WORKING GROUP ON RECREATIONAL FISHERIES SURVEYS (WGRFS; outputs from 2019 meeting)

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i Executive summary

The ICES Working Group on Recreational Fisheries Surveys (WGRFS) role is to summarise and quality assure recreational fishery data collected in European countries, and feed into the ICES advisory process on recreational fishing issues. In 2019, WGRFS shared and evaluated current national surveys; assessed the validity of new survey designs; assessed the use of survey data in stock assessments and the impact of catch and release; discussed the treatment of outliers in the analysis of survey data; reviewed the potential impacts of climate change on species distribution and updated the species list for collection under the Data Collection Framework (Regulation ((EC) No 2017/1004)); reviewed European and regional coordination; assessed data storage options; assessed novel survey methods; and discussed the ICES Workshop on Integrating Human Dimensions into the Management of Marine Recreational Fisheries (WKHDR).

WGRFS provides a useful network for individuals developing surveys to test their ideas and designs that will increase the quality of data delivered. WGRFS has engaged with the Regional Coordination Groups, providing input into meetings and support for issues around recreational fisheries. The profile of the group has been raised through scientific presentations at conferences, and contribution to the development of a theme set in the ICES Journal of Marine Sciences titled "Marine recreational fisheries - current state and future opportunities". Over the last year, the members of the group have published several publications facilitated by the WGRFS including an assessment of the impacts of recreational fishing on key European fish stocks, a review on the potential environmental impacts of recreational fisheries on stocks and ecosystems, and a review on digital camera monitoring of recreational fishing effort.

At the 2019 meeting, further progress was made in key areas. Updates were provided on national sampling programmes, with surveys underway in almost all countries, and the most recent estimates collated. The design and implementation phase of the Galician (Spain), Swedish, and Danish programmes were assessed using the WGRFS quality assurance tool. The need for novel approaches for inclusion of recreational data in stock assessment for a broader range of stocks was highlighted, and approaches for catch allocations were discussed. Furthermore, the potential impacts of climate change on species caught by recreational fisheries and how that could impact on species lists for collection under the DCF was assessed. Approaches for European and regional coordination of data collection were discussed. Novel methods for data collection were highlighted, and need to be reviewed regularly as the landscape is changing very quickly.

Intersessional work was agreed on: analysis and inclusion of data in stock assessments; compiling methods for catch allocation between user groups; and updating the quality assessment tool. The WGRFS recommendations were: developing a database that compiles estimates of recreational fisheries catches; to include recreational fisheries in more stock assessments and advice; that further work on the impacts of catch and release should be funded; and a workshop to review the impact of recreational fisheries based on the outcomes from EU-MAP pilot studies.

ii Expert group information

Expert group name	Working Group on Recreational Fisheries Surveys (WGRFS)
Expert group cycle	Multiannual fixed term
Year cycle started	2017
Reporting year in cycle	3/3
Chairs	Kieran Hyder, UK
	Keno Ferter, Norway
Meeting venues and dates	12–16 June 2017, Azores, Portugal (31 participants)
	11–15 June 2018, Faro, Portugal (49 participants)
	10–14 June 2019, A Coruña, Spain (43 participants)

iii Term of reference

Term of reference	Addressed in this report
Collate and review quality of national estimates of recreational catch, post-release mortality, activity, and socio-economic values for candidate stocks, and identify significant data gaps in coverage and species.	yes
Assess the validity of new survey designs for data collection, including the sampling efficiency, cost of delivery, and levels of accuracy and precision.	yes
Provide guidance to ICES and European Commission on the availability of data, use of data in assessments, and design of future data collection programs as requested.	yes
Review and assess regional data collection programmes for the Regional Coordination Groups to deliver end-user needs and provide recommendations for additional data collection (e.g. species, areas, sectors, uses).	yes

1 Summary of the work plan

This is the third year of a three-year work plan that is given here:

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

The WGRFS agenda was agreed and followed, although some changes were made to timings to complete discussions, and was as follows:

Day	Agenda Item
10 June 2019	Introduction and ToRs Country updates (ToR a)
11 June 2019	Survey design, quality & analysis (ToR a,b and c, WP1) Novel methods for data collection (ToRb) European & regional coordination (ToRs c and d) Preparation of regional recreational fisheries overviews
12 June 2019	Parallel sessions on specific topics (ToRs a, b and d, WPs 2, 4 and 5) Stock assessment and reconstruction Catch allocation Review and update of QAT
13 June 2019	Post-release mortality and tagging (WP3 and4) New species and DCF requirements Discussion on ICES human dimension workshop Report writing.
14 June 2019	Set new ToRs, intersessional work, recommendations, responsibilities and agreement on a new chair.

2 List of outcomes and achievements of the working group in this delivery period (2017-2019)

There have been many outcomes and achievements of the WGRFS between 2017 and 2019. These have centred around the following key areas: creating a broad network to share expertise; developing methods (surveys, assessment, regional cooperation, assessing quality, novel methods); raising the scientific profile (presentation, conference sessions, papers); and inclusion in fisheries legislation (European Commission, RCGs, European Parliament). The nature of the group and the state of recreational fisheries mean that many of the outcomes and achievement have focused on Europe, but the network extends beyond that and is now generating more collaborations and learning across the globe. Some highlights are provided below.

Creating a broad network of experts to share expertise: the WGRFS now has 80 members from 23 countries, with 43 scientists from 20 countries participating at the 2019 meeting. Attendance has increased from southern Europe, and there has been increasing participation from academics and experts from across the globe. The group is now seen as an important network for marine recreational fisheries scientists.

Support network for design-based surveys: a broader range of countries and organisations have started to carry out surveys of marine recreational fisheries. These surveys are complex and there is no "one-size-fits-all" approach, so WGRFS has provided a support network for the design and implementation of surveys using the global network of experts to help new researchers develop robust approaches. In particular, there has been a lot of exchange of knowledge and ideas between the USA, Australia, New Zealand, Canada, and Europe.

Assessing the quality of national recreational survey data: a quality assessment tool (QAT) has been developed by WGRFS. Each year, this tool has been used to assess the quality of three national survey programmes. The outcome is a summary of the issues and assessment of quality of the data. The tool has been updated to improve the utility of the products.

Specification of requirements for ICES Regional Data Base and Estimation System (RDBES): the current marine recreational fisheries database is not fit-for-purpose, limiting the uptake and use of existing data. A solution has been proposed for inclusion in the ICES RDBES that will provide a single access point for survey data. WGRFS has been working closely with the RDBES team to identify an appropriate solution and funding to develop it.

Inclusion of marine recreational fisheries in stock assessments: novel approaches for the reconstruction of marine recreational catches have been developed for inclusion in the sea bass benchmark assessment. In addition, improvements have been made to approaches for inclusion of a time-series of recreational data in western Baltic cod assessments and to estimate trolling catches of Baltic salmon and sea trout.

Regional cooperation: regionalisation is central for delivery of the CFP and DCF, but it is unclear how this should be done. WGRFS members are part of three of the four DGMARE funded projects to develop regional approaches. This includes FishPi2 (North Atlantic), SECFISH (Baltic), and STREAM (Mediterranean and Black Seas). Recreational fisheries are included and there are several case-studies to develop regional approaches (e.g. sea bass).

European Parliament study on recreational fisheries: members of the WGRFS received funding from the European Parliament to deliver the EURecFish project that examined the social benefits, economic value, and environmental impact of marine recreational and semi-subsistence fisheries in Europe (Hyder *et al.*, 2017). The analysis for the project relied on data compiled by the WGRFS.

A workshop was held in the European Parliament for the PECH committee to introduce findings and respond to questions from Members of the European Parliament (MEPs). Based on this report and consultation with stakeholders, the PECH committee developed a position statement on the state of play of recreational fisheries in Europe (2017/2120(INI)).

Development of novel data collection approaches: members of the WGRFS have been working together on novel approaches for data collection focusing on the use of cameras (Hartill *et al.*, 2019) and smartphone apps (Venturelli *et al.*, 2017). The techniques highlight the potential for the use of novel methods in conjunction with traditional surveys to generate more data on marine recreational fisheries.

Human dimensions in marine recreational fisheries research: a workshop on integrating angler heterogeneity into the management of marine recreational fisheries (WKHDR) was proposed by WGRFS and was held in Rostock on 5-7 November 2019. WKHDR aimed to develop approaches for integrating angler heterogeneity into the assessment and management of marine recreational fisheries. The outputs from WKHDR will be published as a peer-reviewed paper and hope that this will generate a network of people collecting data using a comparable approach across countries that will lead to further research and publications.

Raising the scientific profile: this has been done through the organisation of a conference session (e.g. ICES ASC 2019), numerous conference presentations (e.g. World Recreational Fisheries Congress 2017), and publication of peer-reviewed papers from collaborations facilitated by WGRFS. All publications are generating citations with two in the top ranked fisheries journal, Fish and Fisheries. The papers are:

- Hyder *et al.* (2018) provided a synthesis of numbers, participation, effort and expenditure across Europe and presented robust estimates for the first time based on national surveys. This brought together the whole European marine recreational fishing community to provide agreed estimates, was published in Fish and Fisheries and has already been cited over 50 times.
- Lewin *et al.* (2018) estimated post-release mortality for recreationally caught sea bass (Northern stock - ICES 4.bc,4.a,d-h). This was a critical data gap and involved using expert judgement of several members of the group to identify fishing practices in different countries. The fisheries-wide estimate of sea bass post-release mortality has been used in sea bass stock assessment since 2018.
- Radford *et al.* (2018) assessed the impact of recreational fisheries on key European fish stocks. This showed that, where data were available, that recreational fisheries was responsible for between 2 and 43% of total removals. This was published in PLoS One and was in the top 10% of most cited articles for the journal in 2018.
- Lewin *et al.* (2019) reviewed the potential environmental impacts of recreational fishing on marine fish stocks and ecosystems. Alongside the impact on fisheries stocks, this highlighted the potential risks associated with lead loss and introduction of non-native disease and non-native species through use of live bait. This was published in Reviews in Fisheries and Aquaculture Science.
- Hartill *et al.* (2019) investigated the applications and challenges of using digital camera monitoring of recreational fishing effort and was published in Fish and Fisheries.
- Vølstad *et al.* (2019) developed state-of-the-art field survey methods based on expert input from the WGRFS and mapped marine recreational fishing in Norway.

WGRFS has also contributed the development of a Theme Set in the ICES Journal of Marine Science titled "Marine recreational fisheries - current state and future opportunities".

Influencing the European environment: a significant effort has been made by key members of the WGRFS to engage and influence key stakeholders in the European marine recreational fisheries. This has included providing feedback on proposals for regulation, presenting at European Parliament RecFishing Forum, and Stakeholder discussions with angling bodies (e.g. European Angler Alliance).

Integration of marine recreational fisheries within the RCGs: significant effort has been made to ensure that marine recreational fisheries are considered by end-users. The main aspect of this has been the attendance of representatives from the WGRFS at the RCGs, presenting the activities and key issues, and supporting development of the RCGs strategy for marine recreational fisheries. In addition, input has been provided to intersessional groups on data and EU-MAP.

DCF reporting templates and national work plans: WGRFS members provided updated templates for DCF reporting based on experience of reviewing of National Work Programmes.

European Commission training: training was provided to DGMARE on marine recreational fisheries that included: the situation in Europe; data collection; catch and release; inclusion in stock assessment; and management. Travel was funded by DGMARE for three members of the WGRFS to deliver training and is recognition of the importance of marine recreational fisheries.

3 Progress report on ToRs and work plan

3.1 Country updates (ToR a)

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

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

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

These tables relate solely to surveys of recreational fishing defined by WGRFS (ICES, 2013) 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".

An overview of economic evaluation of recreational sea fishing can be found in a table in Annex 3.

Country updates were presented for Spain (Catalonia) by Oscar Sagué Pla, France by Jerome Lafon, Norway by Jon Helge Vølstad, Denmark by Hans Jakob Olesen, Poland by Adam Lejk, Belgium by Thomas Verleye, and Sweden by Andreas Sundelöf.

3.2 Collation and use of data in stock assessments (ToRs a and d)

This section covers inclusion of recreational fisheries in stock assessment and the methods used to reconstruct time-series of catches. In addition, summaries are provided for catch allocation, catch and release, and the impacts of climate.

3.2.1 Stock assessment and reconstruction (WP1)

There have been limited changes to the sea bass stock assessments since the last WGRFS meeting, so this was not presented, but full details can be found in ICES (2019).

Currently, decisions to include recreational data in stock assessments have been made in an *ad hoc* manner. To make this process more transparent and accountable, recreational data should be included in ICES data calls on a regular basis. Then assessment WGs decide, based on the evidence base, if and how recreational data is included or not. The decision to include recreational data would typically result in an analytical stock assessment. The decision not to include recreational data would be made explicit by the assessment WG (with possible input by WGRFS members) that recreational fishing impacts were considered, and an explanation given why data was not further used. This way end users are provided with the complete ecosystem context of a fishery for a certain stock. In the case of including recreational catches data, requirements need to be specified by the relevant assessment WG. In general, the types of data needed consists of but not necessarily: caught and released component in numbers, biological information, (e.g. length distribution, ALK), and an estimate on post-release mortality. In a few cases, the available data is great making inclusion simple. However, for many marine stocks there are a number of challenges associated with data quality. These are:

- Surveys do not cover all assessment years or stocks (catches, releases, age-length, length-frequency).
- High release rates require post-release mortality estimates.
- Interannual variation in catch and CPUE, but sampling irregular.
- No error assessment for sensitivity analysis.
- Data required after implementation of precautionary management measures.
- Allocation decisions and testing competing management measures.

One of the core problems associated with recreational data inclusion is the lack of time-series data. Often only point estimates are available and assumptions are required for years without data. There is no one-size-fits-all approach to reconstruct time-series data. In the case of a data rich situation (e.g. Baltic cod, *Gadus morhua*) this might be average catch data, summed recreational length distributions for years without data and/or a gradual 20% increase in 1991 to account for historical development after the reunification like in the German case. If some data is available, e.g. for European sea bass, the selectivity is fixed and the recreational F adjusted until the catch in the reference year is reached. In a second step, the recreational F is assumed constant for the entire time series. And in the case of Baltic salmon (*Salmo salar*), where only few data are available, reconstruction of time series data is based on expert judgement (min-mode-max). Ideally, sensitivity analyses are conducted to test assumptions and potential implications on assessment and advice.

WGRFS proposes additional intersessional work on the analysis and inclusion of MRF data in stock assessments that will comprise of a subset of members of WGRFS from Sweden, Germany, and UK.

WGRFS recommends that given the evidence on the proportion of removals by marine recreational fisheries (2-43%), the RCGs and ICES regional assessment groups (WGCSE, WGBIE, WGNSSK, WGBFAS) should consider inclusion of recreational catches in a broader set of stock assessments, and highlight where extended data collection is required. To make this process transparent and explicit recreational data should be included in ICES data calls on a regular basis.

3.2.2 Catch allocation (WP5)

As management of marine recreational fisheries becomes more common in Europe, allocation decisions will need to be made between the commercial and recreational fisheries. There are two allocation approaches: implicit and explicit. Implicit allocation approaches occur where the management measures drive catch shares between the sectors. However, it is possible to set a catch share for recreational fisheries (e.g. a constant proportion of the total allowable catch (TAC) based on historical catches) and then set management measures that result in the recreational share of the TAC. The CFP states that decisions should account for biological, social and economic factors, but transparent and consistent approaches for allocation between recreational and commercial fisheries do not exist at a European level. This is probably due to the limited number of stocks where assessment and management include recreational fisheries. Here, examples were presented of approaches for catch allocation from across the world to assess methods and understand best practice.

In Europe, catch allocation between the recreational and commercial sectors has generally been implicit. For example, there have been changes in the relative proportion of recreational and commercial catches from the assessments for sea bass and western Baltic cod, with changes particularly stark since the implementation of management measures (Figure 3.1). However, in other parts of the world explicit allocation decisions are often made with catch shares defined in advance of management measures being set. Good examples include the Gulf of Mexico red snapper fishery, where 49% of the catch has been allocated to the recreational sector since 1990[1] and quota allocation schemes are being trialled for head boats (Abbot and Willard, 2017). In Western Australia, fisheries are viewed as a common resource with allocation for each sector, and allocation developed with stakeholders (Crowe *et al.*, 2013). Explicit allocation is applied for the western rock lobster, abalone and demersal scale fish. In New Zealand, the process varies between stocks and explicit allocation is found for species with high recreational interest (e.g. marlin, kingfish, kahawi, and snapper).

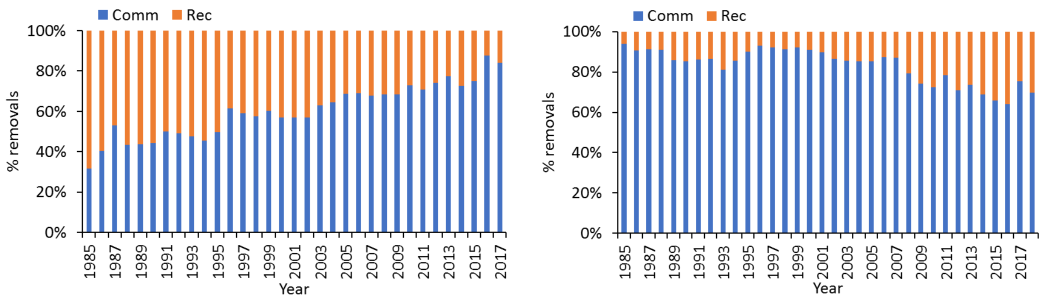

Figure 3.1. Percentage of recreational and commercial catches for European sea bass (left panel) and western Baltic cod (right pane) based on outputs from the stock assessment.

Explicit allocation is generally done based on biological limits, so methods that account for social and economic factors in allocation decisions are needed. Social-ecological systems provide one potential approach to achieve this and have been applied to recreational fisheries (Arlinghaus *et al.*, 2017). The approaches are flexible adaptive and enabling rather than command and control, but there are challenges in including feedbacks, external drivers of changes in state and social and ecological diversity (Arlinghaus *et al.*, 2017).

WGRFS identified the need for transparent approaches for explicit allocation that account for biological, social and economic factors. It was clear that there are many approaches being applied across the globe, but few account for economic and social benefits. The need for catch allocation will increase in Europe as management measures for recreational fisheries are introduced for more stocks. As a result, it is necessary to understand methods for catch allocation and best practice that could be applied in Europe.

WGRFS suggests that methods for catch allocation should be compiled and used to understand best practice by an intersessional group.

3.2.3 Catch and release (WP3 and 4)

3.2.3.1 Impacts of catch and release (WP3)

For many species, discard mortality is unknown, so programmes have been initiated to collect data on commercially caught fish, but these 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. Discards of unwanted bycatch species and target species are high in both commercial and recreational marine hook and line

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1 https://www.fisheries.noaa.gov/history-management-gulf-mexico-red-snapper#allocating-the-quota

fisheries in Europe. In addition, the management measures implemented for recreational fisheries generally increase the proportion of released fish.

Catches by recreational anglers can represent a significant proportion of the total removals. Marine recreational fisheries comprised of between 2 and 43% of removals of some key European fish stocks (Radford *et al.*, 2018), and represented around one quarter of catches of the Northern European sea bass in 2012 and western Baltic cod stocks in 2015 (Hyder *et al.*, 2018). Information is available in Europe for some species, with studies limited to Atlantic cod, European sea bass, and Atlantic halibut. Hence, post-release mortality is a large uncertainty in the assessment of stocks that are targeted by both commercial and recreational fishers. In addition, there is a potential for non-capture (e.g. “drop-off”) mortalities, which may have to be considered.

To fill this evidence gap, we recommend that that the European Commission fund a service contract lot under the EMFF umbrella on post release mortality of recreational hook and line-caught fish. This should assess current state of knowledge and fill knowledge gaps for some key species. To achieve this, 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.

WGRFS recommends that studies of the impacts of catch and release are lacking for most common recreational species. More studies need to be funded on key species including cod, sea bass, pollack, sea trout, salmon, Atlantic halibut and Bluefin tuna. A proposal has been drafted by WGRFS (Annex 6, ICES, 2018a) for the European Commission to fund a service contract lot under the EMFF umbrella that should be put forward to the EC by ICES and the RCGs.

3.2.3.2 Atlantic bluefin tuna tagging (WP3)

A number of studies have started that assess the behaviour of Atlantic Bluefin Tuna (*Thunnus thynnus*) including in Sweden, Norway, Denmark, UK, and Ireland. Fish have been caught using recreational angling gear and tagged before release. Summaries of the programmes in Sweden and Norway were presented. In 2017, Sweden did a study with Denmark where bluefin tuna where caught and tagged with PSAT-archive tags. A number of experienced angling teams with specific gear were assigned to catch Atlantic Bluefin tuna with rod and line by trolling or baited hooks. Atlantic Bluefin tuna is a protected species in Sweden, so no directed fishing can occur, but a dispensation was secured form ICCAT for a scientific programme. The research fishery to deploy tags was financed by ICCAT and WWF to provide behavioural data, and was supported by SLU, DTU, ICCAT, WWF, and Swedish authorities. Collaboration with the angler community was needed to achieve the objectives, but did generate challenges. Clear communication was needed for the anglers about research questions, objectives, conflicts of interest, and scientific methodology, as well as division of responsibilities between organisations and authorities. A satellite tagging study was conducted along the west coast of Norway in 2018. The approach was similar to the Swedish study, using volunteer anglers to catch the tuna (Ferter *et al.*, 2018). These studies will yield valuable information on the migration patterns of this species, and will also inform on post-release survival of rod-and-line caught Atlantic bluefin tuna in Nordic waters.

3.2.4 Recreational fishing and climate change (WP4)

A paper has recently been published on the impacts of climate change on marine recreational fisheries (Townhill *et al.*, 2019). The paper is open access and available online[2].This summarises the key implications for recreational fisheries of climate change and the abstract is as follows:

2 https://onlinelibrary.wiley.com/doi/full/10.1111/faf.12392

"Marine recreational fishing is popular globally and benefits coastal economies and people's well-being. For some species, it represents a large component of fish landings. Climate change is anticipated to affect recreational fishing in many ways, creating opportunities and challenges. Rising temperatures or changes in storms and waves are expected to affect the availability of fish to recreational fishers, through changes in recruitment, growth and survival. Shifts in distribution are also expected, affecting the location that target species can be caught. Climate change also threatens the safety of fishing. Opportunities may be reduced owing to rougher conditions, and costs may be incurred if gear is lost or damaged in bad weather. However, not all effects are expected to be negative. Where weather conditions change favourably, participation rates could increase, and desirable species may become available in new areas. Drawing on examples from the UK and Australia, we synthesize existing knowledge to develop a conceptual model of climate-driven factors that could affect marine recreational fisheries, in terms of operations, participation and motivation. We uncover the complex pathways of drivers that underpin the recreational sector. Climate changes may have global implications on the behaviour of recreational fishers and on catches and local economies."

3.3 European and regional coordination (ToRs c and d)

3.3.1 Current situation (ToR c)

A summary was provided of proposed changes to the legislation at a European level that affects marine recreational fisheries. Marine recreational fisheries are becoming increasingly recognised as important socially, economically, and biologically. Despite this fact, marine recreational fisheries are not embedded in the fisheries management process, often due to the fact that data are limited, so catches are not included in assessment. This was recognised by the European Parliament in their report on the state of play of recreational fisheries[3] which included recommendations to generate robust data on all species and gears, include in future regulation under the CFP, generate new management approaches, and provide financial support through the EMFF.

There have been discussions about marine recreational fisheries in the Landing Obligation and Control Regulations. Marine recreational fisheries have been excluded from the Landing Obligation, but non-discriminatory limits can be set when catches are significant that take social and economic impacts into account and MSs must provide reliable estimates of catch[4]. The proposed update to the Control Regulations (EC 2009/1224) included text on marine recreational fisheries[5]. This included: removal of the definition as non-commercial due to the commercial enterprises involved (e.g. charter boats); control systems using registration or licences and catch recording; prohibition of sales of catch; and conditions to set specific provisions (e.g. gears, vessel tracking). These proposals were unpopular with MSs due to the challenge and burden, so are unlikely to be adopted in their current form.

Revisions to the EU-MAP have been proposed as part of an RCG subgroup that could affect data collection if adopted. This separates the requirement for simple volume of catches for all species from additional information (numbers, lengths or weights) that must be collected for species that are important for assessment. In addition, catch shares will be assessed from the pilot studies

3 http://www.europarl.europa.eu/committees/en/pech/home.html

4 http://www.europarl.europa.eu/meetdocs/2014_2019/plmrep/COMMITTEES/PECH/AG/2019/01-23/1170159EN.pdf

5 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52018PC0368

and used to define future data collection needs. However, the mechanism to achieve this is not clear, but a STECF workshop would be an appropriate method.

WGRFS recommends that the delivery of pilot studies under the EU-MAP provides an opportunity to assess the impact of recreational fisheries on a broad range of stocks and develop data collection approaches for the revision of the DCF. The STECF should consider a workshop in September 2020 to review the impact of recreational fisheries based on the outcomes from EU-MAP pilot studies and make recommendations for future data collection.

3.3.2 Regional coordination and data collection (ToR d)

Regional coordination of recreational fisheries data collection is needed to ensure that end users have catch and other data at the required spatial resolution, temporal coverage, and quality. Coordination is a role for the lead scientists for the surveys in each country, the Regional Coordination Groups and WGRFS (as technical expert). With the aim of strengthening this regional coordination, the Commission launched several calls under the same title: "Strengthening regional cooperation in the area of fisheries data collection" in 2014 and 2016.

The fishPi project included the first assessment of coordination of recreational sampling programme in the Atlantic region. The initial recommendations were adopted by the Regional Coordination Groups (e.g. RCG NANSEA). In the 2016 call (MARE 2016/22), a further four proposals were granted, three of which included recreational fisheries. In the Atlantic region, the fishPi2 project aimed to assess regional coordination, and included a case study on sea bass. The STREM project covered regional coordination in the Mediterranean and Black Sea region. Both fishPi2 and STREAM, were focused on the regional data collection of biological variables. SECFISH covered the socio-economic data collection for these fisheries. The results from these projects are being synthesized into a single output that highlights the main issues across all regions and will be included in discussions about the future EU MAP.

The main outputs of WP5 fishPi2 in relation to marine recreational fisheries related to the pilot studies, sea bass case-study, and data storage. For the pilot studies, there were important differences in the expertise and objectives. Some MSs had the objective to improve routine surveys and test different methodologies, whereas in other cases it was simply to generate the first national estimates of MRF catches. A review of the existing pilot studies showed a large variety of objectives at a MS level (e.g. target population, target species, period, duration etc.). A case-study was done on sea bass using a management strategy evaluation (MSE) approach to test the impact on assessment of different scenarios of different levels of precision and bias in MRF surveys. The uncertainty in regional estimates was driven by countries with largest catch, so the need to focus in these areas (i.e. France and UK). However, MRF is a multispecies fishery, so the precision will vary between stock and assessment methods, so a multispecies approach for optimisation is needed. MRF data need to be included in the European databases (RDBES) to ensure that they are available and utilized by end users (e.g. stock assessors, RCGs etc.). Hence, the RDBES need to be adapted to hold MRF data.

The CFP is moving towards a regional approach for fisheries management, so regionalisation is one goal of the EU MAP (2016/1251/EU). Currently, data collected at regional scale utilise diverse national sampling schemes. The EU MAP identifies the need for a regional sampling approach, with regional cooperation at the heart of this regulation. In addition, recreational fisheries impact on stocks in both inshore and international waters, so the data needs for management may differ and make trade-offs necessary between national and regional needs.

Currently, recreational data (catch and effort estimates) are supplied for relatively few species and stocks, generally only for species that are mandatory (i.e. EU MAP, Control Regulations (EU 1224/2009)). For effective regional data collection and regional coordination, there is a need for multispecies surveys to evaluate the impact of recreational fisheries on different stocks across regions. This regional cooperation and coordination should include different regional sampling plans. This is unlikely to be a single optimized regional sampling plan, rather a set of scenarios, which need to be evaluated. WGRFS has an important role as experts in recreational fisheries in the development and evaluation of these regional plans. This will ensure that methods and sampling designs are statistically sound, appropriate, and provide robust data at regional level.

3.3.3 Potential new DCF species (ToR d)

WGRFS evaluated the current data collection requirements in the EU MAP with a focus on the species covered by the current Commission Implementing Decision (EU) 2016/1251 (Table 3.1). WGRFS reviewed the species list for each individual area. Therefore, three subgroups including the national experts of the corresponding countries were formed for the Baltic Sea, Atlantic waters (including the North Sea and Eastern Arctic), and the Mediterranean. No evaluation of potential new species was done for the Black Sea as WGRFS did not have sufficient representation from countries bordering the Black Sea to be able to assess the relevant species for data collection in this area.

There was a general discussion on the usefulness of specific-species lists versus a general recommendation to perform multispecies surveys that cover all relevant species with end user needs. WGRFS felt that multispecies surveys should be recommended rather than specifying individual species or groups. This is because multispecies surveys are of similar effort to single species surveys, only representing a small increase in the effort during analysis and reporting. Time-series of recreational catches are needed for inclusion in stock assessment, so it will be very difficult to generate time-series for new species unless multispecies annual surveys are routinely done. However, some countries may cease sampling programs without specific-species lists. Therefore, WGRFS felt that it is necessary to keep specific-species lists in the legislation alongside the general recommendation to conduct multispecies surveys by WGRFS. More detailed information for the individual areas can be found in the corresponding subsections below.

Table 3.1. Species currently covered by the EU-MAP (listed in table 3 of the Commission Implementing Decision (EU) 2016/1251) and suggestions of WGRFS for new species that may be added.

	Area	Species currently listed (EU 2016/1251)	Suggested species to be added
1	Baltic Sea (ICES Subdivisions 22-32	Salmon, eels and seatrout (including in freshwater) and cod.	None
2	North Sea (ICES areas 3.a, 4 and 7.d)	Salmon and eels (including in freshwater) seabass, cod, pollack and elasmobranchs	Highly migratory ICCAT species (e.g. tuna).
3	Eastern Arctic (ICES areas 1 and 2)	Salmon and eels (including in freshwater) cod, pollack and elasmobranchs	Highly migratory ICCAT species (e.g. tuna).
4	North Atlantic (ICES areas 5-14 and NAFO areas)	Salmon and eels (including in freshwater) seabass, cod, pollack, elasmobranchs and highly migratory ICCAT species.	Elasmobranchs should focus on blue, angel and mako sharks, and Rajidae spp. Groupers and sparids should be included for all waters, and Ballan wrasse, squid and octopus for the Bay of Biscay and the Iberian waters.
5	Mediterranean Sea	Eels (including in freshwater), elasmobranchs and highly migratory ICCAT species.	*Epinephelus spp., Dicentrarchus labrax, Diplodus sargus, Dentex dentex, Sciaena umbra, Umbrina cirrosa, and Sparus aurata.*

	Area	Species currently listed (EU 2016/1251)	Suggested species to be added
6	Black Sea	Eels (including in freshwater), elasmobranchs and highly migratory ICCAT species.	Not reviewed.

WGRFS proposes that where possible multispecies surveys should be done on a regular basis and that the list of species that need to be sample should be extended as suggested in Table 3.1. WGRFS did not have the expertise to assess the Black Sea requirement.

3.3.3.1 Baltic Sea

In the Baltic Sea, a few species were identified that could be potentially relevant and discussed. These were Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), Atlantic herring (*Clupea harengus*), European flounder (*Platichthys flesus*) and turbot (*Scophthalmus maximus*). New species were not added to the list for the Baltic Sea, as a multispecies approach as recommended by the WGRFS was felt to be more appropriate. Multispecies surveys would mean that all species are covered, and that relevant information could be provided to end users if needed. This approach was considered appropriate for a number of reasons. Firstly, there is currently no end user need (e.g. stock assessment) for several species (flounder, turbot, herring). Secondly, there is variation in the recreational fisheries between stocks of the same species making a single approach challenging (herring, flounder). Finally, rare and hard to sample species require high sampling effort with unknown usefulness (sturgeon). Whilst this is appropriate now, it may change in future depending on stock developments and/or end user needs sampling of these species.

3.3.3.2 North East Atlantic

A revision to the current EU MAP (Table 3.1) was proposed. The current species included in this table should be maintained, but further specification of elasmobranchs was identified as useful. The main species of elasmobranch to be included for this region under this regulation were the blue shark (*Prionace glauca*), the angel shark (*Squatina squatina*), the mako shark (*Isurus oxyrinchus*), and Rajidae spp. especially species considered as threatened (e.g. *Raja undulata*). In addition, groupers and sparids are important target species for recreational fishers, which should be included. In the Bay of Biscay and the Iberian fishing grounds, cephalopods species as squids (Loligo spp.) and octopus (*Octopus vulgaris*) should be also included. Several species are also important at local levels (e.g. Ballan wrasse (*Labrus bergylta*) in Galicia) which should be considered. In addition, the archipelagos (e.g. Canary Islands) should be considered as specific cases, due to the important impact of recreational fisheries in these regions, both at biological and economic level. For these archipelagos in this region, specific species at regional level should be identified to be included under the EU MAP.

3.3.3.3 Mediterranean Sea

The RCG Workshop on Recreational Fisheries (15–16 April 2019, Ancona, Italy) examined the results of five pilot studies on recreational fisheries (Italy, Greece, Cyprus, Spain, and Malta). Preliminary lists of species targeted by recreational fisheries were provided for Italy, Greece, Cyprus and Malta, highlighting the diversity and complexity of the Mediterranean recreational fisheries. In 2017, the MEDAC suggested a list of six species (*Sparus aurata, Dicentrarchus labrax, Dentex dentex, Epinephelus marginatus, Sciaena umbra, Umbrina cirrosa*) which are vulnerable and are targeted by both small-scale and recreational fisheries (MEDAC, 2017). These were consistent with the proposal made for the Mediterranean Sea by WGRFS (ICES, 2016).

WGRFS suggests that for future recreational fisheries data collection under the new EU Multi-annual Plan (EU-MAP) in the Mediterranean that:

1. No threshold should apply to recreational catches.
2. The priority species should include: Epinephelus spp., *Dicentrarchus labrax, Diplodus sargus, Dentex dentex, Sciaena umbra, Umbrina cirrosa*, and *Sparus aurata*.
3. Multispecies survey should be carried regularly to have a complete picture of the recreational fisheries catches and assess if new species should be added.

The group recognised that the nature and diversity of the recreational fisheries in the Mediterranean mean that it will not be possible for all countries to collect data for all species suggested.

3.4 Data storage and retrieval (ToR c)

To maximize the utility and uptake of MRF data by end users, it needs to be included in European databases of fisheries catches. After considering different data storage options, WGRFS recommended using the RDBES system being developed by ICES (ICES, 2017). However, the RDBES have been designed for commercial fisheries, with aggregated catch and effort data (CL and CE tables), raw sampling data (CS) and standardized raising procedures. To apply this to recreational fisheries would be very inefficient and subject to large potential errors, so a different approach is needed. As a result, the RDBES should be used to ensure that data from recreational fisheries are made available for end user alongside quality statements that highlight issues and how the data can be used. Inclusion of raw data and raising procedures for recreational fisheries could be considered in future, but this is a very large task. Hence, in the short-term, the priority should be to compile raised estimates of recreational effort and catches into a common database and make them available for end users through the RDBES.

In 2018 and 2019, there have been discussions with ICES and the RCGs to assess how best to include recreational data, agree the format of data, and system requirements. The key issue has been whether the existing data model in the RDBES for commercial fisheries can accommodate recreational data or whether additional tables are needed. It became clear that similar issues exist for other areas including diadromous fish. The WGRFS has supported exploration of these options within the fishPi2 project.

Inclusion of MRF data in the RDBES data tables designed for catch statistics and raw sampling data would be challenging. It would require modifications to the tables and lead to the inclusion of data of different nature in the same tables. For example, the RDBES would include official commercial statistics with recreational estimates, and raw sampling data with raised length distributions. This would increase the complexity of the tables and be confusing for end users leading to problems with interpretation. To avoid these problems, the option recommended by fishPi2 is the creation of new tables specifically designed to host MRF data. The data types and functionality needed have been proposed to the SCRDBES and are being reviewed by the group. The SCRDBES have also agreed to provide a potential costing and timescale, so that funding can be sought to support development of the functionality needed.

WGRFS recommends that a database that brings together estimates of marine recreational fisheries catches for end-users is needed as a matter of urgency. Recreational fisheries are no longer collated by the economic data call, so catch estimates should be included in the RDBES. A clear timescale and funding requirements need to be developed by ICES, so that it is clear how this can be achieved. ICES SGRDBES to provide estimates of funding requirements and timescales for inclusion of recreational fisheries data in the RDBES, and work with the WGRFS to develop an appropriate funding stream.

3.5 Recreational fisheries overviews by ecoregion (ICES request)

A request was received from ICES for text on recreational fisheries for the Fisheries Overviews. A short summary was needed on recreational fisheries in each ecoregion (Figure 3.2). The original request covered Icelandic Waters, Biscay and Iberian Waters and Norwegian and Barents Sea as these are being produced. However, it was agreed that it would be useful to produce text for the Celtic, Greater North, and Baltic Seas ecoregions that could be included when the Fisheries Overviews are updated.

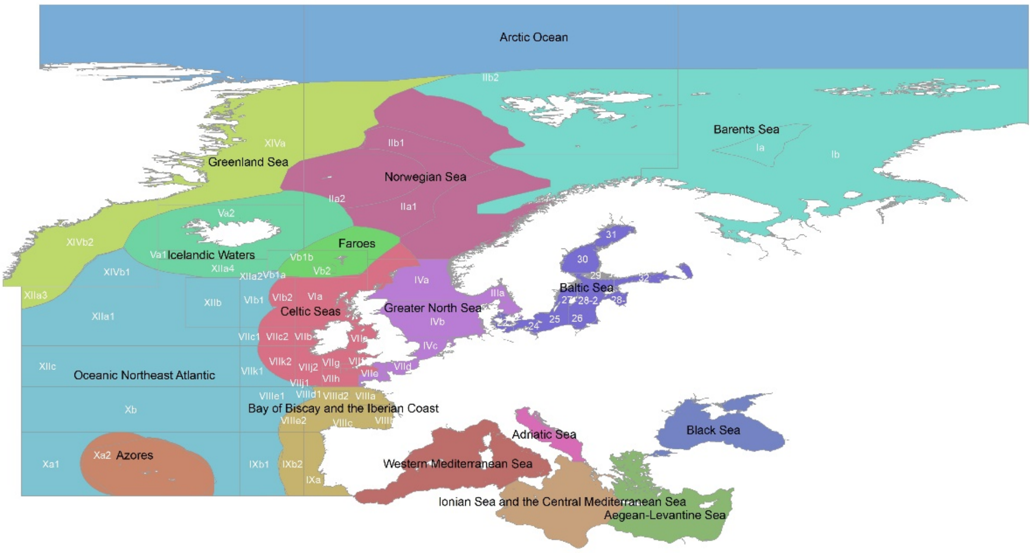

Figure 3.2. ICES ecoregions and areas.

3.5.1 Barents Sea

In the Barents Sea, we only have information on recreational fishing in Norwegian waters. Marine recreational fisheries can be divided into the marine angling tourism sector, and local marine recreational fisheries in Norway. While non-resident marine angling tourists can only use handheld hook-and-line fishing tackle, resident marine recreational fishers can use a range of fishing gears including gill nets, long lines, pots, jigging machines and handheld hook-and-line fishing tackle. In addition, resident marine recreational fishers can sell a limited amount of their catch. Except for the lobster fishery, no fishing license is required. Popular target species are for example cod, saithe (*Pollachius virens*), halibut (*Hippoglossus hippoglossus*), pollack (*Pollachius pollachius*), ling (*Molva molva*), wolfish (*Anarhichas lupus*) and redfish (*Sebastes norvegicus*). As of January 2019, there were 171 registered tourist-fishing businesses with a total of 853 boats in Troms and Finnmark. The most frequently landed species by marine angling tourists are cod and saithe (Vølstad *et al.*, 2011), and catch-and-release rates are high (Ferter *et al.*, 2013).

3.5.2 Norwegian Sea

In the Norwegian Sea, marine recreational fisheries can be divided into the marine angling tourism sector, and local marine recreational fisheries. While non-resident marine angling tourists can only use handheld hook-and-line fishing tackle, resident marine recreational fishers can use a range of fishing gears including gill nets, long lines, pots, jigging machines and handheld hook-and-line fishing tackle. In addition, resident marine recreational fishers can sell a limited amount of their catch. Except for the lobster fishery, no fishing license is required. Popular target species are for example cod, saithe, halibut, pollack, ling, wolfish and redfish. As of January 2019, there were 483 registered tourist-fishing businesses with a total of 2614 boats in this region. The most frequently landed species by marine angling tourists are cod and saithe (Vølstad *et al.*, 2011), and catch-and-release rates are high (Ferter *et al.*, 2013).

3.5.3 Baltic Sea

Information on recreational fisheries has been embedded in the Baltic Sea Ecoregion Fisheries overview. A short description is included of each of the national fishing fleets in the ecoregion, including their commercial and recreational fisheries and fishing gears and patterns. In addition, summaries of the catches and impact on key fish stocks are provided. Rather than to present the full overview text here, the information surrounding recreational fisheries has been extracted and included here.

Recreational fisheries in the Baltic catch a diversity of species, with cod and salmon accounting for the largest number of landings. Recreational fisheries take place in all parts of the Baltic Sea, using a variety of gears including rod and line, longline, gillnets, traps, and spearfishing. Recreational fisheries catch the same species as the commercial fisheries, but also several other species. For most of the stocks, recreational catches are not evaluated or included in the stock assessments. However, for salmon and western Baltic cod, recreational catches are significant and are included in the ICES assessments of the stocks. Very few countries have assessed the numbers of recreational fishers.

There is variation in the species targeted and gears used between countries. In Denmark, recreational fisheries target different species depending on the season with cod, salmon, and trout (*Salmo trutta* trutta) being among the most important species. For cod, the main fishing area is the Sound (Subdivision 23) while for salmon most recreational fishing takes place from the island of Bornholm in subdivisions 24 and 25. Recreational fisheries primarily target perch (*Perca fluviatilis*), pikeperch (*Sander lucioperca*), flounder, and whitefish (*Coregonus maraena*), mainly in the Gulf of Riga in Estonia. In Finland, recreational fisheries target mainly perch, pike (*Esox lucius*), pikeperch, whitefish, bream (*Abramis brama*), and herring using gillnets, rods, fish traps, and fykenets along the coast of Gulf of Finland and in the Archipelago Sea and Gulf of Bothnia. In Germany, recreational fisheries are carried out by an estimated 161 000 fishers, from all German shores and from boats (charter and private boats) mostly within 5 nautical miles (NM) of the coast, and the main target species are cod, herring, trout, salmon, whiting (*Merlangius merlangus*), and flatfish. In Latvia, recreational fisheries occur on all coasts and target flounder, herring, round goby (*Neogobius melanostomus*), smelt (*Osmerus eperlanus*), perch, and cod. The most popular angling method is shore angling, while number of boats is relatively low. In addition to rod and line and spearfishing, registered fishers may use passive gears (gillnets and longlines) if fishing for personal consumption. In Lithuania, recreational fisheries also occur in these waters and focus on cod, herring, salmon, and sea trout using hooks and trolls. In Poland, the recreational fishery is regulated by a licensing system. Number of issued fishing licenses has increased in recent years and in 2014 exceeded 38 000 licences. Rod and line and speargun are the only fishing gears allowed. Recreational fisheries mostly target cod and salmon primarily along the central Polish coast and off the Hel Peninsula. Seasonally, recreational fisheries are also targeting flounder, garfish, herring, sea trout and several freshwater species (e.g. common bream, pikeperch and perch) dominating in Szczecin and Vistula lagoon. In Sweden, recreational fisheries take place along the entire Baltic Sea coast and target marine and freshwater species including cod, salmon, pike, perch, and trout. No information was provided for Russia.

Recreational catches are included in the ICES assessments of the western Baltic cod and the Baltic salmon stocks. Estimated annual recreational catch of western cod has been relatively stable at around 2500 t (only German data available), while estimated annual recreational catches of salmon have been more variable. There may also be significant recreational catches of trout, but these have yet to be quantitatively evaluated or included in the stock assessment. Recreational fishery surveys have been conducted in the Baltic, but few data for other species are available and these have not been used in assessments for the whole Baltic Sea. Release rates for species targeted by recreational fisheries are available for most target species and are high but vary between years and countries. Post-release mortality estimates are available for some species, but further studies are needed.

3.5.4 Greater North Sea

3.5.4.1 Skagerrak and Kattegat (3.a)

Fishing and other sea-based recreational activities are carried out by many people in all coastal parts of 3.a, as well as in the offshore areas. Fishing from private boats is very popular in this area. Most recreational fishing is performed in the coastal region either from shore or from boat, but also the offshore parts of 3.a are accessible for recreational vessels. Recreational fishing in Kattegat and Skagerrak involves many different types of fishing gear including both active (e.g. rod and line, spear and hand-gathering) and passive (e.g. nets, traps and pots) approaches. A broad range of species are targeted. Fishing for migrating schooling fish like mackerel (*Scomber scombrus*) dominates in the area and the recreational fishing is therefore high during summer. Whether fishing from shore, from private boat or tour-boat the angling mainly targets semi-demersal gadoids and salmonids, bottom dwellers like flatfishes and pelagic species like mackerel. In the Skagerrak, the passive gear fishing also targets crustaceans (e.g. Edible crab (*Cancer pagurus*) and European lobster (*Homarus gammarus*)). Many more species are targeted by the recreational fisheries in the Kattegat and Skagerrak with the mix of species varying between countries, and there are fish stocks, where recreational catches may be a significant or even dominant component of total fishing mortality. Approximately 70% of the recreational fishing days occur during May until August. Avid recreational anglers targeting for example sea trout during spring and the fishing with passive gears for lobster is highly seasonal and introduces a peak in effort in spring and autumn, respectively.

3.5.4.2 North Sea

Marine recreational fishing is an important activity in the North Sea with a diverse range of species exploited from a variety of platforms (i.e. shore, boat) using many gears (e.g. rod and line, speargun, nets, pots, traps). The main countries with recreational fisheries in the North Sea are the UK, Belgium, Netherlands, Germany, Denmark, and Norway, with methods varying between countries. In the UK, no license is required and angling from shore and boat is the most popular method, with a number of charter boats offering trips. There is a substantial shore and boat fishery in Denmark that buy a general license and charter boat is important for tourist fishing. In Belgium, there is a diversity of shore-based (angling, passive nets, wading for shrimps) and boat activities (angling and trawling). Angling is the main method in the Netherlands, with catches of cod, sea bass and eel common. In Norway, marine recreational fisheries can be divided into the marine angling tourism sector, and local marine recreational fisheries. While non-resident marine angling tourists can only use handheld hook-and-line fishing tackle, resident marine recreational fishers can use a range of fishing gears including gill nets, long lines, pots, jigging machines and handheld hook-and-line fishing tackle. Resident marine recreational fishers can sell a limited amount of their catch and no fishing license is required apart from for lobster. Popular target species are for example cod, saithe, mackerel, pollack, and ling. The most frequently landed species by marine angling tourists in Norway are cod and saithe (Vølstad *et al.*, 2011), and catch-and-release rates are high (Ferter *et al.*, 2013). Catches in the North Sea can be significant representing around 10% and 27% of total removals of cod and sea bass, respectively (Hyder *et al.*, 2018, Radford *et al.*, 2018). The main species vary by country and location, but include: saithe, cod, flatfish (plaice (*Pleuronectes platessa*), dab (*Limanda limanda*), flounder, sole (*Solea solea*)), herring, mackerel, pollack, sea bass, and whiting. There are also be catches of sharks, skates and rays.

3.5.4.3 English Channel

Marine recreational fishing is an important activity in the English Channel with a diverse range of species exploited from a variety of platforms (i.e. shore, boat) using many gears (e.g. rod and line, speargun, nets, pots, traps). The main countries with recreational fisheries in the English Channel are the UK and France, with methods varying between countries. In the UK, no license is required and angling from shore and boat is the most popular method, with a number of charter boats offering trips. Angling, nets and spearfishing are popular gears in France. Catches can be significant representing around 5%, 27%, and 42% of total removals of cod, sea bass, and pollack respectively (Hyder *et al.*, 2018, Radford *et al.*, 2018). The main targets include: cod, flatfish (plaice, dab, flounder, sole), mackerel, pollack, sea bass, sea bream, and wrasse. There are also be catches of sharks, skates and rays. In addition, shellfish, crustaceans and cephalopods are also exploited.

3.5.4.4 Celtic Sea

Marine recreational fishing is an important activity in the Celtic Sea with a diverse range of species exploited from a variety of platforms (i.e. shore, boat) using many gears (e.g. rod and line, speargun, nets, pots, traps). The main countries with recreational fisheries in the English Channel are the UK, France, and Ireland, with methods varying between countries. In the UK, no license is required and angling from shore and boat is the most popular method, with a number of charter boats offering trips. Angling, nets and spearfishing are popular gears in France. Catches can be significant representing around 5%, 27% and 42% of total removals of cod, sea bass, and pollack respectively (Hyder *et al.*, 2018, Radford *et al.*, 2018). The main targets include: saithe, cod, dogfish (*Squalus acanthias*), flatfish (plaice, dab, flounder, sole), mackerel, pollack, sea bass, sea bream, wrasse and whiting. There are also be catches of sharks, skates and rays. In addition, shellfish, crustaceans and cephalopods are also exploited.

3.5.4.5 Biscay and Iberian waters

Recreational fishing is an important activity carried out by many people around the coast and in offshore waters. The platforms are diverse with fishing from shore, fishing from private boats, charter boats. The main gears used from shore and boats are rod and lines due to the regulations, but spearfishing is also common. This is a multispecies fishery, with a high diversity of species targeted. The main target species are sparids (e.g. white seabream), groupers, and cephalopods (squids and octopuses). Recreational fishers also target important commercial species such as sea bass and highly migratory tuna species including albacore (*Thunnus alalunga*) and bluefin tuna.

In the Bay of Biscay (ICES 8.a,b,d,e), the majority of recreational fishers are from France (see Hyder *et al.*, 2018 for a general review). MRF in France is practiced with passive gears, rod and line, and spear guns from the shore and boats (Herfaut *et al.*, 2013; Levrel *et al.*, 2013; Rocklin *et al.*, 2014). Rod and line fishing with live bait or lures, and spear fishing are the main methods used from shore, with both angling and nets used from boats (Herfaut *et al.*, 2013; Levrel *et al.*, 2013; Rocklin *et al.*, 2014). In 2011, there were 1 319 000 fishers in France making around 9 000 000 fishing trips each year, with around 60% and 40% of the effort in Atlantic and Mediterranean waters, respectively. In addition, 55% of the activity in the Atlantic has been allocated to the Bay of Biscay (Herfaut *et al.*, 2013). The main species caught are sea bass, mackerel, pollack, whiting, pouting (*Trisopterus luscus*), cuttlefish (*Sepia officinalis*), and sea breams (*Spondyliosoma* *cantharus* and *Sparus aurata*). Catches can be significant with 688-1405 t of sea bass kept and 117-496 t of sea bass released each year (ICES, 2018b)

Spain and Portugal are the main countries involved in recreational fisheries in Iberian Waters (see Hyder *et al.,* 2018 for a general review). The number of recreational fishers in the Spanish Atlantic is between 165 000 (Hyder *et al.*, 2018) and 359 493 (Gordoa *et al*., 2019), with 75% fishing from shore, 20% from boat and 5% spearfishing (Pita *et al.,* 2018; Gordoa *et al.,* 2019). In mainland Portugal, 187 372 licenses for recreational fishing were issued in 2018 (DGRM, 2018 licenses), 57% for shore angling, 36% for boat angling, 5% for spearfishing, and 2% for all modes. The main target species are sea bass, seabream (white, black spot, gilthead), ballan wrasse, mackerel and squid. Catches can be large with a total of 10 172 t estimated for Spain (Gordoa *et al.*, 2019).

3.6 Survey design, quality, and analysis (ToR b)

This topic covered assessing the quality of survey data using the QAT, review and updating of the QAT, new survey approaches from other countries, and novel approaches for analysis of survey data and treatment of outliers.

3.6.1 Assessing the quality of survey data (ToR a&b)

Three countries agreed to carry out the QAT to assess their survey programmes. The outcomes for Denmark, Sweden and Spain are described this section.

3.6.1.1 Denmark

The Danish boat survey was assessed using the QAT. The 'REKREA' project was funded from 2016 to 2018 by the European Maritime and Fisheries Fund (EMFF) and carried out by the Technical University of Denmark, National Institute of Aquatic Resources. A sampling strategy for the recreational boat fishing in ICES SD23 was defined to get information on the Danish catches of the western Baltic cod. Data collected were used to verify and adjust (by calculation of a catch multiplier) the time-series of western Baltic cod catch estimates from the offsite recall survey conducted in collaboration with Statistics Denmark since 2009.

The sampling frame was a list of Danish charter boats operating in the area and boat ramps/harbours on the Danish side of the Sound (ICES SD23). Data collection started in 2016 with an onboard survey where observers used questionnaires and collected biological samples for use in the benchmark assessment for the western Baltic cod. An access-point survey was established also using face-to-face questionnaires to gather catch information from the private boats returning to the boat ramps and harbours. The boat and site selection were done using probability sampling proportional to the numbers of visiting anglers onboard the charter boats and to the number of private boats launched from each harbour, respectively. Sampling was stratified by quarter of the year. The completed QAT for Denmark can be found in Annex 6.

WGRFS concluded that the Danish on-site survey is adequate for the boat sector in the Sound (ICES SD23) regarding catches of western Baltic cod and data can be used for stock assessment purposes. However, the present surveys are only targeting boat angling. Effort to include shore-based angling in the data sampling should be done since this fishery is developing around Copenhagen.

3.6.1.2 Sweden

The WGRFS QAT was applied to an onsite survey of eight access points (marinas/boat ramps) in southern Sweden. The survey was undertaken by the Swedish University of Agricultural Sciences and was funded by the Swedish Agency for Marine and Water Management. The goal of the survey was to explore methods to estimate recreational salmon catch from trolling boats using marinas in the south of Sweden and to explore the structure of this fishery. The survey was scheduled to cover the period from 1 April to 30 September 2019.

The primary sampling unit was the list of dates covering the whole period. Stratification was used to increase sampling efficiency. Knowledge from previous surveys was used to divide the period into the four strata shown in Table 3.2. Simple random sampling within each stratum was used to select the days. The access point for each visit was chosen from a list of eight access points where salmon had been reported in previous surveys. Simple random sampling without replacement was used to select the access points. At each visit, the number of trolling boats returning from fishing was counted and one crewmember per boat was interviewed for catch.

Table 3.2. Number of dates sampled in each stratum

Strata	Days total	Days sampled	Percent
High season, weekdays	58	10	17
High season, weekends	33	10	30
Low season, weekdays	66	8	12
Low season, weekends	26	7	27

The QAT revealed no major errors in the design and intended analyses. The group identified a problem with the sample size in combination with the number of access points and number of strata. Since each access point will only be visited once or twice in each stratum, the risk that days not representative for the access site are chosen is too high. This happened during the first half of the survey when too few anglers were intercepted to get usable data. The second half of the study will only sample the most popular harbour. With better knowledge of the variance between effort in different access points, quantitative sampling design optimization could be done. The completed QAT for Sweden can be found in Annex 6.

WGRFS concluded that the sample size was too low to get a usable estimate for the targeted fishery. Besides increasing the sample size WGRFS suggests Sweden to explore the possibility to characterize the access points using AIS-data.

3.6.1.3 Spain

A four-year project designed by the University of Santiago de Compostela to build a protocol for the collection and analysis of information on marine recreational fishing in Galicia (northwest Spain) was presented and assessed (Figure 3.3) using the QAT.

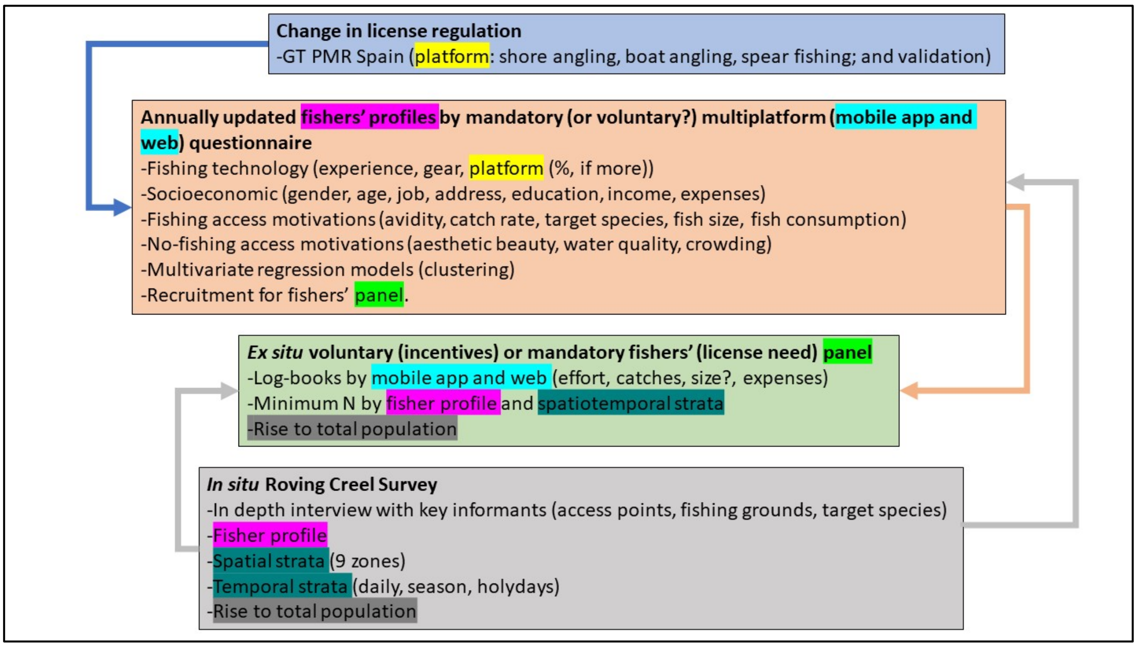

Figure 3.3. Diagram of the assessed proposal to build a protocol for the collection and analysis of information on marine recreational fishing in Galicia (NW Spain). The main attributes of each step are presented. Key words have been highlighted to facilitate the understanding of the workflow.

The protocol has five-steps:

1. Proposing modification of the fishing licenses regulations by the Galician Fisheries Department, based on the recommendation of the Spanish Working Group on Marine Recreational Fishing. The new licensing system will be consistent with similar regulations at the national and European level.
2. Categorizing fishers into homogeneous groups through the information collected in questionnaires. Categorization will be based on fishing technology, socioeconomics, and motivation. The questionnaire will be available in a multiplatform (online and mobile app) application and will facilitate the recruitment of a fisher panel for the next step.
3. The multiplatform application will also be used by the panel of fishers to provide information about their activity through fishing logbooks, considering the previously identified fishers' categories.
4. The data introduced in the multiplatform application via logbooks will be scaled up to total population of fishers, considering the main bias that may affect the process.
5. A roving creel survey will be used to validate the previous results. The experimental design will be based on a spatial and temporal stratification. In-depth interviews with key informants will previously be carried out to identify key attributes of the recreational fisheries.

The completed QAT for Spain can be found in Annex 6.

WGRFS concludes that plans for a Galician survey are adequate to obtain estimates of recreational effort and catches by species, along with socioeconomic information. The methodology allows periodic evaluation of its suitability and moderate adaptation to new requirements in the data collection framework.

3.6.2 Review of QAT (ToR a and b)

To ensure robust recreational catch estimates and document bias in data collection, WGRFS has developed a quality assurance toolkit (QAT) for evaluation of national surveys (ICES, 2013). The aim of this evaluation is to provide statements of quality of recreational data for end-users including stock assessment scientists, and to identify potential improvements to survey design. During the evaluation of Sweden, Denmark and Spain, and during a dedicated breakout session, the QAT was evaluated if it was still fit for purpose and/or if improvements could be made. In general, the group valued the QAT as effective for quality assessment. However, the QAT was edited to address subjectivity of some of the existing questions and recognise the fact that assessment criteria may differ for onsite and offsite surveys. In parallel, an appendix providing sample answers to these questions was developed, but this document is still a working draft (Annex 7). Further work and discussion on the QAT is planned for upcoming WGRFS meetings.

3.6.3 New experiences from outside Europe (ToR b)

Extensive presentations have bene made about surveys in Australia, New Zealand, Canada and USA at previous meetings. As a result, this focused on Uruguay as an expert from Uruguay attended the WGRFS meeting.

In Uruguay, recreational fisheries are defined under national law (i.e. Law for Responsible Fisheries and Promotion of Aquaculture (No 19175)). This is not a specific regulation for recreational fisheries, but establishes the Dirección Nacional de Recursos Acuáticos (DINARA, National Directorate of Aquatic Resources, Ministry of Livestock, Agriculture and Fisheries) as the management institution. Specific laws, decrees, and resolutions establish management measures including mandatory releases, minimum size limits, gear restrictions, and seasonal and areal closures. A fishing license is not required, so there is no registry of recreational fishers. DINARA is collecting information about international regulations for recreational fisheries to improve national management that is compatible with current artisanal and industrial fisheries.

Scientific studies on recreational fisheries in Uruguay are sparse and mainly limited to technical reports, books and theses. In 2015, a pilot monitoring program for marine recreational fisheries on the Atlantic coast of Uruguay was established by DINARA. The main goal of this program is to collect data on the catches and provide a baseline for the management. The main fishery activities included boat, kayak, and coastal angling, gillnetting and spearfishing. Overall, 44 species of Osteichthyes in 32 families, and 7 species of Chondrichthyes in 6 families were identified among the fishes caught. The most common angling species were *Micropogonias furnieri* and *Cynoscion guatucupa*, which were also the main targets of the industrial and artisanal fisheries. Other important species caught using gillnetting and angling (shore and kayak) were *Odontesthes argentinensis, Urophycis brasiliensis, Mugil liza* and *Paralichthys orbignyanus*, also main target species of the artisanal fleet. Spear fishers targeted the rocky reef fishes *Epinephelus marginatus* and *Diplodus argenteus.*

The main challenges for the management of recreational fisheries in Uruguay include: generation of specific regulations; strengthening of monitoring; protocols for effort estimation; promotion of social networks and mobile device applications to collect catch and effort data; and the generation of skills for recreational fisheries research.

3.6.4 Analyses of survey data (ToR c)

Analysis of survey data focused on the treatment of outliers and missing data, and imputation procedures using examples from New Zealand. The methods used to account for data loss and atypical data will always be survey method and fishery context dependent, and are therefore not generalisable, but some examples of how these issues have been addressed in New Zealand are given here, which could be considered for other surveys elsewhere.

Three distinct survey methods are used to quantify and monitor recreational fishing effort and catch in New Zealand. These methods are: an offsite National Panel Survey (NPS – Wynne-Jones *et al.*, 2014) and a concurrent large-scale Aerial-Access survey (Hartill *et al.*, 2011) that are run concurrently to corroborate each other every 5-6 years; and an ongoing digital camera/creel survey monitoring programme that is used to infer relative effort and harvest levels during the intervening years (Hartill *et al.*, 2016).

The National Panel Survey method has been specifically designed to minimise sample loss, and hence the need for any form of imputation. The response rates for the 2011–12 and 2017–18 population screening surveys were 85% and 83% respectively, with 91% and 90% of subsequently selected panellists agreeing to participate in the following 12-month survey. Non-response at this stage is assumed to be a random effect, and demographic data from the most recent national population census is used to scale up the catch reported by the participating panellists over a following 12-month period.

Some panellists withdraw from the survey part way through the year, so methods are required to account for this non-random sample loss. A greater proportion of the higher avidity fishers drop out of the survey than the lower avidity fishers, with 8.5% of panellists across all fishing avidities dropping out of the survey in 2011–2012. Dropout fishers were assigned to one of four categories, given the results of a series of follow up calls with non-completing panellists and others living in the same dwelling. These were: panellists who had died during the survey (1.7% - no imputation required); panellists who had resigned from the survey very early on (3.5% - removed entirely from the panel and readjusted demographic statistical weighting accordingly); panellists who had stated that they no longer intended to fish and the resigned from the survey (2.7% - no imputation required); the remaining non-completing panellists (0.6% or 40 out of 7013- who were likely to have kept fishing and for whom imputation was considered, to account for their unreported catch).

The profiles of the 40 non-completing panellists were compared with those for all other panellists in terms of: species caught, areas fished, fishing methods and platforms used; to identify potential nearest neighbour donors whose reported catch data could be copied for a non-completing panellist's dropout period. No possible donor was identified for nine panellists, and only one possible donor was identified for 10 of the remaining 31 non-completes. Ultimately, no attempt was made to impute the unreported catch of the non-completing panellists, given the limited number of potential donor panellists, and the fact that most had withdrawn from the survey after the peak of the fishing season. This lack of imputation is unlikely to result in a significant underestimation of harvest by this survey method. This outcome demonstrates the benefits of earlier efforts to minimise sample loss.

The aerial-access surveys used to provide harvest estimates that are independent to and concurrent with those provided by the NPS survey combine data from separate aerial and creel surveys conducted on the same random selection of survey days. The creel survey is conducted at high traffic boat ramps throughout the day, to determine the proportion of interviewed boats that would have been fishing at the time than an aerial survey took place, and to quantify the total weight of each species landed at each boat ramp throughout the day. It is therefore necessary to interview all boats returning to a surveyed ramp throughout a selected survey day, which was not always possible when many boats return to land at the same time. As many as 25% of boats may not be approached by an interviewer because they are currently interviewing another boating party.

Nearest neighbour (in time) imputation was therefore used to infer if and when uninterviewed boating parties may have fished, and the catch that might have been observed had they been interviewed. In order to do this, interviewers are asked to note the time at which each boat returned to the ramp, and whether or not they had managed to interview that boat. A copy of the data from the most recently interviewed boat (before or after) was the assigned to an uninterviewed boat, regardless of whether or not it had been used for fishing. This imputation method allows for changes in catch rates and boat usage at different times of day.

The coverage of the companion aerial survey is also sometimes incomplete, because low cloud prevents flying. The pairing of the creel and aerial surveys on the same scheduled days offers a way of predicting the number of boats that would have been seen from the air had a flight taken place, as vessel activity data are available from both the aerial and creel surveys on most other days. The uncertainty associated with these regression-based estimates has been investigated in a variety of ways (e.g. bootstrapping of relative versus absolute residuals), but ultimately this issue has little influence on the magnitude of variance estimates, as low levels of fishing effort are usually predicted on days when weather conditions suppress both flying and boating activities.

Data loss is more of an issue for the digital camera monitoring programme designed to continuously monitor the number of boats returning daily to high traffic boat ramps. Camera systems occasionally go offline for a variety of reasons, failing to collect images for several weeks. When this occurs, GLM regressions are used to predict how many boats would have been seen on these days, given the number of boats returning to nearby ramps where cameras have been operational. The uncertainty associated with each predicted traffic count estimate is taken into consideration when estimating the uncertainty associated with annual effort estimates.

The approach to outliers used in New Zealand is the same as that reported in the 2017 WGRFS report (ICES, 2017). Outliers should be investigated to determine whether any recording error has occurred, but they should not be removed without good reason. Estimates can be calculated with and without the inclusion of outlier values, but experience suggests that their inclusion usually makes little difference to the overestimates produced.

In summary, the methods used to account for missing or atypical survey data are highly survey and fishery dependent and therefore context dependent. When changes are made to a data set to address problematic data, the methods used should be documented and estimates should be calculated with and without predicted values, to show their likely influence.

3.6.5 Novel methods for collection & analysis of data (ToR b)

Smartphone Applications (apps) are a recent development that allow anglers to record and share their catches with others, and might provide valuable recreational fisheries data (Papenfuss *et al.,* 2015; Jiorle *et al.*, 2016; Venturelli *et al.*, 2017). Anglers can choose from many apps that vary in their specificity and functionality (Venturelli *et al.,* 2017). However, anglers that use apps are self-selecting and therefore unlikely to be representative of the angling population (Gundelund *et al*., in review). Anglers who use apps may also underreport small or non-target fishes, or trips with no catch (i.e. blanks). Despite these potential biases, examples of app data tracking some catches (e.g. Jiorle *et al.,* 2016) and other novel uses (Papenfuss *et al.,* 2015, Liu *et al.,* 2017) highlight the need for research to evaluate the potential for app data to inform fisheries management (Venturelli *et al.,* 2017).

The growing interesting and emerging status of recreational app data means that there is a need for government agencies to coordinate their efforts to develop and assess apps. To assess this, a survey was conducted in June 2018 on participants at the WGRFS to understand availability, use, and potential of apps, barriers to uptake, and research needs. The survey included questions about the participant (experience, age, location, role), the current status of app use within their country (availability, uptake, potential for use), prospects for future use (future uptake by data types, barriers, owners), and research needs. A brief introduction was provided that included objectives and instructions to ensure common understanding. Participants were given an hour to complete the survey online using surveygizmo (https://www.surveygizmo.eu/), during which they were discouraged from discussing answers with their peers. There were 40 responses from 20 different countries with a focus in Europe, but also included Canada and the USA. A preliminary analysis of the survey was presented and some of the major findings highlighted.

Angler apps are becoming abundant as a data collection tool in several marine recreational fisheries. Some countries already use app data to support other methods, and there are plans in many countries to use apps for data collection in future. It was felt likely that apps will be used locally or nationally in half the countries that responded. The main barriers to use were: lack of evaluation of the methods; access to anglers that do not have smartphones; and implementation and maintenance costs. Most agreed that app data has potential to be used alongside current survey methods for catch and effort, but it is unlikely to completely replace them within the next 5 years.

Apps provided an opportunity to generate novel data sets (e.g. daily distribution of effort, behaviour) that could be collected to increase knowledge of specific fisheries. However, knowledge of the characteristics of apps users in relation to the general population of anglers was needed to understand bias and increase data quality. In addition, the uptake of app-based approaches was likely to be faster for data-limited fisheries than data-rich fisheries, as this may be the only source of data available. There was potential to use apps as a two-way communication tool between managers and anglers. For example, apps could provide managers with the means to inform anglers with location and species-specific regulations and anglers could inform managers about unusual occurrences (e.g. fish kills, illegal activity).

A reoccurring theme was the need for more research to further our knowledge about the quality of data that angler apps collect, especially in relation to catch rate and effort data, and how app data performs as a stand-alone method. Until this happens, we recommend that catch rates and effort estimates gathered from app data in general are used with great care.

3.7 Human dimensions (WP4 and 5)

Management of fisheries is often thought to be more about managing people than fish, as it is predicated on behavioural responses to measures imposed (Hilborn, 2007). This is likely to be more important for recreational fisheries, where the individual's motivations for participation are very diverse (Fedler and Ditton, 1994; Arlinghaus, 2006; Beardmore *et al.*, 2011). For example, angler behaviour can affect harvest rates through the consumption orientation of the angler (e.g. Beardmore *et al.,* 2011). Moreover, understanding how anglers are affected by different regulations is crucial to sustain the recreational fisheries sector and ensure economic benefit to coastal regions. However, the average angler does not exist, i.e. responses to fishing regulations vary across angler populations. The clear importance of including angler heterogeneity in the management process for recreational fisheries has led to the identification of the need to develop social-ecological systems that can further understanding of optimal management strategies (Hunt, 2013; Arlinghaus *et al.,* 2016; 2017). Many aspects of human dimensions of recreational fisheries have primarily been studied in freshwater systems including extensive research into how angler heterogeneity can impact on management (e.g. Arlinghaus *et al.,* 2017). However, understanding the human dimensions of marine recreational fisheries is limited, so there is need to increase focus on this topic to underpin successful management of fish stocks.

ICES has supported the WGRFS proposal for a dedicated workshop on human dimensions. The workshop on integrating angler heterogeneity into the management of marine recreational fisheries (WKHDR) will be held in Rostock from 5-7 November 2019 chaired by Christian Skov, Harry Strehlow and Kieran Hyder. WKHDR aims to develop approaches for integrating angler heterogeneity into the assessment and management of marine recreational fisheries. A group of international experts will assess current state of the art research, knowledge gaps, methodological approaches, and understand issues how to correct for angler heterogeneity in data collection and stock assessment, as well as its use to design management regulations that take into account diverse groups of recreational fishers. The existing state-of-the-art research approaches and methods will be reviewed and used to assess how best to measure angler heterogeneity. Proposals will be made on how to include angler heterogeneity in existing national surveys and for management advice. The outputs from WKHDR will be published as a peer-reviewed paper and the aim is that this will generate a network of people collecting data using a comparable approach across countries that will lead to further research and publications. Outcomes from WKHDR will be shared with the WGRFS as they become available.

4 Revisions to the work plan and justification

The WGRFS has come to the end of the current three-year programme defined within the existing ToRs. As a result, revisions to the work plan are being made through the development of new ToRs, so there are no requests for changes.

5 Next meeting

The next meeting of WGRFS will be held in Gran Canaria from 15-19 June 2020. It will be hosted by David Jiminez at Instituto Universitario de Acuicultura Sostenible y Ecosistemas Marinos (IU-ECOAQUA), Universidad de Las Palmas de Gran Canaria, (ULPGC), Las Palmas, Gran Canaria, Spain.

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Annex 2: Resolution

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

	MEETING DATES	VENUE	REPORTING DETAILS	COMMENTS (CHANGE IN CHAIR, ETC.)
Year 2017	12–16 June	Azores, Portugal	Interim report by 1 September 2017 to ACOM-SCICOM	Harry Strehlow's 3-year term as chair ends
Year 2018	11–15 June	Faro, Portugal	Interim report by 1 September 2018 to ACOM-SCICOM	Keno Ferter replaces Harry Strehlow as chair. Kieran Hyder's 3-year term as chair ends
Year 2019	10–14 June 2019	A Coruña, Spain	Final report by 1 September 2019 to ACOM-SCICOM	Kieran Hyder to continue as chair for another 3-year term

ToR descriptors

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

Supporting information

Priority	High – Because recreational catches can be high for some stocks
Resource requirements	Expertise on recreational fisheries surveys from areas outside Europe would be beneficial
Participants	The Group is normally attended by some 20–25 members and chair-invited experts.
Secretariat facilities	Normal administrative support in the organization of the group.
Financial	None
Linkages to ACOM, SCICOM and ICES Working Groups	ACOM, WGBFAS, WGEEL, WGBAST, WGCSE, WGNSSK, WGBIE, WGMEDS, WKBASS, WGCATCH, PGDATA
Linkages to other committees or groups	STECF, EU Regional Coordination Groups, Advisory Councils
Linkages to other organizations	WECAFC/OSPESCA/CRFM/CFMC/MEDAC Working Group on Recreational Fisheries. Many linkages to (inter)national angling associations, since WGRFS members estimate national marine recreational catches. Links to broader organizations with interests in angling and fisheries management including EIFACC and FAO.

Annex 3: Marine recreational fishing surveys

Most recent marine recreational fishing surveys

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

Table A3.1. Most recently carried out, ongoing and/or planned marine recreational fishing surveys.

Country	Cod	Eel	Salmon	SEA TROUT	Comments
Denmark	A combined telephone and Internet survey was designed together with Statistic Denmark (DST survey). 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.	Sampled similar to cod. A pilot on-site study has been running since 2016 using access-point and onboard charter boat survey for sampling catches, effort and biological data.	Sampled similar to cod. A pilot study using access-point sampling and camera surveillance was started in 2017 to get biological samples and estimates for catch and effort.	Sampled similar to cod. A pilot on-site study using aerial survey and roving creel survey was carried out in 2017 to collect biological samples and supporting catch and effort estimates to the DST survey.	From 2013 the annual licence list recall survey is web-based only.

Country	Cod	Eel	Salmon	SEA TROUT	Comments
	Data on average size of eel, cod and sea-trout are obtained by a reference panel of 75 fishers. No data on average size of catches are available.				
Estonia	Main catch of cod in recreational fisheries comes from passive gears. The data are reported and stored in the Estonian Fisheries Information System (EFIS).	Catch data are reported and stored in the Estonian Fisheries Information System (EFIS) for passive gears (gillnets, longlines). Eel is mainly caught in inland waters.	Catch comes from gillnets in sea and angling in rivers. For recreational fishermen, it is obligatory to have a licence and report catch, which is stored in the Estonian Fisheries Information System (EFIS).		Catch reporting has been mandatory since 2005. The data are reported and stored in the Estonian Fisheries Information System (EFIS) for passive gears (gillnets, longlines) and salmon and sea trout angling in rivers. Latest recreational fishery survey was carried out in 2016 and was based on phone call approach.
Finland	Cod catch is known to be very low. Catch estimate by postal survey of the whole Finnish population (see comments).	Catch estimate by postal survey of the whole Finnish population (see comments).	Catch estimate by postal survey of the whole Finnish population (see comments). For Salmon rivers, there is an additional postal survey conducted on the basis of local fishing licenses.		A nationwide biennial recreational fishing survey is done for all species and gears. A stratified sample of about 7500 household-dwellings is done with response rates of around 30-40% after a maximum of three contacts. A telephone interview is done for a sample of the non-respondents. Harvested catch and released catch is measured separately by species.
Germany	Cpue data from an 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.	A telephone–diary survey to estimate eel harvests of the recreational passive gear fishery was implemented in 2011–2012 as a pilot study. The panel consisted of 180 recreational passive gear fishers of which 120 have been recruited from the Baltic Sea across seven strata. Participants were called every four months to remind them to fill in the diary.	Derogation pending. A survey is planned for 2015.		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.

Country	Cod	Eel	Salmon	SEA TROUT	Comments
	Length distributions from on-board sampling of charter vessels by survey agents. Length–weight key from commercial sampling for conversion to weight. Releases are only dead releases, i.e. boat-based releases with an assumed post-release mortality of 11.2% and land-based releases with an assumed 100% post-release mortality.				
Latvia	The last survey of the recreational cod fishery from tour boats was conducted in 2012. In 2018, a new pilot study started where contracted tour boats collect biological and haul information. In the end of the year "snowball" method will be applied to estimate total fleet. The first 5 months of sampling showed no activity for cod fishing due to low density of cod in Latvian waters	Data in 2018 are collected by an Internet questionnaire [www.maksker-niekukarte.lv](www.makskerniekukarte.lv) (Internet site where fishermen could buy mandatory fishing card for angling in Latvian waters).	The same as for cod, information is collected from tour boats to cover salmon trolling in the sea. Licensed angling is allowed in few rivers and catches could be estimated from the returned licenses. Additional information will be obtained from an Internet questionnaire.	The same as for cod and salmon, information will be collected from tour boats. Sea-trout angling from seashore is not developed and according to expert estimates is on low level. Additional information will be obtained from an Internet questionnaire.	The catches taken in the recreational fishery with commercial gears (self-consumption fishery) are reported from every haul by fish species. Information is available and could be included in total estimates of the recreational fishery.
Lithuania	All the vessels/boats are registered. From 2013 Lithuania implemented a new system of data collection. Total number of charter vessels and boats engaged in recreational fishing can be obtained from daily reports of coast guard. The total catch and catch per boat is gathered from the direct interviews.	Information on catch volumes can be obtained from the census, direct interviews and questionnaires only. Respondents selected by visiting known fishing spots (The Curonian Lagoon, lakes and rivers) where they come to fish from all over of Lithuania. Eel is only caught in inland waters. Recreational eel catches at sea are forbid-	Separate recreational fishing licence for salmon or sea-trout is mandatory (while fishing in inland waters). All salmon catches have to be reported to the Ministry of Environment, but the number of reported fish is very low. An online survey, a face-to-face interview survey and a personal interview survey was implemented in 2015 as a pilot		All recreational fishers are licensed (with exceptions of anglers under the age of 16, retired and impaired persons).

Country	Cod	Eel	Salmon	SEA TROUT	Comments
		den. Recreational eel catches are observed under the DCF programme annually.	study to estimate recreational salmon catches.		
Poland	In 2018, 24 on-board observer trips were performed to collect biological data and nine harbour masters offices were visited to collect data on number of angling trips and number of anglers on board of charter and private vessels. Also, data on number of cod recorded in recreational daily catch reports from angling trips was collected following new marine fishery act making catch reports mandatory for legal persons organizing angling trips and angling competitions.	The recreational eel fishery will be investigated within the framework of the Polish Eel Management Plan following Council Regulation 1100/2007 adopting the Eel Management Plan (EMP).	Baltic salmon is mainly caught by trolling. Harvest has not yet been monitored. In 2017–2018, a pilot study on salmon and sea trout recreational fishing in Polish Exclusive Economic Zone (EEZ) was conducted. The aim of the pilot study was to gather necessary information and to identify potential issues to allow setting the program for monitoring the recreational salmon trolling catches and coastal recreational fisheries focused on sea trout. Results of this study will be implemented in the future regular monitoring.	Covered by a Pilot Study (see Salmon part)	

Sweden	National survey supported by regional studies (see comments).	It is prohibited to fish for eel - additional information to RCM.	Trolling fishery was surveyed in 2011 and 2015 with catch reports collected with a combination of onsite and online (web). Recreational fishing with passive gear was also surveyed in 2015 with a total census of gear. New studies are planned for 2019 (trolling) and 2020 (passive gear). In addition, recreational catches in the rivers are surveyed every year.	National screening survey (postal).	A national annual recreational fishing screening survey (postal), including most frequently fish and crustacean species targeted in recreational fisheries in subareas and for most common gears have been done. A new improved design was implemented in 2013. New updated data are available for years 2013, 2014, 2015, 2016 and 2017. This survey does not cover tourist fishermen and Swedish residents younger than 16 years as well as Swedish residents older than 80 years of age. The national survey is supported by a regional study on cod (including bycatch) from tour boats fishing primarily in the Sound (SD 23) as well as shoreline anglers and fishers from private boats arriving at access points in SD 23 and 24.

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

Table A3.2. Most recently carried out, ongoing and/or planned marine recreational fishing surveys.

Country	SEA BASS	COD	POLLACK	EEL	SALMON	ELASMOBRANCHS	Comments
Germany		According to a pilot study from 2004–2006, German recreational fishery cod catches in the North Sea have no impact on the stock. Annual cod catches from charter vessels amount to approximately 30 t. Other fishing techniques (e.g. boat angling, shore angling) as well as the recreational passive gear fishery have no further relevance concerning cod catches. A second pilot study was carried out in August 2011 to verify these findings. Results show that there has been no change and that catches have even declined.		A telephone–diary-recall survey to estimate eel harvests of the recreational passive gear fishery was implemented in 2011–2012 as a pilot study. The panel consisted of 180 recreational passive gear fishers of which 60 were recruited from the North Sea across two strata. Participants were recalled every four months to remind them to fill in the provided diary.		A pilot study was carried out in August 2011 to estimate recreational shark catches in the German North Sea. Findings show that recreational shark catches are negligible and have no impact on the stocks.	
Denmark	Sampled as for cod (Table A3.1)	See the Baltic (Table A3.1).		See the Baltic (Table A3.1).		Sampled as for cod (Table A3.1).	See the Baltic (Table A3.1).
Sweden	NA, recreational catches is not considered to be a limiting factor for populations of sea bass in Swedish waters, as their occurrence is mainly regulated by warm-water outflows. Therefore, no ongoing monitoring is done.	Covered by the national screening questionnaire (See comments for the Baltic in Table A3.1)	Covered by the national screening questionnaire (See comments for the Baltic in Table A3.1)	Covered by the national screening questionnaire (See comments for the Baltic in Table A3.1)	Covered by the national screening questionnaire (See comments for the Baltic in Table A3.1)	NA, recreational catches are not allowed due to Swedish legislation.	See comments for the Baltic in Table A3.1
Norway	See “Cod”	Norway is conducting a study funded by the Norwegian research Council from 2017–2019 where	See “Cod”				

Country	SEA BASS	COD	POLLACK	EEL	SALMON	ELASMOBRANCHS	Comments
		the primary objective is to increase knowledge of the extent and development of the marine recreational fishery in Norway with respect to catch, effort and socio-economic dimensions. The aim is to estimate participation, activity, and catches and releases for resident recreational anglers nationally, and to develop methods for studying non-resident anglers that cannot be accessed via telephone registries. The project aims at developing cost-effective off-site and on-site probability-based survey sampling methods with multiple sampling frames to improve sampling coverage of resident and non-resident recreational fishers. The first results will be available in late 2019 - early 2020.					
UK		A new sampling survey was set up for 2016 which had three strands. 1. A national omnibus survey which randomly surveyed the population to get national participation rates. 2. An online survey which fishers completed as a pre-questionnaire to completing monthly diaries. 3. The monthly diaries which were completed throughout 2016 to record participation, gear, catches and spend throughout the year. Covers all species.		Marine recreational survey estimates as for cod		Marine recreational survey estimates as for cod	

Country	SEA BASS	COD	POLLACK	EEL	SALMON	ELASMOBRANCHS	Comments
France	France started a multispecies survey in 2017. The screening survey took place in November - December, and the diary survey has been launched in January 2018. Fishers are recruited to describe their monthly catches based on logbooks. An extrapolation of catches will be made from the scoping data and the quantities caught will be evaluated by species and fishing area. First results will be available in 2020 because the study still underway to validate panel survey figures and estimate error margins. Only Pollack and seabass catches would be reliable (low number of panellists for the other species) and used for 2020 stock assessment.						The pilot study from 2010–2011 covered 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	Belgium has a continuous multispecies survey running since 2017 until 2021. On-site surveys (beach, marinas, aerial, interviews) are combined with a logbook survey (on trips basis) to estimate catches (numbers and weights).						
Netherlands	The RECFISH programme consists of the following elements: Online Screening Survey (omnibus panel) to estimate the number of recreational						Weight estimates can be based on lengths in the onsite survey or the logbook survey.

Country	SEA BASS	COD	POLLACK	EEL	SALMON	ELASMOBRANCHS	Comments
	fishers (marine and freshwater). Surveys were carried out in 2009, 2011, 2013, 2015 and 2017. In 2013 a parallel online and random digit dialling survey was done. Online monthly Logbook Survey to estimate the annual catches. 12 months surveys were carried out starting in March 2010, March 2012, April 2014, April 2016 and March 2018. Onsite surveys to determine length frequency of landed (marine) species carried out at the same time as the logbook survey.						

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

Table A3.3. Most recently carried out, ongoing and/or planned marine recreational fishing surveys.

Country	SEA BASS	COD	POLLACK	EEL	SALMON	ELASMOBRANCHS	ICCAT species	Comments
UK	See North Sea (Table A3.2).			See North Sea (Table A3.2).	Recreational fishing for salmon is almost entirely in inland waters and is monitored by the Environment Agency.	See North Sea (Table A3.2).		See North Sea (Table A3.2).
Ireland	Pilot study in 2011 found that median annual bass harvest by domestic shore anglers, the dominant angler category, was two fish per angler in 2010. Catch and release by this angler category was 79% of catch. No reliable estimate of bass angler numbers available for study. Charter angling boat catch (2007–2009) was negligible (no impact on stocks).			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).	Recreational fishing (angling) is entirely in freshwater. Harvest permitted in freshwater where surplus over Conservation Limits exists. Carcass tagging scheme with mandatory reporting for anglers.	Negligible landings based on fisheries officers observations.		
France								See North Sea (Table A3.2).

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 different sampling frames were the list of surface licences (for shore fishing), the list of spearfishing licences (for spear fishing) and the list of registered recreational vessels (for boat fishing). Contact information is complete for post, but incomplete for e-mail (14% approx.) and telephone (19% approx.). Surveys were done in June 2013 and December 2013 (Ruiz et al., 2015).		A routine glass eel sampling has been carried out since 2004. Fishers have to fill in a diary logbook in order to obtain a fishing license. These logbooks are used to estimate total catches and cpue and the results ae presented in WGEEL.	

Spain (Galicia)	A 5-year project leaded by the University of Santiago de Compostela and funded by the Regional Government of Galicia started in 2015 and will be finished in 2020. The project included a survey to estimate marine recreational effort, catches by species and direct expenditures, among other attributes of the fishery. The study provided the first comprehensive analysis of MRF in Galicia, from a survey of 363 recreational fishers. It was estimated that there are 60000 recreational fishers, comprised of 45000 shore anglers, 12000 boat anglers and 3 000 spear fishers. Recreational fishers reported catching 38 species, but the most common were ballan wrasse (*Labrus bergylta*), European seabass (*Dicentrarchus labrax*), and white seabream (*Diplodus sargus*). Annual recreational catch is about 7500 t (5–13% of commercial and recreational landings of the same species); shore anglers are responsible for 50% of total MRF catches, boat anglers for 40%, and spear fishers for 10% (Pita et al. 2018).

Portugal	The pilot project Pescardata (September 2017 – December 2018) was defined for studying DCF recreational fisheries in mainland Portugal. During the project, and to maximize effort, data on all recreational caught species were collected. For this project, a comprehensive sampling strategy was defined, where the Portuguese mainland coast was divided into 5 km sections of coastline within NUTS II areas (North, Centre, Metropolitan Area of Lisbon - AML, Alentejo and Algarve). Data collection started in January 2018 using face-to-face questionnaire surveys (ODK Android application), angling logbooks, historical sport fishing activity data from anglers' clubs, and fishing tournaments. Onboard observers were also used for boat angling, while face-to-face questionnaires were conducted via roving creel surveys for shore angling and spearfishing, and access point surveys used for boat angling and spearfishing.	Included in the Pescardata pilot project.			Included in the Pescardata pilot project.	Included in the Pescardata pilot project.	

A3.4. Mediterranean Sea and Black Sea

Table A3.4. Most recently carried out, ongoing and/or planned marine recreational fishing surveys.

Country	Eel	Elasmobranchs	ICCAT Species	Comments
Spain	Regional governments Valencia and Catalonia collect information provided to the DGFisheries.	Negligible catches.	Reported to ICCAT collected by IEO.	No standard surveys are performed. Only in the framework of research projects. No current sampling since 2012.
France				See North Sea (Table A3.2).
Italy			Survey is carried out according to to a previous pilot study on the bluefin tuna and other Iccat species including elasmobranchs.	A pilot study on the relative share of catches of recreational fisheries compared to commercial fisheries, for the species considered in the EU-Map work plan, is going to be completed by June 2019.
Greece	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.	The fishery of tunas is practised only by professional fishers and is prohibited for recreational fishers by the Ministerial Decision 170317/162669	A pilot survey for recreational fisheries is underway and is going to be completed in 2019. The final results of the screening survey are currently being analysed.

Annex 4: Most recent catch estimates for DCF species

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

A4.1. Baltic Sea (ICES subdivisions 22–32)

Table A4.1. Most recent marine recreational harvest estimates, in tonnes (t) or numbers (#); figures in brackets indicate differing years.

Country	COD		EEL		SALMON		SEA TROUT		Comments
	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	
Denmark	443 t (2018)	743 340 # (2018)	54 t (2018)	29 957 # (2018)	3790 # (2018)	1633 # (2018)	179 t (2018)	648 481 # (2018)	Extrapolated numbers of Salmon (both harvested and released) of based on very small number of reported catches. Extrapolated catch estimates are in general likely to be biased due to response- and recall bias. Estimates should therefore be interpreted with caution.
Estonia	0.3 t (2018) 0.4 t (2017)	0 (2018) 0 (2017)	0 t (2018)* 0 t (2017)*		3.2 t (2018) 3.1 t (2017)		6.4 t (2018) 6.0 t (2017)		*Eel is mainly caught in inland waters, 0.7 t (2017) and 0.6 t (2018)
Finland	0 t (2018)	0 t (2018)	0 t (2018)	0 t (2018)	40 t (2018)	0 t (2018)			Data from the nationwide biennial recreational fishing survey.
Germany	1 790 576 # 2238 t (2016)	222 017 # 78 t (2016)	4034 # 1.5 t (2012)	1577 # 0.1 t (2012)					
Latvia	0.1 t (2012)	0 (2012–2014)	0.1 t (2013) 0.1 t (2014)	1 386 200 (2014)	2.2 t (2013) 2.2 t (2014)				
Lithuania	30 t (2015)		4,9 t (2015)		10 t (2015)	3 t (2015)			

Country	COD		EEL		SALMON		SEA TROUT		Comments
	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	
Poland	540 t (2018)								
Sweden	538 t (2018)*	50%*	NA	NA	79 t* (2018) 2400#** (2018)	40%* 5600#** (2018)	167 t*	66%*	Cod estimates are from tour boat fishing in the Sound 2017 (SD 23). Salmon estimates are based on regional surveys from coastal and offshore areas. *Data from 2018-years national screening questionnaire (preliminary results) **Expert estimation of salmon caught in Swedish trolling anglers based on surveys from 2011 and 2015 of trolling.

A4.2. North Sea (ICES 3.a, 4 and 7.d) and Eastern Arctic (ICES 1 and 2)

Table A4.2. Most recent marine recreational harvest estimates, in tonnes (t) or numbers (#); figures in brackets indicate differing years.

	Sea bass		Cod		Pollack		Eel		Salmon		Elasmobranchs		
Country	**Harvest**	**Release**	**Harvest**	**Release**	**Harvest**	**Release**	**Harvest**	**Release**	**Harvest**	**Release**	**Harvest**	**Release**	**Comments**
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	6 t (2018)	46 000 # (2018)	461 t (2018)	134 120 # (2018)	33 t (2018)	12 107 # (2018)	48 t (2018)	63 370 # (2018)	2835 # (2018)	NA	102 # (2018)		Extrapolated catch estimates for sharks, sea bass, Pollock and salmon are based on a very small number of catches. Estimates should therefore be interpreted with caution! Data

													on seatrout are also available.
Sweden	NA	NA	176 t (2018)	50%	NA	NA	NA-It is prohibited to fish for eel.	NA	0.2 t	40%	NA –it is prohibited to fish for lesser spotted dogfish, the most common shark in Swedish waters.		Data from 2018-years national screening questionnaire (preliminary results).
Norway			Marine angling tourists[1]: 1613 t (2009) 543 000 # (2009) (RSE 22%) Local Norwegian recreational fishery (all gear types, high potential for bias)[2]: 23 040 t (2003)	Marine angling tourists Northern Norway[3]: 66% (SE 4%) (2010–2011) Marine angling tourists Southern Norway: 62% (SE 8%) (2010–2011) Norwegian Skagerrak recreational 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.		Vølstad *et al*. (2011) Hallenstvedt and Wulff (2004) Ferter *et al*. (2013a) Kleiven *et al*. (2012)
UK (England)	**2012** 229–436t	**2012** 152–252t	**2012** 427–817 t (RSE 26–49%)	**2012** 50–62t (RSE 28–34%)	**2012** 169-190t (RSE 21%)	**2012** 87- 126t (RSE 30-35%)	**2012** Not enough eels caught in fishing trips to reliably raise catches		**2012** 0t	**2012** 0t	**2012** Skates & rays: 40 800-66 000# (RSE 37-	**2012** Skates & rays:	These results cover the catches for the whole of England including

	(RSE 38–35%) 242 900–365 500#(RSE 36–-35%)	(RSE 29–53%)	281 000# (RSE 30%)	201 000# (RSE 36%)	114 600-122 700# (RSE 23-25%)	249 600-272 100# (RSE 37-50%)	49%) smooth-hound (*Mustellus*): 4200-6800# (RSE 37-42%) tope (*Galeorhinus*): 20# (RSE 92%) dogfish (all species): 45 900-52 200# (RSE 28-37%)	39 200-41 700# (RSE 31-42%) smooth-hound (*Mustellus*): 189 600-261 400# (RSE 33-35%) tope (*Galeorhinus*): 6500-6800# (RSE 35-36%) dogfish (all species): 448 300-515 000# (RSE 26-30%)	North Sea, Channel, Celtic Sea and Irish Sea. See Armstrong *et al*. (2013) for full details.
France	3173	828							Sea-bass national catches from Rocklin et al, 2014. The pilot study from 2010–2011 covered 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	3.1t (2018)	15.1t (2018)	19.4t (2018)	2.1t (2018)	1.1t (2018)	NA (22% of pollack catches (in numbers) were released (2018)	0.2t (2018)	NA (37% of eel catches (in numbers) were released (2018)	0t (2018)	0t (2018)	<0.1t	NA (89% of Elasmo. Catches (in numbers) were released (2018)	
Netherlands	108 000 (# 2016) 95 (t 2016)	778 000 (# 2016)	165 000 (# 2016) 191 (t 2016)	324 000 (# 2016)	There are some records of pollacks in the logbooks, however the numbers are too low to raise them to the population number.	There are some records of pollacks in the logbooks, however the numbers are too low to raise them to the population number.	48 000 (# fresh 2016) 10 (t fresh 2016) 55 000 (# marine 2016) 14 (t marine 2016)	166 000 (# fresh 2016) 76 000 (# marine 2016)	There are some records of salmon in the logbooks, however the numbers are too low to raise them to the population number.	There are some records of salmon in the logbooks, however the numbers are too low to raise them to the population number.	There are some records of elasmobranchs in the logbooks, however the numbers are too low to raise them to the population number.	There are some records of elasmobranchs in the logbooks, however the numbers are too low to raise them to the population number.	All data from March 2016–March 2017 and anglers only. Data from van der Hammen (2019). Weights of retained cod and sea bass are based on lengths measured in an onsite survey. Eel weight estimates are based on lengths in the logbook survey.

A4.3. North Atlantic (ICES Areas 5-14 and NAFO areas)

Table A4.3. Most recent marine recreational harvest estimates, in tonnes (t) or numbers (#); figures in brackets indicate differing years.

	Sea bass		Cod		Pollack		Eel		Salmon		Elasmobranchs		ICCAT		
Country	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	Harvest	Release	Comments
UK (Scotland)															
UK (England)	**See Table A4.2**														
Ireland							No marine recreational catches	No marine recreational catches	No marine recreational catches	No marine recreational catches					see Table A 3.3.
France	3173	828													Sea-bass national catches from Rocklin et al, 2014. The pilot study from 2010-2011 covered 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

	Sea bass		Cod		Pollack		Eel		Salmon		Elasmobranchs		ICCAT		
Country	**Harvest**	**Release**	**Harvest**	**Release**	**Harvest**	**Release**	**Harvest**	**Release**	**Harvest**	**Release**	**Harvest**	**Release**	**Harvest**	**Release**	**Comments**
															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 (2012–2013)								Reported eel catches correspond to glass eel.
Spain (Galicia)	2111 t (2017)										Some skates were reported by recreational fishers, but low numbers do not allow reliable estimates				
Portugal															The pilot project (Pescardata) fieldwork has finished in December 2018. Data will be made available as soon as possible.

A4.4. Mediterranean Sea and Black Sea

Table A4.4. Most recent marine recreational harvest/release estimates, in tonnes (t) or numbers (#); figures in brackets indicate differing years, in the sampling period 2014–2015.

	Eel		Elasmo-branchs		ICCAT		
Country	**Harvest**	**Release**	**Harvest**	**Release**	**Harvest**	**Release**	**Comments**
Spain							
France							The pilot study from 2010–2011 covered 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					Survey on ICCAT species currently produce tons estimates only for bluefin tuna: for the other species only relative estimates of catches of a species respect to the other species are given.		Estimates on the relative share of catches from recreational fishery respect to commercial are expected to come from the pilot study for the species considered in the EU-Map
Greece							

Annex 5: Economic information by country

Table A5.1. Most recent marine recreational economic information.

Country	Survey Methods (description of method, assumptions made, and applicable species)	Economic Value (direct, indirect & induced), trip spend, & willingness to pay estimates	Magnitude and direction of bias
Austria			
Belgium	The onsite interviews at the beaches and in the marinas, part of the current Belgian monitoring program, also include socio-economic questions which will provide first quantitative insights in the expenditures of Belgian recreational fishermen (expenses big material (rod, etc.), small material (bait, etc.), travelling costs, boat related costs). The direct expenditures of the Belgian marine recreational fisheries sector is estimated at minimum 8.6 million euros on an annual basis.		
Bulgaria			
Croatia			
Cyprus			
Czech Republic			
Denmark	1. Web panel (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 3349 Euro (25 000 DKR).	
	2. Tourism; Economic impact (input output). Unclear how number of tourists are found and how relative share of angling related economic activity 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)	

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
	3. CE analysis (DK angler= no distinction between marine and freshwater (Cowi, 2010), Web panel 1500 respondents) 4. Tourism (German web panel, not distinction between marine and freshwater fishing) CE analysis, (Jensen *et al.*, 2010). (Table 6.1)	3. CE Analysis: Average WTP is about 100 Euro (736 DKR) angler, but methodological very insecure estimate. Important WTP estimates (ranked from highest to lowest) 1) Nature component (beautiful scenery), 2) Water quality, 3) catch opportunity (numbers). Note that in a higher quality study (Toivonen 2000) WTP for Danish anglers was estimated to 82 Euros (616 DKR) in 1999/2000 prices. 4. Tourism CE analysis: WTP -34 to 59 Euro (-255 to 444 DKR); positive WTP for increased catch opportunity, Increased size of fish, Beautiful surroundings and improved water-quality. Negative WTP if distance to fishing water is increased and/or if number of other anglers increase.	
Estonia			
Finland	Several surveys have been done in Nordic countries to evaluate the economic value of recreational fisheries including: Toivonen, A.-L., Appelblad, H., Bengtsson, B., Geertz-Hansen, P., Guðbergsson, G., Kristofersson, D., Kyrkjebø, H., Navrud, S., Roth, E., Tuunainen, P., Weissglas, G. In: TemaNord 6042000. 1–70 Toivonen, A.-L. In: Pitcher, T. J., Hollingworth, C. (eds). Recreational Fisheries: Ecological, Economic and Social Evaluation. Blackwell Science. 2002. p. 137–143 A comparison of the economic effects of salmon fishing: commercial vs. recreational with input-output model (abstract in English) Lohenkalastuksen taloudellisten vaikutusten vertailua: lohen ammattikalastus Pohjanlahden maakunnissa ja vapaa-ajankalastus Torniojoella ja Simojoella. Storhammar E, Pakarinen T, Söderkultalahti P and Mäkinen T 2011. Riista- ja kalatalous – Tutkimuksia ja selvityksiä 13/2011. 35 p.	http://www.rktl.fi/www/uploads/pdf/uudet%20julkaisut/tutk_selv_13_2011_web.pdf	
France			
Germany	In 2014, a nationwide telephone–diary survey with quarterly follow-ups was initiated contacting 50 000 households. This survey will produce estimates of anglers, effort and expenditures per category for the North and Baltic Sea. During the screening survey respondents were asked to provide a 12-month recall estimate of annual expenditures for recreational sea angling.	There are 174 000 sea anglers in Germany, with the majority (161 000) going angling in the Baltic Sea (unpublished data). Average annual expenditure was 677 € per angler.	

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

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
Latvia	Value of landings in self consumption fishery	9762 EUR	
Lithuania	Have not been performed similar studies in Lithuania	No data on economic value, no economic-social surveys have been done.	
Luxembourg			
Malta			
Netherlands	Screening survey (50 000 households) followed by 12 months Diary Survey (1377 marine participants, 2238 freshwater participants) (van der Hammen and de Graaf, 2017).	200 € per fisher per year, 341 € million (accommodation, travel, durable equipment, consumables, etc.)	
Norway	In 2009, a survey using a sampling frame of 434 fishing tourism enterprises was conducted to compile data on fishing tourism season, capacity in number of beds and rental boats, the number of fishing tourism guest nights and the length of stay (nights) of fishing tourists. Additional data on expenditure during a fishing tourism holiday in Norway was collected from 597 tourists (that had visited Norway to participate in tourist fishing the previous year). The data were used in an input-output model to calculate total economic impact from fishing tourism in 4 regions (including indirect and induced effects). For more information about results see Borch, T., M. Moilanen and F. Olsen (2011a). "Marine fishing tourism in Norway: Structure and Economic Effects." Økonomisk fiskeriforskning 21 (1), 1–17. Also, a more comprehensive report of results was produced in Norwegian: Borch, T., M. Moilanen and F. Olsen. (2011b) Sjøfisketurisme i Norge - debatter, regulering, struktur og ringvirkninger. Tromsø: Norut, report no 1. In 2014, a profitability study was performed of businesses that offer marine angling services to tourists in Arctic Norway (Borch & Svorken 2014). The most important findings in this are that profitability vary with distance to airport, number of beds relative to boats available for rent and with capacity utilization of beds throughout the year. (E.g. if the businesses have other types of guests during the winter season like skiing or aurora borealis tourists. In 2017, a valuation study was performed in Arctic Norway on the value of the coast for outdoor recreational activities. This study concluded that marine recreational fisheries was the most important outdoor recreational activity in this region.	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.	

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
	For more results see Aanesen, M., J. Falk-Andersson, K. Vondolia, T. Borch, S. Navrud, D. Tinch (2018): Valuing coastal recreation in the Arctic and the visual intrusion from commercial activities, Ocean and Coastal Management, 153, pp 157–167.		
Poland	Have not been performed similar studies in Poland.	No data on economic value, no economic-social surveys have been done.	
Portugal	The pilot project Pescardata (September 2017 – December 2018) was defined for studying DCF recreational fisheries in mainland Portugal. During the project, and to maximize effort, data on all recreationally caught species were collected. For this project, a comprehensive sampling strategy was defined, where the Portuguese mainland coast was divided into 5 km sections of coastline within NUTS II areas (North, Centre, Metropolitan Area of Lisbon - AML, Alentejo and Algarve). Data collection started in January 2018 using face-to-face questionnaire surveys (ODK Android application), angling logbooks, historical sport fishing activity data from anglers' clubs, and fishing tournaments. Onboard observers were also used for boat angling, while face-to-face questionnaires were conducted via roving creel surveys for shore angling and spearfishing, and access point surveys used for boat angling and spearfishing. The pilot project has finished, and the results will be made available as soon as possible.	The questionnaires survey included questions regarding the economic contribution of the activity according to the fishing mode. In total 996 questionnaires were validated for shore angling recreational fishery and 428 for boat-angling. For spearfishing, the number of valid questionnaires (n = 31) was considered low, consequently, this fishing mode was not considered in the data analysis. Results on the economic contribution of this activity in Portugal will be made available as soon as possible. These results include socio-economic characterization of fishers and direct expenditures estimates.	
Romania			
Slovakia			
Slovenia			
Spain (Basque Country)	A postal survey was carried out during 2009 and 2010. The target population was the vessel owners and skippers of the recreational fleet, but shore anglers and spear fishers were not included in this study. The contact details for skippers could not be obtained because of confidentiality, so AZTI contacted recreational fisheries associations and federations in the Basque Country. Postal and face-to-face surveys were done with approximately 2000 surveys sent and 549 completed. More questionnaires were completed with face-to-face than in postal surveys. The name of the vessel, registration number and the home port were obtained from Basque	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	Only covers recreational boat owners. Spear fishing and shore fishing is not included.

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
	Country administration 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.	impact including the induced effect was almost 54 million € and maintaining 624 FTE/year. No survey on WTP has been carried out.	
Spain (Galicia)	Online and face to face survey of 363 recreational fishers in 2017 from a total population of 60000 recreational fishers. Recreational associations were involved in the survey dissemination.	Direct expenses were obtained, and when raised to total numbers (corrected by avidity classes, platform and other strata) it was estimated that per year recreational fishers spend 85.6 €M (CI95%=54.9–112.3 €M), while boat owners spend another 10.6 €M (CI95%=5.8–13.0 €M). Mean total individual annual expenses reported by the fishers were 1637 € (CI95%=1595-1871€) per year. Boat anglers spent 15474 € (CI95%=12644–18026 €) to buy their boats, mostly in the second-hand market (61% of total). The mean annual boat related expenses were 2902 € (CI95%=2 233–3 502 €) per boat (Pita *et al*. 2018).	Relatively low number of interviews. Some problems derived with online interviews. However, avidity bias was corrected.
Sweden	National postal survey, approximately 20.000 questionnaires (in 2018) sent three times a year (recall time four months) to randomly selected individuals (permanent residents of Sweden found in the Swedish population register).	1.4 million Swedes (age 16–80) engaged in recreational fishing at least once during 2017. Number of days fished in marine and coastal waters were 3.6 million days in 2017. Total number of fishing days (marine and freshwater combined) was approximately 11.9 million days. Total expenditures for recreational fishing during 2017 was 8.8 billion SEK. Short-term expenditures amounted to 2.4 billion SEK, while long-term investments amounted to 6.4 billion SEK. Data for 2018 on economic value will be analysed during the Q3 2019.	
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.	Angler spend: Annual trip spend per angler - £761 Annual spend on major items - £633 Total annual spend per angler - £1394 Direct spend in England: Total spend = £1.23 billion (£831M excl. taxes and imports) Supports over 10 000 FTEs	+

Country	Survey Methods (description of method, assumptions made, and applicable species)	Economic Value (direct, indirect & induced), trip spend, & willingness to pay estimates	Magnitude and direction of bias
	In 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 is home to relatively few domestic firms that manufacture rods and reels, such that domestic spending on these goods tends to support foreign manufacturers, but with domestic firms perhaps benefiting as distributors of goods. How far this total spending on recreational sea angling, once discounted for imports, supports gross value added and employment in the English economy. How spending on recreation sea angling supports activity in other sectors. Here for example, spending on accommodation might support employment in the hotel trade, but also jobs in the sectors that supply hotels. Data for estimating spend per angler were obtained from 2512 respondents to an online survey and from 340 face-to-face interviews at five case study locations (Weymouth, Deal, Liverpool, Northumberland and Lowestoft) where local businesses were also surveyed. The onsite survey locations included a variety of rural-coastal (Northumberland, Deal), mid-sized (Lowestoft and Weymouth) and city/urban locations (Liverpool). Site based research was conducted throughout the period from March 2012 to February 2013. Site based research also allowed collection of data from some groups who were more likely to be underrepresented in the self-select online survey, such as occasional anglers and holidaymakers. The total annual spend in England was estimated by raising the mean spend per angler to the total number of sea anglers in England estimated from the Office of National Statistics Survey. All data were re-weighted using demographic and frequency-of-angling data from the surveys to reduce bias. An Input–Output framework was used to estimate the multiplier impacts of sea angling expenditure at the England level. This I–O framework enabled the effect of any spending or activity to be traced through the various supply chains, ultimately estimating indirect and induced-income effects. Average spend was also calculated for all respondents from	£358 million GVA Total value (direct, indirect and induced spend): Total value = £2.10 billion Supports over 23 000 FTEs £978 million GVA Average trip spend at case study sites: Deal = £46.2 Liverpool = £43.7 Lowestoft = £35.9 Northumberland = £37.2 Weymouth = £161.7	

Country	Survey Methods (description of method, assumptions made, and applicable species)	Economic Value (direct, indirect & induced), trip spend, & willingness to pay estimates	Magnitude and direction of bias
	the five case-study locations and showed spend was much higher at the charter boat location (Weymouth). The social benefits of sea angling were also assessed, with 47% of respondents said that 'being outdoors and active' was their main motivation for going sea angling, and 55% said it was to 'relax and get away from things'. Sea angling contributes to health and well-being with 69% of sea anglers saying it is their main way of 'experiencing nature' and 70% saying that it is important to their quality of life. Better fish stocks were cited most often as the factor that would increase participation, although cost, time and family commitments were also important. For more information see Armstrong *et al*. (2013).		

Annex 6: QAT assessments

QAT assessment for Denmark

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	All boat angling.
	Is there illegal/tourist fishery, which is not accounted for?	Yes	Not all boat ramps/access points in SD23 are covered.
	Are there elements of the target population that are not accessible?	Yes	Same as above.
Target frame	Is the PSU identified and documented?	Yes	Charter boat/boat ramp.
	Does the sampling frame fully cover the target population?	No	Not all boat ramps/access points in SD23 are covered.
	Are there elements of the target population that are excluded from the frame (e.g. non-residents, private access sites)?	Yes	Not all boat ramps/access points in SD23 are covered.
Stratification	Are the strata well defined, known in advance and stable?	Yes	Size (effort) in terms of effort for each stratum are not stable.
	Is there an overstratification leading to excessive imputation?	No	
Selection	Is sampling probability based (e.g. stratified random with spatial strata, PPS)?	Yes	PPS for PSU and simple random for SSU.
IMPLEMENTATION			
QUESTION		ANSWER	COMMENTS (INCLUDING MAGNITUDE AND DIRECTION OF BIAS)
Selection	Has the survey been designed to maximize precision?	Yes	For the catch rates (PPS)
	Are there protocols in place and have they been followed for subsamples (selection of individuals, times, boats, biological samples)?	Yes	Protocol for sampling is followed.
	Are the right sites, times, respondents, biological data sampled?	Yes	According to protocol and biological samples, e.g. length, weight and otoliths.
	Is there a language barrier (tourist fishery)?	Yes	Very few tourist anglers encountered during on-site surveys. Questionnaire in English and German.
	Is there a preference not to engage with illegal fishers (e.g. threatening behaviour)?	No	
	Has the assignment been completed?	No	Not all planned sampling trips carried out for each stratum.
Nonresponse	Are response rates recorded and evaluated?	Yes	Recorded but not evaluated yet.
	Are refusal rates (e.g. according to spatial issues, fishing in MPAs or fishing for high value species) recorded and evaluated?	Unknown	Reconsider the questions: categories of non-response e.g. language problems, survey fatigue, blocked number.
	Have you re-evaluated refusals?	No	
	Have you accounted for not completed assignments (unobserved sample bias)?	No	Only catch rates are being sampled. Will be studied later to account for difference in characteristics between sampled vs missed trips.

Recall	Is the recall period appropriate?	Yes / No / Unknown	Not relevant, but anglers can have difficulties remembering number of released fish even on the actual trip sampled.
	Does recall period match fishing season?	Yes / No / Unknown	Not relevant.
Effort	Is effort well defined (unit, fishing mode, target species, location) and related to CPUE measures?	Yes	Effort is gained from the recall survey. Effort unit from on-site survey is trip.
	Is the concept of effort understood by respondents?	Yes	Not relevant for the onsite survey, since effort is gathered from off-site recall survey.
	Is it possible to record incorrect fishing areas?	No	Interviewer recording the area.
Catch	Is catch verified by surveyors (e.g. all filleted, don't show)?	Yes	All harvested fish counted. All cod measured and weighted.
	Is species identification and naming reliable?	Yes	Done by DTU Aqua observer.
	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	All fish harvested are identified by DTU Aqua observer.
	Is there a digit preference in the reports?	Yes	For number of released cod from private boats. Not relevant for charter boat survey since all cod are measured and weighted by observer.

ANALYSIS

Question		Answer	Comments (including Magnitude and Direction of Bias)
General	Does the estimation procedure follow the survey design?	Yes	Catch estimates calculated using selection probability.
	Has imputation been used to account for missing observations and, if so, is the procedure documented?	No	Will look into this as the trips being cancelled can be different in terms of skipper skills (e.g. catches from the ones being sampled).
	Has the precision of estimates been calculated and, if yes, where are the documented?	Yes	ICES WKBALTCOD2 report.
	Has there been weighting to correct for nonresponses/avidity bias	No	Will look into this as the trips being cancelled can be different in terms of skipper skills (e.g. catches from the ones being sampled).
	In panel surveys, have those selected changed their fishing pattern or activity?	Yes / No / Unknown	
	Is the bias caused by drop-outs and drop-ins in a panel corrected for?	Yes / No / Unknown	

WGRFS ASSESSMENT OF SURVEY

WGRFS concluded that the Danish on-site survey is adequate for the boat sector in the Sound (ICES SD23) regarding catches of western Baltic cod and data can be used for stock assessment purposes. However, the present surveys are only targeting boat angling. Effort to include shore-based angling in the data sampling should be done since this fishery is developing around Copenhagen.

QAT assessment for Sweden

DESIGN			
QUESTION		ANSWER	COMMENTS (INCLUDING MAGNITUDE AND DIRECTION OF BIAS)
Target population	Are all sectors contribution to the total catch, harvest or release well-known and documented?	Yes / No / Unknown	Yes, only trolling boats from south Sweden are targeted.
	Is there illegal/tourist fishery, which is not accounted for?	Yes / No / Unknown	No.
	Are there elements of the target population that are not accessible?	Yes / No / Unknown	Yes, outside of survey period.
Target frame	Is the PSU identified and documented?	Yes / No / Unknown	Yes, list of days.
	Does the sampling frame fully cover the target population?	Yes / No / Unknown	
	Are there elements of the target population that are excluded from the frame (e.g. non-residents, private access sites)?	Yes / No / Unknown	Yes, outside of survey period. Other ports.
Stratification	Are the strata well defined, known in advance and stable?	Yes / No / Unknown	Yes.
	Is there an overstratification leading to excessive imputation?	Yes / No / Unknown	No, sampling occurs in all strata.
Selection	Is sampling probability based (e.g. stratified random with spatial strata, PPS)?	Yes / No / Unknown	Yes.
IMPLEMENTATION			
QUESTION		ANSWER	COMMENTS (INCLUDING MAGNITUDE AND DIRECTION OF BIAS)
Selection	Has the survey been designed to maximize precision?	Yes / No / Unknown	No, prior quantitative data not available.
	Are there protocols in place and have they been followed for subsamples (selection of individuals, times, boats, biological samples)?	Yes / No / Unknown	Yes.
	Are the right sites, times, respondents, biological data sampled?	Yes / No / Unknown	
	Is there a language barrier (tourist fishery)?	Yes / No / Unknown	No.
	Is there a preference not to engage with illegal fishers (e.g. threatening behaviour)?	Yes / No / Unknown	No.
	Has the assignment been completed?	Yes / No / Unknown	No - ongoing.
Nonresponse	Are response rates recorded and evaluated?	Yes / No / Unknown	Yes.
	Are refusal rates (e.g. according to spatial issues, fishing in MPAs or fishing for high value species) recorded and evaluated?	Yes / No / Unknown	Yes.
	Have you re-evaluated refusals?	Yes / No / Unknown	
	Have you accounted for not completed assignments (unobserved sample bias)?	Yes / No / Unknown	

Recall	Is the recall period appropriate?	Yes / No / Unknown	Yes, only same day.
	Does recall period match fishing season?	Yes / No / Unknown	Yes, only same day.
Effort	Is effort well defined (unit, fishing mode, target species, location) and related to CPUE measures?	Yes / No / Unknown	Yes, trip.
	Is the concept of effort understood by respondents?	Yes / No / Unknown	Not relevant.
	Is it possible to record incorrect fishing areas?	Yes / No / Unknown	NA.
Catch	Is catch verified by surveyors (e.g. all filleted, don't show)?	Yes / No / Unknown	No, add codes.
	Is species identification and naming reliable?	Yes / No / Unknown	Yes.
	Is there a clear division between fish kept and fish released?	Yes / No / Unknown	Yes.
	Are there any high-valued/threatened species taken in the fishery that might be unreported?	Yes / No / Unknown	Maybe wild salmon (with adipose fish) are not allowed.
	Is there a digit preference in the reports?	Yes / No / Unknown	No.

ANALYSIS

QUESTION		ANSWER	COMMENTS (INCLUDING MAGNITUDE AND DIRECTION OF BIAS)
General	Does the estimation procedure follow the survey design?	Yes / No / Unknown	Yes.
	Has imputation been used to account for missing observations and, if so, is the procedure documented?	Yes / No / Unknown	Unknown.
	Has the precision of estimates been calculated and, if yes, where are the documented?	Yes / No / Unknown	Future.
	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	
	Is the bias caused by drop-outs and drop-ins in a panel corrected for?	Yes / No / Unknown	

WGRFS ASSESSMENT OF SURVEY

WGRFS concluded that the sample size was too low to get a usable estimate for the targeted fishery. Besides increasing the sample size WGRFS suggests Sweden to explore the possibility to characterize the access points using AIS-data.

QAT assessment for Spain (Galicia)

		Question	Answer	Comments (including magnitude and direction of bias) Off-site	On-site
Design	Target population	Are all sectors contributing to the total catch, harvest or release well-known and documented?	Yes	Yes	Yes.
		Is there illegal/tourist fishery, which is not accounted for?	Yes	Some license holders from other Spanish regions, tourists and unlicensed fishers could be underestimated.	No.
		Are there elements of the target population that are not accessible?	Yes	Some older people, people without internet access, unlicensed fishers. This can be solved by delivering paper questionnaires for older fisher, and fishers with no internet access	Some illegal fishers and fishers operating out of sampling hours (e.g., at night; in this case they could be approached extending the sampling hours).
	Target frame	Is the Primary Sampling Unit (PSU) identified and documented?	Yes	Fisher profile and spatiotemporal strata.	Fisher profile and spatiotemporal strata.
		Does the sampling frame fully cover the target population?	Yes	Some older people, people without internet access, unlicensed fishers. This can be solved by delivering paper questionnaires for older fisher, and fishers with no internet access.	Some illegal fishers and fishers operating out of sampling hours (e.g., at night; in this case they could be approached extending the sampling hours).
		Are there elements of the target population that are excluded from the frame (e.g. non-residents, private access sites)?	Yes	Some older people, people without internet access and fishers from other Spanish and European regions.	No.
	Stratification	Are the strata well defined, known in advance and stable?	No	The second stage of the study is designed to define the strata.	In depth interviews with key informants and Roving Creel Survey based in random spatio-temporal strata.
		Is there an overstratification leading to excessive imputation?	Yes	Some strata could be eliminated to minimize this issue.	Some strata could be eliminated to minimize this issue.
	Selection	Is sampling probability based (e.g. stratified random with spatial strata, PPS)?	Yes	Fishers' profiles by multivariate regression models (clustering).	Fisher profile and spatiotemporal strata.
Implementation	Selection	Has the survey been designed to maximize precision?	Yes	Designed to maximize accuracy and to minimize bias.	Designed to maximize accuracy and to minimize bias.

		Are there protocols in place and have they been followed to select subsamples (selection of individuals, times, boats, biological samples)?	Yes	Yes.	Yes.
		Are the right sites, times, respondents, biological data sampled?	Yes	Weekends should be included in the strata.	Weekends should be included in the strata.
		Is there a language barrier (tourist fishery)?	Yes	English, Portuguese, German, French, version will be available to minimize this issue.	No.
		Is there a preference not to engage with illegal fishers (e.g. threatening behaviour)?	No	No.	No.
		Has the assignment been completed?	No	No.	No.
	Nonresponse	Are response rates recorded and evaluated?	Yes	Yes.	Yes.
		Are refusal rates (e.g. according to spatial issues, fishing in MPAs or fishing for high value species) recorded and evaluated?	No	Illegal activities (e.g. exceeding bag limit and minimum landing sizes). These can be recorded but not always evaluated.	Illegal activities (e.g. exceeding bag limit and minimum landing sizes). These can be recorded but not always evaluated.
		Have you re-evaluated refusals?	Yes	Will be evaluated for log-book data.	No.
		Have you accounted for not completed assignments (unobserved sample bias)?	Partially	Yes.	Yes. Some unfinished journeys will be accounted for by regression. Or treated it separately.
	Recall	Is the recall period appropriate?	No	Some recall is expected. It is going to be taken into account by asking for 12 and 3-month period.	Yes.
		Does recall period match fishing season?	Yes	Yes, if both 12 and 3-month period are included.	No.
	Effort	Is effort well defined (unit, fishing mode, target species, location) and related to cpue measures?	Yes	Yes.	Yes.
		Is the concept of effort understood by respondents?	Yes	Yes.	Yes.
		Is it possible to record incorrect fishing areas?	Yes	Not applicable.	Not applicable.
	Catch	Is catch verified by survey agents (e.g. all filleted, don't show)?	No	No.	Yes. Some fishers would refuse showing.
		Is species identification and naming reliable?	Yes	There are some changes by area. They can be solved by showing pictures of the fish.	There are some changes by area. They can be solved by showing pictures of the fish.
		Is there a clear division between fish kept and fish released?	Yes	Yes.	Estimations will be obtained.

		Are there any high-valued/threatened species taken in the fishery that might be unreported?	Yes	Sharks, tuna.	Sharks, tuna.
		Is there a digit preference in the reports?	Yes	Yes.	Yes, when fishers are asked about previous effort.
Analysis	**General**	Does the estimation procedure follow the survey design?	Yes	Yes.	Yes.
		Has imputation been used to account for missing observations and, if so, is the procedure documented?	Yes	Mean, median, mode, estimated by models when possible.	Mean, median, mode, estimated by models when possible.
		Has the precision of the estimates been calculated and, if yes, where are they documented?	Yes	Estimated by models when possible.	Estimated by models when possible.
		Has there been weighting to correct for nonresponses/avidity bias	Yes	Following previous work.	Following previous work.
		In panel surveys, have those selected changed their fishing pattern or activity?	No	Not applicable.	Not applicable.
		Is the bias caused by drop-outs and drop-ins in a panel corrected for?	Yes	Not applicable.	Not applicable.

WGRFS ASSESSMENT OF SURVEY
WGRFS concludes that plans for a Galician survey are adequate to obtain estimates of recreational effort and catches by species, along with socioeconomic information. The methodology allows periodic evaluation of its suitability and moderate adaptation to new requirements in the data collection framework.

Annex 7: Revised QAT – working draft

The QAT has been in existence since 2013 and has been reviewed since 2018. WGRFS felt that there was the need to update some of the questions and to reflect onsite and offsite surveys. The revised QAT presented below is a working draft and the first step in this process. Further work will be needed in the coming years to improve the QAT further and consider how to ember this within the TAF. The text in blue relates either to examples of text or what needs to be considered in order to answer the question.

Define the scope and objective(s) of the survey
List the study main objective(s) and scope of the study. Some additional details should be provided on the recreational fishing modes being surveyed, scale (regional, national, multi-country), the study area, if it is a long-term monitoring survey, one-time study, etc

DESIGN

	Question	Answer	Off-site survey comments (if not applicable, type NA)	On-site survey comments (if not applicable, type NA)
Target population	Have all components of the target population been identified?	Yes / No	*A component could be a specific fishing mode or another segment for the fisher population (e.g., non-resident fishers)* *Example: On a national scale survey, non-resident fishers are usually not well identified, as these are not part of the national phone lists etc.*	*Private access points not considered.*
Target population	Is there a component of the target fishery that is not covered by the survey and if so, what was it?	Yes / No	*For example, in a telephone survey, fishers without a listed phone number (either because they do not have a phone or are not in the national phone list (e.g. tourists)*	*For example, for roving creel or access point surveys it is common to exclude night fishing for safety reasons. When this is the case, it should be noted here, along with an explanation on why.*
Target population	Are there elements of the target population that are not accessible, and if so, what are they (e.g. private access points or unlisted telephone numbers)?	Yes / No	*For example, in a telephone survey, fishers without an identified/ associated phone number (either because they do not have a phone or are not in the national phone list (e.g. tourists)*	*Private access points not surveyable.*
Sample frame	What is the sample frame(s) and the associated PSU?		*For example, on mail survey it would be the list of addresses; PSU = address*	*Sample frame = days of the year; PSU = day*
Sample frame	Does the sampling frame adequately cover the target population?	Yes / No	*Example for No - Fishers from overseas*	*No - only part of the day surveyed.*
Sample frame	Are there elements of the sample frame that have been deliberately excluded, and if so and what were they (e.g. quiet season)?	Yes / No	*Yes – visitors from overseas*	*Yes – night fishing.*

Stratification	Are the strata well defined, known in advance (spatial/temporal)?	Yes / No	*No – poor or inadequate record keeping for license database.*	*Fishing season / area not well understood.*
	Is there adequate sampling within each stratum (e.g. days surveyed during weekend/summer)?	Yes / No / Unknown		*No – proportion of days allocated to weekend strata too low*
Selection	Is sampling probability based (e.g. stratified random, PPS -Proportional to Population Size)?	Yes / No	*If No, provide short explanation on approach.*	*If No, provide short explanation on approach.*
	Has the survey been designed to achieve target precision in an analytically optimal fashion?	Yes / No	*No – no prior data to inform sample size determination.*	*No – no prior data to inform sample size determination.*
	Have issues associated with ethics/ permits and privacy been addressed?	Yes / No	*If No, provide short explanation on approach.*	*If No, provide short explanation on approach.*
IMPLEMENTATION (FILL OUT IF THE SURVEY HAS STARTED)				
	QUESTION	ANSWER	OFF-SITE SURVEY COMMENTS	ON-SITE SURVEY COMMENTS
Selection	Has the survey actually followed the sampling design?	Yes / No / Unknown	*Unknown – survey is still running* *If No, provide short explanation on approach.*	*Unknown – survey is still running* *No – New temporal strata introduced pathway through survey* *If No, provide short explanation on approach.*
	Have sampling protocols been documented and followed at each stage (selection of individuals, times, boats, biological samples)?	Yes / No		
	Have contingency protocols been specified to deal with issues such as incomplete interviews of unsurveyable weather and were they required?	Yes / No		*Yes – to deal with need to sub-samples large catches for measuring.*
	Has there been any major departure from the survey design (frequent refusal to take observers on board a charter vessel)?	Yes / No		*Yes - frequent refusal to take observers on board a charter vessel.*
	Is there a language barrier (tourist fishery)?	Yes / No / Unknown		
	Have the planned number of sampling events and/or interviews taken place and have the completion rates been documented?	Yes / No	*No – low uptake by spearfishermen.*	*No – too many days cancelled because of poor weather*
Nonresponse	What were the following non-response rates were relevant? - Screening – blocked contact - Screening – no reply - Screening – language problem - Panel survey – not contactable - Creel survey – refusal - Creel survey – language problem - Other	Yes / No / Unknown	*Screening – blocked contact (xx%), etc.*	*Creel survey – refusal (xx%), etc.*

Recall	What is the recall period and is it appropriate for the questions asked?		*Please note and explain any relevant information on if the recall period is different depending on the indicator. For example, for effort (number of fishing trips) it can be one month, three months or 12 months. For catch it could only refer to the last fishing trip (which could also be variable depending on the fisher avidity).* *Example of excessive recall period: Three months for catch data*	*Not an issue as fishers interviewed when they returned at end of day.* *Could be an issue if you call them later on because they were still fishing when interviewed on the water.*
Effort	How is effort defined (unit, fishing mode, target species, location) and related to CPUE measures?			
	Was the measure of effort clearly communicated to the fisher (i.e. time spent with gear in the water)?	Yes / No / Unknown		*No – if not asked to distinguish between time on the water vs time actually spent fishing*
	Is it possible to record incorrect fishing areas?	Yes / No	*Yes – map not provided to phone respondents*	
Catch	Is the retained catch verified by surveyors (e.g. all filleted, don't show)?	Yes / No		*No – if too many cases where fishers refuse to show their catch*
	Is species identification and naming reliable?	Yes / No / Unknown		*No – if too many cases where fishers refuse to show their catch*
	Is there a clear division between fish kept and fish released?	Yes / No	*No – if no question made about the fate of the fish caught*	*No – if no question made about the fate of the fish caught*
	Is it possible that an individual will have also reported the catch of those fishing with them?	Yes / No / Unknown	*Yes – evidence of multiples of the individual bag limit reported by the individual fisher.*	
	Is there a digit preference in the reports (catch numbers and/or length frequencies)?	Yes / No	*Yes - Catches reported at multiples of 5.*	*Yes – length frequency peaks at every 5 cm.*
ANALYSIS & REPORTING (FILL OUT IF THE SURVEY IS COMPLETE)				
	QUESTION	ANSWER	OFF-SITE SURVEY COMMENTS	ON-SITE SURVEY COMMENTS
General	Does the estimation procedure follow the survey design?	Yes / No	*If no, clearly explain why.*	*If no, clearly explain why.*
	Has imputation been used to account for missing observations and, if so, is the procedure documented?	Yes / No		
	Has there been weighting to correct for nonresponses/avidity bias	Yes / No		
	Has the precision of estimates been calculated and, if yes, how have they been calculated and where are they documented?	Yes / No	*Yes – data bootstrapped at all levels.*	
	Were estimates estimated with acceptable precision.	Yes / No	*For example, a coefficient of variance less than 20% is good, less than 30% is acceptable, but 40% above is considered to be poorly estimated*	*For example, a coefficient of variance less than 20% is good, less than 30% is acceptable, but 40% above is considered to be poorly estimated*

WGRFS ASSESSMENT OF SURVEY
Short description of the survey and key issues followed by conclusion and suggestions form improvement. **WGRFS concludes…**