defined, and sampling frames are being developed in 2017. Some groups, e.g. guest workers, and tourist fishers in the informal sector (i.e. tourist fishers that do not stay at registered fish camps) can mainly be contacted using on-site methods. The informal sector may also be reached through social media groups, but such methods can introduce bias of unknown magnitude and direction.
	Is there illegal/tourist fishery, which is not accounted for?	Yes / No / Unknown	Active gear (angling): Some groups are not accounted for in the offsite (telephone) survey (anglers without a Norwegian telephone number), but all are included in the onsite survey. Passive gear (traps, gillnets, etc.): Some groups are not accounted for neither in the offsite survey (residents without Norwegian telephone number) nor in the onsite survey (unmarked fishing gear).
	Are there elements of the target population that are not accessible?	Yes / No / Unknown	All legal fishing is accessible, but illegal fishing (unmarked fishing gear) may not be accessible. Control institutions may estimate illegal activity (map illegal fishing gear), so in theory all elements are accessible.
Target frame	Is the PSU identified and documented?	Yes / No / Unknown	All PSUs are documented.
	Does the sampling frame fully cover the target population?	Yes / No / Unknown	Yes for legal fishing activity. People with Norwegian telephone number offsite, all legal recreational fishers onsite.
	Are there elements of the target population that are excluded from the frame (e.g. non-residents, private access sites)?	Yes / No / Unknown	Not in the onsite survey, but in the offsite survey (all fisheries without a Norwegian telephone number).
Stratification	Are the strata well defined, known in advance and stable?	Yes / No / Unknown	Will be defined before the survey starts.
	Is there an overstratification leading to excessive	Yes / No	Action will be taken to avoid overstratification.

	imputation?	/ Unknown	
Selection	Is sampling probability-based (e.g. stratified random with spatial strata, PPS)?	Yes / No / Unknown	Selection probability will be specified before sampling.

IMPLEMENTATION			
QUESTION		Answer	Comments (including Magnitude and Direction of Bias)
Selection	Has the survey been designed to maximize precision?	Yes / No / Unknown	Work in progress. Pilot studies have been conducted in 2016 and 2017 to inform the design of the main survey in 2018.
	Are there protocols in place and have they been followed for subsamples (selection of individuals, times, boats, biological samples)?	Yes / No / Unknown	Will be developed based on experience from pilot studies. Biological data will be collected in the onsite survey.
	Are the right sites, times, respondents, biological data sampled?	Yes / No / Unknown	In development.
	Is there a language barrier (tourist fishery)?	Yes / No / Unknown	Yes. Over 50 nationalities were identified in the pilot survey.
	Is there a preference not to engage with illegal fishers (e.g. threatening behaviour)?	Yes / No / Unknown	Main focus on legal fishing.
	Has the assignment been completed?	Yes / No / Unknown	Survey design and instruments are being developed, and the survey will start during second quarter of 2018 and continue until second quarter of 2019. First results are expected in 2019.
Nonresponse	Are response rates recorded and evaluated?	Yes / No / Unknown	Response rates wll be recorded in the telephone screening area survey, and diary studies. Non-respondents in the offsite survey will be evaluated, and partly evaluated in the onsite survey (personal information cannot be collected, but some basic information will be recorded, e.g. gender, fishing method)
	Are refusal rates (e.g. according to spatial issues, fishing in MPAs or fishing for high value species) recorded and evaluated?	Yes / No / Unknown	N/A

	Have you re-evaluated refusals?	Yes / No / Unknown	Ongoing work.
	Have you accounted for not completed assignments (unobserved sample bias)?	Yes / No / Unknown	N/A will be attempted in main survey 2018/2019.
Recall	Is the recall period appropriate?	Yes / No / Unknown	One year in the screening survey (fished yes/no), but follow-up fishing days with shorter recall (max 2–3 months) on a subsample. Recall period for catch diaries will be <30 days, and onsite will be hours.
	Does recall period match fishing season?	Yes / No / Unknown	No defined fishing season.
Effort	Is effort well defined (unit, fishing mode, target species, location) and related to cpue measures?	Yes / No / Unknown	Need to define if data are collected per person, or per fishing group/trip.
	Is the concept of effort understood by respondents?	Yes / No / Unknown	
	Is it possible to record incorrect fishing areas?	Yes / No / Unknown	N/A
Catch	Is catch verified by surveyors (e.g. all filleted, don't show)?	Yes / No / Unknown	Yes, for a subsample of boats intercepted in the on-site survey, and for a subsample of sites/days in the study based on diaries in the survey sampling of fish-camps.
	Is species identification and naming reliable?	Yes / No / Unknown	Will be evaluated in on-site studies.
	Is there a clear division between fish kept and fish released?	Yes / No / Unknown	Will be clearly defined in diary studies and during interviews.
	Are there any high-valued/threatened species taken in the fishery that	Yes / No / Unknown	Since there are no bag limits, there is no reason for underreporting if fishery is legal.

might be unreported?		
Is there a digit preference in the reports?	Yes / No / Unknown	Unknown. Will be evaluated if relevant in the main survey.

ANALYSIS			
	QUESTION	Answer	Comments (including Magnitude and Direction of Bias)
General	Does the estimation procedure follow the survey design?	Yes / No / Unknown	The estimators to be used in the main survey will follow survey design.
	Has imputation been used to account for missing observations and, if so, is the procedure documented?	Yes / No / Unknown	To be assessed in 2019
	Has the precision of estimates been calculated and, if yes, where are the documented?	Yes / No / Unknown	Will be included in 2019 analysis.
	Has there been weighting to correct for nonresponses/avidity bias	Yes / No / Unknown	To be determined
	In panel surveys, have those selected changed their fishing pattern or activity?	Yes / No / Unknown	To be addressed in 2019 analysis if relevant
	Is the bias caused by dropouts and drop-ins in a panel corrected for?	Yes / No / Unknown	To be addressed in 2019 analysis if relevant

A5.3. Sweden

DESIGN			
QUESTION		ANSWER	COMMENTS (INCLUDING MAGNITUDE AND DIRECTION OF BIAS)
Target population	Are all sectors contribution to the total catch, harvest or release well-known and documented?	Yes / No / Unknown	Yes, harbour and shoreline sampling not quantified yet
	Is there illegal/tourist fishery, which is not accounted for?	Yes / No / Unknown	No, sampling is randomized for times, days, harbours. Illegal fishery should be picked up
	Are there elements of the target population that are not accessible?	Yes / No / Unknown	Yes, fishing trips ending in other country
Target frame	Is the PSU identified and documented?	Yes / No / Unknown	Yes, SD23 + SD24 + nearest municipality to outside border
	Does the sampling frame fully cover the target population?	Yes / No / Unknown	Yes
	Are there elements of the target population that are excluded from the frame (e.g. non-residents, private access sites)?	Yes / No / Unknown	Private access is minor
Stratification	Are the strata well defined, known in advance and stable?	Yes / No / Unknown	ICES Subdivision * Quarter
	Is there an overstratification leading to excessive imputation?	Yes / No / Unknown	No. Tour boats included as separate sampling program
Selection	Is sampling probability based (e.g. stratified random with spatial strata, PPS)?	Yes / No / Unknown	Yes
IMPLEMENTATION			
QUESTION		ANSWER	COMMENTS (INCLUDING MAGNITUDE AND DIRECTION OF BIAS)
Selection	Has the survey been designed to maximize precision?	Yes / No / Unknown	No – it is designed to pickup spatial and temporal changes in effort
	Are there protocols in place and have they been followed for subsamples (selection of individuals, times, boats, biological samples)?	Yes / No / Un-known	Yes
	Are the right sites, times, respondents, biological data sampled?	Yes / No / Un-known	Yes
	Is there a language barrier (tourist fishery)?	Yes / No / Un-known	Potentially but not yet
	Is there a preference not to engage with illegal fishers (e.g. threatening behaviour)?	Yes / No / Un-known	Yes, avoiding shorelines at night due to general safety concerns

	Has the assignment been completed?	Yes / No / Un-known	No
Nonresponse	Are response rates recorded and evaluated?	Yes / No / Un-known	Recorded, not evaluated
	Are refusal rates (e.g. according to spatial issues, fishing in MPAs or fishing for high value species) recorded and evaluated?	Yes / No / Un-known	Recorded, not evaluated
	Have you re-evaluated refusals?	Yes / No / Un-known	Not yet
	Have you accounted for not completed assignments (unobserved sample bias)?	Yes / No / Un-known	?
Recall	Is the recall period appropriate?	Yes / No / Un-known	Yes. Same as for off-site mail survey by Statistics Sweden
	Does recall period match fishing season?	Yes / No / Un-known	No
Effort	Is effort well defined (unit, fishing mode, target species, location) and related to cpue measures?	Yes / No / Un-known	Yes
	Is the concept of effort understood by respondents?	Yes / No / Un-known	Not by all, but questions clear aon time and gear etc.
	Is it possible to record incorrect fishing areas?	Yes / No / Un-known	No
Catch	Is catch verified by surveyors (e.g. all filleted, don't show)?	Yes / No / Un-known	Yes
	Is species identification and naming reliable?	Yes / No / Un-known	Yes
	Is there a clear division between fish kept and fish released?	Yes / No / Un-known	Yes
	Are there any high-valued/threatened species taken in the fishery that might be unreported?	Yes / No / Un-known	Potentially. Always a risk.
	Is there a digit preference in the reports?	Yes / No / Un-known	No.

ANALYSIS			
QUESTION		ANSWER	COMMENTS (INCLUDING MAGNITUDE AND DIRECTION OF BIAS)
General	Does the estimation procedure follow the survey design?	Yes / No / Unknown	
	Has imputation been used to account for missing observations and, if so, is the procedure documented?	Yes / No / Unknown	
	Has the precision of estimates been calculated and, if yes, where are the documented?	Yes / No / Unknown	
	Has there been weighting to correct for nonresponses/avidity bias	Yes / No / Unknown	
	In panel surveys, have those seleted changed their fishing pattern or activity?	Yes / No / Unknown	
	Is the bias caused by dropouts and drop-ins in a panel corrected for?	Yes / No / Unknown	

DESIGN			
QUESTION		ANSWER	COMMENTS (INCLUDING MAGNITUDE AND DIRECTION OF BIAS)
Target population	Are all sectors contribution to the total catch, harvest or release well-known and documented?	Yes / No / Unknown	Yes, harbour and shoreline sampling not quantified yet
	Is there illegal/tourist fishery, which is not accounted for?	Yes / No / Unknown	No, sampling is randomized for times, days, harbours. Illegal fishery should be picked up
	Are there elements of the target population that are not accessible?	Yes / No / Unknown	Yes, fishing trips ending in other country
Target frame	Is the PSU identified and documented?	Yes / No / Unknown	Yes, SD23 + SD24 + nearest municipality to outside border
	Does the sampling frame fully cover the target population?	Yes / No / Unknown	Yes
	Are there elements of the target population that are excluded from the frame (e.g. non-residents, private access sites)?	Yes / No / Unknown	Private access is minor
Stratification	Are the strata well defined, known in advance and stable?	Yes / No / Unknown	ICES Subdivision * Quarter
	Is there an overstratification leading to excessive imputation?	Yes / No / Unknown	No. Tour boats included as separate sampling program
Selection	Is sampling probability based (e.g. stratified random with spatial strata, PPS)?	Yes / No / Unknown	Yes
IMPLEMENTATION			
QUESTION		ANSWER	COMMENTS (INCLUDING MAGNITUDE AND DIRECTION OF BIAS)
Selection	Has the survey been designed to maximize precision?	Yes / No / Unknown	No – it is designed to pickup spatial and temporal changes in effort
	Are there protocols in place and have they been followed for subsamples (selection of individuals, times, boats, biological samples)?	Yes / No / Un-known	Yes
	Are the right sites, times, respondents, biological data sampled?	Yes / No / Un-known	Yes
	Is there a language barrier (tourist fishery)?	Yes / No / Un-known	Potentially but not yet
	Is there a preference not to engage with illegal fishers (e.g. threatening behaviour)?	Yes / No / Un-known	Yes, avoiding shorelines at night due to general safety concerns

	Has the assignment been completed?	Yes / No / Un-known	No
Nonresponse	Are response rates recorded and evaluated?	Yes / No / Un-known	Recorded, not evaluated
	Are refusal rates (e.g. according to spatial issues, fishing in MPAs or fishing for high value species) recorded and evaluated?	Yes / No / Un-known	Recorded, not evaluated
	Have you re-evaluated refusals?	Yes / No / Un-known	Not yet
	Have you accounted for not completed assignments (unobserved sample bias)?	Yes / No / Un-known	?
Recall	Is the recall period appropriate?	Yes / No / Un-known	Yes. Same as for off-site mail survey by Statistics Sweden
	Does recall period match fishing season?	Yes / No / Un-known	No
Effort	Is effort well defined (unit, fishing mode, target species, location) and related to cpue measures?	Yes / No / Un-known	Yes
	Is the concept of effort understood by respondents?	Yes / No / Un-known	Not by all, but questions clear aon time and gear etc.
	Is it possible to record incorrect fishing areas?	Yes / No / Un-known	No
Catch	Is catch verified by surveyors (e.g. all filleted, don't show)?	Yes / No / Un-known	Yes
	Is species identification and naming reliable?	Yes / No / Un-known	Yes
	Is there a clear division between fish kept and fish released?	Yes / No / Un-known	Yes
	Are there any high-valued/threatened species taken in the fishery that might be unreported?	Yes / No / Un-known	Potentially. Always a risk.
	Is there a digit preference in the reports?	Yes / No / Un-known	No.

ANALYSIS			
QUESTION		ANSWER	COMMENTS (INCLUDING MAGNITUDE AND DIRECTION OF BIAS)
General	Does the estimation procedure follow the survey design?	Yes / No / Unknown	
	Has imputation been used to account for missing observations and, if so, is the procedure documented?	Yes / No / Unknown	
	Has the precision of estimates been calculated and, if yes, where are the documented?	Yes / No / Unknown	
	Has there been weighting to correct for nonresponses/avidity bias	Yes / No / Unknown	
	In panel surveys, have those seleted changed their fishing pattern or activity?	Yes / No / Unknown	
	Is the bias caused by dropouts and drop-ins in a panel corrected for?	Yes / No / Unknown	

Annex 6: Multiannual ToRs for WGRFS (2017–2019)

The **Working Group on Recreational Fisheries Surveys** (WGRFS), chaired by Kieran Hyder, UK, and Keno Ferter, Norway, will work on ToRs and generate deliverables as listed in the Tables below.

	Meeting dates	Venue	Reporting details	Comments (change in Chair, etc.)
Year 2017	12–16 June	Azores, Portugal	Interim report by 1 September 2017 to EOSG, SCICOM and ACOM	Harry Streholow's 3 year term as chair ends
Year 2018	11–15 June	Faro, Portugal	Interim report by 1 September 2018 to EOSG, SCICOM and ACOM	Keno Feter's replaces Harry Strehlow as chair. Kieran Hyder's 3 year term as chair ends
Year 2019	To be confirmed		Interim report by 1 September 2019 to EOSG, SCICOM and ACOM	

ToR descriptors

ToR	Description	Background	Science Plan topics addressed	Duration	Expected Deliverables
a	Collate and review quality of national estimates of recreational catch, post-release mortality, activity, and socio-economic values for candidate stocks, and identify significant data gaps in coverage and species.	Advisory need and requests by other WGS.	27, 30	Regular activity in each year	Reported in annex to interim report each year
b	Assess the validity of new survey designs for data collection, including the sampling efficiency, cost of delivery, and levels of accuracy and precision.	Scientific need for efficient evidence production and feed to other working groups	25, 26, 28, 31	Regular activity in each year	Reported in annex to interim report each year
c	Provide guidance to ICES and European Commission on the availability of data, use of data in assessments, and design of future data collection programs as requested.	Advisory need and response to specific requests from the EC.	25, 26, 28, 31	Regular activity in each year, and response to ad hoc requests	Reported in annex to interim report each year
d	Review and assess regional data collection programmes for the Regional Coordination Groups to deliver end-user needs and propose additional data collection requirements (e.g. species, areas, sectors, uses).	Advisory need and response to specific requests from the RCGs and ACs.	25, 26, 28, 31	Regular activity in each year	Reported in annex to interim report each year

Summary of the Workplan

Year 1	Critically review the potential of novel survey methods to deliver recreational fisheries data (e.g. citizen science approaches using smartphone apps). Identify new post-release mortality estimates, potential sublethal effects, and reasonable extrapolations across species and fisheries for inclusion in stock assessments. Mini workshop on human dimension: reviewing and collecting available information on the compliance and response of recreational fishers to different management measures. Review the treatment of outliers in survey data analysis.
Year 2	Agree an approach for the collection and storage of recreational fisheries survey data by ICES. Develop a cost–benefit analysis for the implementation of multispecies surveys, including how this might be implemented at a regional level. Assess proposals for standards in smartphone apps and critically review studies that have compared traditional and app-based approaches. Review the use of choice experiments to value marine recreational fisheries and assess if standard approaches could be implemented across Europe. Develop a proposal for a specific workshop on human dimensions in recreational fisheries.
Year 3	Design approaches for the treatment of outliers in the analysis of survey data. Review methods for inclusion of recreational fisheries removals in stock assessment and provide recommendations for reconstruction. Develop approaches for the extrapolation of post-release mortality across species and fisheries. Review the potential for impact of climate change on species caught by recreational fisheries and how that should impact on species lists for collection under the DCF. Review approaches for catch allocation and develop recommendations for appropriate methods.

Supporting information

Priority	High – because recreational catches can be high for some stocks
Resource requirements	Expertise on recreational fisheries surveys from areas outside Europe would be beneficial
Participants	The Group is normally attended by 25–30 members and guests.
Secretariat facilities	Normal backstopping support in the organization of the group.
Financial	None
Linkages to ACOM and groups under ACOM	ACOM, WGBFAS, WGEEL, WGBAST, WGCSE, WGNSSK, WGBIE, WKMEDS, WKBASS, WGCATCH
Linkages to other committees or groups	EOSG, SCICOM, STECF, EU Regional Coordination Groups, Advisory Councils
Linkages to other organizations	WECAFC/OSPESCA/CRFM/CFMC/MEDAC Working Group on Recreational Fisheries Many linkages to (inter)national angling associations, since WGRFS members estimate national marine recreational catches. Links to broader organizations with interests in angling and fisheries management including EIFACC and FAO.