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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 under the EU Data Collection Framework (DCF-EC 199/2008 and 2010/93/EU) and control regulations (EC 1224/2009), and provide advice for ICES on recreational fishing issues. In 2015, 32 scientists from 15 countries attended the WGRFS with the aim to: share current national surveys; develop estimates for RSF at a European scale; compile information on diadromous species; review post-release mortality estimates; characterise the spearfishing sector; evaluate the quality of national recreational catch sampling schemes; assess methods for validating surveys; review the use of recreational fishing data in stock assessments; investigate methods for the reconstruction of historical catches; provide advice on future EU data collection requirements; and assess potential interactions between RSF and environmental legislation (Section 1). Expert advice is provided on how to take each of these areas forward.

WGRFS compiled and assessed the quality of recreational harvest and release data collected within Europe for use in stock assessment (Section 2). These are summarized by country for four major sea areas and species (European sea bass, cod, sharks, salmon, eels, and tuna) defined under DCF and control regulations. Estimates are being developed for the participation, expenditure, activity, and catches of RSF that synthesise data from across Europe and use surrogate data where none exist. Preliminary results were available that are being finalised for publication. Marine and freshwater catches of diadromous species were compiled along with descriptions of the survey methods, and a review of national sampling schemes was proposed. A review of post-release mortality studies indicated that fishing methods and environmental parameters are important in determining mortality rates. As a result, data fishing practices (e.g. gear, depth, temperature) are needed to define the relevance of existing mortality studies to other species and locations. There was still a lack of data on post-release mortality of species including bass and eel, so a proposal was developed and submitted to ICES Advisory Committee to recommend for EU funding. An initial assessment of the spearfishing showed a lack of data on the sector and highlighted the need for a more in-depth review.

Recreational fishing surveys are difficult to conduct and methods are complex, so the quality and validity of surveys was investigated (Section 3). The quality of national recreational catch sampling schemes in Denmark, the Netherland, and Sweden were evaluated using the WGRFS Quality Assessment Tool. All were consider of acceptable quality for use in stock assessments, but represented an underestimate of the actual levels due to lack of coverage of fishing modes and platforms. Experience from New Zealand showed the importance of survey validation that needed further investigation for Europe, but was of lower priority than expansion of surveys to cover all fishing modes and platforms.

The use of recreational fishing catches in stock assessment for Baltic cod and Salmon, and European sea bass was reviewed (Section 4). Few time-series of recreational catches exist, so different methods for incorporation of recreational catches in stock assessment have been developed and the sensitivity of the assessment model to different approaches investigated. It is unlikely that a single methodology to reconstruct historical catches will work across all fisheries as both the data available and stock modelling approaches vary. However, it is very important time-series are collected for sea bass and that new methods for reconstructing time-series of catches are devel-

oped to improve the accuracy of assessments of stocks with significant recreational components.

A WGRFS position statement was developed to provide recommendation for future surveys of recreational fishing under the EU Multiannual Plan (EU-MAP) in response to a request from the European Commission to ICES (Section 5). The main conclusions were that the need for surveys should be evaluated regularly based on the magnitude of catches in relation to commercial removals. The surveys being conducted need to cover the entire stock area and the survey plan should be evaluated by regional coordination groups and WGRFS before being ratified by the European Commission. Multispecies data should be collected in existing surveys and regular sampling is needed to develop time-series of recreational mortality comprising of both kept and released components of the catch. Biological data should also be collected if required for an assessment model. To aide allocation decisions, socio-economic data should be collected, but at a lower frequency and based on end-user needs. This response was used alongside responses from PGDATA as the basis for the production of ICES advice through the Advice Drafting Group on Recreational Fishing published on 21 August 2015.

The potential for interactions between RSF and legislation other than CFP including the Water Framework Directive (WFD), Marine Strategy Framework Directive (MSFD) and Maritime Spatial Planning (MSP) was assessed (Section 6). It was felt that the WGRFS should engage with ICES efforts on MSFD and that RSF experts needed to ensure that RSF is adequately represented in national MSP.

1 Background and Terms of Reference (ToRs)

The ICES Working Group on Recreational Fishing Surveys (WGRFS) meeting took place between the 1 and 5 June 2015, at AZTI-Tecnalia in Sukarrieta, Spain. A total of 32 scientists from 15 countries contributed to the meeting and was co-chaired by Harry V. Strehlow and Kieran Hyder (see Annex 1 for list of participants). The agenda was agreed and followed, although some changes were made to timings in order to complete discussions, and was as follows:

Day	Session
1 June 2014	Introduction and ToRs Review of recreational fishing surveys across Europe DC-MAP Update on latest requirements
2 June 2014	Review of post-release mortality estimates Beyond CFP – potential interactions between RSF and other legislation Reviewing country data using the Quality Assessment Tool (QAT)
3 June 2014	Validating survey methods Reconstruction of RSF time-series for use in assessments Diadromous species
4 June 2014	Use of Recreational Fishing Data in Stock Assessments RSF in Europe – production of pan-European estimates for RSF.
5 June 2014	Funding opportunities ToRs for next meeting

The ToRs for the 2015 WGRFS meeting were as follows:

Multiannual ToRs

a) Collate and evaluate national estimates of recreational catch, activity, and socio-economic value.

b) Assess different survey designs for improved data collection.

c) Evaluate national surveys using the WGRFS quality assessment tool (QAT).

Specific ToRs

d) Review recreational catch estimates for candidate stocks (e.g. Baltic salmon, western and eastern Baltic cod, Atlantic sea bass), including assessing the relative importance of recreational fisheries and identifying data gaps.

e) Provide recommendations on the reconstruction of recreational fisheries time-series for use in stock assessments.

f) Identify post-release mortality estimates, potential sublethal effects, and reasonable extrapolations across species and fisheries for inclusion in stock assessments.

g) Review updates of the EU MAP data requirements for recreational fishing effort, catches, and socio-economic aspects.

h) Assessing methods for estimating recreational catches of diadromous species in freshwater and identify potential synergies with marine recreational fisheries catch sampling schemes.

i) Identify potential interactions between recreational fishing and legislation other than CFP including MSFD, WFD, and marine spatial planning.

ToR (c) was addressed through a mixture of plenary sessions and break-out groups using the national sampling schemes of Denmark, Netherlands and Sweden as case study examples. ToRs (a), (b), (d), (e), (f), (g), (h) and (i) were addressed in individual sessions.

2 Recreational fishing surveys across Europe (ToRs a, f, h)

2.1 Results from the latest recreational sea fishing surveys

Recreational fishing surveys are carried out across Europe covering all species and areas required under the DCF (EC 199/2008 and 2010/93/EU) and control regulations (EC 1224/2009).

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 IIIa, IV and VIId) and Eastern Arctic (Areas 1 and II);
- North Atlantic (ICES Areas V–XIV 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 and Annex 5 provides a view on new surveys that will be ongoing over the coming year.

2.2 Estimation of recreational sea fishing participation, expenditure, effort and catches across Europe

Existing estimates of recreational sea fishing in Europe are sparse and vary significantly. For example, in Europe the European Anglers Alliance estimated there are 8–10 million anglers spending €8–10 billion (cited in Pawson *et al*., 2008), global studies by Cisneros and Sumaila (2010) found a 3.7% participation and expenditure of $400 per fisher, and Arlinghaus *et al*. (2014) estimated a participation rate 11% for all fishers (freshwater & marine).

Recreational sea fishing estimates have been required under the DCF since 2002, and significant amounts of information have been complied that can be used to improve estimates at a European level. Here, data compiled by WGRFS was synthesised to estimate numbers, participation rates, effort and direct expenditure by recreational sea fishers in Europe, and total recreational removals of European sea bass (ICES areas IV and VII) and Western Baltic cod. For countries with data, a semi-quantative assessment of the biases in the survey was compiled relating to the coverage and quality of the survey. Despite data collection requirements under DCF, large data gaps still exist, so simple assumptions were made in order to extrapolate to countries without data. Where no information on numbers of fishers existed, the participation rate of a similar country was used along with the population size to estimate total

numbers of anglers, so assuming that participation rate same in extrapolated country. For effort, it was assumed that the numbers of days fished per person each year was the same in the extrapolated country. For direct expenditure, it was assumed that fishers spend the same proportion of their income in the extrapolated country, so the expenditure was adjusted for the difference in GDP between the countries.

The key deliverable for this session was to compile the best available data, understand potential bias, and decide on the most relevant country to use as surrogate data. Using a simple methodology with the best knowledge of existing studies and reasonable assumptions, it was possible to produce estimates of the numbers, participation rates, effort and direct expenditure by recreational sea fishers in Europe. The estimates are still being developed and will be presented once finalised, but are likely to be significant. However, there was a significant lack of information for the Mediterranean, specifically for other modes like spear fishing, so these figures are likely to represent a significant underestimate of the true value, so more surveys are required in the Mediterranean. Estimates of removals (caught and dead released) showed that recreational fishers are responsible for 27 and 30% of total removals for European sea bass and western Baltic cod respectively.

These estimates demonstrate the synthesis of existing knowledge of European recreational fishing and further support the thesis that recreational catches represent the high-value forgotten catch (Hyder *et al*., 2014). This work is being developed for publication in a peer-reviewed journal. The tables in Annex 4 provide an overview of the economic data available.

WGRFS advises that this analysis should be completed and submitted for publication in a peer-reviewed journal, and that additional efforts should be made to engage scientists in the Mediterranean to collect additional data on RSF.

2.3 Assessing methods for Diadromous species (ToR h)

It is a DCF (EC 199/2008) requirement that recreational catches of salmon and eel should be reported and eel recovery plan (EC 1100/2007) includes statutory monitoring of recreational catches of eel. Hence, EU Member States (MS) are obliged to report their recreational catches (= harvest ***and*** releases) of eel and salmon in inland waters. However, the number of MS reporting recreational catches is limited with even fewer reporting release rates (Annex 6). Eel and salmon fishing is banned in some MS, but catch-and-release is allowed in the inland waters of many MS. As a result, it is important to quantify post-release mortality to manage fish stock effectively. Consequently, WGRFS has collected the available information of inland recreational fisheries data collection schemes for eel and salmon, including:

- Description of current and planned inland recreational fisheries surveys, including contact details of the responsible institutes.
- Description of the eel and salmon recreational fisheries (gears, numbers of fishers, regulations).
- Catch estimates (numbers and weight) of Eel and Salmon in inland waters, including precision estimates.

The tables in Annex 6 provide an overview of the above data from eel and salmon inland fisheries.

WGRFS advises reviewing national catch sampling schemes and ensure that recreational fishing surveys cover the entire stock area (inland and marine waters).

2.4 Post-release mortality (ToR f)

2.4.1 Synthesis of information

To obtain accurate estimates of fishing induced mortality, one has to account for post-release mortalities which may occur as a consequence of catch-and-release (Kerns *et al*., 2012). Several surveys have shown that marine recreational anglers release large proportions of their Atlantic cod catches, both due to voluntary and regulatory catch-and-release practices (Sparrevohn and Storr-Paulsen, 2012; Strehlow *et al*., 2012; van der Hammen and de Graaf, 2012; Ferter *et al*., 2013a; Ferter *et al*., 2013b). For the German Baltic Sea recreational fishery, post-release mortality of Atlantic cod has been included in the stock assessment since 2012 (Eero *et al*., 2014). During the last years, several post-release studies on Atlantic cod have been conducted covering a range of potential mortality factors including anatomical hooking location, water temperature, air exposure and capture depth (Weltersbach and Strehlow, 2013; Mandelman *et al*., 2014; Ferter *et al*., 2015a,b). Bleeding and high water temperatures significantly increased post-release mortality of cod, while fish without substantial hooking injuries were found to have high survival potential. Bleeding and anatomical hooking location are dependent on the lure/bait and hook type used (Weltersbach, personal communication) which is why post-release mortality of cod can be expected to vary between fisheries. It is therefore not possible to determine a default post-release mortality which is valid for all recreational cod fisheries.

A workshop was conducted during to collect 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). The workshop showed that there is a general lack of data on actual fishing practices. However, based on expert knowledge, there seems to be a large variation between countries likely leading to different post-release mortality of cod in different countries. As release proportions for other DCF species are also high (Ferter *et al*., 2013b) a collection of fishing practices for these species (based on expert knowledge) has also been initiated both from members of the WGRFS and members of the angling community (citizen science). Together with future post-release mortality estimates, this information can be used to extrapolate experimental estimates to the different fisheries.

WGRFS advises collecting recreational fishery characteristics for certain target species to enable extrapolation between stocks and fisheries. This needs collaboration across Europe and between stakeholders (e.g. angling associations, angling clubs etc.). Citizen science has good potential to contribute to the evidence base and fill existing data gaps.

2.4.2 Proposal for EU Lot funding to fill data gaps on post-release mortality of hook and line caught fish

It is clear from the session on post-release mortality that there are still large gaps in our knowledge that need to be addressed. As a result, the WGRFS has proposed the need for a project titled "**Discards in European hook and line fisheries: mortalities, consequences for stock assessments, and mitigation potential**" that should include to following:

1) A desk based review to compile existing data on catch and release mortality, and group species with similar hooking mortalities based on underlying biology and fishing practices. Ranges of post-release mortality will be derived from studies to provide generic hooking mortality profiles for

groups of species and fisheries. Species with high survival rates that have the potential to be excluded from discard bans will also be identified.

2) Experimental programmes for European sea bass and European eel that represent best practice for hooking mortality studies based on existing knowledge derived from other marine species including cod and striped bass.

This proposal has been sent to ACOM for consideration for recommendation of funding as an EU Lot Proposal. A full description of the background and rationale for the study can be found in Annex 7.

WGRFS advises that the EU funds the proposed study titled: "Discards in European hook and line fisheries: mortalities, consequences for stock assessments, and mitigation potential". This proposal has been submitted to ACOM for approval.

2.5 Spear fishing

Spear fishing is an ancient fishing technique and recreational spear fishing in Europe developed in the early twentieth century. Generally, it is practised in daylight by free-divers, but the use of SCUBA is allowed in some countries (e.g. in Norway, Denmark or Cyprus). The management of spear fishing is generally through bag limits or limiting fishing days. Spear fishing contributes to national and local economies (e.g. fishing equipment, boats, fuel, permits and travel expenses including food and overnight stays). Spear fishing plays an important social role facilitating people from different age and gender to meet, know each other and this way it facilitates to reduce generation gap and promote cultural exchange among generations and also among different social classes. It is also likely to have other benefits in terms of well-being, especially in terms of physical exercise and stress reduction.

Southern European countries including Croatia, France, Greece, Italy, Portugal and Spain have large numbers of spear fishers (Table 1), but spear fishing is also practised in Denmark, Finland, Malta, Norway and United Kingdom. It is difficult to estimate the number of spear fishers as the need for licences varies among countries. Where licences exist, information on the number of spear fishers can be obtained from the administrations, but in many countries the little information available is provided by associations or federations of spear fishers. In most EU countries, spear fishers are not allowed to sell their catch.

Some studies have indicated that European spear fishers spend between 2 and 4 hours per fishing trip and conducted 20 to 60 fishing trips per year, typically in the summer months. Spear fishers target around 40 species mainly of finfish, but also some invertebrates, and the catch per unit of effort varies between 1.08 and 2.04 kg fish per hour. Some comparisons with local commercial fisheries revealed that for some species spear fishing catch estimates represent between 15% and 30% of the commercial catch, including some highly vulnerable species. This fishery is controversial and generates intense debate among different stakeholders, scientists and managers regarding the impact on fish populations, but there is little evidence to underpin management decisions. More information is needed on the participation, activity, social benefits, expenditure and catch to ensure that the needs of spear fishers are taken into account in management decisions and enable effective management of fish stocks.

Table 1. Approximate number of spear fishers available by country obtained from several sources (stakeholders, governments, industry assessments). (N.Av.=Data not available; N.Ap.=Data not applicable).

COUNTRY	SPEAR FISHERS (N)	OVERALL RECREATIONAL (N)
Croatia	N.Av.	28 000
France	90 000	N.Ap.
Greece	10 000	N.Ap.
Italy	80 000	N.Ap.
Portugal	10 000	N.Ap.
Spain	25 000	N.Ap.

WGRFS advises the collection of spear fishing data, at least in those countries where fishing mortality is likely to be significant. This should involve the quantification of catches, characteristics of the fishery as well as information on the economic value and social benefit of spear fishing.

3 Assessing Quality of Different Survey Designs (ToRs b, c)

WGRFS 2015 addressed two Terms of References (b and c) related to assessing different survey designs (onsite, offsite) for improved data collection and reviewing and optimizing the WGRFS 'Quality Assurance Toolkit' (QAT) based on the experience of completing at country level. The "toolkit" was developed by ICES (2013a) to assess and document the quality of recreational fishery surveys and thus recreational catch estimates. The aim of this evaluation is to provide statements of quality of recreational data for end-users including stock assessment scientists, and identify potential improvements to survey design. This was done for Denmark, the Netherlands, and Sweden, and the potential for validation of survey methods was made using New Zealand as example.

3.1 Denmark

In Denmark two different off-site surveys are used to collect recreational catches for cod, sea trout and eel. Both, the omnibus survey and the recall survey (twice a year) are carried out by Statistics Denmark. In 2013 the recall survey was changed from a telephone survey to a web survey. The main findings were that the coverage of the sampling frame for the omnibus and the recall survey are incomplete due to the inclusion of annual licence holders only. It would be useful to extend the sampling frame to include day and week license holders, non-licence holders, and non-resident tourist fishers. The recall period should be shortened to reduce recall bias, and response and refusal rates should be recorded and evaluated. It would also be beneficial to conduct on-site surveys to verify off-site data and collect biological data to deliver catch-at-age data for the assessment of western Baltic cod. For full details of the assessment of quality of the Danish survey programme see Annex 5.1.

WGRFS advice: the overall quality of these data is good and can be used for assessment purposes. However, there are biases that need attention including expanding the survey coverage, shortening the recall period and controlling for avidity.

3.2 Netherlands

In the Netherlands, a multistage survey approach is applied to estimate total recreational catch in inland and marine waters. A screening survey is used to estimate the numbers of recreational fishers and an online logbook survey is used to estimate monthly catches. Panellists are provided with a fish identification card to minimise fish identification errors. The data are weighted by avidity and non-response bias is corrected by an individual nonresponse survey, with hot-deck imputation used to fill in missing data and drop-outs excluded from the analysis. Tourist fishers are not included in the survey and some panellists are self-selecting leading to potential risk of biases. For full details of the assessment of quality of the Dutch survey programme see Annex 5.2.

WGRFS advice: the overall quality of these data is good and can be used for assessment purposes, but is likely to represent an underestimate of total recreational catch due to non-coverage of some fishing sectors.

3.3 Sweden

In Sweden three individual surveys are applied:

- A national postal survey carried out by Statistics Sweden with three waves per year to monitor recreational catch and effort in inland and marine waters.
- An on-site access point survey targeted at trolling boats leaving Swedish harbours fishing for salmon.
- A tour boat survey targeting all tour boats fishing in the Sound (Øresund) to monitor cod catches.

The evaluation of the national survey was done using the documentation as the lead surveyor was not at the WGRFS. The sample frame excludes tourist fishers and some fishing modes may be undersampled leading to low precision of estimates. The national survey provided high quality recreational catch estimates at a national level, but local and regional level estimate were not precise enough to be included in stock assessments.

The on-site trolling boat survey asks anglers to volunteer information on their catches from the previous three trips. This is a self-selecting sample, so bias is likely, and the target frame is not adequately defined with only few harbours sampled. It would be prudent to expand the target frame to all potential harbours and use a stratified random sample of harbours and dates. Collaboration with Denmark and Germany is desirable as trolling boats from these countries often fish in the same parts of the Baltic Sea. Non-response should be documented and the on-site survey should be extended to gather biological data.

The coverage of the tour boat survey in the Sound (SD 23) is good (close to census). However, a few tour boats are not participating creating potential bias in the catch estimates. Catch estimates are only provided by weight. In general, the total recreational fishing mortality in SD 23 covers private boats and shore fishing activities as well. WGRFS advises expanding the survey including various fishing modes and platforms, and expanding the sampling frame accordingly. Catch estimates should be reported in numbers and biological data collected as catch-at-age data are required by the assessment. In general, the tour boat survey provides good quality data on kg cod taken for inclusion in the assessment.

For full details of the assessment of quality of the Swedish survey programme see Annex 5.3.

WGRFS advises re-evaluating the Swedish national survey with knowledgeable national expert, but overall the national survey was of sufficient quality to provide recreational catch estimates at a national level for inclusion in stock assessment. For the on-site trolling boat survey, WGRFS advises re-designing the survey as part of a regional approach with Denmark and Germany and include collection of biological samples. The Sound tour boat survey provides good data on the catches by tour boats for inclusion in stock assessment, but is likely to underestimate overall removals, so expansion to more fishing platforms is necessary to estimate total removals by recreational fishers.

3.4 Validating survey methods–the New Zealand experience

The first attempts to estimate recreational harvests in New Zealand were a series of telephone diary surveys conducted between 1992 and 2001. The approach used followed a two phase survey design: an initial screening survey followed by a 12 month diarist reporting period. Improvements were made to the design of each successive

survey to minimise identified sources of bias. Prevalence estimates provided by face-to-face screening surveys in 2000 and 2001 were up to three times higher than in earlier surveys, however, and the resulting harvest estimates were considered to be implausibly high, leading to far greater scrutiny. Subsequent comparisons of creel survey and diarist data highlighted many other issues including: significant recall bias, diarists underreporting zero catch trips, and over-reporting the number of fish caught in a trip. The decision was therefore made to switch to on-site methods that relied on direct observations of the fishery rather than self-reported data.

Most on-site methods are not cost effective over large spatial scales, however, and the decision was made to initiate a series of maximum count aerial-access surveys, which were used to assess recreational harvests taken off coasts over 1000 km long (as described in Hartill *et al.*, 2011). Although the estimates provided by these surveys were accepted and used to inform fisheries management, their accuracy was unknown and untested, which led to renewed interest in off-site survey approaches that could be used to provide concurrent harvest estimates for comparative purposes. Off-site survey methods with a wider scope were required, as on-site surveys are not viable on a national scale.

Three years of planning and survey design pre-testing led to the development of a National Panel Survey. The sample frame used in the initial screening survey was a highly stratified GIS database maintained by Statistics New Zealand, which is the government agency that conducts a five yearly national census. Considerable thought went into minimising all known sources of bias and maintaining high response rates, which are too numerous to discuss here, but the methods are fully described in Wynne-Jones *et al*. (2015).

The reliability and accuracy of the Aerial-Access and National Panel Survey approaches was assessed in 2011–2012, when both methods were used to concurrently and independently provide recreational harvest estimates for some of New Zealand's largest fisheries. The magnitude of the estimates provided by the two surveys were remarkably similar (Figure 1), and both methods are now considered to be reliable (Hartill and Edwards, in press).

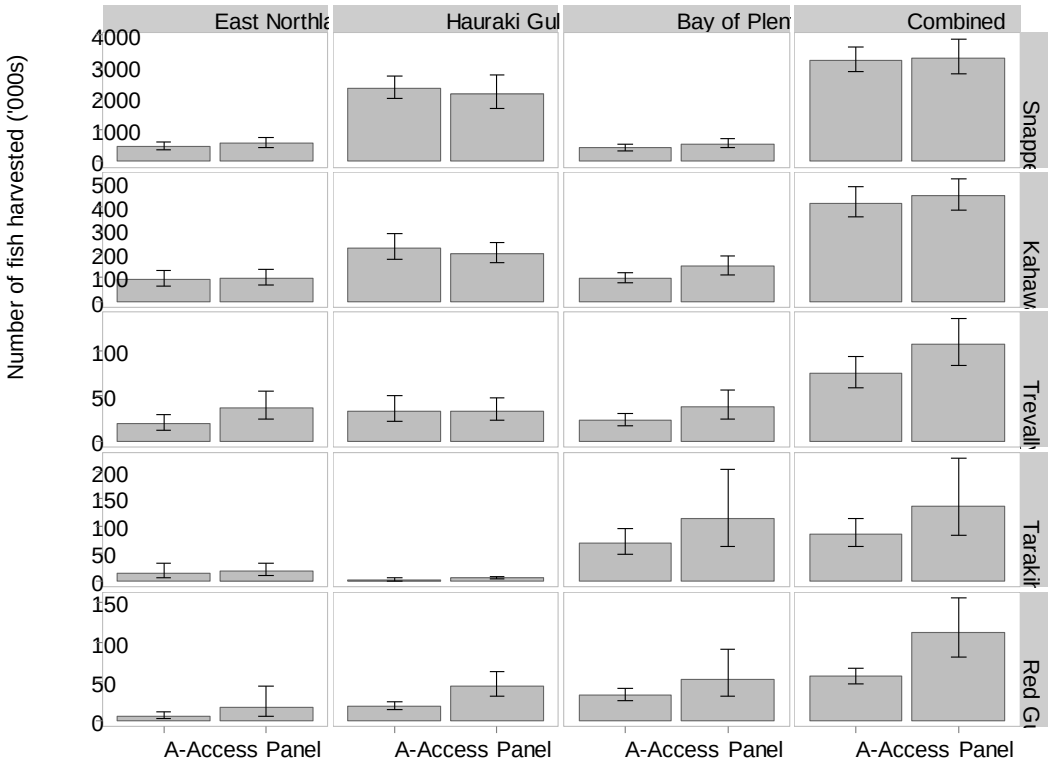


Figure 1. Comparison of harvest estimates (tonnes) provided by the two surveys, by species and region. Harvest numbers with associated 95% lognormal confidence intervals.

Web cameras have been used since 2005 to monitor trends in effort at key boat ramps in the North Island. Daily traffic count data provided by these systems have been combined with creel survey data, to continuously monitor trends in recreational harvests of commonly caught species. There is a close correspondence between changes in the magnitude of aerial-access harvest estimates over time, and the trend in harvest inferred from this web-camera/creel survey monitoring approach (Hartill *et al.*, 2015).

WGRFS advises: further efforts should be made to assess the potential of validating existing survey data and methods should be reviewed in 2016. However, this is of lower priority than expansion of surveys to cover all fishing modes.

4 Use of recreational fishing data in stock assessments (ToR d)

4.1 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, 2015a). 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, 2015a).

German marine recreational fisheries removals of western Baltic cod between 2005 and 2014 were provided for SD 22 and 24, and historical data were reconstructed for the period 1990 to 2004 for inclusion in the stock assessment (ICES, 2013b). Recreational cod catches taken in SD 22 and 24 by Germany were considered western Baltic cod and included in the assessment. Spatial analysis revealed that recreational catches by charter boat around the Island of Ruegen were close to shore in area 38G3. All catch-at-age data from 2009 onward was estimated using the recreational length distribution from SD 24 and age–length keys from German commercial data for SD 22. For a further description of the compilation method see ICES (2103b). Only German recreational catches are included in the 2015 assessment, so probably represent a large underestimation of recreational removals. However, Danish and Swedish recreational fishery data will also be included in the 2016 assessment.

WGRFS advises that the actual recreational catches of western Baltic cod are likely to be higher than accounted for in the assessment due to lack of Danish and Swedish catches. Collection of biological catch data in SD 23 and inclusion of private boats in Swedish catch sampling scheme are needed.

4.2 Baltic salmon

The Baltic Salmon and Trout Assessment Working Group assessed the status of salmon and sea trout in the Baltic Sea and proposes management advice (ICES, 2015b). Recreational catch estimates of salmon in freshwater and marine habitats have been included in the assessment for many years. However, catch estimates of the recreational salmon fishery are uncertain, incomplete or missing for several Member States. Consequently, recreational fishing is thought to take 13% of the total marine catch, but this is likely to change as better estimates become available. There has been an increase in recreational sea fishing, so it is prudent to include this as an independent fishery. However, this would require improving the quality of recreational effort and catches in both marine and freshwater. WGRFS explored the uncertainty and potential countries that could report recreational salmon catches. For example, the trolling fishery in the Main Basin has developed considerably and involves an increasing number of fishermen in several countries. To assess the total exploitation rate in this recreational fishery, increased efforts are needed from all countries involved.

WGRFS advises that MS asses the relative importance of recreational salmon catches in inland and marine waters and, where relevant, include in national catch sampling schemes. National agencies should contact each other to ensure that the entire stock area is covered.

4.3 European sea bass

The trends and status of the sea bass stock in the North Sea, Channel, Celtic Sea and Irish Sea (ICES Areas IVb,c and VIIa,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), updated by ICES WGCSE in 2013 (ICES, 2013c), then further developed by IBP-Bass in 2014 (ICES, 2014c) and updated at the 2014 and 2015 meeting of WGCSE (ICES, 2014a; 2015c,d). The assessments in 2012 and 2013 did not include any information on recreational fishery catches.

Since 2014, ICES has used an assessment approach for sea bass that allows inclusion of an estimate of recreational fishery removals and associated selectivity-at-age. Data on bass catches from recreational fishery surveys in Europe are only one or two years over the period 2009–2013 (see Table 2, from surveys described by Armstrong *et al*., 2013; Rocklin *et al*., 2014; Van der Hammen and de Graaf, 2012b & 2015), and coverage by space and time of the different national surveys has not been fully aligned. The recent estimates of total recreational harvests of sea bass for France, Netherlands, England and Belgium (data supplied informally) in Subareas IV and VII amounted to 1400–1500 t. With no direct knowledge of hooking mortality on sea bass, WGCSE reviewed studies on similar species such as striped bass in the USA but did not include a value in the assessment and assumed the total recreational removals were approximately 1500 t in 2012. Discards in the commercial fisheries are around 5% by weight, mainly from trawls, and survival rates are unknown.

Table 2. Estimates of annual recreational fishery catches of sea bass in France, Netherlands and UK (England) from surveys in recent years. RSE = relative standard error. An estimate of 60 t of removals by Belgium in 2013 was provided informally to WGCSE 2014. Estimates are by weight except for Netherlands where weight and numbers are given. (From ICES, WGCSE 2015c.)

(a) France		Kept	RSE	Released	RSE	Total	RSE	Release rate
2009-2011	NE Atlantic	2,343t		830t		3,173t	26%	26%
	ICES IV & VII	940t		332t		1,272t	>26%	26%
2011-2012	NE Atlantic	3,146t		776t		3,922t		20%

RSE was 26% for area VII and VIII combined; area VII represented 40% of total.

~ 80% by weight in 2009/11 was recreational sea angling

(b) Netherlands			Kept	RSE	Released	RSE	Total	RSE	Release rate
March 2010-Feb 2011	Southern North Sea	By number	234000	38%	131000	27%	365000	26%	64%
		By weight	138t	37%					
March 2012-Feb 2013	Southern North Sea	By number	335000	26%	332000	21%	667000	17%	50%
		By weight	229t	26%					

93% by weight in 2010/11 was recreational sea angling. 2012/13 figure is angling only

(c) England		Kept	RSE	Released	RSE	Total	RSE	Release rate
2012	ICES IVbc, VIIa,d,e,f	230– 440t		150-250t		380 – 690t	26-38%	36-39%

Survey covered only recreational sea angling

Range of values is for different effort estimation procedures

The recreational harvests are large enough that their exclusion from the sea bass stock assessment will lead to an assumption that all the fishing mortality, F, as estimated from the age profile in the catch-at-age data, is due to commercial fishing. In reality, any management actions applied to the commercial fishery based on a forecast from an assessment excluding recreational fishery data would only affect part of the total F and would be less effective than intended because of the additional F due to recreational fishing.

ICES therefore considered it desirable to have the recreational fishery F represented in some way the assessment and forecast so that impacts of measures on either fishery can be evaluated. Several approaches were possible that could make use of only one estimate of international recreational harvest of sea bass, centred on 2012. These included:

i) The same recreational harvest (1500 t) in all years of the assessment from the mid-1980s.

ii) The same proportion of total fishery harvest each year, e.g. 25% as in 2012.

iii) The same recreational fishery F in all years as in 2012.

Options (i) and (ii) have very low probability due to the large variations in sea bass abundance over time and the known growth of the commercial fishery for sea bass

since the 1970s and 1980s. It is possible that, before the large growth in biomass of the stock in the 1990s, with associated growth of commercial fisheries on this species, recreational fishing may have been a much larger proportion of total fishery removals of sea bass than at present.

Option (iii) was considered the most defensible approach, and is similar to the treatment of natural mortality in most stock assessments where a value is chosen, for example based on life-history traits, and is held constant over time. It must be acknowledged that such an approach is very approximate and will not hold if management measures introduced by the EU in 2015 (bag limit of three sea bass per day for recreational fishing and an increase in minimum landing size from 36 cm to 42 cm in all fisheries) are effective in reducing recreational F.

There are few data to test the assumption that recreational F may be more or less constant over time. Information from a series of angling surveys in England and Wales since 1970 (Table 4) show random variations around ~1–1.8 m people. Part of the observed variability will relate to differences in survey methodology, but all are based on some form of sampling of the population as a whole. Sea bass has been a prized target for recreational sea anglers in England and Wales (and southern Ireland) over a much longer period than the current ICES assessment, and sea bass angling was developed to a high level of technical skill and knowledge of the species as far back as the 1970s. There is no information on the actual effort expended by the angling population on sea bass as the stock has changed in abundance, or on changes in efficiency, but an assumption of a constant recreational fishing mortality is a reasonable first approximation for evaluating recreational F. Surveys in the Netherlands indicate that sea angling participation has varied with very little trend since the early 2000s (data supplied to WGRFS 2015 by Martin de Graaf).

Table 4. Estimated numbers of sea anglers in the UK (England and Wales) from a number of different population surveys.

REPORT	YEAR OF SURVEY	ESTIMATED NUMBER OF SEA ANGLERS
National Angling Survey	1970	1 280 000
National Angling Survey	1980	1 791 000
National Rivers Authority 1995	1994	1 104 000
Drew Associates 2004	2003	1 450 000
Simpson & Mawle 2005	2005	2 035 705 (small sample)
Sea Angling 2012. (Armstrong *et al.*, 2013)	2012	960 000

To implement approach (iii) in the sea bass stock assessment for ICES Areas IV and VII, a vector of selectivity-at-age and weights-at-age equivalent to the commercial line fishery in the UK was developed. This was converted to absolute F at-age using a multiplier and included in the model as an additional, year-invariant mortality, added to the base M value of 0.15 at each age (from life-history characteristics), but treated as fishing mortality in the results. A series of assessment runs was carried out, progressively adjusting the recreational F multiplier until the estimated recreational harvests in 2012 were around 1500 t, which is roughly the total of estimates from

recent national surveys. The uncertainty in the survey estimates of recreational catch were not accounted for in the overall uncertainties around the assessment results.

For 2012, the split of the mean F at-ages 5–11 between recreational and commercial fishing from the latest (2015c,d) assessment was: recreational F = 0.10; commercial F = 0.24; total F = 0.34; i.e. recreational fishing was responsible for 29% of total F. This split is approximate, as the recreational estimates are not complete (no survey data for Wales), and are subject to estimation error (CVs >0.20). Assessment runs carried out by IBPBass including different recreational F vectors from zero to 0.092 showed the same relative stock trends and total F; the effect of the recreational F vector was to scale up the stock numbers and biomass, and increase the proportion of total F due to recreational fishing, without changing trends.

The latest assessment results (ICES, WGCSE 2015c,d) show that total biomass and SSB are in decline due to a combination of progressively increasing commercial fishing mortality and an extended recent period of very poor recruitment from 2008 onwards. The trend of increasing F occurs against a backdrop of rapidly increasing landings from the mid-1990s to mid-2000s, driven by the very strong 1989 year classes and a series of above-average recruitments formed during an extended period of warmer sea conditions that occurred from the late 1980s. Recruitment of the 2008–2012 year classes however appears very weak and is a large contributor to the expected continued decline in SSB towards the lowest previously observed value. The ICES catch advice is based on a short-term forecast where the effect of catch options in 2016 on SSB in 2017 is explored (ICES, 2015d). These catch options are shown only for the combined commercial and recreational catch, assuming the same change in fishing mortality in both types of fishing.

WGRFS advice: there is an urgent need to develop a coherent time-series of sea bass recreational catch estimates with associated size composition data, to allow a more accurate estimate of the fishing mortality due to recreational fishing and assessment of the likely impacts of proposed management actions.

4.4 Reconstruction of time-series

Time-series of recreational catches are very important for understanding the impact of recreational catches on stocks and assessment of management measures, and how these choices may be affected by changes in participation, effort, catches and value over time. A number of different methods exist for the reconstruction of time-series of historical recreational catches that vary in complexity and use (e.g. ICES, 2013b; 2014a; Zeller *et al*., 2010; Richardson, 2006; Richardson *et al*., 2006; Monkman *et al*., 2013; Martin *et al*., 2014; Pita and Freire, 2014). However, these have been generated on a case-by-case basis using methods that best represent the underlying fishery. Some examples of the methods used are outlined below.

For assessment of European stocks, the methods have been developed on a case-by-case basis, with a constant recreational fishing mortality assumed for European sea bass (ICES, 2014a) and average catches assumed for Baltic cod after a linear increase from nothing for the first five years for the period between the start of the stock assessment (1990) and the start of recreational data collection (2005) (Eero *et al*., 2014). The sensitivity of the outcome of the stock assessment to changes in the methods of historical reconstruction of recreational time-series is also assessed (Eero *et al*., 2014). Data from recreational fisheries surveys have been used to inform recreational catch histories used in two New Zealand stock assessments; for snapper and for kahawai. In both cases the magnitude of the recreational catch history was determined by aeri-

al-access survey harvest estimates, and the trend in harvest was inferred from recreational cpue indices. In each case the geometric mean of the aerial access harvest estimates was used to scale up the cpue index, to provide harvest estimates for those years for which no aerial-access harvest estimates were available. Estimates of recreational catch histories were required back as far as 1900, when both stocks were assumed to be relatively unexploited, but the first year in which cpue data were available was in 1990. Estimated recreational catches in 1990 were therefore ramped back to 1900, when the recreational catch was assumed to be 10% of that in 1990. No allowance was made for incidental mortality of released fish. These catch histories are considered to be broadly indicative, but different catch histories have been offered to model sensitivity runs, as aerial access surveys have only been conducted since 2005. The recreational F based method used to generate a recreational catch history for the European Bass assessment would not have been an appropriate approach for the New Zealand assessments. This is because the exploitation history of fish stocks in New Zealand is much more recent than in Europe. The snapper and kahawai models therefore provided estimates of stock biomass over 100 years ago, at a time when levels of recreational fishing mortality would have far lower than in recent years. This means that it would not have been appropriate to assume that recreational fishing mortality would have been constant over the period assessed.

Other methods have also been proposed for research based studies that use simple models with significant assumptions. For example, total removals from the Baltic Sea for the period 1950 to 2007 were reconstructed by estimating total unreported removals using recreational data from Finland, but it is not clear exactly how this was modelled (Zeller *et al*., 2010). Trophy catches have been extracted from angling club and magazine reports in Wales for 27 years (Richardson *et al*., 2006) and more recently social media activity has been used to look at effort (Martin *et al*., 2014) and catches (Monkman, 2013). These historical and Internet sources provide an interesting and useful alternative to traditional methods that should be investigated further.

WGRSF advises that methods are developed for the reconstruction of time-series data and that a ToR is developed for a mini-workshop at the 2016 WGRFS meeting to investigate the methods further and provide recommendations on how best to reconstruct time-series.

5 Recommendations for future surveys under EU-MAP (ToR g)

ICES was asked by the European Commission to address the following questions:

- What are the drivers for the collection of recreational fishing data?
- What recreational fishery data (biological, economic and fisheries activity) are needed to support the CFP?
- How will these data be used in stock assessment and fishery management advice?
- What spatial and temporal resolution of data is needed to support fisheries management?

These were discussed at the ICES WGRFS and a short document outlining the WGRFS position was produced (Annex 8). This response was used alongside responses from PGDATA as the basis for the production of ICES advice through the Advice Drafting Group on Recreational Fishing published on 21 August 2015 (http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2015/Special_Requests/EU_data_needs_for_monitoring_the_recreational_fisheries.pdf). A summary of the key points made in the response provided by the WGRFS is given below.

There are many drivers for the collection of recreational fishery data including: collecting recreational fishing mortality for inclusion in stock assessment, designing effective controls of recreational fishing and monitoring outcomes, estimating economic value and social benefits to local communities, developing long-term management plans, and supporting the delivery of environmental and marine spatial planning legislation. Recreational fishing data are used by international, national, regional and local fisheries managers, alongside recreational fishing bodies, and the media. There are three main notable challenges associated with recreational fisheries data collection: (1) there is no central registration of recreational fishers, (2) recreational catches are not documented, and (3) recreational fishers fish in remote and hard to access areas. As a result, recreational fishing surveys are complex and difficult to conduct, often requiring a number of different surveys to collect effort, catch per unit of effort, biological composition of the catch, economic value, and post-release mortality. This expertise is difficult to maintain unless surveys are conducted regularly, but generally it is easy to collect multiple species within the same survey programme. At present, recreational mortalities are largely unquantified and/or lacking completely from some Member States and thus not included in stock assessments (with the notable exception of Baltic cod and European sea bass). This means that current assessments may underestimate fishing mortality significantly and impact on the ability to sustainably manage fish stocks at MSY. It is also very difficult to make effective allocation decisions between recreational and commercial fisheries without this information.

WGRFS advises that:

- The need to include recreational fishery data in a stock assessment procedure should be evaluated on a case-by-case basis, according to the known magnitude of catches compared with commercial catches based on previous surveys or pilot studies. This should be reviewed regularly as recreational catches can fluctuate significantly between years and recreational effort can remain high even where stock are depleted.

- The types of surveys being conducted for the successful management of shared stocks need to cover the stock area and thus need to be agreed at a regional level. Precision targets should be set at the overall stock level for combined international estimates, and bias in data collection and estimates should be documented. Data collection requirements should be evaluated by regional coordination groups and WGRFS before being ratified by the European Commission. This approach mirrors regional coordination of commercial fishery sampling.
- Where recreational fishing surveys exist, multispecies data should be collected as the costs are not significantly greater than for single species data collection.
- To facilitate the inclusion of recreational fishery data in stock assessments, an annual frequency of data collection is needed over a number years to develop time-series of recreational mortality that comprises of both kept and released components of the catch.
- Biological data on catches (size or age composition) are required both for caught and released components if catch-at-size or age is needed for an assessment model.
- In order to make optimum allocation decisions between commercial and recreational sectors, it is also necessary to collect information on the economic value and social benefits of recreational sea fishing. However, this is unlikely to change quickly, so a frequency of every five years is appropriate and be driven by end-user needs.

6 Interactions between recreational fishing and legislation other than CFP (ToR i)

6.1 Water Framework Directive (WFD)

The European Water Framework Directive (WFD) commits MS to achieve good qualitative and quantitative status of all water bodies (including marine waters up to one nautical mile from shore) by 2015. The WFD includes River Basin Districts covering entire river catchments as natural transboundary unit. For each waterbody type biological quality elements (i.e. macrophytes, fish, invertebrates) are given and these should be included in MS monitoring programs in order to determine the 'good ecological status' of specific waterbodies. Assessment of quality must be monitored through extensive national networks/programs and must be evaluated against water type specific reference values. If good status cannot be achieved measures must then be taken to improve status toward good ecological status/conditions. The WFD should have been implemented in all MS by 2015. However although it varies between countries, its implementation is being delayed.

Marine recreational fisheries can have an impact on the WFD objectives if recreational activities impact on the biological quality elements (BQE) in particular fish. However this is only the case in transitional waters where fish is currently included as a BQE. Hence changes in fish communities in coastal waters are currently not taken into consideration when evaluating ecological status or only indirectly if recreational fishing result in negative consequences for other BQEs. In the WFD commercial fisheries are considered a potential "pressure" meaning that this is considered a potential threat to good ecological status. However, at present this seems not to be the case for recreational fisheries, although not clearly described in the WFD text and related annexes. The aim of the WFD is to protect and improve the ecological status of water bodies and for many fish species potentially also improving the recreational fishery. Stocking or unintentional introductions of non-indigenous species is also considered a pressure under WFD, and a successful implementation of WFD could reduce the occurrence of such stockings and introductions.

6.2 Marine Strategy Framework Directive (MSFD)

The European Marine Strategy Framework Directive (MSFD) was developed to provide a framework for MS to protect the marine environment more effectively (EU, 2008). This is to be done by maintaining biodiversity and providing diverse and dynamic oceans, which are clean and healthy, while allowing the sustainable use of marine resources (EU, 2008). The MSFD is based on an ecosystem approach and will, where necessary and appropriate, draw on existing regulation in order to achieve coherence between policy areas (e.g. CFP - EU, 2013; Habitats Directive - CEC, 1992). It came into force in 2008, and aims to allow Member States to take the necessary measures to achieve or maintain Good Environmental Status (GES) by 2020. European marine regions were defined for the purpose of monitoring water status and developing actions to achieve GES (e.g. NE Atlantic Ocean, Mediterranean Sea, Black Sea, Baltic Sea), with subregions also defined in the Northeast Atlantic and Mediterranean. In order to meet the requirements of the Directive, Member States are obliged to cooperate with others in the same (sub)region, including through the relevant Regional Sea Conventions. Cooperation is also required between MSFD regions in order to ensure consistency and coherence across the EU.

To determine GES, eleven qualitative descriptors of the state of the environment were defined comprising biodiversity, non-indigenous species, commercial fish, foodwebs, eutrophication, seabed integrity, hydrographical conditions, contaminants, food safety, litter, and underwater noise (EU, 2008). The European Commission (EC) developed a detailed set of criteria and indicators to help interpret these descriptors (COM, 2010). There are there potential interactions between RSF and MSFD: positive benefits of legislation on RSF; positive benefits of RSF in delivering legislation; and impacts of RSF on delivery of legislation. Currently, there is no mention of RSF in either the member states assessments or the programmes of measure (POMs), possibly due to the regional scale impacts considered within MSFD and the mitigation under existing legislation like CFP (EU, 2013). The most likely interactions between RSF and MSFD are under D1 biodiversity, D3 fish stocks in relation to fishing mortality and population structure, D4 foodwebs in relation to uncertainty and anthropogenic pressures; and D6 seabed integrity for passive fishing gears. Workshops are being planned by ICES in 2016 that provide an opportunity to engage with the process, and should be attended by experts in RSF.

There is also the potential for time-series of recreational fishing data to be used in the development of indicators of GES, so it is worth considering how monitoring of recreational fishing may provide evidence to underpin indicators or monitor progress against indicators in future. For example, simple additional information could provide data that will underpin both DCF and MSFD monitoring needs. It is also important to develop thinking around how RSF should engage with future MSFD cycles.

WGRFS advises that experts in RSF should engage with ICES workshops on MSFD and develop thinking about how RSF data might be used in future MSFD cycles.

6.3 Maritime Spatial Planning (MSP)

Maritime spatial planning (MSP) has been succinctly defined as the "Public process of analysing and allocating spatial and temporal distribution of human activities in marine areas to achieve ecological, economic and social objectives […] through a political process" (Ehler and Douvere, 2007). The European Union policy instrument for MSP is Directive 2014/89/EU which gives the definition as "A framework under the Integrated Maritime Policy to manage human activities at sea & in coastal zones" (EC, 2014). Other relevant policy instruments include The United Nations Convention on the Law of the Sea (UNICLOS 2014), the MSFD (2008/56/EC), the Habitats directive (92/43/EEC) and Birds directive (2009/147/EC). Marine related legal instruments such as the MSFD are likely consumers of MSP outputs and do not explicitly legislate on MSP.

MSP is believed to reduce conflicts, encourage investments, increase coordination between administrations, increase cross-border cooperation between EU countries and protect the marine environment. The financial provision for MS to implement Directive 2014/89/EU is delivered by European Structural and Investment Funds, including the European Maritime Fisheries Fund (EMFF). No explicit reference to recreational sea fishing (RSF) is made by MSP (2014/89/EU), but consideration of RSF is implicit under the tourism and fisheries sectors. The relevant minimum requirements for RSF within MSP is covered under:

- Article 6 takes into account environmental, economic and social aspects, ensures the involvement of stakeholders, and makes the use of the best available data.
- Article 8 establishes national maritime spatial plans that must account for relevant interactions between activities and across uses.
- Article 9 enshrines stakeholder engagement in decision-making.

Recent assessments of recreational catches and activity levels in specific fisheries evidence the importance of including RSF in MSP under the above listed articles and planning should also consider incidental and non-fishing recreational fisher activity (e.g. bait collection and foot-fall) with any associated ecosystem effects where both relevant and practicable. Despite RSF being frequently perceived as a predominantly extractive activity, current evidence indicates that the sector is of socio-economic importance and that the ecological impact might be significant. Recreational fishing has been linked to positive health and wellbeing in participants and can generate economic benefits through direct and secondary effects. Hence the sympathetic management of resources valued by recreational fishers will contribute to the fulfilment of the MSP.

MSP planners require digitised maps of spatial and temporal RSF effort. Maps should be of sufficient temporal and spatial resolution to enable informed decision-making in consideration of coastal and marine habitats and the activity of other marine stakeholders. Other potentially relevant factors should be recorded with spatial and temporal activity data, for example fishing platform (e.g. for-hire or shore sectors) and key aspirational and caught marine species. In making value judgements on use policy, economic maps are critical, particularly where economically significant activity is thought likely to occur. RSF stakeholders need to be engaged to understand what and where they value within their marine environment (e.g. fishing areas, fishing types, target species). There is a general need to understand what conflicts and compatibilities exist, or could arise, with other marine activities. In addition, stakeholders will have valuable insights on how to maximise the socio-economic value derived from the recreational sea fishing sector.

The Belgian marine spatial plan (Royal Decree of 20 March 2014) was implemented before the EU MSP Directive, but provides a good example of the types of interactions. The Royal Decree stipulates two limitations for recreational fishermen including:

- Recreational bottom and beam trawlers are not allowed to fish in the Habitat Directive area of the 'Flemish Banks' unless they are able to demonstrate three or more years of activity before publication of the Royal Decree.
- Trawling is restricted on the munitions dump site 'Paardenmarkt'.

There are other Belgian Royal Decrees that impose additional spatial limitations including the prohibition of fishing outside 3 nautical miles with recreational trawlers, exclusion from offshore constructions, and restriction of fishing within 200 m of the shore. There is a lack of evidence to support RSF in MSP decisions, with the first activity map produced in 2015 (Verleye *et al*., 2015), and future surveys are being developed to assess seasonal and annual patterns of RSF activity.

All Member States require provision for a maritime spatial plan covering all marine activities. The objective is to balance stakeholder interests, economics and environmental management of marine resources. Maritime Spatial Planning and associated recommendations and legislation are evolving nevertheless, it is assured that a description of the activities and economics of recreational sea fisheries in time and space will be critical to the maritime spatial planning process. It is important (as specified in the EU directives) for the process to be transparent and stakeholder driven.

WGRFS advises that further evidence outlining the activity of RSF is developed by individual countries to ensure that RSF is adequately represented in MSP.

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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 in the sampling period 2013–2014.

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 2 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 is preliminary.

Country	Cod	Eel	Salmon	Sharks	Comments
Estonia	Catch data are reported and stored in Estonian Fisheries Information System (EFIS) for passive gears.	Catch data are reported and stored in EFIS for passive gears.	Catch data (length and numbers) are reported and stored in EFIS for passive gears.		Catch reporting has been mandatory since 2005 For licensed recreational fishery with passive gears.
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 licences.		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 3 contacts. A telephone interview is done for a sample of the non-respondents. Harvested catch and released catch is measured separately by species.
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.	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 7 strata. Participants were called every 4 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 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 recreational fishery (self consumption fishery) as well as from licenced fishery in several inland water bodies.	The same as for eel. The catches from self consumption hve to be reported and are available. Licenced angling is allowed in three rivers and catches could be estimated from the returned licences.	There is no recreational shark fishery.	The catches taken in recreational fishery with commercial gears (self consumption fishery) should are reported and added to commercial catches.

Country	Cod	Eel	Salmon	Sharks	Comments
Lithuania	Small commercial angling boats are licensed, for number of trips and anglers can be obtained from census, direct interviews and questionnaires. From 2013 Lithuania implemented new system of data collection. Total number of charter vessels and boats enaged in recreational fishery can be obtained from daily reports of border police. For inspection of recreational fishery twice per week joint surveys with fishery inspectors at sea are performed, where data on number of fishers, catch volumes by species as well as length-weight distribution of catches have been collecting.	Information on catch volumes can be obtained from census, direct interviews and questionnaires only. Respondents selected in gathering places of fishers where they come to fish from all parts of Lithuania. For example smelt fishing in Curonian Lagoon.	All salmon catches have to be reported to Ministry of Environment protection.	There is no recreational fishery for sharks in Lithuanian waters or from Lithuanian boats.	All recreational fishers are licensed
Poland	In 2014, 11 on-board observer trips were performed to collect biological data and 10 Harbour Masters Offices were visited to collect data on number of angling trips and number of anglers onboard charter vessels.	Eel recreational fishery will be investigated within the framework of the Polish Eel Management Plan following Council Regulation 1100/2007 adopting the Eel Management Plan (EMP).	Sea angling in Polish waters started in 2011. Since then the number of charter boats increased to approximately 30. Baltic salmon is mainly caught by trolling. Harvest has not been monitored.		

Country	Cod	Eel	Salmon	Sharks	Comments
Sweden	National survey supported by regional studies (see comments).	It is prohibited to fish for eel - additional information to RCM.	National survey, regional studies (see comments)	It is prohibited to fish for sharks - additional information to RCM)	A national biennal recreational fishing survey (mail and telephone), 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. The national survey is supported by a regioinal study on cod (tourboat fishing) that has been done for the last two years in the Sound between Sweden and Denmark (2011–2013) and continued in 2014. This is the most important area in Swedish waters for recreational cod fishing. The collection of data on recreational salmon fishing is exhaustive and contains regional studies. The regional studies are adapted to different catch areas and are based on postal surveys, gear inventories and catch reports on the web. Salmon catches by trolling boats is estimated from a survey directed to trolling anglers. Recreational catch with traps are estimated from gear counts.

A2.2. North Sea (ICES IIIa, IV and VIId) and Eastern Arctic (ICES I and II)

Table A2.2. Most recently carried out, ongoing and/or planned marine recreational fishing surveys in the sampling period 2013–2014.

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 2 strata. Participants were recalled every 4 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	A rowing-creel survey was conducted in Southern Norway from April–August 2012 to: • Estimate the proportion of angling tourists vs. Norwegian recreational anglers targeting cod • Get a size frequency distribution of cod landed by recreational anglers • Estimate the cpue for cod among Norwegian recreational anglers • Estimate the release proportion for cod catches			
UK Scotland				

Country	Cod	Eel	Sharks	Comments
UK (England)	A major survey programme (Sea Angling 2012) took place in England in 2012 and part of 2013. The survey components were: • Monthly surveys of households, using face-to-face interviews, to estimate recreational sea angling effort (angler-days) by region and fishing mode • On-site surveys of anglers at shore angling sites and private boat launching sites in nine regional strata in England, to estimate mean catch per unit of effort (cpue), length compositions by species, angling effort and trip expenditure • Sampling from a known population of sea angling charter vessels to estimate total effort and catches by species • A separate survey of economic and social benefits of recreational sea angling involving online surveys and direct interviews at sites around the coast of England • Quarterly online catch surveys to collect additional information and to help interpret the other survey results	Marine recreational survey estimates as for cod	Marine recreational survey estimates as for cod	See Armstrong *et al*. (2013) for full details. Dowloadable at: http://webarchive.nationalarchives.gov.uk/20140108121958/http://www.marinemanagement.org.uk/seaangling/index.htm

Country	Cod	Eel	Sharks	Comments
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	There is an ongoing study (2014–2015) to estimate the number of active recreational fishing vessels and fishing effort based on on-site observations. A protocol for assessing catches of cod and sea bass is under development. Interviews are ongoing to get insight into the total catches of a.o. cod and sea bass by sea-anglers. 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. 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 taking into account in the pilot study surveys.			In Belgium, there is no obligation to register recreational sea fishing. For recreational fishing in freshwater, a permit is obligatory. This results in additional challenges for gathering and analysing 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 and 2013. In 2013 a parallel online and random digit dialling survey was done. Online monthly Diary Survey to estimate the annual cod and eel catches. 12 month surveys were carried out in 2010, 2012 and the latest survey started in April 2014. 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 the onsite survey or the logbook survey

A2.3. North Atlantic (ICES Areas V–XIV and NAFO areas)

Table A2.3. Most recently carried out, ongoing and/or planned marine recreational fishing surveys in the sampling period 2013–2014.

Country	Sea bass	Salmon	Eel	Sharks	Comments
UK (Scotland)					
UK (England)	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 2# fish per angler in 2010. Catch & 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 fishery (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% aprox) and telephone (19% aproximately). 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 2013–2014.

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 performed in Balearic Islands. Only in the framework of research projects. No current sampling on 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 Minestrial 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 exists is from research projects.

Annex 3: Most recent harvest/release 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 2013–2014.

Country	Cod		Eel		Salmon		Sharks		Comments
	HARVEST	RELEASE	HARVEST	RELEASE	HARVEST	RELEASE	HARVEST	RELEASE	
Denmark	1860.4 t (2014)	1,895,021 # (2014)	35.8t (2014)	37,877 # (2014)	3,500 # (2014)				Data are also available for seatrout.
Estonia									
Finland	3 t (2012)	0 t (2012)	2 t (2012)	0 t (2012)	36 t (2012)	3 t (2012)			Data from the nationwide biennal recreational fishing survey.
Germany	2,739,264 # 2564 t	1,545,566 # 468 t	4034 # 1,5 t (2012)	1577 # 0,1 t (2012)					Eel catch estimates (recreational passive gear fishery) will be available in 2014
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	10 t (2014)				0.1 t, 50 # (2014)				Salmon catches estimates with seatrout

Country	Cod		Eel		Salmon		Sharks		Comments
	HARVEST	RELEASE	HARVEST	RELEASE	HARVEST	RELEASE	HARVEST	RELEASE	
Poland	1273 t (2014)								Salmon estimates will be available in 2015
Sweden	142 t (2013)		NP	NC	7300 # (2013)				Cod estimate are from tour boat fishing in the Sound. 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 IIIa, IV and VIId) and Eastern Arctic (ICES I and II)

Table A3.2. Most recent marine recreational harvest estimates, in tonnes (t) or numbers (#); figures in brackets indicate differing years, in the sampling period 2013–2014.

Country	Cod		Eel		Sharks		Comments
	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	886.4 t (2014)	827,701 # (2014)	19.2 t (2014)	30,367 # (2014)	445# (2014)		Data on seatrout are also available.
Sweden	226.3 t (2010)	275.9 t (2010)					National survey (ref.year 2010)
Norway	Marine angling tourists[1]: 1,613 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 (Scotland)							

Country	Cod		Eel		Sharks		Comments
	HARVEST	RELEASE	HARVEST	RELEASE	HARVEST	RELEASE	
UK (England)	430–820 t 281,000# (RSE 30%) (2012)	50 t 201,000# (RSE 36%) (2012)	5,300# (RSE 140%) (2012)	32,000# (RSE 62%) (2012)	skates and rays: 41,000# (RSE 51%) smooth-hound (*Mustellus*): 4200# (RSE 42%) tope (*Galeorhinus*): 20# (RSE 92%) dogfish (all species): 46,000# (RSE 37%) (all 2012)	skates and rays: 39,000# (RSE 43%) smooth-hound (*Mustellus*): 190,000# (RSE 35%) tope (*Galeorhinus*): 6,800# (RSE 36%) dogfish (all species): 448,000# (RSE 30%) (all 2012)	These results cover the catches for the whole of England including North Sea, Channel, Celtic Sea and Irish Sea. The range of estimates for cod catches by weight represents different methods of estimating seasonal and annual shore and private boat effort. Catches by number for cod and other species are for the method that is likely to be most consistent with future surveys. See Armstrong *et al*. (2013) for full details.
France							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.
Belgium	100–200t (2007)						These data result from a pilot study in 2007. A new study is ongoing to estimate the catches by sea-anglers.

Country	Cod		Eel		Sharks		Comments
	HARVEST	RELEASE	HARVEST	RELEASE	HARVEST	RELEASE	
Netherlands	690 000 (23) # 737(22) t	392 000 (23)#	313 000 (20) # fresh 41(20) t fresh 91 000 (32) # marine 18(39) t marine	517 000(14)# fresh 67 000 (40)# marine	0 (0) # 0 (0) t	15,000 (32) #	All data from 2012 and anglers only. Survey period from March 2012 to February 2013 with RSE in parentheses. Numbers are more accurate than weights. Data from van der Hammen & de Graaf (2013 & 2015). Weights of retained cod are based on lengths measured in an on-site survey. Other weight estimates are based on lengths in the logbook survey. In the 2012 survey no length measures of released fish were collected. Therefore only numbers are available

A3.3. North Atlantic (ICES Areas V–XIV 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 2013–2014.

Country	Sea bass		Salmon				Eel	Sharks	Comments
	HARVEST	RELEASE	HARVEST	RELEASE	HARVEST	RELEASE	HARVEST	RELEASE	
UK (Scotland)									
UK (England)	230–440 t (2012) 243,000# (RSE 38%) (2012)	150–250 t (2012) 467,000# (RSE 43%)	No marine catches	No marine catches	5,300# (RSE 140%) (2012)	32,000# (RSE 62%) (2012)	skates and rays: 41,000# (RSE 51%) smooth-hound (*Mustellus*): 4,200# (RSE 42%) tope (*Galeorhinus*): 20#(RSE 92%) dogfish (all species): 46,000# (RSE 37%) (all 2012)	skates and rays: 39,000# (RSE 43%) smooth-hound (*Mustellus*): 190,000# (RSE 35%) tope (*Galeorhinus*): 6,800# (RSE 36%) dogfish (all species): 448,000# (RSE 30%) (all 2012)	These results cover the catches for the whole of England including North Sea, Channel, Celtic Sea and Irish Sea. The range of estimates for bass catches by weight represents different methods of estimating seasonal and annual shore and private boat effort. Catches by number for bass and other species are for the method that is likely to be most consistent with future surveys. See Armstrong *et al.* (2013) for full details.
Ireland			No marine recreational catches	No marine recreational catches	No marine recreational catches	No marine recreational catches			see Table A 2.3.

Country	Sea bass				Salmon		Eel	Sharks	Comments
	HARVEST	RELEASE	HARVEST	RELEASE	HARVEST	RELEASE	HARVEST	RELEASE	
France	3,922 t (2012, provisional)	776 t(2012, provisional)							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.
Spain (Basque Country)	145 t [112-180] (2013)				1.5 t (2012–13)				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 2013–2014.

Country	Bluefin tuna		Eel		Sharks		Comments
	Harvest	Release	Harvest	Release	Harvest	Release	
Spain							
France							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.
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			
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).	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 3,349 Euro (25000 DKR).	
	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).	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 (DK angler= no distinction between marine and freshwater (Cowi, 2010), Webpanel 1500 respondents)	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 (German webpanel, not distinction between marine and freshwater fishing) CE analysis, (Jensen *et al*., 2010). (Table 6.1)	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 of conomic 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 & 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 195,000 sea anglers in Germany, with the majority (163,000) going angling in the Baltic Sea (unpublished data). Average annual expenditure was 736 € 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). 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. 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.	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). Per trip expenditure range of €858 – €1,027 per person for overseas anglers. Domestic anglers annual expenditure estimated at €1,740. From the omnibus survey & 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. 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	9,762 EUR	
Lithuania	Have not been performed similar studies in Lithuania	9 000 EUR licence sales in 2014 An average angler spends 200 EUR per year. Total 600 000 EUR in 2014	
Luxembourg			
Malta			
Netherlands	Screening survey (50,000 households) followed by 12 month Diary Survey (2000 participants) (van der Hammen & de Graaf, 2013).	200 € per fisher per year, 341 € million (accommodation, travel, durable equipment, consumables etc)	

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
Norway	Survey to 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-tot-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 engaged in recreational fishing at least once during 2013. Total expenditures for recreational fishing during 2013 was 5.8 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 2,512 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 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	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 & imports) Supports over 10,000 FTEs £358 million GVA Total value (direct, indirect & 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
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 license frame samples in states without MRIP followed slightly different 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 license 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	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
	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, labor 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 3,200 individuals. The multiplier effects of this activity were substantial. An additional $193.7 million in sales, $66.5 million in income, and 1,290 jobs 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 4,500 jobs in the overall Northeast regional economy were supported by the active for-hire fleet in 2010. For full detials see Steinbeck & Brinson (2013). **An Assessment of Marine Recreational Fishing Values in Massachusetts** This study compared nonmarket values based on actual cash transactions to	Economic Impact $334 million in output (sales impacts) $117 million in personal income 7,530 jobs Economic Value Mean Economic Value per Angler Hypothetical WTA Estimate = $593 annually Hypothetical WTP = $80 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
	those estimated by inferring values from revealed behavior 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 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 4,577 surveys were mailed outand 1,491 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 2,039 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.	Actual WTA = $317 annually 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 recreational catch sampling schemes

A5.1. Denmark; off-site survey

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	Only annual licence holders are included (anglers and passive gear fishers) Day and week licences are not included in the recall survey (effort data from omnibus used to adjust and include these license holders)
	Is there illegal/tourist fishery, which is not accounted for?	**Yes** / No / Unknown	Adjustments for illegal fishing derived from Omnibus survey data from 2009–2010. No adjustment for tourist fishery. (How well does the omnibus perform in terms of reaching the whole population?). Tourist catch and effort could be supplemented by on-site survey
	Are there elements of the target population that are not accessible?	**Yes** / No / Unknown	Non-residents, foreign tourists and certain age groups. Licence only mandatory for ages 18 <> 65 years. No contact information available for anglers using daily or weekly licences
Target frame	Is the PSU identified and documented?	**Yes** / No / Unknown	Each licence holder (Recall survey) Omnibus normally targets households? Possible gate-keeper effect?
	Does the sampling frame fully cover the target population?	Yes / **No** / Unknown	List of licence holders. Some adjustments based on the Omnibus data It could be relevant to let Statistics Denmark compare the demographics of respondents with the whole community of annual licence holders. This could be used to explore if the respondents reflect the target population
	Are there elements of the target population that are excluded from the frame (e.g. non- residents, private access sites)?	**Yes** / No / Unknown	Non-residents and certain age groups. Licence only mandatory for ages 18 <> 65 years. No contact information available for tourists using daily or weekly licences
Stratification	Are the strata well defined, known in advance and stable?	**Yes** / No / Unknown	Anglers and passive gear fishers Regional stratification could be applied, i.e. are anglers in specific areas fishing more/less? Could potentially influence future design of omnibus survey

DESIGN			
QUESTION		ANSWER	COMMENTS (INCLUDING MAGNITUDE AND DIRECTION OF BIAS)
	Is there an overstratification leading to excessive imputation?	Yes / **No** / Unknown	Two strata
Selection	Is sampling probability based (e.g. stratified random with spatial strata, PPS)?	**Yes** / No / Unknown	Random Sample

IMPLEMENTATION			
	QUESTION	ANSWER	COMMENTS (INCLUDING MAGNITUDE AND DIRECTION OF BIAS)
Selection	Has the survey been designed to maximize precision?	Yes / **No** / Unknown	Simple Random sampling
	Are there protocols in place and have they been followed for subsamples (selection of individuals, times, boats, biological samples)?	**Yes** / No / Unknown	Recall survey: n/a Omnibus: Protocols for selection of respondent within household should be in place.
	Are the right sites, times, respondents, biological data sampled?	Yes / No / Unknown	n/a
	Is there a language barrier (tourist fishery)?	Yes / No / Unknown	Language barriers as reason for non-respondents are minor (recall survey) Statistics Denmark could put together the demography of the anglers and compare that with the national demography.
	Is there a preference not to engage with illegal fishers (e.g. threatening behaviour)?	Yes / No / Unknown	n/a
	Has the assignment been completed?	Yes / No / Unknown	n/a
Nonresponse	Are response rates recorded and evaluated?	**Yes** / No / Unknown	Response rates are recorded but not evaluated. Relationship between demographics and refusal rates from Statistics Denmark?
	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 Relationship between demographics and refusal rates from Statistics Denmark? It could be relevant to let Statistics Denmark compare the demography of respondents and non-respondents with the whole community of annual license holders. This could be used to explore and evaluate how non-respondents and refusal rates reflect the target population
	Have you re-evaluated refusals?	Yes / **No** / Unknown	
	Have you accounted for not completed assignments (unobserved sample bias)?	Yes / No / Unknown	Could be relevant to ask Statistics Denmark to explore how many respondents start an interview and how many finish it.

IMPLEMENTATION			
QUESTION		ANSWER	COMMENTS (INCLUDING MAGNITUDE AND DIRECTION OF BIAS)
Recall	Is the recall period appropriate?	Yes / **No** / Unknown	The recall period is too long (6 months). Two interview surveys/year. Consider surveys every 2–3 years with shorter recall periods instead of sampling two times every year. Consider making length of recall period species-specific.
	Does recall period match fishing season?	**Yes** / **No** / Unknown	Yes- for cod and sea trout. No – for eel
Effort	Is effort well defined (unit, fishing mode, target species, location) and related to cpue measures?	**Yes** / No / Unknown	Effort in days of fishing. Consider to get independent data from specific platforms e.g. tourboats and private boats (cod). Check if a boat register exists.
	Is the concept of effort understood by respondents?	**Yes** / No / Unknown	
	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	n/a
	Is species identification and naming reliable?	**Yes** / No / Unknown	Maybe some issues with distinction between salmon and sea trout.
	Is there a clear division between fish kept and fish released?	**Yes** / No / Unknown	
	Are there any high-valued/threatened species taken in the fishery that might be unreported?	**Yes** / No / Unknown	Eel catches could be unreported due to negative public opinion when fishing on threatened species
	Is there a digit preference in the reports?	**Yes** / No / Unknown	Some preference when reporting catches in weight

	ANALYSIS		
	QUESTION	**Answer**	**Comments (including Magnitude and Direction of Bias)**
General	Does the estimation procedure follow the survey design?	**Yes /** No / Unknown	Partly, as the effort component is derived from the omnibus survey (fixed 'old' data) and the catches from the recall interview surveys (new data)
	Has imputation been used to account for missing observations and, if so, is the procedure	Yes / **No** / Unknown	
	Has the precision of estimates been calculated and, if yes, where are the documented?	**Yes** / No / Unknown	Sparrevohn and Storr-Poulsen (2012) ICES Journal of Marine Science , 69(2), 323–330
	Has there been weighting to correct for nonresponses/avidity bias	Yes / **No** / Unknown	
	In panel surveys, have those selected changed their fishing pattern or activity?	Yes / No / Unknown	n/a
	Is the bias caused by drop-outs and drop-ins in a panel corrected for?	Yes / No / Unknown	n/a

A5.2. Netherlands; off-site survey

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/Unknown	Most sectors are in the survey. Seperate gillnet survey (2014 survey)
	Is there illegal/tourist fishery, which is not accounted for?	Yes	Tourists are not accounted for. The Dutch angling association ('Sportvisserij Nederland'), estimates that ~ 5% of the fishers are from abroad. There is probably some illegal fisheries. Our survey is anonymous: some participants report illegal activities in the logbooks (retaining eel f.e., night fishing). It is unknown which proportion of illegal activities are not reported in our survey.
	Are there elements of the target population that are not accessible?	No	Tourist, non-residents and people without Internet access (~4%)
Target frame	Is the PSU identified and documented?	Yes	Individual fishers
	Does the sampling frame fully cover the target population?	Yes	Our target population is the Dutch population. This is fully covered. Total catches in Dutch waters are not fully covered (tourists are not included).
	Are there elements of the target population that are excluded from the frame (e.g. non-residents, private access sites)?	Yes	Non-residents and tourists are not included in the survey.
Stratification	Are the strata well defined, known in advance and stable?	Yes	Avidity groups are sampled seperately. The size of the avidity groups are known and relatively stable.

	Is there an overstratification leading to excessive imputation?	No	Participants in the higher avidity groups are weighted a bit more than those in the lower avidity groups (covered with weighting, not with imputation)
Selection	Is sampling probability based (e.g. stratified random with spatial strata, PPS)?	Yes/No	Random samping in the strata. Some high avid fishers come from fisheries websites, these are not probability based.

IMPLEMENTATION			
QUESTION		**ANSWER**	**COMMENTS (INCLUDING MAGNITUDE AND DIRECTION OF BIAS)**
	Has the survey been designed to maximize precision?	Yes	Precision is maximised by stratified sampling of avidity. Furthermore precision is maximised by having a large sample (~2500) fishers and a long survey (1 year). Increased sampling in high avid groups increases precision.
	Are there protocols in place and have they been followed for subsamples (selection of individuals, times, boats, biological samples)?	Yes	Selection of individuals is done using a documented protocol.
	Are the right sites, times, respondents, biological data sampled?	Yes	n/a
	Is there a language barrier (tourist fishery)?	No	Tourist fisheries are not included
	Is there a preference not to engage with illegal fishers (e.g. threatening behavior)?	No	n/a
Selection	Has the assignment been completed?	Yes	Logbook survey is completed
Nonresponse	Are response rates recorded and evaluated?	Yes	

IMPLEMENTATION			
QUESTION		**ANSWER**	**COMMENTS (INCLUDING MAGNITUDE AND DIRECTION OF BIAS)**
	Are refusal rates (e.g. according to spatial issues, fishing in MPAs or fishing for high value species) recorded and evaluated?	Yes/No	Refusal rates in the screening survey to join the logbook survey are recorded, but not evaluated.
	Have you re-evaluated refusals?	Yes	Reminders if logbook participants did not respond.
	Have you accounted for not completed assignments (unobserved sample bias)?	Yes	By impution and weighting
Recall	Is the recall period appropriate?	Yes	No recall: fishers fill in logbooks at the site. This may not always occur, then the recall period is 1 month.
	Does recall period match fishing season?	Yes	Max 1 month recall period
Effort	Is effort well defined (unit, fishing mode, target species, location) and related to cpue measures?	Yes	Trip duration, trip date, trip start time, gear (s) used, boat or shore. Target species is unknown.
	Is the concept of effort understood by respondents?	Yes	They understand start time , end time and gear used....
	Is it possible to record incorrect fishing areas?	Yes/na	We don't stratify by area. It is possible to record the location incorrectly.

IMPLEMENTATION			
QUESTION		**ANSWER**	**COMMENTS (INCLUDING MAGNITUDE AND DIRECTION OF BIAS)**
Catch	Is catch verified by surveyors (e.g. all filleted, don't show)?	No	
	Is species identification and naming reliable?	Unknown	We provided the fishers with a identification card. We are working on a fish identify test. There are probably some errors. Participants are allowed to fill in 'species unknown' and we group some species for which we know that errors are often made (f.e. dab and plaice).
	Is there a clear division between fish kept and fish released?	Yes	
	Are there any high-valued/threatened species taken in the fishery that might be unreported?	No/Unknown	The survey is anonymous. Therefore illegal catches are also reported. However, it is possible that some fishers still do not report illegal removals.
	Is there a digit preference in the reports?	Yes / No	In the first survey there is a digit preference the length measurements. In the second and third surveys we asked if lengths were measured or estimated and the measured estimates did not show much digit preference. Also we have a onsite length measure survey. This survey only covers some (marine) species

ANALYSIS			
QUESTION		Answer	Comments (including Magnitude and Direction of Bias)
General	Does the estimation procedure follow the survey design?	Yes	
	Has imputation been used to account for missing observations and, if so, is the procedure documented?	Yes	Only a small % of missing observations is imputed. Procedure is documented.
	Has the precision of estimates been calculated and, if yes, are they documented?	yes	RSE's are reported.
	Has there been weighting to correct for nonresponses/avidity bias	Yes	Weighting has been applied for avidity.
	In panel surveys, have those selected changed their fishing pattern or activity?	Yes	Low avid marine fishers often did not fish for a whole year (drop-outs).
	Is the bias caused by drop-outs and drop-ins in a panel corrected for?	Yes	Drop-outs are excluded from the analysis. This is a high % in marine (low avid) fishers. The exclusion means that it is assumed that the number of fishers between two subsequent years does not change

A5.3. Sweden

A5.3.1. Sweden; off-site survey (national survey)

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	There is no obligation to repport or any registration of recreational fishers in Sweden. Target population are residants between 16–80 years
	Is there illegal/tourist fishery, which is not accounted for?	Yes	Tourist fishers ares not included, illegal fisheries are unknown
	Are there elements of the target population that are not accessible?	No	
Target frame	Is the PSU identified and documented?		
	Does the sampling frame fully cover the target population?	Yes	
	Are there elements of the target population that are excluded from the frame (e.g. non-residents, private access sites)?	No	
Stratification	Are the strata well defined, known in advance and stable?	Yes	
	Is there an overstratification leading to excessive imputation?		
Selection	Is sampling probability based (e.g. stratified random with spatial strata, PPS)?	Yes	

QUESTION			
Selection	Has the survey been designed to maximize precision?	Yes	
	Are there protocols in place and have they been followed for subsamples (selection of individuals, times, boats, biological samples)?		
	Are the right sites, times, respondents, biological data sampled?		
	Is there a language barrier (tourist fishery)?	Yes	The questionary is in Swedish so there is a potential language problem
	Is there a preference not to engage with illegal fishers (e.g. threatening behavior)?	Unknown	
	Has the assignment been completed?		
Nonresponse	Are response rates recorded and evaluated?	Yes	
	Are refusal rates (e.g. according to spatial issues, fishing in MPAs or fishing for high value species) recorded and evaluated?		
	Have you re-evaluated refusals?		
	Have you accounted for not completed assignments (unobserved sample bias)?		
Recall	Is the recall period appropriate?	Yes	
	Does recall period match fishing season?	Yes	
Effort	Is effort well defined (unit, fishing mode, target species, location) and related to cpue measures?	Yes	
	Is the concept of effort understood by respondents?	Unknown	
	Is it possible to record incorrect fishing areas?		
Catch	Is catch verified by surveyors (e.g. all filleted, don't show)?		
	Is species identification and naming reliable?	No	There is some problem with salmonides, trout and rainbow trout is probably to some unknown extent reported as salmon
	Is there a clear division between fish kept and fish released?	Yes	
	Are there any high-valued/threatened species taken in the fishery that might be unreported?		
	Is there a digit preference in the reports?		

QUESTION			
General	Does the estimation procedure follow the survey design?	Yes	
	Has imputation been used to account for missing observations and, if so, is the procedure documented?		
	Has the precision of estimates been calculated and, if yes, where are the documented?	Yes	
	Has there been weighting to correct for nonresponses/avidity bias	Yes	
	In panel surveys, have those seleted changed their fishing pattern or activity?		

	DESIGN		
QUESTION	Is the bias caused by drop-outs and drop-ins in a panel corrected for?	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	There is no obligation to repport or any registration of recreational fishers in Sweden. Target population are residants between 16–80 years
	Is there illegal/tourist fishery, which is not accounted for?	Yes	Tourist fishers ares not included, illegal fisheries are unknown
	Are there elements of the target population that are not accessible?	No	
Target frame	Is the PSU identified and documented?		
	Does the sampling frame fully cover the target population?	Yes	
	Are there elements of the target population that are excluded from the frame (e.g. non-residents, private access sites)?	No	
Stratification	Are the strata well defined, known in advance and stable?	Yes	
	Is there an overstratification leading to excessive imputation?		
Selection	Is sampling probability based (e.g. stratified random with spatial strata, PPS)?	Yes	

QUESTION			
Selection	Has the survey been designed to maximize precision?	Yes	
	Are there protocols in place and have they been followed for subsamples (selection of individuals, times, boats, biological samples)?		
	Are the right sites, times, respondents, biological data sampled?		
	Is there a language barrier (tourist fishery)?	Yes	The questionary is in Swedish so there is a potential language problem
	Is there a preference not to engage with illegal fishers (e.g. threatening behavior)?	Unknown	
	Has the assignment been completed?		
Nonresponse	Are response rates recorded and evaluated?	Yes	
	Are refusal rates (e.g. according to spatial issues, fishing in MPAs or fishing for high value species) recorded and evaluated?		
	Have you re-evaluated refusals?		
	Have you accounted for not completed assignments (unobserved sample bias)?		
Recall	Is the recall period appropriate?	Yes	
	Does recall period match fishing season?	Yes	
Effort	Is effort well defined (unit, fishing mode, target species, location) and related to cpue measures?	Yes	
	Is the concept of effort understood by respondents?	Unknown	
	Is it possible to record incorrect fishing areas?		
Catch	Is catch verified by surveyors (e.g. all filleted, don't show)?		
	Is species identification and naming reliable?	No	There is some problem with salmonides, trout and rainbow trout is probably to some unknown extent reported as salmon
	Is there a clear division between fish kept and fish released?	Yes	
	Are there any high-valued/threatened species taken in the fishery that might be unreported?		
	Is there a digit preference in the reports?		

QUESTION			
General	Does the estimation procedure follow the survey design?	Yes	
	Has imputation been used to account for missing observations and, if so, is the procedure documented?		
	Has the precision of estimates been calculated and, if yes, where are the documented?	Yes	
	Has there been weighting to correct for nonresponses/avidity bias	Yes	
	In panel surveys, have those seleted changed their fishing pattern or activity?		

	Is the bias caused by drop-outs and drop-ins in a panel corrected for?

A5.3.2 Sweden; on-site survey (trolling boats)

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?	No	Target population is all trolling boats leaving Swedish harbours in the Baltic trolling for Salmon
	Is there illegal/tourist fishery, which is not accounted for?	Yes	Maybe non swedish speaking trollingboats are excluded
	Are there elements of the target population that are not accessible?	Yes	Non residents, non respondents
Target frame	Is the PSU identified and documented?	No	
	Does the sampling frame fully cover the target population?	Unknown	
	Are there elements of the target population that are excluded from the frame (e.g. non-residents, private access sites)?	Yes	It is likely that foreign anglers are not reached in the same degree but we assume that their cpue are similar
Stratification	Are the strata well defined, known in advance and stable?	Yes / No / Unknown	NA
	Is there an overstratification leading to excessive imputation?	Yes / No / Unknown	NA
Selection	Is sampling probability based (e.g. stratified random with spatial strata, PPS)?	Yes / No / Unknown	The survey is a pilot study with a convinience sample

IMPLEMENTATION			
QUESTION		Answer	Comments (including Magnitude and Direction of Bias)
Selection	Has the survey been designed to maximize precision?	No	NA
	Are there protocols in place and have they been followed for subsamples (selection of individuals, times, boats, biological samples)?	No	NA
	Are the right sites, times, respondents, biological data sampled?	No	
	Is there a language barrier (tourist fishery)?	Yes	Parts of the population are foreign tourists. Unknown if they are reached and magnitude of language barrier
	Is there a preference not to engage with illegal fishers (e.g. threatening behavior)?	No	
	Has the assignment been completed?	No	In general, the assignments are completed, however this is not specifically planned
Nonresponse	Are response rates recorded and evaluated?	No	Current implementation is a convinience sample with undefined response rate

	Are refusal rates (e.g. according to spatial issues, fishing in MPAs or fishing for high value species) recorded and evaluated?	No	See above
	Have you re-evaluated refusals?	No	See above
	Have you accounted for not completed assignments (unobserved sample bias)?	No	See above
Recall	Is the recall period appropriate?	Unknown	Anglers are asked to report 3 latest trips. Previously a 12-month recall period was recorded.
	Does recall period match fishing season?	Yes	
Effort	Is effort well defined (unit, fishing mode, target species, location) and related to cpue measures?	Yes	The effort is one trip but we also ask for the length of the trip in hours.
	Is the concept of effort understood by respondents?	Yes	
	Is it possible to record incorrect fishing areas?	Unknown	
Catch	Is catch verified by surveyors (e.g. all filleted, don't show)?	No	
	Is species identification and naming reliable?	Yes	
	Is there a clear division between fish kept and fish released?	Yes	
	Are there any high-valued/threatened species taken in the fishery that might be unreported?	Yes	
	Is there a digit preference in the reports?	No	At least not in the reports of the number of fish. Unknown for the weight.
ANALYSIS			
QUESTION		Answer	Comments (including Magnitude and Direction of Bias)
General	Does the estimation procedure follow the survey design?	Unknown	NA
	Has imputation been used to account for missing observations and, if so, is the procedure documented?	No	
	Has the precision of estimates been calculated and, if yes, where are the documented?	Yes	Confident intervalls
	Has there been weighting to correct for nonresponses/avidity bias	No	
	In panel surveys, have those seleted changed their fishing pattern or activity?	Unknown	NA
	Is the bias caused by drop-outs and drop-ins in a panel corrected for?	No	

A5.3.3 Sweden; off-site survey (tour boats)

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?	No	Released cod are not estimated Private boat catch unknown Tour boats only landed weight estimated
	Is there illegal/tourist fishery, which is not accounted for?	No	All tour boats are known
	Are there elements of the target population that are not accessible?	Yes / No / Unknown	Some captains do not report (3 of 13 in 2014) but are given the quarterly mean of reporting captains
Target frame	Is the PSU identified and documented?	Yes	PSU = tour boat Tour boats only
	Does the sampling frame fully cover the target population?	No	Private boats missing
	Are there elements of the target population that are excluded from the frame (e.g. non-residents, private access sites)?	Yes	Private boats Land-based fishing
Stratification	Are the strata well defined, known in advance and stable?	Yes	
	Is there an overstratification leading to excessive imputation?	No	
Selection	Is sampling probability based (e.g. stratified random with spatial strata, PPS)?	No	All fishing trips are included

implementation			
question		answer	Comments (including Magnitude and Direction of Bias)
Selection	Has the survey been designed to maximize precision?	Yes	However, controls have been too few, see below
	Are there protocols in place and have they been followed for subsamples (selection of individuals, times, boats, biological samples)?	Yes	A simple paper protocol where the captains fill in their estimates of catch in kg for each fishing trip
	Are the right sites, times, respondents, biological data sampled?	Yes	However, weight and length of cod is only recorded during controls
	Is there a language barrier (tourist fishery)?	No	
	Is there a preference not to engage with illegal fishers (e.g. threatening behavior)?	No	
	Has the assignment been completed?	No	Private boats are not included. However, the number of controls should be increased. A major control effort could be done every 3 to 4 years.
Nonresponse	Are response rates recorded and evaluated?	Yes	We have full knowledge over the number of operating tour boats and know which boats are not participating
	Are refusal rates (e.g. according to spatial issues, fishing in MPAs or fishing for high value species) recorded and evaluated?	Yes	Captains that do not want to participate are asked why. One boat may have several captains over the year and some captains just do not want to participate.
	Have you re-evaluated refusals?	Yes	See above
	Have you accounted for not completed assignments (unobserved sample bias)?	Yes	Captains that do not report are given the quarterly mean estimate of reporting captains
Recall	Is the recall period appropriate?	Yes	Captains record their estimates daily on paper protocol and reports are sent annually to the investigator

	Does recall period match fishing season?	Yes	All fishing trips are included
Effort	Is effort well defined (unit, fishing mode, target species, location) and related to cpue measures?	Yes	Cod catches in kg for each fishing trip
	Is the concept of effort understood by respondents?	Yes	
	Is it possible to record incorrect fishing areas?	Yes	But not considered a problem. If a tour boat is fishing outside the Sound it will not record any catches.
Catch	Is catch verified by surveyors (e.g. all filleted, don't show)?	Yes	But at a very low intensity. Controls on 9 and 12 fishing trips were only done in 2012 and 2013, respectively (weight of cod kept). The controls showed highly different results (2% and 25 % overestimate in catches over 30 kg). There were 1540 and 1608 fishing trips in 2012 and 2013, respectively. Number of controls were only 0.6 % and 0.7 % of number of fishing trips explaining the variable results. One large control every 3 or 4 years could be considered if funding is available.
	Is species identification and naming reliable?	Yes	
	Is there a clear division between fish kept and fish released?	Yes	
	Are there any high-valued/threatened species taken in the fishery that might be unreported?	No	
	Is there a digit preference in the reports?	No	But check!

Analysis			
Question		Answer	Comments (including Magnitude and Direction of Bias)
General	Does the estimation procedure follow the survey design?	No	Lack of controls is a major concern. This is a financial problem, not a practical problem
	Has imputation been used to account for missing observations and, if so, is the procedure documented?	Yes	Captains not participating are simply given the quarterly means of reporting captains. In 2014, 3 out of 13 captains did not report catch estimates. In the first year (2011), all captains reported estimates.
	Has the precision of estimates been calculated and, if yes, where are the documented?	Yes	The few controls are documented in the survey database. However, reported data are not corrected for these controls which are too variable and can therefore not be used. Hopefully, future larger controls can be used to correct old data. But this is not without problems since attitudes towards the survey may change in unknown directions affecting the estimates. Non-parametric bootstrapping might be a useful technique.
	Has there been weighting to correct for nonresponses/avidity bias	Yes	See above
	In panel surveys, have those selected changed their fishing pattern or activity?	No	NA No panels

Annex 6: Current/most recent inland recreational fishing surveys

A6.1. Inland recreational fisheries

Table A6.1. Most recently carried out, ongoing and/or planned inland recreational fishing surveys in the sampling period 2013–2014.

Country	Eel	Salmon	Comments
Netherlands	The RECFISH programme consists of the following elements: • Online Screening Survey (panel) to estimate the number of recreational fishers (marine and freshwater). Surveys were carried out in 2009, 2011 and 2013. In 2013 a parallel online and random digit dialing survey was done. • Online monthly Diary Survey to estimate the annual eel catches. 12 month surveys were carried out in 2010, 2012, and 2014. • Onsite surveys to determine length frequency of landed (marine) species.	As for Eel. Salmon and Seatrout are pooled durig analysis due to difficulties with identification.	No onsite length data for eel and salmon in inland waters. Estimated numbers are more accurate then weights. Catch estimates for salmon in inland waters are less accurate, high RSE and few fishers with catches in the survey. Salmon and Seatrout are pooled durig analysis due to difficulties with identification.
Latvia	Recreational net fishery is estimated on the base of logbooks. The catches are low because recreational fishermen are not allowed to cacth with gears applicable for catching eel. For eel angling irregular on-site survey.	Only licensed angling is allowed in three rivers. The total cacth is estimated on the base of sold and returned licences.	The catches taken in recreational fishery with commercial gears should be reported and added to commercial catches.
Poland	Eel recreational fishery is estimated based on questionnaires.	River salmon fishery almost does not exist as the natural spawning of salmon in Polish rivers almost does not occur.	

Country	Eel	Salmon	Comments
Lithuania	Information on catch volumes can be obtained from census, direct interviews and questionnaires. Respondents selected in gathering places of fishers where they come to fish from all parts of Lithuania. For example smelt fishing in Curonian Lagoon.	All salmon catches have to be reported to Ministry of Environment protection.	All recreational fishers are licensed
Ireland	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).	Rivers managed on an individual basis. Harvest fishery permitted in freshwater where surplus over Conservation Limit exists. Anglers licensed and annual bag limit of 10 fish per angler of salmon (any size) applies. Carcass tagging scheme with mandatory reporting. Released fish also reported in angler logbook.	Recreational fishing for salmon and sea trout is angling only. Mandatory reporting of sea trout >40 cm caught by commercial sector and anglers.
Finland	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 are additional postal surveys conducted on the basis of local fishing licences.	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 3 contacts. A telephone interview is done for a sample of the non-respondents. Harvested catch and released catch is measured separately by species.
Belgium -Flanders -Wallonia	A new survey/inquiry is planned at the end of 2015 to investigate the harvest of freshwater fish in public waters by recreational anglers. Most recent data are based on the results of an inquiry from 2008 and more recent estimates (Vlietinck, pers. comm.) No recent surveys		Available data for Wallonia based on the control of recreational fishermen (1,400 in 2014)

Country	Eel	Salmon	Comments
Sweden	It is prohibited to fish for eel - additional information to RCM.	National survey, regional studies (see comments)	A national annual recreational fishing survey (mail and telephone), including all species, subareas and all gears is been done every year. Data for river catches of salmon are collected from local management organizations or local exports by WGBAST. Quality varies a lot between different rivers due to varying interest by local organizations and local culture. Release data available for some rivers, seatrout data availabe for some rivers. A new national onsite survey targeting primarily rec. fishing for pike, pike-perch and perch in both freshwater and coastal waters are planned for 2015–2016 starting in coastal waters south of Stockholm.

Country	Eel	Salmon	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.	Catches (harvest and release in numbers) is reported (mandatory) for each of the rivers in Denmark where there is fishing for salmon.	From 2010, catch of seatrout has also been estimated using data from the recall survey (as for eel). From 2013 the annual licence list recall survey is web-based only. No results are available in missing categories for the group of non-respondents as a consequence of the new approach. Additional national data on eel catches from ICES WGEEL.
UK			
Norway			
Spain			
Germany	There is no national survey for inland eel catches.	There is no national survey for freshwater salmon catches.	Inland fishery is managed by the indidual federal states (Länder). There has been one study estimating recreational inland catches (including eel) in northern Germany (Dorow and Arlinghaus 2011)

A6.2. Estimates for inland recreational fisheries

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

Table A6.2. Most recent inland recreational harvest estimates, in tonnes (t) or numbers (#); figures in brackets indicate differing years, in the sampling period 2013–2014.

Country	Eel		Salmon		Comments
	Harvest	Release	Harvest	Release	
Netherlands	313000 (#) (RSE 20) 41 t (RSE 20) (2012–2013)	1 517 000 (#) (RSE 14) (2012–2013)	2000 (#) 0.2 (t) (2012–2013)	5000 (#) (2012–2013)	Salmon and Seatrout are pooled during analysis due to difficulties with identification. Estimate for Salmon is only indicative due to very small number of fishers reporting a catch.
Latvia	0.1 t (2014)	1 386 200 (2014)	0.2 (2014)	773914 (2014)	Eel harvest =recreational net fishery. Harvest in eel angling was estimated to be around 1 t based on on-site survey in 2007. Evidently has not increased since then. Is planned to repeat in 2016.
Poland	26.7 t (2013)	NC			River catches of salmon are reported to WGBAST
Lithuania	1.8 t (2014) 3.0 t (2013) 1.3 t (2012)	ND	400 # (2014) 120 # (2013) 0,8 t (2014) 0.5 t (2013)	ND	Salmon catches estimates with seatrout
Ireland	Fishery closed		18,178# (2013)	10,682#(2013)	Catch data for sea trout >40 cm available
Finland	3 t (2012)	0 t (2012)	103 t (2012, Baltic salmon) 147 t , 18000 # (2014) 54 t, (2014) 0.26 t (2013)	3 t (2012)	Data from the nationwide biennal recreational fishing survey. Released catch is from inland and sea area together. Estimates for 2014 will be available in 2015. Baltic salmon, River Torniojoki: data from a postal survey conducted on the basis of local fishing licences. Atlantic salmon, River Tenojoki: data mainly from postal and telphone surveys conducted on the basis of local fishing licences. Baltic salmon, River Simojoki: data from a postal survey conducted on the basis of local fishing licences.

Country	Eel		Salmon		Comments
	Harvest	Release	Harvest	Release	
Denmark	2.0 t (h= 21) (2014)	1336 # (h=2) (2014)	5.6 t (2014) 625 # >75cm 604 # 40-75cm	8.4 t (2014) 919 # >75cm 983 # 40–75cm	Data on eel only from fykenets. Data on salmon is based on mandatory catch reporting from anglers. Data on seatrout is also available. Number of respondents contributing to the catch estimate (h) Harvest 30.1.t (h=81) Release 183,348 # (h=141)
Belgium -Flanders	30 t (2010)				Data (2010) for Flanders is based on Vlietinck (pers comm). Based on an inquiry by the Agency for Nature and Forest in public waters in Flanders in 2008, recreational anglers harvest on a yearly basis 33.6 tons of eel (Vlietinck, 2010). Now a reduction of 10% has been estimated related to a Flemish legislation published in 2010.
-Wallonia	0 t (2014*)				*For Wallonia: Last year, on about 1,400 controlled recreational fishermen, only two of them had illegally harvested eels, so it is believed that eel poaching is rare in Wallonia and that the nul total eel harvest hypothesis seems realistic.
Sweden	NP	NC	340 t (2013) 116 t, 14,835#	NC	National survey (total Swedish inland includes landlocked salmon in great lakes) WGBAST
Germany	187 t ±45 (2007)				Dorow and Arlinghaus 2009, only northern Germany

A6.3. Organisations responsible for inland recreational fisheries

Table A6.3. Overview organisations involved with marine and inland recreational fisheries.

Country	Marine Recreational Fisheries	Inland Recreational Fisheries
Netherlands	Martin de Graaf & Tessa van der Hammen IMARES Martin.degraaf@wur.nl Tessa.vanderhammen@wur.nl	Martin de Graaf & Tessa van der Hammen IMARES Martin.degraaf@wur.nl Tessa.vanderhammen@wur.nl
Latvia	Institute of Food Safety Animal Health and Environment BIOR	Institute of Food Safety Animal Health and Environment BIOR, Department of Fish Resources Research, Janis Birzaks: janis.birzaks@bior.lv
Poland	NMFRI	Inland Fisheries Institute (IRS)
Lithuania	Fisheries Service	Fisheries Service and Ministry of Environment of Lithuanian Republic
Ireland (Rep)	Inland Fisheries Ireland suzanne.campion@fisheriesireland.ie	Inland Fisheries Ireland suzanne.campion@fisheriesireland.ie
Finland	Luke (Natural Resources Institute Finland)	Luke, (Catches estimated from national surveys) Luke, (Baltic salmon, River Torniojoki) Luke, (Atlantic salmon, River Tenojoki) Luke, (Baltic salmon, River Simojoki)
Denmark	DTU Aqua	DTU Aqua

Country	Marine Recreational Fisheries	Inland Recreational Fisheries
Belgium		
-Flanders	ILVO (Institute for Agriculture and Fisheries Research) VLIZ (Flanders Marine Institute)	ANB (Agency for Nature and Forest) for Flanders INBO (Research Institute for Nature and Forest) for Flanders
-Wallonia		DGARNE (Direction générale opérationnelle de l'Agriculture, des Ressources naturelles et de l'Environnement); DNF (Direction de la Chasse et de la Pêche du Département de la Nature et des Forêts); Service de la Pêche (for Wallonia)
Sweden	SwAM + SLU Freshwater institute	SwAM + SLU Freshwater institute
Germany	Thünen-Institute of Baltic Sea Fisheries Alter Hafen Süd 2 18069 Rostock Germany	Federal state agencies
Greece	Ministry of Reconstruction of Production, Environment and Energy Rural Development, General Secretary of Sustainable Fishery, Mr Tsahageas Panagiotis, syg013@minagric.gr, Sygrou 105 Str., 17671, Athens, Greece	Ministry of Reconstruction of Production, Environment and Energy Rural Development, General Secretary of Sustainable Fishery, Mr Tsahageas Panagiotis, syg013@minagric.gr, Sygrou 105 Str., 17671, Athens, Greece

Annex 7: Proposal for EU Lot funding for post-release mortality study: "Discards in European hook and line fisheries: mortalities, consequences for stock assessments, and mitigation potential"

Commercial and recreational hook and line fisheries are widespread in European coastal waters, yet studies have shown that unaccounted hooking mortalities of over 30% in released fish have rendered fishing regulations like minimum sizes and bag limits ineffective (Coggins *et al*., 2007). There is also potential for sublethal effects, e.g. behavioural changes (Cooke and Sneddon, 2007). Sublethal effects can occur as a consequence of hooking and handling stress and, even if the individual fish survives, can have significant consequences for the stock. For example, discarded fish may skip spawning or interrupt protection of spawning nests, both of which can lead to a loss of reproductive success (Suski *et al*., 2003). Fish with altered behaviour after being discarded are more prone to predation which can lead to increased mortalities if predators are present (Cooke and Philipp, 2004). This lack of knowledge will affect our ability to effectively manage stocks that are exploited by hook and line fisheries.

The European Commission have pledged to end discarding in the period 2014–2018, with only "species for which scientific evidence demonstrates high survival rates, taking into account the characteristics of the gear, of the fishing practices and of the ecosystem" excluded from the landing obligation. For many species, discard mortality is unknown, so programmes have been initiated to collect data on commercially caught fish. However, these studies generally focus on commercial netting and trawling with little data collection planned on hook and line fisheries. This represents a large gap in the evidence-base and has a significant impact on effective fisheries management as stock assessments will be inaccurate if discard mortality is not accounted for. This is particularly important if discard proportions and mortality is high, which may lead to a significant underestimation of actual fishing induced mortality (Kerns *et al*., 2012).

Discards of unwanted bycatch species and target species are high in both commercial and recreational marine hook and line fisheries in Europe. European marine recreational anglers often release more than 50% of their Atlantic cod, European sea bass, pollock, and sea trout catches (Ferter *et al*., 2013). The European eel and some elasmobranch species are protected in many countries so must be discarded, and target species that are under the legal minimum size must also be returned. Catches by recreational anglers can represent a significant proportion of the total removals (e.g. 25% of removals of European sea bass). Hence, post-release mortality is a large uncertainty in the assessment of stocks that are targeted by both commercial and recreational fishers. However, discard mortality of hook and line caught fish is not easy to measure and can vary significantly between species and fisheries. Many factors are also important including water temperature, hooking damages and on-board handling (Bartholomew and Bohnsack, 2005; ICES, 2014b).

A mixture of desk-based study and experimental work is needed to compile data on mortality of hook and line caught fish, to underpin the evidence-base to account for discard survival. This should consist of reviewing existing literature, assessing the potential for extrapolation between species and fisheries, setting up generic mortality profiles, and conducting two species-specific mortality studies on European sea bass and European eel to fill existing data gaps. It needs collaboration across Europe and with other countries including the USA to ensure that the best use of existing data is made.

Specific knowledge gaps to be addressed and methods to be used:

1) Despite high discard rates, species and fishery specific discard mortalities are unknown for most of the relevant European marine hook and line fisheries, so discard mortalities need to be estimated for use in stock assessments. A desk based review will be done to compile existing data on catch and release mortality, and group species with similar hooking mortalities based on underlying biology and fishing practices. Ranges of post-release mortality will be derived from studies to provide generic hooking mortality profiles for groups of species and fisheries. Species with high survival rates that have the potential to be excluded from discard bans will also be identified.

2) European sea bass and European eel are species that are caught regularly on hook and line, have high release rates, and are caught using different fishing practices. However, few data are available that can be used for post-release mortality in existing stock assessments or to develop best practice guidelines to maximise post-release survival. Experimental programmes will be developed for European sea bass and European eel that represent best practice for hooking mortality studies based on existing knowledge derived from other marine species including cod and striped bass.

Estimated cost and time-scale: Euro 350 000 over two years

Annex 8: European requirements for recreational fishing data

Introduction

ICES was contacted by the European Commission to address the following questions:

- What are the drivers for the collection of recreational fishing data?
- What recreational fishery data (biological, economic and fisheries activity) are needed to support the CFP?
- How will these data be used in stock assessment and fishery management advice?
- What spatial and temporal resolution of data is needed to support fisheries management?

These were discussed at the ICES WGRFS meeting in June 2015 and responses are provided below.

What are the drivers for the collection of recreational fishing data?

There are many drivers for the collection of recreational fishery data, and a wide range of existing or potential end-users of the data (see Table A8.1). The view of WGRFS is that the following are the main drivers for collection of recreational fisheries data:

i) The need to quantify the catches and fishing mortality exerted on stocks by recreational fishing, and hence identify stocks where this needs to be included in assessments and advice;

ii) The requirement for information on recreational fisheries to help design effective and enforceable control measures where these are needed, and to monitor the outcomes;

iii) The need for a comprehensive description of regional and often poorly monitored small-scale fisheries, which include large numbers of small commercial and recreational vessels using similar methods and targeting similar species and areas, and for an evaluation of their impacts on stocks and their social and economic benefits to coastal communities to help develop local management of shared resources;

iv) The need for information to support development of long-term regional fishery management plans and the increasing focus on management of mixed fisheries and ecosystem impacts;

v) The need for information on recreational fishing activity and pressures to support marine spatial planning and marine strategy framework directive.

Further details are given below.

Quantifying catches and fishing mortality exerted by recreational fisheries

The principal driver for collection of recreational fishery data in Europe is to allow the removals of fish by recreational fishing to be quantified, and where appropriate included directly into stock assessments or used qualitatively in providing fishery management advice. The impacts of recreational fisheries in Europe are likely to be

underestimated, as catch data for very few species have been submitted into the stock assessment and advisory process and/or are lacking completely from some Member States. If these data are excluded from assessments, it is not possible to accurately determine all the human impacts on stocks, and this degrades our ability to achieve MSY.

In the USA, Australia and New Zealand, recreational fishing has been shown to be an influential or even dominant cause of fishing mortality in many stocks, and inclusion of recreational survey data in assessment models in these countries allows the fishing mortality to be correctly apportioned between commercial and recreational fishing and where appropriate included in catch forecasts.

In Europe, recreational harvests of Atlantic salmon in freshwater and marine habitats have been included in stock assessments for many years, but there are very few examples of including recreational catch estimates in assessments of marine species. Current examples are sea bass and western Baltic cod. Many other species in the Northeast Atlantic and Mediterranean are taken in recreational fisheries, with widely varying extent of catch and release, and it is likely that recreational fishing is a sufficiently large part of the total fishing mortality of many species that assessments and management advice are degraded or absent by ignoring this source of mortality (e.g. European lobster, pollock, sea trout, groupers, Sparidae, Cephalopods). Without surveys to estimate recreational catches of a wider range of species in each region, recreational impacts on these species cannot be determined.

Designing and monitoring effectiveness of control measures

Where there is a need to control exploitation by commercial and recreational fisheries, information is needed on the characteristics of the fisheries, their selectivity patterns, fishing behaviour, and taxon-specific post-release (catch and release) mortality so that control measures can be well-designed and enforced. Time-series of recreational fisheries data are needed for this purpose and to monitor the effectiveness of the measures including minimum landing sizes and bag limits. Without this information, the ability to manage effectively is severely impeded. For example, data on sea bass catches from recreational surveys in the UK, France and Netherlands were used by the European Commission in 2014 to develop proposals for increasing the Minimum Conservation Reference Size (MCRS) and bag limits.

Evaluation of small-scale commercial and recreational fisheries

Recreational fisheries should be considered as a component of small-scale fisheries which involve very large numbers of under-10 m commercial fishing vessels. In many areas such as the Mediterranean and Norway, these are diffusely distributed and poorly monitored. In addition there is extensive shore-fishing activity in many areas as well. Recreational boat fisheries may operate in similar ways to small-scale commercial fisheries, e.g. in similar areas and targeting similar species assemblages, often using similar fishing methods such as rod-and-line, handlines, longlines, nets, pots, spear fishing and hand picking using SCUBA. This can lead to conflicts between sectors that are difficult to resolve without information on fishing activities and catches. Recreational fishing vessels can be larger and technologically more advanced than many vessels used by commercial fishermen, and can have high catching power.

In some areas, recreational fishery catches may be comparable to small-scale commercial fishery catches for many inshore species (e.g. charter and private boats), and the issues around estimating effort and catches is similar in both fisheries. Both types

of fishery require sampling schemes if exhaustive logbook coverage is not possible. Where controls such as minimum landing size or catch limits are imposed, problems of enforcement can be similar in small-scale commercial and recreational fleets. Finally, the definition of commercial and recreational fishing can be blurred in these fisheries, where recreational fishers also sell part of their catch legally or illegally. A clearer understanding of small-scale commercial and recreational fisheries as a whole is needed if fishery impacts on fish resources is to be properly understood, and this is a demanding area of data collection that requires adequate funding matched to the resolution of information needed.

Currently the EU Data Collection Framework includes requirements to collect employment and other economic data on the commercial catching and processing sectors and the aquaculture industry. Studies have shown that recreational fisheries have high economic value. Small-scale commercial and recreational fisheries support common industries such as boat and tackle manufacturers, and these fisheries can also have a strong influence on business development and employment, and on the prosperity of many coastal communities beyond the larger harbours used by larger-scale fisheries. Angling tourism is an additional example of local economic benefits. Effective co-management of these fisheries requires comparable understanding of the social and economic benefits as well as information on their relative impacts on fish resources. Collection of economic data such as expenditure can be included with some forms of recreational fishery surveys, though detailed survey data may only be needed at intervals of several years.

Development of long-term management plans, and mixed fishery and ecosystem approaches

The move towards long-term regional fishery management plans, and increasing focus on management of mixed fisheries and ecosystem impacts, add additional drivers for collection of recreational fishery data. The attainment of GES by 2020 under MSFD for biodiversity (descriptor 1), commercial stocks (descriptor 3), and foodwebs (descriptor 4) may also be impeded. For example, if there are significant non-quantified recreational landings with unknown impact, these could prevent reductions in fishing mortality expected through controls applied only to commercial fisheries. It is therefore important that regional, long-term management plans fully cover all commercial and recreational fisheries in the region so that the key pressures and impacts can be fully understood.

Small-scale commercial and recreational fisheries can also be viewed as mixed fisheries, where a range of species may be caught together by hook and line fishing or netting for example. It is difficult to consider the management of either fishery in isolation, and they must be viewed as targeting shared resources in inshore waters. At a local scale, co-management of the fisheries is possible, but requires a sound evidence base on all the fisheries operating in the same area.

A large proportion of many recreational catches are released alive, so it is also important to quantify post-release mortality and assess other potential sublethal effects of the catch. Some information exists for cod and there are studies from outside Europe, but more data are needed and methods for extrapolation across species and regions are also needed. If this is not accounted for, then the mortality associated with recreational fishing will be underestimated and again impact on sustainable management of fish stocks. This includes unwanted bycatch or species captured incidentally (non-target species, protected species, inedible or less palatable species).

Marine spatial planning

There is a drive to establish networks of Marine Protected Areas to aid the conservation of stocks and preservation of sensitive habitats. Evaluation of candidate MPAs or any other form of spatial management clearly needs detailed information on spatial activities of all forms of fishing activities. The spatial resolution required may exceed the possibilities of most recreational fishing surveys and require dedicated smaller-scale surveys at higher intensity. Comprehensive data that represents the spatial use patterns of recreational fisheries may be used in the MPA design and evaluation process.

What recreational fishery data (biological, economic and fisheries activity) are needed to support the CFP?

Estimation of recreational fishery catches

To estimate total catches and releases, the following information is usually needed:

- The total number of recreational fishers, charter boats, number of fishing trips or other measure of participation or fishing effort, generally estimated from a national survey, or a list of vessels.
- Catch per unit of effort (or catch per person or per boat depending on the type of survey) recorded for a representative sample of fishers, boats or trips etc., for example from on-site surveys of individual anglers or completion of catch diaries or vessel logbooks. Data are needed for the retained (harvested) catch as well as for released fish if total fishery removals are to be estimated using data on post-release mortality, or if a cpue index series is to be developed.
- Demographic and avidity (frequency of fishing) data where these are needed to re-weight samples to be more representative of the population and improve accuracy.
- Biological data on catches–size or age composition is required both for caught and released components if catch-at-size or age is needed for an assessment model. Direct on-site measurements of fish length are known to be more accurate than self-reported data.
- Post-release mortality, this accounts for the chance of released fish dying due to the capture and handling process, and depends on a number of different factors. Specific studies are required for this.
- Spatial and temporal resolution at an appropriate scale, e.g. the stock level

Economic value of recreational fishing

To estimate economic value of recreational fisheries, we generally need the following information:

- Direct expenditure data by spend categories associated with fishing trips and capital items.
- Information to determine the indirect and induced (multiplier) impacts and local economic impact. This requires input-output analysis.
- Estimation of the marginal values associated with a change in stock.

There are several different ways to investigate the value of fisheries, for example willingness-to-pay studies, but it is important that commercial and recreational fisheries can be compared using equivalent metrics. It may be possible to collect expenditure from anglers alongside existing surveys done annually, but then carry out a more detailed survey every five years to assess marginal values and impacts of changes in fish stocks. Information on social/societal benefits of recreational fishing can also be gathered through existing or bespoke surveys at intervals of several years.

End-users should request the information necessary and RCGs, WGRFS, and PGECON should assess the feasibility to collect such additional information.

How will these data be used in stock assessment and fishery management advice?

Deciding which recreational catch data to collect

The need to include recreational fishery data in a stock assessment procedure should be evaluated on a case-by-case basis, according to the known magnitude of catches compared with commercial catches based on previous surveys or pilot studies. It is possible that recreational catch estimates of a stock have been relatively small in the past, and a decision has been made to suspend data collection for that species. If the situation changes due to declining commercial catches and increasing recreational fishing, a need to include recreational catches in the assessment and advice may become apparent. Reconstruction of recreational catch history for the assessment would be facilitated if data collection for that species had been maintained, even if at a relatively low or intermittent level. Where dynamic changes in fish populations, fish availability or fishing effort are possible, collection of recreational catch data for a broad range of species is advantageous provided species identifications are sufficiently reliable.

Including data in stock assessments

If a long enough time-series of recreational catches is available, together with size/age composition data if collected, these can be included directly in a stock assessment model. There is considerable experience of this in the USA, for example, where it has been done for many stocks with recreational survey data collected since the 1980s. This allows forecasts to be made including recreational catches, and decisions can then be made on catch allocations.

Complete, reconstructed or imputed catches and age compositions for recreational fisheries may be used within catch-at-age models such as XSA, SAM or ADAPT which require complete data. Alternatively, length or age compositions that cover only part of the time period can be fitted using integrated statistical models such as Stock Synthesis or other statistical models. Time-series of recreational harvests could be included in simpler models such as production models. Cpue data from recreational surveys could be included as relative abundance data in analytical stock assessments, production models or in simple data-limited approaches where advice on catch opportunities is given based on trends in relative abundance data or even just trends in fishery harvests. Currently, advice for pollock in Areas VI and VII is given by ICES using the depletion-corrected average catch (DCAC) method, which uses only the trends in commercial fishery landings series although recreational catches are likely to be significant. This may introduce bias if commercial and recreational

catches have different trends, emphasizing the need for recreational catch estimates for widely targeted species.

Marine recreational fishery surveys are a relatively recent introduction within Europe. For species such as sea bass there are only a few catch estimates starting in the late 2000s, collected in a poorly coordinated way across countries and with gaps in coverage. This makes it difficult to accurately characterise the contribution of recreational catches to fishing mortality, and large assumptions are needed to represent the recreational catch history in the assessment. Assumptions of this nature are made in the Area IV/VII sea bass assessment and the western Baltic cod assessment, using different approaches. It is extremely important to build time-series of recreational catch estimates and to collect size or age data to avoid degrading the quality of management advice by having to make potentially erroneous assumptions about catch trends.

Even if recreational catch data are too limited to include in a stock assessment procedure, presentation of the data in fishery management advice documents such as the ICES advice sheets provides a different context for the advice than if the data are not shown. A comparison between the quantities taken in commercial and recreational fisheries will give an indication of the relative fishing mortality in the years of the surveys (depending on the accuracy of the surveys and the commercial fishery landings and discards). The relative magnitude may influence the form of advice.

Fishery managers may also wish to take decisions based on more information than catches and stock trends alone, for example by taking economic value of fisheries into account. Economic data collected on a common basis from commercial and recreational fisheries will be valuable for this purpose.

What spatial and temporal resolution of data is needed to support fisheries management?

Spatial resolution

The type of surveys being conducted to meet the requirements of the EU Data Collection Framework are generally designed to provide estimates with sufficient precision at country level. For successful management of shared stocks requirements to collect recreational data needs to cover the stock area and thus need to be agreed on a regional level. Precision targets should be set at the overall stock level for combined international estimates, and bias in data collection and estimates should be documented.

For the management of fisheries at much smaller (local) scales the resolution of these data may be insufficient. The survey effort needed to give acceptable precision for a small area, such as a small proposed MPA, or a region within a country, may be as great as for an entire stock area. This is an extremely important message for government or other bodies funding recreational surveys, as they may have unrealistic expectations of what can be delivered from the surveys. The limitations of data use should also be made clear when the design of a survey is documented and presented, so that funders can decide if additional resources are warranted to give better spatio-temporal resolution for particular areas.

Data on recreational fisheries are needed to inform the development of regional management plans and for marine spatial planning, otherwise there is an incomplete picture of relative pressures and impacts of all fisheries in a region. If it is known that

spatial mapping of recreational effort or catches is likely to be required, this would have a major impact on how a survey would be designed and the types of data to be collected. For example detailed heat maps could be produced from aerial overflight surveys or roving surveys but are less feasible using off-site survey methods such as diaries if they cover relatively small numbers of respondents and exclude tourists. Tourists (and/or non-residents) can make up significant part of recreational catches (e.g. Norway), but tourist fisheries are largely unaccounted for in current surveys. Assessment of the potential magnitude of the tourist fishery within a pilot survey or prevalence of tourists identified in on-site surveys could be used as evidence of need or exclusion of this sector.

Frequency of surveys

Stock assessment models generally need annual data on fishery removals, even if the assessments are multiannual. If the removals estimates are not annual, imputations are needed which introduce more uncertainty. Collection of data on an annual basis is therefore preferable unless recreational catches are so small that errors introduced by imputations for missing survey years have only a small effect on the assessment results. This would need to be evaluated on a case by case basis in consultation with end-users, and considering what resources are available and the extent to which estimates for each stock are to be combined with those of other countries. Costs of surveys vary widely between different types of off-site and on-site surveys, and also depend on the size, complexity and accessibility of the coastline of a country and the nature of the recreational fishing methods. Available budgets may also be limited. This may lead to consideration of running surveys at intervals of two or more years. It would be difficult to prescribe a minimum survey frequency in EU-MAP regulations to be applicable to all countries.

A more appropriate approach may be for an expert group to review management requirements and available information, and to determine the needs for survey frequency and sampling intensity as part of the regional coordination process. This is currently being examined as part of the new EU Fish Pi project (Work Package 3). Factors to be considered would be:

- Which stocks (also endangered/threatened species) within a region are caught by recreational fisheries in each country, and the management needs for those stocks.
- Results of previous surveys or pilot projects indicating size of total catches, size/age compositions, and variability within and between years.
- Characteristics of the coastline, fisheries and population in each region that affect how surveys can be designed and conducted.
- Spatial and seasonal variability of fishing activity and catches.
- Recreational fishing tourism between countries.
- Resources, skills and facilities to do surveys in each country, and possibilities for task sharing.
- Desired overall precision across the range of species of interest.
- How sampling could be optimised and coordinated between countries to deliver the required estimates and achieve the overall desired precision.

The outcome of this exercise would be a proposal for a regional coordinated programme of recreational fishery surveys, to be reviewed by Member States, ICES

WGRFS experts, and the European Commission. This approach follows the move to regional coordination of commercial fishery sampling.

However, recreational fisheries for particular species may become more or less important over time, and there is a need for time-series data to show trends. Furthermore, in a situation of overfishing, recreational fisheries could still be exerting a significant fishing mortality even if the estimated total removals weight is below a designated threshold. This may occur particularly if the recreational fisheries have a large component of young fish with low average weight, where the numerical catch could be relatively large but the catch weight relatively small, for example in coastal or estuarine nursery areas.

Variability of recreational catches from year to year in a country is an important issue for frequency of surveys (cpue of western Baltic cod fluctuated by a factor of 2–8 over the period of five years), as carrying out a survey in a year with abnormal weather or fish availability will introduce more uncertainty in an assessment if the survey is only done every three years instead of annually. Generally, little extra effort is required to collect information on all species compared to a single species, so it may also be that the choice of survey frequency is based solely on species for which recreational fishing is the largest proportion of the total commercial and recreational harvest for those species. The frequency of surveys should also consider the life-history characteristics of an exploited stock and their vulnerability, as more frequent surveys were required for more dynamic and highly vulnerable stocks.

The desired precision for each stock from a survey may also vary considerably depending on the contribution of recreational catches to total fishery removals; greater precision would be required for stocks where recreational fishing is a substantial part of the total harvest. Ideally, the relationship between precision of survey estimates, precision of assessments and costs of data collection should be evaluated using simulation models, to aid decision-making on survey design.

It is also more difficult to sustain staffing, expertise, facilities and other infrastructure for surveys if there are lengthy gaps between surveys. The complexity of recreational surveys means that it takes time to develop expertise and training opportunities are limited. It may be worth considering development of an ICES training course on recreational fishing or development of a distance learning module for a Master's programme, to ensure the development of scientists with the appropriate skills.

Additional comments

The current specification of the DCF requires recreational catch estimates for some individual species (cod, salmon, sea bass, eels, bluefin tuna and more recently "sharks" (all sharks and skates/rays listed by region in Commission Decision 2010/93/EU)), which also vary by region and result in an incomplete spatial picture of recreational catches of species such as cod and sea bass and potential lack of data for other key recreational species. This arrangement limits the potential usefulness of the data for end-users if estimates for other species and stock areas are not being collected. It is also not compatible with treating recreational fisheries as additional métiers as it is not possible to consider mixed-fishery aspects of recreational fishing and how this might impact management of fisheries. Continuation of the present DCF arrangement risks MS adapting their surveys over time to respond to new requests on a stock-by-stock basis, causing potential problems with continuity of survey designs and dataseries.

Recreational fishery surveys are costly to run, but the collection of additional species data in on-site surveys or diary surveys adds considerable value at relatively little additional cost. This also gets rid of the problem of "what is a shark" as defined in the DCF Decision. In any case, "sharks" are so ubiquitous and diverse that their inclusion in the current DCF specification in all areas by default implies the need for multi-species surveys. If a national survey has to be modified or extended considerably to collect additional species data, this may incur more substantial additional costs than just adding species reporting to an existing survey. An evaluation is needed to identify species and stock coverage of existing surveys and how they would need to be changed to collect mixed-species data, costs of data collection vs. impact of the data on fisheries management or other end use, and costs of collecting additional size or age data for species where this is needed.

Table A8.1. Existing and potential end-users of recreational fishery data.

End-user	End-user subgroups	Use of data
ICES	Working Group on Recreational Fishery Surveys (WGRFS)	Collation of participation, catch and economic data by country and area; Quality assurance of data collected; Development of survey methods; Provision of advice on data collection and use of recreational fishing data in stock assessment.
	Working Group on North Atlantic Salmon (WGNAS); Assessment WG on Baltic Salmon and trout (WGBAST)	Recreational catch data used in assessments
	Baltic Fish Assessment WG (WGBFAS)	Recreational catch estimates included in Western Baltic cod assessment; recreational flounder catches considered by WGRFS as suitable for assessment.
	Working Group on Celtic Seas Ecoregion (WGCSE)	Recreational catch estimates for sea bass used in assessment.
	Working Group on eels (WGEEL)	Recreational catch data sought but not sufficient for use in assessments
	Other assessment Working Groups, and Expert Groups / Steering Groups dealing with ecosystems assessments	Recreational catches of all species other than salmonids, bass, Baltic cod are needed to more completely evaluate human impacts on ecosystems and for single species assessments for stocks where recreational harvests are significant contributor to fishing mortality.
NASCO	Working groups dealing with salmon	Recreational catch data used in assessments
European Commission	DG MARE	Recreational survey data used by Commission in 2014/15 to review effects of MLS and bag limits for sea bass management. Future requests may be envisaged for other species.
	DG Environment	Implementation of MSFD; achievement of GES with good management of recreational as well as commercial fishery impacts.

End-user	End-user subgroups	Use of data
Regional Coordination Groups	RCGs for each region	Coordination and cost-effectiveness of national recreational fishery data collection within regions
PGECON		Evaluating social and economic impacts of fishing and relative value of commercial and recreational sectors. This may be best done by occasional one-off surveys than in annual surveys, so we may not want to consider this as a recurrent EUMAP requirement.
National Governments and regional fisheries authorities within countries		Developing policy positions on management that includes controls on recreational fishing and aspects of sustainable development in coastal regions. Management of recreational fishing in context of spatial planning such as MCZs.
International and National recreational fishing bodies	European Anglers Alliance; national marine recreational fishing bodies, etc.	Developing policy and lobbying positions on management and sustainable development of marine recreational fishing.
National and local businesses	Charter boat businesses; tackle trade; boat manufacturers; hotels etc.	Time-series of effort and catches by species and region are useful for planning, and local authorities could benefit when making decisions on local development if they have data on how much recreational fishing takes place and the economic value.
Scientific community in general.	Universities; Govt. departments; other Institutes	Scientists working on impacts of climate change should be interested in how recreational fishery species compositions are changing in each region and occurrences of species beyond previous range. Development of new recreational survey methods requires evaluation of data from existing surveys. Data for publication
Journalists	All media	Information for media articles on news items referring to recreational fishing.
Representative bodies for International and national commercial fisheries.	Commercial fishermen's organisations and federations.	Policy developments;
Advisory Councils	e.g. North Western Waters AC; North Sea AC, etc.	Policy developments
Marine NGOs		Policy developments

Annex 9: ToRs for WGRFS in 2016

The **Working Group on Recreational Fisheries Surveys** (WGRFS), co-chaired by Harry V. Strehlow, Germany and Kieran Hyder, UK, will take place from 6–10 June 2016 in Kavala, Greece. The ToRs for the meeting were split into multi-annual ToRs that will be addressed each year as they represent core outputs and specific ToRs for issues that will be addressed at this particular meeting.

Multiannual ToRs

a) Collate and review national estimates of recreational catch, activity, and socio-economic value for candidate stocks, and identify significant data gaps in coverage and species.

b) Evaluate the quality of national surveys using WGRFS quality assessment tool (QAT).

c) Provide advice to ICES, Regional Coordination Groups, and European Commission on the availability of data, use of data in assessments, and design of future data collection programmes.

d) Assess the validity of new survey designs for data collection, including the sampling efficiency, cost of delivery, and levels of accuracy and precision.

Specific ToRs

a) Review updates of the EU MAP data requirements for recreational fishing effort, catches, and socio-economic aspects.

b) Assess the magnitude of recreational catches using non-angling active methods including spear fishing, SCUBA diving, and hand gathering.

c) Develop examples of regional data collection programmes (e.g. species, areas, third countries) using two case studies Mediterranean and Atlantic.

d) Recommend methods for extrapolating post-release mortality across species and fisheries and identify significant data gaps.

e) Review data collection methods in inland/transitional waters and identify potential synergies with marine recreational fisheries catch sampling schemes.

f) Assess methods for the reconstruction of recreational fisheries time-series.

WGRFS will report by 1 September 2016 to the attention of SCICOM/ACOM.

Supporting Information

Priority	High-Because recreational catches can be high for some stocks
Scientific justification	This work is required under the EC-ICES MoU that requests ICES to provide support for the Data Collection Framework (EC Reg. 199/2008 and EC Decision 2008/949/EC). WGRFS is the ICES forum for planning and coordination of marine recreational fishery data collection for stock assessment purposes. DG MARE should engage with WGRFS to ensure proper coordination with the DCF activities. WGRFS shall develop and approve standards for best sampling practices within its remits and for marine recreational fisheries in the ICES area, in line with the ICES Quality Assurance Framework.
Resource requirements	Expertise on recreational fisheries surveys from areas outside Europe would be beneficial
Participants	The group is normally attended by some 20–25 members and guests.
Secretariat facilities	Normal backstopping support in the organization of the group.
Financial	None.
Linkages to advisory committees	SCICOM/ACOM
Linkages to other committees or groups	WGBFAS, WGEEL, WGBAST, WGCSE, WGNSSK, WGBIE, WKMEDS and EU Regional Coordination Groups
Linkages to other organizations	WECAFC/OSPESCA/CRFM/CFMC Working Group on Recreational Fisheries Many linkages to national angling associations, since WGRFS members estimate national marine recreational catches.