WORKING GROUP ON RECREATIONAL FISHERIES SURVEYS (WGRFS)

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Contents

i Executive summary

The ICES Working Group on Recreational Fisheries Surveys (WGRFS) role is to summarize and quality assure recreational fishery data collected in European countries and feed into the ICES advisory process on marine recreational fisheries (MRF) issues. In 2021, WGRFS met virtually to continue to work on many aspects of MRF including collation and review of national survey programmes; assessment of the validity of new approaches; provision of guidance on availability, quality and use of data; supporting regional data collection and storage; the human dimension; and review of workshops organized by the group. The sessions focused on sharing information, assessing the quality of national survey programmes, development of the intersessional groups, and publication plans.

Information was shared on a number of different topics. First, new national survey programmes and new survey results were presented. Then perspectives on MRF were provided by the European Commission and the European Angling Alliance. An update on the outcomes of the RCG intersessional group on Recreational Fisheries was given which included development species requirements for future MRF data collection. Methods for allocation of catches between recreational and commercial fisheries from around the world were highlighted alongside potential approaches that could be applied within Europe. Summaries of the outcomes from stock assessments of European sea bass and Western Baltic cod were presented, and the approach for MRF at the North Sea cod benchmark was shared. An update was provided on bycatch of Protected, Endangered and Threatened species (PETS) and the need for consideration of MRF identified. Finally, there was a discussion about improving links with diadromous species working groups.

Two national survey schemes were reviewed using the WGRFS Quality Assurance Tool: France and Uruguay. Issues were highlighted with existing designs and suggestions made for future improvements. The main focus of the meeting was to review, develop and progress the intersessional groups (ISGs) as the WGRFS' main mode of delivery. The ISGs cover governance; survey methods; quality assurance; regional coordination and data storage; catch and release and animal welfare; stock assessment and reconstruction; novel methods; human dimensions; and communication and engagement. Each group is co-led by two members of the WGRFS with a workplan including delivery goals. The discussions and outcomes are too diverse to be summarized here, instead details are provided in the text of the report.

The WGRFS has continued to deliver outcomes centred on: creating a broad network to share expertise; developing methods; raising the scientific profile; and providing the scientific evidence of inclusion in fisheries management. WGRFS has expanded the network beyond Europe to generate more collaborations and wider learning, with around 108 members from 30 countries. The profile of the group has been raised at the international congress and through a presentation in the European Parliament. Two papers have been published and a further manuscript submitted that resulted from collaborations within the WGRFS. Finally, support has been provided to STECF to review the outcomes of the MRF pilot studies, and MRF data compiled for the North Sea cod benchmark leading to the inclusion of provisional estimates of MRF on the advice sheet.

ii Expert group information

Expert group name	Working Group on Recreational Fisheries Surveys (WGRFS)
Expert group cycle	Multiannual fixed term
Year cycle started	2019
Reporting year in cycle	2/3
Chairs	Kieran Hyder, UK
	Estanis Mugerza, Spain
Meeting venues and dates	Year 1: 15–19 June 2020, online meeting, (50 participants)
	Year 2: 14–18 June 2021, online meeting, (54 participants)
	Year 3: 13–17 June 2022, Las Palmas, Gran Canaria, Spain

iii Terms of reference

Term of reference	Addressed in this report
Collate and review quality of national estimates of recreational catch and effort, catch-and-release impacts, and socio-economic benefits for candidate stocks, identify significant data gaps in coverage and species, and support the ICES TAF.	Yes
Assess the validity of traditional knowledge, new survey designs, novel methods (e.g. citizen science, apps), and innovative statistical methods for data provision.	Yes
Provide guidance to ICES and respond to ad hoc requests from ACOM on the availability of data, design of data collection programs, data storage systems, use of data in assessments, and catch allocation.	Yes
Develop approaches for regional data collection programmes that generate robust data for end-users and support the ICES TAF.	Yes
Evaluate the use of economic (e.g. impact, valuation), social (e.g. governance, behaviour, welfare, health), and communication (e.g. participatory process, messaging) to support the assessment and management of recreational fisheries.	Yes
Review outcomes of the workshops organized by the group.	Yes

1 Summary of the work plan

Working Group on Recreational Fisheries Surveys (WGRFS)

Year	Work Plan
Year 1	Establish intersessional groups and leads within WGRFS to progress key tasks including governance, survey design, quality and analysis, regional coordination, data storage, post-release mortality, novel methods, assessment and catch allocation, human dimensions, and communication.
	Develop a plan for at least three WGRFS publications.
	~~Review national programmes including assessment of quality of up to three programmes and provide feedback on tasks requested by ICES, RCGs, EC and STECF~~. *This item could not be completed due to COVID-19 restricting the length of the meeting.*
	Support initiatives by STECF and RCGs to assess the impact of recreational fisheries on a broad range of stocks using data from the EU-MAP pilot studies.
	Assess existing governance structures and what constitutes 'world-class' recreational fisheries management.
	Investigate animal welfare issues related to recreational fisheries (e.g. catch and release) and identify how these could impact management.
	Review outcomes from WKHDR and assess potential for inclusion of angler behaviour in future surveys.
	Assess progress with storage of data within RDBES and agree on future needs.
	Develop framework for inclusion of recreational data in stock assessments and propose workshop to design reconstruction approaches.
Year 2	Review national programmes including assessment of quality of up to three programmes and provide feedback on tasks requested by ICES, RCGs, EC and STECF.
	Assess the potential of novel survey methods to deliver recreational fisheries data (e.g. citizen science approaches, smartphone apps, traditional knowledge).
	Review and share methods for engaging with stakeholders and the potential for participatory approaches.
	Assess novel approaches for traditional surveys (e.g. combining probabilistic and non-probabilistic sampling) and analysis methods (e.g. treatment of outliers, machine learning).
	Develop a framework for understanding potential allocation of catches between sectors through review of existing systems and provide best-practice guidance.
Year 3	Review national programmes including assessment of quality of up to three programmes and provide feedback on tasks requested by ICES, RCGs, EC and STECF.
	Review food safety and human health issues from consumption of recreational caught fish (e.g. environmental toxins).
	Review the potential for impact of climate change on species caught by recreational fisheries and how that should impact on species lists.
	Review new post-release mortality estimates, potential sublethal effects, and reasonable extrapolations across species and fisheries for inclusion in stock assessments.
	Review progress against the three-year plan and design future WGRFS programme.

2 List of outcomes and achievements of the working group in the current delivery period (2020–2022)

The latest WGRFS terms of reference were approved for a three-year term starting in 2020, so it is now possible to include some information on the outcomes and achievements in this delivery period (2020–2022). The COVID-19 pandemic has led to large changes in ways of working and has slowed progress as individuals adapt. However, the aim is to build upon the success between 2017–2019 that centred on: 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 providing the scientific evidence of inclusion in fisheries management. This will include broadening the scope of the group and expanding the network beyond Europe to generate more collaborations and wider learning.

Creating a broad network to share expertise: there are currently 108 members (permanent and chair-invited) of the WGRFS from 30 countries. We have increased participation in countries from South America and Africa, alongside participation across Europe.

Developing methods: we have introduced intersessional groups as our main mode of delivery covering: governance; survey methods; quality assurance; regional coordination and data storage; catch and release and animal welfare; stock assessment and reconstruction; novel methods; human dimensions; and communication and engagement. These have led to several joint publications and surveys. The WGRFS Quality Assessment Tool (QAT) has been updated and three national survey programmes were assessed in 2021.

Raising the scientific profile: members of the WGRFS have raised their profile at the World Rec Fishing Congress and convened a session on recreational fisheries at the World Fisheries Congress. In addition, work has been presented at the RecFish Forum in the European Parliament. Finally, several manuscripts have been submitted for publication that resulted from WGRFS collaborations including:

- Skov *et al.* (2021). Expert opinion on using angler smartphone apps to inform marine fisheries management: status, prospects, and needs. ICES Journal of Marine Science 78, 967–978.
- Gundelund *et al.* (2021). Evaluation of a citizen science platform for collecting fisheries data from coastal sea trout anglers. Canadian Journal of Fisheries and Aquatic Sciences. https://doi.org/10.1139/cjfas-2020-0364.
- Pita *et al.* (2021). First assessment of the impacts of the COVID-19 pandemic on global marine recreational fisheries. Frontiers in Marine Science 8, 735741.

Further manuscripts and workshops are planned for 2021.

Providing the scientific evidence of inclusion in fisheries management: surveys have been completed in many countries across Europe and support has been provided to STECF to review the outcomes of the pilot studies. In addition, marine recreational fisheries data were compiled across countries for the North Sea cod benchmark and included as an issue in the scientific advice for the first time. Finally, members of the workgroup have provided support in discussions around the revisions of the Control Regulation.

3 Progress report on terms of reference 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 are required under the DCF (EC 199/2008, 2010/93/EU, 2016/1251/EU, and 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 the most recent recreational catch data can also be found in Annex 3 and economic surveys of recreational in Annex 4.

Country updates were presented for Uruguay by Martín Laporta, Sweden by Andreas Sundelöf, the Netherlands by Tessa van der Hammen, Greece by Anastasios Papadopoulos, Finland by Pentti Moilanen, Ireland by William Roche and Diarmuid Ryan, France by Niamh Smith and Jules Selles, and the French Antilles by Solène Ropers.

3.2 Perspectives from end-users

3.2.1 European Commission update

The Commission gave a presentation on the legislative (EU) framework of recreational fisheries on the existing legislation and upcoming proposals at the EU and GFCM levels. This reiterated the European context on sustainable use of the ocean and its fish stocks being key to meeting the EU climate-neutrality commitments within the European Green Deal. Where recreational fisheries play an important role in all this, also in ensuring that the MSY objective of the Common Fisheries Policy is reached, as for certain species recreational catches represent a significant portion of the total catches and can affect sustainability. The Commission is aware and concerned that recreational fisheries can have an impact on the state of some stocks. This is the case, for example, for Baltic cod, European sea bass or European eel, where, in some instances recreational catches are more important than the commercial ones. The Commission is monitoring the situation closely and proposes measures for recreational fisheries on a case-by-case basis, as was the case for recreational catches of sea bass and European eel (Council Regulation (EU) 2021/92 of 28

January 2021 fixing for 2021 the fishing opportunities for certain fish stocks and groups of fish stocks, applicable in Union waters and, for Union fishing vessels, in certain non-Union waters).

Reliable and uniform data collection remains vital for the Commission to assess the impact of recreational fishing on specific stocks and to set appropriate measures. The various multiannual plans (Western Waters, Baltic, North Sea and the Western Mediterranean) contain provisions for the Council being able to set non-discriminatory catch limits when scientific advice indicates that recreational fishing is having an impact on the fishing mortality of a stock. As well as a reference that Member States shall take the necessary and proportionate measures for monitoring and collection of data for a reliable estimation of the actual recreational catch levels. The obligation to provide data on recreational fisheries for some stocks under the Data Collection Framework was mentioned, as well as the financial support under the new European Maritime, Fisheries and Aquaculture Fund (Regulation (EU) 2021/1139 of the European Parliament and of the Council of 7 July 2021 establishing the European Maritime, Fisheries and Aquaculture Fund and amending Regulation (EU) 2017/1004) where recreational fishers are eligible for support insofar as their projects help achieve the fund's objectives. For example, they can participate in actions that protect the marine environment and in partnerships on sustainable maritime tourism in local communities.

The Technical Measures Regulation (Regulation (EU) 2019/1241 of the European Parliament and of the Council of 20 June 2019 on the conservation of fisheries resources and the protection of marine ecosystems through technical measures, amending Council Regulations (EC) No 1967/2006, (EC) No 1224/2009 and Regulations (EU) No 1380/2013, (EU) 2016/1139, (EU) 2018/973, (EU) 2019/472 and (EU) 2019/1022 of the European Parliament and of the Council, and repealing Council Regulations (EC) No 894/97, (EC) No 850/98, (EC) No 2549/2000, (EC) No 254/2002, (EC) No 812/2004 and (EC) No 2187/2005), adopted in August 2019, foresees that certain provisions apply to recreational fishing and, in cases where recreational fishing has a significant impact in a particular region, the Commission has the power to adopt, on the basis of a joint recommendation submitted by the relevant Member States having a direct management interest, delegated acts to establish minimum conservation sizes for specific recreational fisheries. In 2020, certain technical measures have been adopted specifically for recreational fisheries in the North Sea and in the South Western Waters (Commission Delegated Regulation (EU) 2020/2013 of 21 August 2020 amending Regulation (EU) 2019/1241 of the European Parliament and of the Council as regards technical measures for certain demersal and pelagic fisheries in the North Sea and the South Western Waters).

The Commission's proposal for the revision of the Control Regulation introduces a general requirement to monitor the number of recreational fishers through a licensing or registration system – as well as the requirement that a data collection or catch registration system is in place for all recreational catches - to improve control and monitoring (Proposal for a Regulation of the European Parliament and the Council amending Council Regulation (EC) No 1224/2009, and amending Council Regulations (EC) No 768/2005, (EC) No 1967/2006, (EC) No 1005/2008, and Regulation (EU) No 2016/1139 of the European Parliament and of the Council as regards fisheries control, COM/2018/368 final). This proposal is currently being negotiated with the co-legislators. At the request of the European Parliament, DG MARE launched in November 2019 a pilot project to develop and test a "control scheme for recreational catches of sea bass" (MARE 2019/006). An external contractor has developed an integrated IT tool to allow recreational fishers to inform quickly about their daily catches by registering those catches in the app "FishFriender" and a web-based platform, RecFishing.eu. This pilot project shows that it is possible to have an integrated EU catch reporting system for recreational fisheries.

The Commission also mentioned the recently published Communication on the sustainable blue economy (COM/2021/240 final), describing the importance of the interaction of the various

sectors within the blue economy, as well as commercial and recreational fishing. The Blue Economy report of 2021 also has been published.

3.2.2 Regional Coordination Groups

The RCG NANSEA and RCG Baltic proposed creating an Intersessional Subgroup on Marine Recreational Fisheries (ISSG MRF) in 2020. For this Subgroup to work properly, it is necessary to ensure that the right people are involved, including experts from WGRFS (and other relevant Working Groups), DCF, RCG LP, RCG MED&BS, and RCG ECON. National Correspondents (NC) need to be approached to ensure that relevant bodies are contacted to ensure expert participation.

During the WGRFS 2021, the progress of the intersessional work of ISSG on Recreational Fisheries (RF) was presented. The ISSG RF focuses on preparatory work for decision-making, including input for regional work plans. RF ISSG work is already coordinating with WGRFS and the FISHN'CO consortium. Some of the initial workplan objectives proved ambitious for this newly formed Subgroup, and adjustments were made, including the proposal for some subgroup work during the RCG NANSEA and RCG Baltic 2021 technical meeting. As a result of the work done during the technical meeting, several outputs are highlighted regarding the tasks for this Subgroup below.

Regional species list: the outcome should be a species list proposal for MRF data collection at a regional level based on end-user needs. The RF ISSG members were asked to identify priority species for each Member State and Region, based on the RCG MED&BS approach (with the criteria defined by GFCM). The different opinions expressed (and how different MS filled out the table) clarified that diverse concepts and expectations were surrounding this issue, probably due to differences in interpretation of the legislation. A suggestion to build a list of mandatory species came after plenary discussions at the RCG NANSEA and RCG Baltic 2021 meeting:

- Core-group stocks: data already required by end-users, where recreational catches are known and, in some cases, the length and other biological data.
- Prospective coarse catch data on a broader range of species, where it is not currently used, with species selection based on:

1. Assessment groups identify additional stocks where MRF data may be required based on expert judgment.
2. Relevant Working Groups screening lists of stocks and develop a final list after dialogue with other groups.

Regional sampling plans: four candidate species should be included in the RSP: cod, sea bass, eel, and salmon. Several considerations were identified during discussions including:

- Concerning main end-users needs, it was agreed that WGRFS should prepare a questionnaire to be sent to relevant Assessment Working Groups (Are they using the data? How are they using it? Which difficulties were encountered? etc.);
- Key WG members should be invited to relevant WG meetings to promote better communication between data collectors and stock assessors;
- Also, the Regional WP will serve as an essential roadmap for MS action on Recreational Fisheries data collection.

Storage of MRF data in the RDBES: the WGRDBESGOV stated that MRF data should be incorporated in the RDBES by 2023. It was agreed that the best way forward would be to arrange a test data call using CSV/Excel file submission based on the proposed recreational data format. It was also highlighted that progress can be made on recreational data without waiting for the commercial data developments to be completed. This work will be carried out through

collaboration between the RCG ISSG on Recreational Fisheries, the WGRFS, and the FISHN'CO Project. This work needs to be done in discussions with the RDBES Core Group to guarantee that the transition to the RDBES will be simple.

Discussions at the RCG NANSEA and RCG Baltic plenary identified that the list of species to incorporate at the regional level should also be decided by analysing the results of the pilot studies (PS1: Relative share of catches of recreational fisheries compared to commercial fisheries). COM will provide access to PS1 reports to this SG. This subgroup should be pan-regional, and so, a close collaboration with the other (relevant) RCGs will be promoted—RCG LP and RCG MED&BS. Liaison with these RCGs is needed to harmonize the methodologies used, alongside collaboration with RCG ECON to define the social and economic data needs for MRF.

The following Workplan was proposed for 2021–2022:

- Develop the RSPs for cod, sea bass, eel, and salmon.
- Analyse the end-user needs regarding regional data collection and the results of the pilot studies in collaboration with WGRFS and other relevant WG.
- In collaboration with WGRFS (and other relevant WG), selection criteria and thresholds (based on end-user needs) should also be decided. Discuss the suggestions to build a list of required species.
- As this subgroup is pan-regional, develop close collaboration with the other (relevant) RCGs (i.e. RCG LP and RCG MED&BS) to harmonize the methodologies used.
- Develop links with RCG ECON to define the social and economic data needs for MRF.

3.2.3 Diadromous species groups

A trialogue was started between WGRFS, WGEEL and the RCG intersessional group for diadromous fishes (ISSG Diad) to identify issues and drawbacks in data collection, storage, use and quality assurance as well as to find areas for future collaboration and exchange. The current state of play and the agendas around the data collection and utilization for diadromous fishes were presented by the chairs of WGEEL (Jan-Dag Pohlmann) and RCG ISSG Diadromous (Marko Freese) to start the discussion. There were three main outcomes highlighted below.

A general problem identified is the wide geographical range in which data collection for diadromous fish takes place. A wide geographical range in the natural distribution ranges of diadromous fishes in Europe means different cultural backgrounds and fisheries methodologies, but also different licensing systems. This makes it virtually impossible to have a fully standardized pan-European (or even more extensive) data collection for these species, not only in terms of recreational fisheries. Furthermore, it was highlighted that the actual data needs for assessment need to be clarified to support the discussion about regional data collection. For the EU data collection framework (DCF), this will ultimately be led at a regional level through the respective RCGs and ISSGs and need to be coordinated with other potentially overlapping data collection programs (e.g. such as those currently run by the GFCM).

The very diverse methods for the collection of data on diadromous recreational generate a range of different quality datasets. The Quality Assessment Tool (QAT) developed by the WGRFS (see Section 3.6.3) is a useful approach and could be transferred to other WGs to address a wider range of issues.

The integration of "non-standard" data to the RDBES is a common issue for both WGEEL and WGRFS (Section 3.6.4) that could be addressed. While the meeting did not result in any concrete recommendations, it was agreed that the communication should be kept open through future meetings with relevant parties (e.g. other diadromous WGs, GFCM, ISSG, ICES data centre) to

take the next steps to further formalize the process, e.g. as specific ToRs, WK recommendations or possibly through the ISSG.

3.2.4 Recreational fishing community

David Curtis and David Vertegaal presented a perspective from the European Anglers Alliance on marine recreational fisheries. This covered: data collection, stock assessment, and fisheries management.

3.2.4.1 Data collection

The European Commission and the European Parliament regularly highlight the need for better recreational catch data. The EAA welcomes better data collection for MRF, as bad data makes for bad management decisions. However, the CFP currently focuses most of its efforts related to MRF on the collection of catch data, regulation, and control, but has little regard for the added value of MRF on the social, cultural, and economic level. This is in stark contrast to the commercial sector, making a balanced approach difficult. Fishery managers may wish to increase societal benefits from the best use of fish stocks, but currently have very little data on how they should do this. For example, if decision-makers want to increase benefits from MRF, what levers should they pull?

The MRF sector is diverse, made up of a number of segments. Each segment (angling, netting, spearfishing, pots/traps etc.) has its peculiarities with regard to the impact on the fish stocks and the environment (such as C&R opportunities and PRM); participation rates; and socio-economic output. Fair and equitable management of these MRF segments requires data collection to be segmented as well. Fisheries Management is increasingly looking at operating on a regional level. Doing this properly requires having regional data on MRF, but very little reliable regional MRF data exists, and this is a clear gap that fisheries managers and scientists need to address.

There are many difficulties in collecting MRF data, including species identification, recall bias, avidity differences, population significance, and long coastlines with many access points. Some fishery managers appear to have unrealistic expectations that mandatory catch reporting for MRF is a panacea. In reality, catch reporting should be just one tool among many to collect data on MRF and traditional methods like on-site surveys will remain important while new methods of collecting data will improve the data. Compliance with catch apps may well be very limited unless MRF can see clear benefits, for example in being able to access a monthly bag limit rather than a daily bag limit.

The EAA, its members, and sea anglers want to see increased transparency of commercial catches. For example, commercial impacts on the sea bass stock are not adequately recorded in many cases. In particular, there is little data on sea bass discarding although in recent years commercial discards have exceeded MRF removals. To make selectivity improvements in commercial métiers, we need much more information on discards: where are they happening, at what time of year, what gear types, whereas fishing for what species, etc.

3.2.4.2 Stock assessment

The EAA welcomes the inclusion of MRF in stock assessments for species that are of interest to MRF, for example, sea bass, cod, and pollack. All fishing pressure must be included in assessments. Additionally, being included in stock assessments makes it clear that MRF is a stakeholder in those fisheries and so should have a voice in how those stocks are managed.

Being included in stock assessments means MRF may be subjected to fishing restrictions. MRF compliance with restrictions is likely to be greater when: it is clear that a stock is in trouble; MRF is known to have a meaningful impact on stocks; and the restrictions are proportionate, properly

considering social, economic and environmental factors and restrictions on other stakeholders. There are many species of interest to MRF that do not have stock assessments, for example, mullet, wrasse, sea bream. This is presumably because these stocks are of low economic importance to commercial fishing. However, these stocks are important to MRF, so stock assessments are needed.

MRF suffers unfairly when MRF is included in stock assessments only once a stock is in trouble. This is because there is no historic benchmarking of MRF's position in a fishery. In the case of sea bass, there is evidence this was once primarily a recreational fishery (at least in the UK), but now fishery managers have no benchmarking data before 2012 and by 2012 commercial fishing had significantly increased its sea bass catches and become the major exploiter of the stock. This damages MRF's ability to claim a fair share of fishing opportunities.

3.2.4.3 Fisheries management

It is not clear to the recreational community if current fisheries management is sufficiently precautionary to protect stocks. From an MRF perspective, there are several key questions:

- For slow-growing stocks, that are late-maturing with highly variable year classes, how effective are the reference points and the methodology to reduce recommended fishing pressure?
- If B_{lim} is adjusted down to the lowest observed stock level and $B_{trigger}$ is referenced to B_{lim}, does this create a risk that fish stocks will be managed incorrectly?
- Is setting a probability of an adverse stock change at 5% sufficient? Does this mean that there will be an adverse stock change sometime in the next 20 years and is this an acceptable level of risk?
- Once a stock is below $B_{trigger}$, fishing pressure is reduced by the fraction $SSB/B_{trigger}$. Since this fraction only goes to zero when SSB = zero, is it sufficiently restricting fishing pressure between the reference points $B_{trigger}$ and B_{lim}?

There is a political desire to move fisheries management decisions to a regional level, underpinned by a belief that local fishers and fishery managers are best placed to decide what is right for their region. Yet little work has been done to consider what decisions are best made at a regional level and what decisions are best made at a national level or supra-national level. There is also a political desire to move towards co-management, but there has been little work done to consider when co-management is and is not appropriate or to investigate the risks of co-management and how they may be mitigated.

Currently, most fisheries managers are trying to manage stocks to achieve MSY, a commercial fishing goal, without considering if this is the most appropriate strategy, or if they should be working towards more ambitious stock levels, particularly for species where MRF is the most valuable stakeholder. The inclusion of MEY options into stock assessments would enable fishery managers to start considering if MSY is the right target.

3.3 Catch allocation

As management of marine recreational fisheries becomes more common in Europe, allocation decisions will need to be made between the commercial and recreational fisheries. Most fisheries legislation, including the CFP, encompasses the need to account for biological, social and economic factors in management decisions. This suggests that catches within safe biological limits should be allocated to parts of the fishery in a way that maximizes societal benefits and that this allocation should drive management measures. This 'explicit allocation' is found in some parts of the world (e.g. Australia, New Zealand, USA), where catches are allocated between the commercial and recreational sectors (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. However, catch allocation between the recreational and commercial sectors has generally been implicit in Europe, where management measures drive catch shares between the sectors. 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 large changes since the implementation of management measures. Hence, transparent and consistent approaches for explicit allocation of catches between recreational and commercial fisheries that account for social and economic benefits are needed in Europe.

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). Potential approaches were discussed including economic impact (e.g. Armstrong *et al.*, 2013; Robert *et al.,* 2017), economic value (e.g. Andrews *et al.*, 2021; Lewin *et al.*, 2021), social value (e.g. ICES, 2021), and systems approaches (e.g. Tidbury *et al.,* 2021).

Many approaches are being applied across the globe, but few approaches 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. Further research is needed to develop best practices for catch allocation that could be applied in Europe.

3.4 Bycatch of protected species

ICES developed the Roadmap for ICES Bycatch Advice[1]. This roadmap should ensure more efficient and complete advice with regards to the bycatch of sensitive species. The primary goal is to facilitate a more efficient consolidation of data and knowledge to support bycatch. This will ensure delivery of the immediate goal to "assess risk and impact of fleet activity for incidental bycatch, to be included in fisheries overviews by 2022" (ICES, 2020). Under this roadmap, relationships between relevant ICES Working Groups are also identified regarding bycatch issues (e.g. WGCATCH, WGMME, WGEF etc.). The engagement and the communication between these relevant working groups—especially with WGBYC—is essential. WGRFS is not included under this roadmap as a relevant group regarding bycatch issues. However, WGRFS considers that MRF could have some impact on some of these Protected, Endangered, and Threatened Species. With this aim in mind, WGRFS plans to start reviewing the different works that have been and are being carried out around the world related to the bycatch of these species by marine recreational fishing.

3.5 Sea bass control scheme

As part of the COM pilot project control scheme recreational catches European sea bass, the integrated European catch reporting system, RecFishing.eu, developed, tested and deployed (Halieuticom *et al.*, 2020). The pilot project demonstrates that a technical basis exists for the generalization of catch reporting and the viability of web-based data reporting for the sharing of fishery-related data by EU marine recreational fishers.

A common database was chosen as the best solution to bring together European data from independent fishers' apps, based on a standard dataset for reporting catches and fishing sessions. This solution could be easily deployed in Member States, is easy to integrate a new reporting

[1] https://www.ices.dk/sites/pub/Publication Reports/Advice/2020/2020/Roadmap_ICES_Bycatch_Advice.pdf.

application, and no divergence in data standard or tool functionality between countries would occur. This requires the organization and governance of the programme to be centralized at the European level, and the agreement of the Member States that the data pertaining to their countries' fisheries be hosted by the European Commission. The reporting dataset implemented in the IT tool specifies a minimum data standard for catches, and some optional fields (e.g. fishing sessions). An advantage of the platform is that the fishers use commonly available logbook applications as an interface, which are available to suit their regional differences, including languages and modes of interaction.

RecFishing.eu has three main accessible components:

- **Administration web portal (https://admin.recfishing.eu): t**he administration web portal is the component of the RecFishing.eu programme dedicated to the administration of access to data and users (Member State fisheries authorities, fishers institutions (federations/clubs), scientific community) who will be able to visualize aggregated data, export data, and create access for new administrator users within the same scope. The aggregate data by species, period or place (e.g. country, ICES region) available includes numbers of fishers, fishing platform, gear, session duration, catch (kept, release), size, and weight.
- **Public fisher's web portal (https://recfishing.eu):** fishers can create an account on the RecFishing.eu programme, find out more about the programme, and access their declaration history.
- **Partner app for reporting (https://fishfriender.com/app):** fishers can create an account on the RecFishing.eu programme or log in directly on the partner apps with their existing RecFishing.eu account, declare their catches, and access their declaration history. The RecFishing.eu system went through initial functional testing and tests in real conditions during the summer of 2020. In October 2020 the platform was opened to all FishFriender users. To date, hundreds of fishers had registered to the programme and declared their catches, effort, and biological information (e.g. size) available on the admin portal.

The RecFishing.eu platform is fully operational, from both the fishers and the administration point of view.

There are several next steps required to move forwards with the system. The programme is designed to be open to the integration of other catch declaration tools that are fit to be used to collect data in the EU Member States. Potential partners (commercial applications, non-profit applications and publicly sponsored applications—i.e. applications developed by national authorities) to become a RecFishing.eu partner will need to comply with a set of preselection and certification criteria (e.g. minimum standards for data collection).

Recreational fishers already use the reporting tools available to them, but that use is not ubiquitous. If catch reporting is made compulsory without a greater proportion of community engagement or too soon, the fishers who do not agree with catch reporting may be actively opposed. Using angler apps have advantages to get people to engage in self-reporting program: social, feed, challenges, forecast, statistics to boost engagement.

Member States will adopt the tool if it improves the effectiveness of the control system or the reporting of data on recreational fisheries under the Data Collection Framework. The possibility to embed additional specific features (mandatory licensing, surveying) in addition to the catch declaration/receipt features could also promote the engagement of the Member States.

In addition, the RecFishing platform is an opportunity for the scientific community to get more information about recreational fishing practices on a large scale. More recreational fishing data could be collected, and non-aggregated data could be exported for specific needs (catch, effort, demographics, or specific surveys) with minimal integration.

3.6 Intersessional groups (ToRs a–e)

The ICES WGRFS covers a large range of topics, with many of these topics being quite specific and requiring expert knowledge and in-depth work. During the yearly meetings, there is not enough time to cover these topics thoroughly, so the WGRFS has decided to establish nine intersessional groups. These will cover governance, survey methods, quality assessment of surveys, regional coordination and data storage; catch and release and fish welfare; stock assessment and reconstruction; novel methods; human dimensions; and communications and engagement. The groups consist of WGRFS members and-invited experts that will meet regularly to address agreed goals. They will be led by two members of the WGRFS, who will be responsible for reporting progress to the WGRFS. A summary of the progress for each group is provided below.

3.6.1 Governance

Leads: Fabio Grati and Kieran Hyder

MRF governance varies greatly between countries (Arlinghaus *et al*., 2019; Potts *et al*., 2020), with effective governance requiring a clear legal definition, policy, co-management, monitoring, cost recovery, and must be adaptive (Potts *et al*., 2020). In Europe, MRF is not effectively embedded fisheries governance, but there is increasing recognition of the importance of MRF and moves to include it more effectively in future. The role of the governance intersessional group is to consider how this could be done and support future integration. The aim is to review existing governance structures and develop an understanding of 'world-class' recreational fisheries management that could be embedded in a future revision of the CFP, through addressing the following questions:

- What constitutes world-class?
- What is the current situation in Europe?
- What is needed in future to improve governance in Europe?
- How could this be embedded in the fisheries policy and management?
- How can WGRFS support this process?

Discussions at the workshop this year focused on two areas: identification of bright spots of effective national governance; and key issues for effective governance in Europe. The examples presented of bright spot identified were at very local scales (e.g. Slovenia, Spain, Italy, UK), and were usually developed through co-design with support of the local community. This makes it a challenge to take these examples and apply them at larger (inter)national levels.

To assess the key issues for effective governance in Europe, the framework of Potts *et al.* (2020) was used. We discussed each of the key principles and the current situations in Europe, before developing a SWOT analysis (Figure 1). The next steps are for the governance ISG are to:

- Develop a short position paper for publication on European governance of MRF;
- Provide feedback to the EC on the future needs for MRF with respect to fisheries governance (e.g. CFP, DCF, Control Regulations).

Strengths	Weaknesses
Clear goal for fish stocks (i.e. MSY). Frameworks for data collection. Vibrant community (e.g. WGRFS, GFCM, EC, EAA, Anglers, MEDAC). MRF mentioned in legislation. Local, national, and regional governance drives discussions at appropriate levels. Engagement from angling organizations.	MRF not embedded fully in EU legislation and no mechanism to allocate stocks. MSY is not a 'relevant' goal for MRF. Lack of biological and socio-economic data. Varied national legislation. Communication with angling sector. Enforcement difficult and limited. No common forums that allow discussion between MRF and commercial. Licence revenue not used for MRF.
Opportunities	**Threats**
Define appropriate MRF data collection once pilots studies are complete. Include MRF in more stock assessments Licensing/registration systems implemented through Control Regulations. Develop benefits case based on economics and physical health and well-being. Inclusion in EU policy will result in obligations for MRF. Recognize progress and develop quick wins for key MRF stocks. Co-design including whole MRF sector (e.g. anglers, spearfishers, netters etc.). Generate European funding for research.	Lack of definition of MRF as a sector. Diversity of the sector. Time scales for inclusion of MRF data in stock assessments. Different national agendas. Impact of management on socio-economic benefits. Changes in fishing opportunities (e.g. climate, non-natives, other uses). Finding common ground between MRF and commercial fishers. Illegal fishing driving conflict between sectors.

Figure 1. SWOT analysis of the current European governance of MRF.

3.6.2 Survey methods

Leads: Annica de Groote and Steven Taylor

In many regions, MRFs are difficult to survey due to the diverse and dispersed nature of the activity. MRFs can be sampled from a list of licence holders (i.e. a registry) cost-effectively when such activities are legislated. However, for many fisheries, a registry of fishers is unavailable. Many different probabilistic survey methods are available (e.g. onsite roving creel, offsite diary), each of which has its advantages, limitations, and sources of bias (see Pollock *et al.*, 1994; Jones and Pollock, 2012). This makes each survey challenging to design, implement, and analyse, meaning that bespoke approaches are needed based on the fishing situation and the resources available.

Response rates in screening surveys are decreasing, making representative samples more difficult to obtain. Emerging evidence also indicates that recall bias can compromise the accuracy of estimates in offsite surveys. This has implications on the cost of surveys, the accuracy of the survey outputs and the need to future-proof survey designs. Non-probabilistic sampling is an alternative method that is often used when it is unfeasible or impractical to conduct probabilistic sampling (see Pennay *et al.*, 2018). The use of non-probabilistic approaches is increasing, but the impact on data quality is largely unknown. The main problem is that it is difficult to generalize

research findings from non-probabilistic surveys and to assess sampling variability and identify possible biases. For MRF surveys, non-probabilistic sampling methods may be particularly relevant in the study of specialized fishers that take a large portion of the catch but are too rare within existing sampling frames to be sampled cost-effectively using probabilistic methods. Additional categories of non-probabilistic sampling of relevance for recreational fisheries surveys include network sampling (including snowball sampling); opt-in web panels; and opt-in app surveys.

The overall aim of this intersessional group is to assess traditional and novel approaches for surveying MRF. This includes the design, implementation, and analysis processes, and the potential utility of the data generated.

The overall leads for the group are Annica de Groote and Stephen Taylor, with ideas also being developed by Jon Helge Vølstad, Jeremy Lyle and Kieran Hyder. The primary focus of the intersessional group will be on the use of probabilistic and non-probabilistic methods to estimate broad-scale estimates of catch and effort. This may also include the design of regional validation studies to evaluate the utility of non-probabilistic sampling, describing the assumptions that must be met for non-probabilistic samples to yield accurate results, and gathering empirical evidence on the accuracy of non-probabilistic surveys.

The group leads are compiling a survey of intersessional group members that will be completed before the next working group meeting. This will provide a greater understanding of how the various participants undertake surveys and how known challenges in survey design are being addressed at a global scale. It is hoped that this will raise awareness of emerging techniques to improve recreational fishing surveys.

3.6.3 Quality assessment of surveys

Leads: Pedro Veiga, Mafalda Rangel, and Bruce Hartill

The WGRFS quality assurance toolkit (QAT) was created in 2013 (ICES, 2013). It was developed to ensure quality assurance of recreational catch estimates from national surveys and document bias in data collection to satisfy ICES and EU MAP requirements. This evaluation has aimed to provide statements of quality of MRF data for end-users including stock assessment scientists and identify potential improvements to survey design (ICES, 2018).

Since its development, the QAT has been used to assess the quality and provide guidance on the design and implementation of multiple types of national survey programmes. In 2018 and 2019, the tool was reviewed to assess if it was still fit for purpose and/or if improvements could be made to the whole assessment framework, and a thorough update was undertaken to address the subjectivity of some of the existing questions, provide a more logical flow of the questions, and create different assessment criteria for onsite and offsite surveys. Examples of text or what needs to be considered to answer the questions were also added to the QAT template. The main intent was to minimize different interpretations of the questions, and ultimately increase consistency in the QAT assessments.

There has been an intersessional working group (ISG) since 2020, which has been dedicated to the QAT. One of the core objectives of these intersessional groups is to maintain existing workflows between WGRFS meetings. The dedicated WRFRS session in 2020 focused on three main points: (a) revisiting the most recent (2019) changes to the QAT template; (b) discussing persisting gaps to the tool, and the main working areas for the next year; and (c) agreeing on a 'core' team for the intersessional group. Unfortunately, and due to the COVID-19 pandemic, most of the planned work for the year was affected and only limited progress was made.

In 2021, the QAT intersessional group addressed the following topics: 1) A review of a French survey was used to assess how well the new QAT template worked; 2) pending aspects to improvements to the new QAT; 3) updating the glossary of Recreational Fishing Terms; 4) reviewing and updating guidelines for best practice in recreational catch sampling schemes; 5) follow up on a potential QAT related publication.

On agenda point 1, the French survey was the first study to be formally assessed using the new QAT, which was conducted online. The group found the process more challenging than in previous years when the QAT assessment was done face-to-face. The group also found that some of the questions remain hard to answer (i.e. still hard to apply to all kinds of surveys and contexts, and some additional work to improve the template is needed. Another outcome from the session was that the QAT itself makes more sense for complete/ almost completed surveys but can still be used to indicate potential issues when designing a survey.

Regarding improvements to the revised QAT (agenda point 2), the main suggestions were: to develop a workflow of the process for the country assessments (e.g. identify tasks and communication strategy); to require the survey provider to complete as much of the QAT as possible in advance, with someone to guide if required; to add a section to the beginning of the QAT, where a brief description of the survey can be recorded; to provide reviewers with access to details of the survey and the pre-filled QAT template ahead of the session; to add separate subheadings to the off-site survey answer panels for some of the questions, where the question could refer to both the screening survey and also, for panel survey feedback to be provided as recommendations rather than a conclusion/evaluation of the assessment. Other suggestions included: developing library of all the QATs conducted so far, potentially organized by survey type (in part to provide examples); defining a group of experts on the various fields of expertise; providing support during the implementation and design of the surveys (linked to the list of experts proposed by the Survey methods ISG).

Agenda point 3 dealt with discussing the proposed revisions and updates to the document (i.e. several new terms and definitions added). It was agreed that this is a living document, to be updated as new terms are used to the ICES WGRFS scope.

Regarding topic 4, a publication related to the QAT, the group considered that a concept note explaining the QAT would be a potential interesting first paper from this intersessional group.

The main goals for the next 12 months are to:

1. Get an updated list of core participants, and define the meeting schedule and format of the QAT intersessional group
2. Work on at least part of the recommended aspects to improve the new QAT (including a proposed workflow of the process for the country assessments)
3. Consider drafting a proposal for improved inclusion of the QAT assessment results and recreational data into the stock assessment process
4. Develop a rough outline for the first QAT potential paper, and define the list of authors and expected timelines

3.6.4 Regional coordination and data storage

Leads: Lucia Zarauz and Estanis Mugerza

It has long been recognized by the WGRFS that MRF data needs to be included in European databases of fisheries catches in order to facilitate the integration of data coming from different countries and maximize the utility and uptake of MRF data by end-users. The RDBES is the most appropriate solution to this as highlighted in previous reports. Funding for MRF is included in

the current "2+2" RDBES funding agreed by ICES, which detailed that data on bycatch and PETS AND/OR recreational data should be incorporated in the RDBES by 2023.

Currently, the structure of the RDBES for commercial fisheries, with aggregated catch and effort data (CL and CE tables), raw sampling data (CS), and standardized raising procedures, would be very inefficient and subject to large potential errors. The reason for that is: (i) the lack of any census data on catch and effort; and (ii) the large variety of sampling designs (including on-site and off-site methods) and raising procedures due to the varied nature of MRF. The preferred solution is a database to store raised tonnages and numbers of fish caught and released by area and year, alongside length–frequency distributions. In addition, a description of the survey and an assessment of its quality would be needed. The full process from survey design, implementation, data archiving and quality control, data analysis and reporting must be documented and transparent for each country contributing to a regionally coordinated recreational survey program. The principal focus of such a database should be to ensure that data from national surveys of different types are properly archived and subjected to appropriate QA/QC procedures so that they can be used by end-users. The need for further developments in line with the data model developed for commercial fisheries will need to be discussed. However, the current priority should be to compile all MRF regional data in a common database and make them available for end-users.

Given the current focus of the ICES Data Centre and RDBES Core group on developing the RDBES to store and use commercial fisheries data, it was agreed that the best way forward was to arrange a test data call. For this to take place, the following steps are needed:

- Revise the data model proposed for MRF catch and effort data. Compare it with the RDBES CL and CE formats. Liaise with the RDBES Core Group to ensure that the future transition to the RDBES will be as easy as possible.
- Launch a voluntary data call based on the proposed format. Efforts will be made to publicize in order to get representative examples of existing data types.

1. Evaluate the proposed MRF data format.
2. Develop a database structure that can be incorporated into the RDBES in future.

This strategy would allow the evaluation of the MRF data format without the burden of adapting the RDBES database and upload portal. For a successful outcome, the work needs to be carried out with tight collaboration between the RCG ISSG on Marine Recreational Fisheries, the ICES WGRFS, the FISHN'CO Project, and the RDBES Core Group.

3.6.5 Catch and release and animal welfare

Leads: Simon Weltersbach and Keno Ferter

Catch and release (C&R) is a common practice for many species in European marine recreational fisheries (Ferter *et al.*, 2013), and can have both lethal and sublethal impacts on the released fish. Although an increasing number of C&R impact studies on European marine species has been conducted in recent years (e.g. Alós *et al.*, 2009; Weltersbach and Strehlow, 2013; Ferter *et al.*, 2015a; Ferter *et al.*, 2015b; Pinder *et al.*, 2017; Lewin *et al.*, 2018; Watson *et al.*, 2020), there is still a lack of knowledge of potential negative impacts of C&R for many European marine recreational fisheries and species. In this session, the current state of C&R impact studies for European marine recreational fisheries, animal welfare issues, and future research needs were discussed.

Several planned, ongoing or recently finished research projects on potential lethal and sublethal C&R impacts were presented and discussed. In Italy, the post-release survival of several Mediterranean species in a multispecies marine fishery will be studied using a containment study. Individuals are caught with angling gear equipped with three different hook sizes at about 60–

70 m depth, tagged with spaghetti tags, and put into cages that are lowered to the seabed for 3–4 days. In Denmark, the survival of sea trout and potential effects on growth after C&R were studied using experimental angling in a pond. The mortality results will be coupled to gear use and hooking injury reported through a Danish angler app to make "real life" implications from the experimental results (Skov *et al.*, in prep.). In the UK, experimental C&R mortality data from a previously published study (Lewin *et al.*, 2018) were used to estimate the discard mortality of sea bass in the UK commercial hook and line fishery (Lamb *et al.*, 2021). Although this study is about commercial fisheries, it has important implications for the estimation of post-release mortality based on the extrapolation of experimental results for marine recreational fisheries. In Latvia, the sublethal impacts of C&R on Atlantic salmon are studied using acoustic telemetry in the Salaca river. Another telemetry study on C&R impacts on perch and carp in Germany was presented. Although this study was on freshwater species, the methods used in this study have great potential to be used for marine species to study both lethal and sublethal impacts.

Due to the lack of knowledge of the post-release survival of several frequently released marine species, studying post-release mortality is a high priority. Species for which such studies should be conducted include DCF species and other species with high release rates like blackspot sea bream and wrasse species. Although studies may show that release survival is high, sublethal impact studies should be conducted to assess impacts on for example behaviour, spawning, and post-release predation risk. The results of lethal and sublethal impact studies can be used to develop guidelines that minimize negative C&R impacts, thereby improving fish welfare (Ferter *et al.*, 2020).

Two paper ideas were discussed by the group. The first paper could be a review study on C&R rates and lethal and sublethal C&R studies in European marine recreational fisheries, including the development of a review framework and simple quality assessment tool for C&R studies like the QAT developed by ICES WGRFS or the critical review questions develop by ICES WKMEDS (ICES, 2015). The second paper could be an assessment of C&R attitudes and general C&R practices among marine recreational fishers in Europe. For this, a survey among recreational anglers could be conducted in several countries for comparison.

3.6.6 Stock assessment and reconstruction

Leads: Martina Scanu and Zachary Radford

The agenda of the intersessional group focused on: (1) the prioritization of stocks for MRF data collection; (2) the development of a decision tree for incorporating MRF data into the assessment process; and (3) catch reconstruction strategies.

A brief background introduction was presented to the participants. In MRF, catches can be very high (Hyder *et al.*, 2018), however, they are often ignored in the stock assessment process (Radford *et al.*, 2018). The perception of low MRF impact, and especially the lack of data is the primary reason for which the inclusion of MRF data in stock assessments is not the default position. Even when data are available, recreational catches can be difficult to include in assessment models due to the uncertainty of the estimates and short length of time-series. To complicate the picture, many recreational target species do have no commercial relevance and there is still no analytical stock assessment performed on them.

Starting from the identification of end-users of MRF catch data (e.g. EU, RCG, Stock Assessment WGs), prioritization criteria and their categories were discussed. Approaches for incorporating MRF data in stock assessments from around the globe were presented and used to identify potential approaches (GFCM, 2021; Lewin *et al.*, 2019; McCully Phillips *et al.*, 2015). Based on these, on NOAA Productivity and Susceptibility (PSA) toolkit, and some other National examples, an exercise to identify selection criteria was performed. Productivity and susceptibility parameters,

MRF biological importance, existing regulation, methods and assessment, socio-economic relevance, and additional information were chosen as categories for the exercise, to be separately evaluated and weighted, generating a ranking of species.

Some examples of stock assessment including MRF data were presented (European sea bass, North Sea cod, red snapper in the Gulf of Mexico), each one including reconstruction and strong assumptions. Indeed, patchy time-series, possible strong interannual variation, limited post-release mortality (PRM) data, no uncertainty in estimates, and lack of consistency between when the assessment is carried out and when MRF data are ready, were the issue highlighted in understanding how to incorporate recreational catch data into stock assessment models.

Working on developing the decision tree at the stock level, the key drivers to be considered were identified as the presence of any regulation for the data collection on the species (e.g. DCF); catch amount compared to the commercial fishery (each fleet segment); catch location (for management purposes); recreational selectivity; and current stock status.

Data collection on MRF started relatively recently, so there are generally only short and often non-continuous time-series. To overcome these issues when performing a stock assessment, catches could be assumed as constant or reconstructed back in time, based on different methods or strategies (e.g. bootstrap, proportions, tuning indices), and sensitivity analysis should be done to test the effect of different assumptions. Participants highlighted that the approach selected should not only consider data availability by species but also the model in use for the regular stock assessment, as each one requires a different data type. It was highlighted that when MRF has an impact on a species and it is not possible to integrate a catch time-series into the model, MRF should be considered when formulating the final advice.

During the next year, this intersessional group has two primary aims. First, we will develop a risk-based approach for assessing which species and/or stocks are most susceptible to the impacts of MRF, and so should have both MRF data collected and included in the stock assessment. Second, we will develop a decision tree to help stock assessors with the inclusion of MRF data within the stock assessment process that will encapsulate the different data availabilities, biases and errors that occur within MRF surveys. The results from these will be submitted as a manuscript.

3.6.7 Novel methods

Leads: Christian Skov and Paul Venturelli

Novel methods to collect data from recreational fisheries to supplement or even replace existing, more traditional methods are emerging in these years, and are a focus of the WGRFS. Examples of novel methods are internet scraping, internet search volume, social/online listening, georeferenced photographs, trail cameras/car counters and Smartphone Applications (apps). The group aims to encourage the development and evaluation of non-probability sampling methods, comparisons to traditional methods, the exploration of opportunities and limitations, and encourage fisher cooperation and engagement (e.g. through citizen science) as appropriate.

Between June 2020 and June 2021 the group expected to

1. Use its expertise and influence to provide recommendations, encourage cooperation, and establish standards in relation to the development of new apps. In the period we gave guidance and input to groups from Australia, France, Japan, and Lithuania. We also gave a presentation at a Webinar: Recreational fisheries monitoring and control, Brussels, 4 December 2020 relating to the Danish experiences from collecting app data and provided recommendations and input during the discussions at the webinar.

2. Engage in cooperation with the intersessional group on survey methods to initiate and plan a process that ultimately should develop a rigorous approach to non-probability sampling in general and app data in specific. The working title on the peer review paper that should emerge from this work is "Too much to ignore: how big data are breathing new life into non-probability sampling in recreational fisheries". Contact between groups was established, but no results have emerged yet.
3. Submit at least one paper that evaluates novel data against data from traditional methods. Members of the group evaluated novel data (angler app, citizen science) against traditional methods, and were involved in the production and submission of two peer-reviewed publications on this topic (Gundelund *et al.*, 2021, Johnson *et al.*, 2021).
4. Submit at least on paper that illustrates how novel methods can produce novel insights into recreational management. Members of the group evaluated how novel methods (citizen science) can be used to show how COVID-19 affected recreational angling (Gundelund and Skov, 2021).
5. Submit a paper that, among WGRFS members, survey availability, use, and potential of apps in recreational marine. The manuscript was discussed by WGRFS participants at the 2020 meeting and published in 2021 (Skov *et al.*, 2021).

The three-hour virtual breakout session at the 2021 meeting began with a short review of aims and progress toward 2020 milestones. David Lusseau from the Technical University of Denmark then gave an inspiring talk about estimating effort and catch (and more!) from social media data. The group then endeavoured to broaden the list of novel data sources that may be of use to fisheries science and management (e.g. to include drones) and initiated a process of documenting current and planned projects that involve novel data. The session ended with a general discussion that ended with draft milestones for 2021. Important points that were not necessarily incorporated into the final 2021 Milestones below include the need for i) traditional surveys to ask respondents if they are using novel methods (e.g. posting on Facebook, using an app); ii) cooperation, coordination, and synergy among projects; iii) recognition that novel does not necessarily mean digital; and iv) a repository of relevant projects and publications.

Between June 2021 and June 2022 the group expects to:

1. Meet virtually 2–3 times outside the annual WGRFS meeting to maintain momentum. Can be thematic and involve invited speakers.
2. Develop, maintain, and share an online spreadsheet[2] for members to log ongoing and planned activities related to novel methods.
3. Use its expertise and influence to provide guidance, encourage cooperation, and establish standards in relation to the development of new apps.
4. Cooperate with the intersessional group on survey methods to initiate and plan a process that ultimately should develop a rigorous approach to non-probability sampling in general and app data in particular.
5. Continue to publish exploratory research (e.g. potential of novel data).
6. Continue to publish comparative research (novel vs. conventional sources).

3.6.8 Human dimensions

Leads: Harry Strehlow and Christian Skov

The human dimension of recreational fisheries is a multidimensional topic covering different research areas. A focus of the intersessional group on the human dimension is to capture angler heterogeneity to integrate aspects of it into data collection, stock assessment and management.

[2] https://docs.google.com/spreadsheets/d/1L3QSjK6wHJ12BvQllR6HURYFkaF4oQ77Y7TXc0FMKxw/edit?usp=sharing.

In November 2019 WGRFS members ran a workshop, WKHDR–Integrating Angler Heterogeneity into the Management of Marine Recreational Fisheries. This aimed to develop approaches for integrating the human dimensions into the future assessment and management of marine recreational fisheries. In order to collect these data in ongoing national recreational fisheries surveys, the aim was to identify a standard minimum set of questions that would capture angler heterogeneity adequately. The outcome of WKDR and following discussions of the members was a condensed set of questions that required testing if these questions perform as expected. This year's ISSG HD presented the first results testing the condensed set of HD questions (skill dimension: 2 items; affective dimension (centrality): 3 items; behavioural dimension: 2 items) to capture angler heterogeneity in two national surveys (Denmark and Germany). Preliminary results are presented below.

In one of the surveys, a principal component analysis (PCA) with varimax rotation grouped all items into one component explaining about 60% of the variation of the data. Cronbach's alpha for this component was 0.82 suggesting good reliability of the selected items. The only item that was grouped separately was the expenditure for angling related goods, as a behavioural measure next to avidity, indicating that this item is not much related to the other items. The remaining cluster (2 skill items, 3 centrality items, and 1 behavioural item) can be seen as an expression of angler heterogeneity and potentially angler specialization. The calculated factor scores calculated for the distribution of angler heterogeneity showed a variation among anglers. In the next step, factor scores were compared with catch rates of sea trout and cod revealing that more specialized anglers caught more cod and sea trout while at the same time having higher release rates compared to less specialized anglers. The level of specialization also varied between the cod and sea trout fishery.

The other survey targeted only cod anglers in the Baltic Sea. Compared to the other survey, the condensed set of questions was extended by one centrality question, but the behavioural commitment was only measured as avidity using a 5-point Likert scale for all items. An exploratory factor analysis (EFA) revealed three distinct clusters with one cluster consisting of the condensed set of questions. Factor loadings based upon the correlation matrix were generally well defined. Only avidity and one centrality item scored below 0.7. Cronbach's alpha for this cluster was 0.60 standing for the lowest acceptable level. No catch data were available yet as the survey is still running, therefore the correlation of angler heterogeneity and catch and release propensity could not be tested.

The cross-country comparison revealed that the condensed set of questions seemed reliable to capture angler heterogeneity (specialization). Item reliability between countries however revealed different performance. The level of variation was in such a way that could be expected. Several key issues were detected that require further consideration:

- Cultural differences: Different skill questions were used in Germany and Denmark. Asking someone in Denmark to consider himself an expert is not feasible as this is a cultural peculiarity. Yet, ideally, the same question is asked requiring high-quality questionnaire translation to ensure comparability.
- Comparison: Different numbers of questions were asked in the two surveys capturing centrality. Ideally, the number of questions is equal at least for comparison.
- Weighting: Survey data inevitably underly some form of weighting. Transforming individual design weights to the psychometric scales of the individual items remains a question to be solved.
- Methods: Commonly used methods such as PCAs, EFAs etc. have different implications, which are seldom discussed in the available literature. For cross-country comparisons and depending on the question of the comparison, e.g. validation of the condensed set, the grouping of items etc. a single approach needs to be selected.

- Item validity and reliability: Future steps require thorough testing of item validity and reliability.

In 2022, the group is expecting to publish the outcome of WKHDR and the performance of the condensed set of questions (Denmark, Germany, NN) will continue to be tested in relation to predicting how angler heterogeneity affect catch metrics.

3.6.9 Communication and engagement

Leads: Pablo Pita and Sean Tracy

The coordinators of the intersessional group on communications and engagement, Pablo Pita (University of Santiago de Compostela, Spain) and Sean Tracey (University of Tasmania, Australia), organized a session during the annual meeting of the WGRFS in which the progress made during the last period was presented, and next steps were discussed in an open session.

The general and specific objectives of the group were reviewed first: this intersessional group aims to progress knowledge and provide content to allow the development of communication skills in the recreational fishing research sector. This will be achieved by: 1) raising the profile of communication and engagement in research funding and result dissemination; 2) reviewing strategies to improve communication and engagement with the recreational fishing community, and 3) developing measures to assess the effectiveness of communication and engagement strategies.

The results of an online survey were performed just before the meeting to obtain the opinion of the WGRFS members about how to improve the communication and engagement between academics, managers and policy-makers, recreational fishers, and other stakeholders, NGOs, and civil society were presented. The questionnaire included questions aimed at gathering ideas about potential communication strategies and tools for the four main groups of receptors, to collect ideas about who should send the message, to understand factors to achieve efficient communication strategies, and to learn about successful communication strategies in place.

A total of 30 answers were collected from members of the WGRFS in 17 different countries. Mean age was 43 (ranging from 23 to 63), 71% were men, and all obtained a university degree. Most respondents were scientists (93%), followed by policy-makers, and employees (4% each). Notably, few of the respondents never practised recreational fishing (4%), while most (68%) fished sometimes, and the remaining 28% was divided equally among those who fished often and a lot. Face to face meetings was the preferred option to connect with the four main groups of receptors. Monthly e-mails were also identified as a good option to connect with managers and policy-makers; biannual webinars to connect with academics; and monthly updated websites to connect with recreational fishers, other stakeholders, NGOs, and civil society. The respondents were divided about who should create and disseminate the communications. Almost half of the responses (44%) indicated that anyone involved in the generation of the information that is shared, while 41% preferred a hired communication specialist. Finally, the respondents valued the use of plain language and the involvement of different stakeholders in research and management projects as optimal solutions to develop efficient communication strategies.

An open session was held in which ideas to improve communication and engagement in the marine recreational fishing sector in general, and in the WGRFS were discussed. The different agendas of scientists and fishers are a key barrier to developing good communication of research results and increasing fishers' engagement, especially when the results of research initiatives are used in management through new regulations. It is difficult that fishers avoid losing confidence if new regulations limit fishing opportunities. Focusing on specific groups of fishers and enlisting active key fishers on social media to act as influencers for other fishers has been a successful

strategy in some fisheries research and management initiatives. However, caution is needed with excessive exposure of scientists who also assume the role of disseminators. Media policies of scientific and management institutions play a role part in this kind of communication and engagement initiatives.

In relation to the current communication strategy of the WGRFS, it was noted that the group is dealing with non-commercial fisheries, who are not on the main political agenda, and that the recreational fishers' associations are less strong and organized than the commercials. From the results obtained in the survey, it was found that the current communication strategy, based on annual meetings, reports, and scientific papers, must be reviewed.

Before the next annual meeting, it was agreed to review some of the questions in the questionnaire[3] and share them again in the group, and outside it, to increase the number of responses. The results of the survey will be used to:

1. Propose a communication strategy for the WGRFS. In this regard, the coordinators proposed building an infographic about the WGRFS and disseminating it through a press release, and among key potential interested persons, groups, and institutions. A contact list will be created by the WGRFS. Also, contact will be made with ICES secretariat to organize a joint plan.
2. Write a policy-brief-type paper on how to improve the engagement between academics, managers and policy-makers, recreational fishers, and other stakeholders, NGOs, and civil society. The paper will look at examples of good practices and will include a toolbox to help to develop communication and engagement strategies, i.e. research dissemination, fishers' recruitment and retainment, and change in fishers' minds or behaviour. Furthermore, the paper will have a focus on available communication frameworks, and on potential utility to develop adaptive management. The target journal is *Frontiers in Marine Science*.

3.7 Publications

It is important to highlight the outputs that have been generated and plan for future outputs to raise the profile of the group. The focus of this discussion was on peer-reviewed papers due to the lead times, as broader communications materials (e.g. blogs, reports, and social media) will be covered by the Communications intersessional group. One paper was published entitled "Expert opinion on using angler Smartphone apps to inform marine fisheries management: status, prospects, and needs" in *ICES Journal of Marine Science* (Skov *et al.*, 2021). A second publication comparing app data with traditional surveys facilitated by collaborations developed within WGRFS was published in the *Canadian Journal of Fisheries and Aquatic Science* (Gundelund *et al.*, 2021). In addition, a manuscript on the impacts of COVID-19 on recreational fisheries has been published (Pita *et al.*, 2021). Further papers are in development on governance, assessment of quality, impacts and allocation, novel methods and big data, non-probabilistic approaches, and angler heterogeneity. A workshop on novel methods is being planned for 2021 and further workshops are being developed covering: animal welfare in fisheries; and interactions between recreational fisheries and marine protected areas.

[3] The most recent version of the questionnaire is available at: https://forms.gle/eMuQpPxqazt4VmAx9.

4 Revisions to the work plan and justifications

Due to the restrictions on travel due to COVID-19, the WGRFS 2021 meeting was also held online. To account for time zones and maintain participation, the meeting was scheduled for two afternoons and three full days. All the ToRs and tasks were covered. The focus of the meeting was on the intersessional groups with parallel sessions to allow more time for discussions, the collaboration and coordination with ICES Working Groups focused on diadromous species, WGRFS potential contributions to the European Commission, and collaboration with the angling community. No further changes are requested at this stage. The group was consulted to find out how the meeting went and especially about the new way of working in these intersessional groups. The response of the participants was positive in this aspect and confirmed the idea of continuing to work in this way in the following years to cover the most relevant topics identified by the Working Group.

5 Next meeting

The next meeting of WGRFS will be held in Gran Canaria from 13–17 June 2022. It will be hosted by David Jiménez 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: Resolutions

WGRFS – Working Group on Recreational Fisheries Surveys

2019/2/EOSG07 The **Working Group on Recreational Fisheries Surveys** (WGRFS), chaired by Kieran Hyder, UK, Keno Ferter, Norway, Estanis Mugerza*, Spain, and [chair]*, [country], will work on ToRs and generate deliverables as listed in the table below:

	Meeting dates	Venue	Reporting details	Comments (change in Chair, etc.)
Year 2020	15–19 June 2020	Online meeting	Interim report by 01 November 2020 to EOSG	Keno Ferter's 3-year term as chair ends. Incoming chair in 2021: Estanis Mugerza
Year 2021	14–18 June 2021	Online meeting	Interim report by 01 November 2021 to DSTSG	Kieran Hyder's 3-year term as chair ends. Incoming chair in 2022: TBD
Year 2022	13–17 June 2022	Gran Canaria	Final report by 01 November 2022 to DSTSG	

ToR descriptors

ToR	Description	Background	Science Plan codes	Duration	Expected Deliverables
a	Collate and review quality of national estimates of recreational catch and effort, catch-and-release impacts, and socio-economic benefits for candidate stocks, identify significant data gaps in coverage and species, and support the ICES TAF.	Most countries are engaged in data collection. This activity collates national participation, catch and socio-economic datasets together, understands the quality of data, and highlights where new data are needed. This is important for supporting the ICES TAF.	5.4	Regular activity in each year, with specific intersessional tasks to develop new approaches.	Report WG perspectives and publication of scientific papers
b	Assess the validity of traditional knowledge, new survey designs, novel methods (e.g. citizen science, apps), and innovative statistical methods for data provision.	Recreational data can be collected in many ways, with different associated biases. This supports the improvement of analysis of existing surveys and understanding the utility of new methods. This will lead to the most robust and broad evidence-base to underpin assessment and advice.	3.1, 3.2, 3.3, 3.6, 4.1, 4.3, 5.4	Regular activity in each year	Report WG perspectives and publication of scientific papers

ToR	Description	Background	Science Plan codes	Duration	Expected Deliverables
c	Provide guidance to ICES and respond to ad hoc requests from ACOM on the availability of data, design of data collection programs, data storage systems, use of data in assessments, and catch allocation.	Recreational catches are not included in many assessments and data collection is limited to a few species. This activity supports data collection requirements, access to data and methods needed. This will facilitate embedding recreational fisheries into fisheries management.	3.1, 3.2, 3.3, 3.6, 5.1	Regular activity in each year, with specific intersessional tasks to develop new approaches.	Report WG perspectives and publication of scientific papers
d	Develop approaches for regional data collection programmes that generate robust data for end-users and support the ICES TAF.	Regionalisation is an important goal, but implementation is unclear This is a challenge for recreational fisheries due to the different actors, gears and survey instruments. This will underpin generation of transparent and robust regional data to support end-user needs.	3.1, 3.2, 3.3, 3.6,	Regular activity in each year.	Report WG perspectives and publication of scientific papers
e	Evaluate the use of economic (e.g. impact, valuation), social (e.g. governance, behaviour, welfare, health), and communication (e.g. participatory process, messaging) to support the assessment and management of recreational fisheries.	Recreation fisheries have broad benefits and behavioural responses are difficult to predict due to diverse motivations. Hence, understanding of the human dimension is needed. This develops an understanding of the data and methods needed for co-management to ensure engagement in the process.	7.1, 7.4, 7.6	Regular activity in each year, with specific intersessional tasks to develop new approaches.	Report WG perspectives and publication of scientific papers
f	Review outcomes of the workshops organized by the group.	Recreational fishery is a diverse topic, so not all aspects can be addressed at WGRFS. Several workshops on specific topics have been done (e.g. WKHDR) or are in the work plan (e.g. inclusion in assessment). This reviews outcomes of the workshops and the implications for recreational fisheries.	5.4, 7.1, 7.4	Activity-dependent on workshop	Report WG perspectives and publication of scientific papers

Supporting information

Priority	High—the biological, social and economic impact of recreational fisheries is becoming increasingly recognized and needs to be included in the fisheries assessment and management processes.
Resource requirements	None.
Participants	The WG is normally attended by around 40 members and chair-invited experts.
Secretariat facilities	Normal backstopping support in the organization of the group.
Financial	None.
Linkages to advisory and science committees	ACOM, WGBFAS, WGEEL, WGBAST, WGCSE, WGNSSK, WGBIE, WGMEDS, and benchmark workshops for stocks that have recreational catches.
Linkages to other groups	WGQUALITY, WGCATCH, WGRDBESGOV
Linkages to other organizations	EC, STECF, Regional Coordination Groups, Advisory Councils 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 fish surveys (Biological data)[4]

Table A1. Most recent survey of MRF catches. This may relate to most completed or ongoing surveys.

Country	Objectives	Approach	Contact and references
Belgium	The aim is to generate reliable data on all species caught by marine recreational fishers in Belgium.	Belgium has a continuous multispecies survey running from 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).	Thomas Verleye: thomas.verleye@vliz.be Verleye *et al.* (2020)
Denmark	The overall aim is to be able to generate reliable estimates of the total catches (harvested and released components) for the mandatory species (EU 2021/1167). To collect biological data from relevant MRF to be able to include catches in stock assessment where relevant.	Two different types of surveys are providing information on catch, effort and biological data. Biannual offsite recall web-based survey (questionnaire) targeting both angling and passive gear fishing (Sampling frame = license list). Yearly 6000–7000 respondents (ca. 50% respondent rate). Running since 2009 and providing data on catch and effort on the mandatory species (EU 2021/1167). Onsite survey (on-board) for charter vessels. Targeting charter vessels in the ICES SD23. PPS sampling (number of trips). Strata = Quarter of the year. Providing catch and biological data for Western Baltic cod (WBC). The data are used for tuning of the off-site survey and yearly estimates of the total catches are included in the WBC stock assessment since 2019. As a supplement to the above studies a digital citizen science platform collects angling CPUE, length distributions and human dimension aspects	Hans Jakob Olesen: hjo@aqua.dtu.dk Sparrevohn *et al.* (2012); ICES (2019); Gundelund *et al.* (2021) Link: https://www.rekrea-fisk.dk/english/eng/cod
Estonia	To estimate catches of cod, eel and salmon by marine recreational fisheries in Estonia.	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.	

[4] This includes only the most recent marine recreational fishing surveys.

Country	Objectives	Approach	Contact and references
Finland	The objectives are: 1) to estimate recreational catches of the internationally managed commercially exploited fish species and catches of the PETS fish species to be transferred to the Commission and the expert working groups for further analyses; and 2) to produce the Official Statistics of Finland for the recreational marine and inland fisheries.	A nationwide biennial recreational fishing survey is conducted for all species and gears. A stratified sample of 11 000 household dwellings was carried out for 2020 with a decreasing trend in response rate, being only 25% after three contacts. A telephone interview was targeted for a sample of the non-respondents. Harvested catch and released catch were inquired by species.	Pentti Moilanen: pentti.moilanen@luke.fi Link: https://stat.luke.fi/en/recreational-fishing
France	The objective is to provide reliable catch estimates for the species listed under the EU 2021/1167 regulation, and for all other relevant species. The data collected includes catch and release estimates, fishing effort and biological data when necessary.	Multispecies survey divided into three steps: (1) Screening survey, using an online panel tool to sample 10 042 individuals to whom a short questionnaire was delivered. This panel was representative of the French socio-demographics using the quota method, based on the INSEE data. (2) Additional survey on a target sample of 2646 fishers, excluding onshore hand-gathering fishers. The aim is to characterize fishers activity on a large sample. The individuals were recruited through social media advertising, fishing federations and using the screening survey answers (3) Panel survey on a target sample of 900 fishers. The aim is to follow a whole year of recreational fishers activity. Panellists will record all information on their fishing sessions on the FishFriender phone/web application. This information will include: fishing location, fishing mode, catches and weight and/or length of the catch. Panellist catch volumes will be weighted according to the stratum they belong to and the results of the 2017 or 2021 screening survey.	Jules Selles: jules.selles@gmail.com Amélie Régimbart: amelie.regimbart@ifremer.fr
Germany	Germany has been collecting marine recreational fisheries data on an annual basis since 2005 in the	Three different surveys are carried out on a regular basis:	Harry Strehlow: harry.strehlow@thuenen.de

Country	Objectives	Approach	Contact and references
	framework of the German marine angling program (DMAP). The main objective is the collection of robust and representative data on the number of recreational fishers, fishing effort, catch and harvest rates to estimate total catches (harvest and releases) considering all relevant species as well as socio-economic impacts of recreational fishing.	Offsite telephone diary survey: a representative telephone screening survey (CATI) using random digit dialling (RDD) of the general German population combined with a one-year diary study is carried out every 5–7 years. This marine and freshwater multispecies survey aims to collect nationwide data on angling effort, socio-demographics and harvest and release rates. The last survey (screening of 50 000 households) was conducted in 2014/2015 (Weltersbach *et al*., 2021). A subsequent survey (screening of 150 000 households) has been initiated in 2020 and will run until 2022. Multiannual on-site access point survey: a stratified random on-site access point intercept survey (79 access points) is annually conducted since 2005 along the Baltic coast. The survey follows a multi-annual survey design and collects information based on completed fishing days on socio-demographics of anglers, fishing characteristics, and catch rates for stock assessment purposes, in particular western Baltic cod (*Gadus morhua*), although all species are considered (Strehlow *et al*., 2012). Remote camera survey: a remote camera survey supplemented with an on-site access point intercept survey is conducted annually since 2017 to monitor the highly specialized recreational salmon (*Salmo salar*) trolling fishery in the Baltic Sea from December until May (Hartill *et al*., 2020).	Simon Weltersbach: simon.weltersbach@thuenen.de Strehlow *et al.* (2012); Hartill *et al.* (2020); Weltersbach *et al.* (2021). Link: https://www.thuenen.de/en/of/fields-of-activity/research/german-marine-angling-program/
Greece	A pilot study for the period 2017–2019 has been done with the aim to estimate, as accurately as possible, a number of parameters relating to recreational fishers and their catches in Greece. The study has been extended for the period of 2020–2021 during which only the ''onsite'' survey has been done. The aim of the on-site multispecies survey is to enhance the results and conclusions of the pilot study completed in 2019. The primary objectives for the years 2020–2021 are: a) to record recreational fishers practices and activity; and b) to collect biological and quantitative data of their catches. The study covers all types of recreational fisheries in Greece namely boat, shore, and spearfishing.	Management of recreational fishing during the 2020–2021 period of pandemic included long periods of prohibition and severe restrictions. Recreational fishing was practically prohibited for prolonged periods creating significant setbacks to the sampling efforts and undermining the consolidation of cooperation and the future application of the sampling programme. In an effort to increase representation (during periods when the survey was possible), the FRI mobilized its collaborators who work as correspondents in areas of interest and managed to extend the onsite sampling geographically in North Aegean and Ionian Sea. This was not possible in the South Aegean and Crete. The originally expected outcomes of the pilot study were achieved for the number of the scheduled seasonal sampling trips when the opportunity was given and by expanding the network of interviewers resulting in increasing the spatial coverage. The total fishing trips recorded during 2020 were 1527 in all areas of sampling. For the period 2021, the on-site survey is realized when the conditions allow it.	Anastasios Papadopoulos: apapadop@inale.gr Paraskevi Karachle: pkarachle@hcmr.gr
Ireland	The objective of the Irish Marine Recreational Angling (IMREC) pilot study (2019–2021) was to develop and test methods to produce robust estimates of	To estimate sea angler participation rates and annual effort, an independent survey company carried out a phone-based random omnibus survey. Over 5000 Irish residents were interviewed to provide, for the three major	Diarmuid Ryan: diarmuid.ryan@fisheriesireland.ie

Country	Objectives	Approach	Contact and references
	participation, effort and catches of nominated species by sea anglers resident in Ireland	sea angling types in Ireland (shore, small boat and charter angling), an estimate of (a) participation rates and (b) their average number of annual fishing trips in the previous year. Several survey methods were applied to estimate multispecies CPUE (number of fish caught by species per angler day) in Ireland. Onsite survey methods were: for shore angling – stratified roving creel approach; for small boat angling – stratified access point approach and for charter angling – stratified onboard sampler approach. Offsite survey methods were: for charter angling – charter skipper angling diary; for all sea anglers, a web-based sea angling diary app. The angler diary was released on a trial basis in July 2021 and allows self-selecting anglers to provide multispecies catch data for all angling trips. Total annual catch of all retained and released species will be estimated by combining participation and effort data with CPUE data. Consistent with pilot study objectives these data streams are currently being reviewed and refined. In due course, they will be used to provide preliminary estimates of the total annual catch of all retained and released species. The pilot study has provided valuable information which will be used to improve survey design.	William Roche: william.roche@fisheriesireland.ie Link: https://www.fisheriesireland.ie/what-we-do/research/marine-recreational-fishery-in-ireland-mrec
Italy	Italy has been collecting marine recreational fisheries data: a) since 2018 in the context of the pilot study foreseen by the European Data Collection Framework, and b) since 2020 in the context of the Marine Strategy Framework Directive. The main objectives of both surveys are: i) to determine the number of marine recreational fishers in Italy; ii) to monitor fishing activity in terms of gears used and time dedicated to this activity;	There are two main approaches: In the framework of the DCF pilot study, a preliminary assessment of the list of marine recreational fishers registered on a Ministerial (MIPAAF) database was performed. Due to the strong weaknesses of the MIPAAF database, during 2020 a telephone survey was carried out on a sample of Italian families. This survey allowed estimates the number of fishers, their distribution and the overall fishing effort. In 2021, a panel of fishers obtained	Adriano Mariani (coordinator pilot study DCF): a.mariani@unimar.it Sasa Raicevich (coordinator data collection for MSFD): sasa.raicevich@isprambiente.it

Country	Objectives	Approach	Contact and references
	iii) to collect information on retained and released catches (species, weight and number); and iv) to collect macro-data on the overall economic impact of the recreational activity. At sea basin level (Northern Adriatic Sea) a further pilot study was funded by GFCM in order to collect data on marine recreational fisheries in the Italian GSA17 by testing the methodology of the "Handbook for data collection on recreational fisheries in the Mediterranean and the Black Sea". This study started in 2019 and was carried out in the framework of a GFCM project including other four pilot studies across the Mediterranean and Black Sea: Turkey BS, Algeria, Tunisia, and Lebanon.	from the telephone survey was recruited for a logbook survey, in order to estimate effort and volume of the catches, and to better tune the results of the telephone survey. Three different surveys were carried out: A telephone survey carried out on the whole Italian territory, aimed at quantifying marine recreational fishers in Italy, collecting data and information on fishing practices and intensities, and creating a panel of recreational fishers for the subsequent recall survey. The recall survey was carried out at a monthly level in all marine administrative regions collecting data (effort, catches, expenditures) through interviews. Onsite survey in selected Italian Regions (2–3 administrative regions by MSFD subregion, i.e. Veneto, Marche, Apulia, Sicily, Tuscany, Campania, Liguria) aimed at collecting information on fishing practices, abundance and biomass of retained and released species, size of catches.	Fabio Grati (coordinator of the five GFCM pilot studies): fabio.grati@cnr.it Luca Bolognini (coordinator of the GFCM pilot study Italy GSA17): luca.bolognini@cnr.it
Latvia	The objective is to provide reliable catch estimates for the species listed under the EU 2021/1167 regulation, and for all other relevant species. The data collected includes catch and release estimates, fishing effort and biological data when necessary.	The program consists of several surveys that are run annually: Logbook survey – part of marine recreational fisheries (self-consistence fishery) is obliged to fill logbook after every fishing activity. Onsite surveys – in the case of salmon and sea trout trolling contracted trained volunteers from NGO (what is representing the major part of trollers in Latvia) is collecting catch and biological data (length, weight, age data, fin clipping). Due to critical status of cod stock in the Eastern Baltic, cod recreational fishery is closed in one part of the sea (SD 26), while in other (SD 28) – no interest from anglers due to low abundance of cod. Therefore, cod surveys were stopped.	Didzis Ustups: didzis.ustups@bior.lv Jānis Dumpis: janis.dumpis@bior.lv
Lithuania	Catches of cod, eel and salmon are estimated using different approaches.	All recreational fishers are licensed (with exceptions of anglers under the age of 16, retired, or with disabilities). **Cod:** 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 the coast guard. The total catch and catch per boat are gathered from the direct interviews.	Justas Poviliūnas: justas.poviliunas@zuv.lt

Country	Objectives	Approach	Contact and references
		Eel: 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 Lithuania. Eel is only caught in inland waters. Recreational eel catches at sea are forbidden. Recreational eel catches are observed under the DCF programme annually. **Salmon:** Separate recreational fishing licence for salmon or seatrout 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 study to estimate recreational salmon catches.	
Netherlands	In 2009 the Recreational Fisheries Programme commenced at Wageningen Marine Research under the Statutory Tasks ('Wettelijke Onderzoekstaken') on behalf of the Ministry of Agriculture, Nature and Food Quality. The aim of the programme is to collect data on recreational fisheries catches as obliged under the DCF. However, the programme is a multispecies programme and information on all fresh and marine species is collected.	The programme consists of several surveys that are run biannually: **Screening survey**: Online panel survey conducted by the company Kantar that surveys a large number (~ 50 000 households) of Dutch citizens on their participation in recreational fisheries. The participants reflect the demographics of the entire Dutch population. Data collected are used to estimate the total population of anglers in the Netherlands and their demographic profile. It is also used to select participants for the logbook survey. **Logbook survey**: Participants (~ 2500) are asked to keep a monthly logbook of their recreational catches in which they report trip information, number and length of species caught and whether fish was retained or	Tessa van der Hammen: tessa.vanderhammen@wur.nl Esther Beukhof: esther.beukhof@wur.nl van der Hammen *et al.* (2016).

Country	Objectives	Approach	Contact and references
		released, among other things. Participants are mostly recruited via the screening survey, but some are recruited through social media and recreational fishing websites. Collected data are used to estimate the yearly catch per angler. **Onsite survey**: Trained volunteers and/or Wageningen Marine Research employees visit marine fishing sites and collect data on fishers' catches in terms of species' length and weight. The length-weight measurements are used to calculate the total biomass of recreational catches based on the estimated total number of anglers (from screening survey) and the yearly catch per angler (logbook survey). **Gillnet survey**: Methods as in the logbook survey, but with only recreational gillnet fishers.	
Norway	Norway has conducted a study funded by the Norwegian Research Council (NRC) from 2017–2020 where the primary objective was 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 was 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 aimed 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.	A national phone diary was conducted to estimate participation and catches. In addition, roving creel surveys were conducted in three study regions. Furthermore, 20 tourist fishing businesses were selected from the national tourist fishing business registry, and a combined on- and off-site survey was conducted to estimate catches.	Keno Ferter: keno@hi.no Jon Helge Vølstad: jon.helge.voelstad@hi.no Link: https://prosjektbanken.forskningsradet.no/en/project/FORISS/267808
Poland	A pilot study was done of diadromous fish in 2017 and led to regular monitoring since 2020. The aim of monitoring recreational sea fisheries for diadromous species is a development of a current map of the Polish Exclusive Economic Zone with spatial and temporal distribution of salmon, sea trout, and eel recreational fisheries by species and fishing techniques. Depending on the target species and fishing techniques used, the monitoring covers the period from late autumn to late spring. This is done to determine areas and times with highest recreational fisheries	The following approaches are taken occur: The five main methods are applied to monitor the trolling recreational sea fishery. Remote CCTV cameras installed in ports identified as the most important for salmon and seatrout recreational fishery. The cameras record boat movements between 04:00 and 18:00 each day. A high image frame rate: HD format (25 images per second) is set to ensure full coverage of the activity at each monitored marina and correct identification of trolling boats. In addition, monthly on-site questionnaire interviews are conducted. Trolling boats are randomly sampled from both groups, commercial recreational boats and private fishing boats. The number of interviewed boats is selected randomly. The App dedicated to the survey is used by the	Adam Lejk: adam.lejk@mir.gdynia.pl Krzysztof Radtke: krzysztof.radtke@mir.gdynia.pl Link: https://dcf.mir.gdynia.pl/wp-content/uploads/2021/05/Sampling-Plan-Marine-recreational-fisheries-for-Diadromous-species_rev1.pdf

Country	Objectives	Approach	Contact and references
	activities and to provide reliable monitoring data for estimates of fishing effort as well as catch volume and composition for recreational fisheries for salmon, sea trout and eel. Catch estimates are provided each year following the data call of ICES Baltic Salmon and Trout Assessment Working Group (WGBAST) and ICES Working Group on Eels (WGEEL) for sea trout and eel respectively. Quality of the data provided are discussed and verified during the group meetings. In Poland, there is a dedicated fleet segment of private boats and registered charter boats adapted to cod recreational fishery – angling with fishing rods (LHP). For the purpose of sampling this segment under DCF, the Primary Sampling Unit is vessel/trip, and the target population was defined as the total number of recreational sea-going trips targeting cod. The size of this target population varies between years with decreasing trend over the last years. Each year, 24 randomly sampled fishing trips were monitored.	observers. The refusal rate is recorded. The number of anglers on boat and fishing rods are recorded in the protocol. In addition, sociological data are collected. This is supported by onboard observations when biological samples (length, weight, sex, age, maturity stage) and catch composition are collected. Furthermore, a fishing logbook, containing cruise data as well as biological data of fish caught are distributed among the trolling boats' skippers/owners to fill-in on a voluntary basis and an annual offsite survey is targeting in general sea recreational fishing in Polish Maritime Waters with a particular emphasis of diadromous fish species. In the case of Sea trout and eel, the on-site questionnaire interviews covering the period from late autumn to late spring (sea trout) and from late summer to early autumn (eel) is conducted. In the case of eel, a pilot study revealed that onsite questionnaire interviews highlighted the difficulty of distinguishing anglers targeting eel from total number of anglers interviewed. The recreational fishery for cod (*Gadus morhua*) in Poland is monitored using effort information (number of angling trips in sampling frames - ICES Subdivision and quarter) provided by Harbour Master Offices and mean weight of cod per trip in the given sampling frame calculated from onboard observed trips. Four types of data were collected in order to monitor the development of *Gadus morhua* recreational fisheries and to estimate the catch level: Data on the number of recreational sea-going trips and the number of anglers participating in those trips were collected from Harbour Master Offices' registers. Data on total weight of fish caught and biological data (length, weight, sex, maturity and age) were collected and processed from angling trips with observers on-board. Daily reports of recreational catch delivered until 2018 to regional inspectorates of marine fisheries and from 2019 to General Inspectorate of Marine Fisheries by owners of charter boats (mandatory catch reporting since March of 2015). Interviews with anglers (questionnaires' survey) during onboard observer trips. Data on number of recreational sea-going trips and the number of anglers participating in those trips collected from Harbour Master Offices' registers	Link: https://dcf.mir.gdynia.pl/wp-content/uploads/2021/05/PS1-PL-2021_Report.pdf Radtke and Dąbrowski (2016); Radtke, and Wójcik (2020).

Country	Objectives	Approach	Contact and references
		are the comprehensive data source on marine recreational fisheries status. Each angling vessel's departure, including number of anglers onboard, is recorded in Harbour Master Offices' documents. Data on number of recreational fishing trips in the given year can be collected from Harbour Master Offices during the following year.	
Portugal	The pilot project *Pescardata* (September 2017–December 2018) was defined for studying DCF recreational fisheries in mainland Portugal aiming at characterizing several aspects of this fishery, describe catches and define robust catch estimates. A subsequent national offsite survey was launched in March 2020. The online survey aims at filling some important gaps (e.g. night fishing) that were identified during the *Pescardata* onsite project.	The *Pescardata* project consisted of collecting data on fishing effort, catch (on all captured species), and fisher demographics, for all marine recreational fishing modes in Portugal mainland. The study took place between January and December 2018, and the data were collected via both onsite and offsite methods. **Onsite methods:** a stratified random sampling design was followed to select the areas to sample and conduct face-to-face questionnaires (using ODK Android application) to active recreational fishers. Roving creel surveys were conducted for shore angling and spearfishing, and access point surveys were used for boat angling and spearfishing. Further data on boat angling was also obtained via onboard observers of boat angling fishing events.	Mafalda Rangel: mrangel@ualg.pt

Country	Objectives	Approach	Contact and references
		Offsite methods: angling logbooks and historical data on fishing competitions were also used and analysed to further complement the data from the onsite surveys. For the onsite survey, a total of 995 questionnaires were validated for shore angling recreational fishery and 429 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. Data collection on logbooks and fishing competitions is still ongoing. For *Pescardata2* (ongoing), we used a web-based survey to collect information on recreational fishing. The survey was promoted via a text message to the license holders, social media, and recreational fishing associations, to maximize participation and representativeness of the active recreational fishing population. The dedicated webpage for the study is www.pescardata.pt.	
Spain (Andalusia)	A survey is in place to generate annual estimates of participation, effort, and catches of recreational fishers in the Autonomous Region of Andalusia	Two approaches are underway: Sea angling APP: a record of the daily activity (spearfishers and boat anglers). Onsite survey. monthly visits to selected fishing sites for shore anglers and spearfishers.	Matias Lozano: matias.lozano@ieo.es
Spain (Balearic Islands)	The Marine Resources Service of the Autonomous Government of the Balearic Islands maintains a permanent sampling system aimed at recreational boat fishing (the main recreational modality in the Balearic Islands) to obtain estimates on targeted fish biology and ecology, and on recreational fishing effort and catches.	The system has two complementary surveys: Standardized fishing samples done approximately twice a month to collect data on sizes, species, and fishing performance. Obtaining basic data on catches through the App "Diari de Pesca Recreativa" is mandatory for recreational fishers who access marine protected areas.	Antoni M. Grau: agrau@dgpesca.caib.es
Spain (Basque Country)	A routine monitoring programme is running since 2015 to estimate catch and effort for DCF mandatory species. In addition, since 2020 multispecies surveys are carried out to estimate effort, catch estimates for main target species and human dimensions of the activity.	Two approaches are being used: An offsite routine survey to respond to DCF0specific request: mandatory species catch and effort estimates. An onsite survey and an electronic application developed to collect catch, effort, length and human dimension information.	Estanis Mugerza: emugerza@azti.es Lucia Zarauz: lzarauz@azti.es

Country	Objectives	Approach	Contact and references
Spain (Catalonia)	A monitoring system has been established with an aim to generate a continuous stream of data on participation, effort and effort distribution, fishing yields, catches (including catchweight and size), social profile, expenses, and human dimensions of the activity.	Two complementary surveys are implemented: Onsite surveys: a spatio-temporal model is applied to cover shore angling, boat angling, and spearfishing along the Catalan coastline. Online surveys: distributed to large subsets of the e-mail registry of license holders.	Full report expected in 2022.
Spain (Murcia)	A pilot study was performed in 2020 in this Autonomous Region to estimate spatial and temporal distribution of effort and catches, and of the demographic structure of the catches of different recreational fishing modalities.	An on-site sampling program was carried out focused on recreational fishing competitions.	Martínez-Baños *et al*. (2020)
Sweden	Estimates of participation and catches by Swedish recreational fishers.	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 ongoing since 1990. A new improved design was implemented in 2013. New updated data are available for years 2013–2019. This survey does not cover tourist fishers and Swedish residents younger than 16 years as well as Swedish residents older than 80 years of age. **Census of recreational Swedish cod fishery in Sd 23 (Western Baltic cod):** Sweden routinely collects information on volumes of landed cod in SD23 through voluntary lo books from tour boat operators. In addition, on-board sampling of randomized trips is performed quarterly to collect biological information, length, weight and otoliths. Assumed landings from private boats are raised to the tour boat landings by fractions of catches taken by the different segments during 2017–2019. **Camera assisted marina sampling core sites – CAMS-CS, design 2019:** fully random design of a sampling scheme to estimate recreational catches	Andreas Sundelöf: andreas.sundelof@slu.se Hege Sande: hege.sande@slu.se

Country	Objectives	Approach	Contact and references
		needed a highly stratified structure (SLU-MRFS 2017–2018). Several strata in both space and time distributed the sampling effort and a majority of the sampling time was spent observing zero fishing trips within a sampling unit as sites and times did not represent a representative sampling frame. The estimation procedure was straightforward as effort and catch were sampled in parallel, but variance measures very unsatisfactory large. Ways to sample a representative sampling frame was explored in order to reduce the variance of future estimates. Through the work described in this report, it was possible to assess the appropriate sampling frame. Following the efforts made in 2017 and 2018 of counting boats and assessing boat types at all access points the sampling frame could be reduced to cover active times for fishing. Although fishing was observed during all types of work shifts during the day of the SLU-MRFS sampling during 20:00 and 06:00 could be disregarded due to negligible fishing effort. As the number of boats with signs of fishing was counted at all access points it was also possible to revise the sampling sites and set up a frequency-based probability of site selection. Effort was recorded by a set of cameras registering the number of trips at a certain access point and catch rate was sampled through an on sight creel survey (Figure 1). Prerequisites of the CAMS-CS: Boat counts of different types of boats Cameras covering traffic patterns of a large component of potential fishing boats Creel to sample catch rate targeted sets of days with a forecast optimistic for fishing conditions Boat counts and activity patterns from 2017–2018 were used in the design of the effort and catch rate sampling for 2019.	
UK	The overall objective is to generate annual estimates of participation, effort, catches, economics and social benefits of sea anglers resident in the UK.	Two independent surveys provided data on effort and CPUE: Watersports Participation Survey (WPS): a face-to-face survey of 12 000 households across the UK that provided a population-level estimate of the numbers, demographic profile, and activity of sea anglers in the UK. Sea angling diary: a year-long online catch diary tool and app that provided a record of the trip-by-trip catches from a self-selecting UK-wide panel of	Kieran Hyder: kieran.hyder@cefas.co.uk Link: www.seaangling.org Armstrong *et al.* (2013); Hyder *et al.* (2020, 2021)

Country	Objectives	Approach	Contact and references
		sea anglers. Mean CPUE in terms of annual catch of each species per angler was estimated from the diary. The total annual catch of a species in any defined stratum (e.g. region, age) was estimated by multiplying an estimate of the number of sea anglers in that stratum (using the WPS) by an estimate of the annual catch per angler for that stratum (CPUE) in the sea angling diary panel. In addition, surveys were done of the diary panel during the year to assess expenditure to generate information on total economic impact, and other areas of interest (e.g. impact of COVID-19).	

Annex 4: Economic information by country[5]

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

Country	Survey Methods (description of method, assumptions made, and applicable species)	Economic Value (direct, indirect, and induced), trip spend, and willingness to pay estimates	Contact and references
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 into the expenditures of Belgian recreational fishers (expenses big material (rod, etc.), small material (bait, etc.), travelling costs, boat-related costs). The direct expenditures of the Belgian marine recreational fisheries sector are estimated at a minimum 8.6 million euro on an annual basis.		Thomas Verleye: thomas.verleye@vliz.be Verleye *et al.* (2020)
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). 2. Tourism; Economic impact (input-output). Unclear how the number of tourists is found and how relative share of angling related economic activity is established (but see Jacobsen, 2010; Jensen *et al.,* 2010). 3. CE analysis (DK angler = no distinction between marine and freshwater (Kromand *et al.*, 2010), Web panel 1500 respondents) 4. Tourism (German web panel, no distinction between marine and freshwater fishing) CE analysis, (Jensen *et al.,* 2010). (Table 6.1)	1. Economic impact: Total 388 536 824 euro (2 900 000 000 DKK) Excluding taxes and leakages 147 376 037 euro (1 100 000 000 DKK). An average angler spends 543 euro (4051 DKK) per year, but specialized sea anglers (trolling fishers) spend on average 3349 euro (25 000 DKK). 2. Economic impact from Tourism: Total 50 241 830 euro (375 000 000 DKK), excluding taxes, leakages 33 896 488 euro (253 000 000 DKK). 3. CE Analysis: Average WTP is about 100 euro (736 DKK) angler, but a 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 *et al.*, 2000) WTP for Danish anglers was estimated to be 82 euro (616 DKK) at 1999/2000 prices. 4. Tourism CE analysis: WTP −34 to 59 euro (−255 to 444 DKK); positive WTP for increased catch opportunity, Increased size of fish, beautiful surroundings and improved water quality. Negative WTP if the distance to fishing water is increased and/or if the number of other anglers increases.	Hans Jakob Olesen: hjo@aqua.dtu.dk Toivonen *et al.* (2000) Jacobsen (2010); Ministry of Food, Agriculture and Fisheries of Denmark (2010); Jensen *et al.* (2010); (Kromand *et al.*, 2010).

[5] This includes only the most recent marine recreational fishing surveys.

Country	Survey Methods (description of method, assumptions made, and applicable species)	Economic Value (direct, indirect, and induced), trip spend, and willingness to pay estimates	Contact and references
Estonia	No data are currently collected.		
Finland	Several surveys have been done in Nordic countries to evaluate the economic value of recreational fisheries including Toivonen (2002) and Toivenen *et al.* (2004). A comparison of the economic effects of salmon fishing: commercial vs. recreational with input-output model (Storehammer *et al.*, 2011).	The estimated value of a fishing day in Finland (EUR 104) indicates that people are willing to pay more for fishing than other water recreation activities. The estimated total recreational use value for fishing was EUR 528 million in Finland in 2018 (Pokki *et al.*, 2020).	Heidi Pokki: heidi.pokki@luke.fi Toivonen (2002); Toivenen *et al.* (2004); (Storehammer *et al.*, 2011); (Pokki *et al.*, 2020).
France	Between 2011 and 2013, a nationwide survey was implemented in two steps: a random-digit-dialling (RDD) survey combined with a diary survey. RDD survey produced an initial estimate of the population of recreational fishers and a description of the diversity of their fishing practices. Diary survey provided more precise information about the diversity of practices, catch characteristics (size, weight etc.) and expenditures. Data were compared and then used in combination to provide a reliable estimate of the socio-economic value of recreational fisheries activity in France (Levrel *et al.,* 2013).	According to the 2011–2013 survey, fishing expenditure was estimated at 200 million euro: recreational sea anglers spend an average of €146 per year on equipment, including €83 for fishing gear and €36 for bait and lures. Approximately 25% of recreational sea anglers have a boat. Boat-related expenditures are estimated at around 1000 € per year on average (with 50% for anchorage and trailer, 30% for maintenance and 20% for insurance purposes) (Levrel *et al.,* 2013).	Amélie Régimbart: amelie.regimbart@ifremer.fr Levrel *et al. (*2013).
Germany	In 2014/2015, a nationwide telephone-diary survey with quarterly follow-ups was initiated contacting 50 000 households. This survey produced estimates of marine 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. Furthermore, participants of a complementary one-year diary study were asked to report quarterly expenditures for marine angling. In 2021, a similar survey (150 000 households) will be conducted to update the 2014/2015 data.	There were approximately 200 000 sea anglers in Germany in 2014/2015, with the majority (161 000) going angling in the Baltic Sea. Average annual expenditure was 938.8 € per angler resulting in an overall expenditure of 184.6 million €.	Harry Strehlow: harry.strehlow@thuenen.de Simon Weltersbach: simon.weltersbach@thuenen.de Weltersbach *et al.* (2021).

Country	Survey Methods (description of method, assumptions made, and applicable species)	Economic Value (direct, indirect, and induced), trip spend, and willingness to pay estimates	Contact and references
Greece	During the 2017–2019 pilot study, a nationwide telephone survey was conducted with 16 501 households. The survey allowed for estimates of the number of RF in the country, effort and expenditures. During the survey respondents were asked to provide a 12-month estimate of annual expenditures for marine recreational fishing.	Results suggest that 8% of the population, approximately 700 000 residents in the country engage in marine recreational fishing. Regarding annual expenses 13% spends no money, 43% spend between 1–50 €/year, 13% 51–100 €/year, 12% 101–250€/year, 7% 251–500€/year and 8%500+ €/year. On average fishers spend 181 €/year (median 38 €/year) and that amounts to 126 700 000 €/year nationally.	Anastasios Papadopoulos: apapadop@inale.gr Paraskevi Karachle: pkarachle@hcmr.gr
Ireland	'Socio-economic Study of Recreational Angling in Ireland' (TDI, 2013), commissioned by IFI, was based on a sample size of 903 participants (692 face to face interviews, 211 online). Findings include an estimated 406 000 individuals (aged 15+) who participated in recreational angling in 2012 (252 000 domestic, 113 000 overseas, 41 000 Northern Irish). An omnibus survey was carried out in 2015 to estimate total domestic participation in angling (MB, 2015). Results indicate a total of 273 600 Irish individuals aged 15+ who consider themselves to be 'anglers. Of these, approximately 4% consider themselves to be bass anglers (11 000) and a further 24% consider themselves to be sea anglers who target other sea species (65 600). Lower bound estimates for overseas anglers in 2014 are in the region of 132 000. These combined figures give a total value of angling in 2014 in the region of €836 million; of this approximately €71 million relates to bass angling and €158 million relates to angling for other sea species. A study, 'Economic Impact of Irish Angling Events' (based on a 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.	The estimated value of angling to the 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 (WTP) 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 consumer surplus for participants using the travel cost method; results indicated a consumer surplus of up to €252 per angler per day (see below). 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. Case study sea angling event with 124 participants was estimated to be worth nearly €200 000 to the host region in southwest Ireland. Consumer surplus estimates of €252 per angler per day.	Diarmuid Ryan: diarmuid.ryan@fisheriesireland.ie William Roche: william.roche@fisheriesireland.ie Link: http://www.fisheriesireland.ie/media/tdistudyonrecreationalangling.pdf
Italy	Italy has been collecting marine recreational fisheries data in the context of: i) the pilot study foreseen by the European Data Collection Framework, ii) for the Marine Strategy Framework Directive, and iii) for the GFCM in	Economic data collected in the different surveys are still under assessment.	Adriano Mariani (coordinator pilot study DCF): a.mariani@unimar.it

Country	Survey Methods (description of method, assumptions made, and applicable species)	Economic Value (direct, indirect, and induced), trip spend, and willingness to pay estimates	Contact and references
	the framework of a pilot study (GSA17 only). Expenditures and macro-data on the overall economic impact of the recreational activity are collected in all the three types of survey by means of logbooks and monthly recall surveys on probabilistic panels of fishers recruited through the national screening surveys.		Sasa Raicevich (coordinator data collection for MSFD): sasa.raicevich@isprambiente.it Fabio Grati (coordinator of the five GFCM pilot studies): fabio.grati@cnr.it Luca Bolognini (coordinator of the GFCM pilot study Italy GSA17): luca.bolognini@cnr.it
Latvia	Value of landings in self-consumption fishery	9762 EUR	Didzis Ustups: didzis.ustups@bior.lv Jānis Dumpis: janis.dumpis@bior.lv
Lithuania	Have not been performed similar studies in Lithuania	No data on economic value, no economic-social surveys have been done.	Justas Poviliūnas: justas.poviliunas@zuv.lt
Netherlands	Screening survey (50 000 households) in 2009 followed by 12 months logbook Survey in 2010 (1377 marine participants, 2238 freshwater participants) (van der Hammen and de Graaf, 2013). In following logbook surveys the questions about economics are not repeated.	200 € per fisher per year, 341 € million (accommodation, travel, durable equipment, consumables, etc.).	Tessa van der Hammen: tessa.vanderhammen@wur.nl Esther Beukhof: esther.beukhof@wur.nl van der Hammen and de Graaf (2013)
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	Average daily expenditure by fishing tourists visiting Norway was 173 euro and an average length of stay 7.4 days (this implies that the total average expenditure on a fishing holiday in Norway is 1280 euro). Total expenditure from fishing tourists that visited the 434 enterprises in the year 2008 was 104 million euro.	Trude Borch: trude.borch@akvaplan.niva.no Keno Ferter: keno@hi.no

Country	Survey Methods (description of method, assumptions made, and applicable species)	Economic Value (direct, indirect, and induced), trip spend, and willingness to pay estimates	Contact and references
	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 *et al*. (2011a; 2011b), In 2014, a profitability study was performed of businesses that offer marine angling services to tourists in Arctic Norway (Borch and Svorken 2014). The most important findings in this are that profitability varies with distance to airport, number of beds relative to boats available for rent and with capacity utilization of beds throughout the year. For example, if the businesses have other types of guests during 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 were the most important outdoor recreational activity in this region. For more results see Aanesen *et al.* (2018).		Jon Helge Vølstad: jon.helge.voelstad@hi.no Borch *et al*. (2011a; 2011b); Borch and Svorken (2014); Aanesen *et al.* (2018).
Poland	Have not been performed similar studies in Poland.	No data on economic value, no economic-social surveys have been done.	Adam Lejk: adam.lejk@mir.gdynia.pl Krzysztof Radtke: krzysztof.radtke@mir.gdynia.pl
Portugal	The pilot project Pescardata (September 2017–December 2018) was defined for studying DCF recreational fisheries in mainland Portugal aiming at characterizing several aspects of this fishery, describe catches and define robust catch estimates. A subsequent national offsite survey was launched in March 2020. The online survey aims at filling some important gaps (e.g. on night fishing and spearfishing) that were identified during the Pescardata onsite project. Both surveys include socio-economic	Estimates on the economic contribution of this activity in Portugal will be made available as soon as possible, and will come from results from both Pescardata (pilot onsite survey) and Pescardata2 (web-based survey). The outputs will also include other socio-economic data on Portuguese recreational fishers (e.g. demographics, motivations for fishing, attitudes towards existing regulations).	Mafalda Rangel: mrangel@ualg.pt

Country	Survey Methods (description of method, assumptions made, and applicable species)	Economic Value (direct, indirect, and induced), trip spend, and willingness to pay estimates	Contact and references
	characterization of fishers and direct expenditures estimates.		
Spain (Andalusia)	A survey is in place to generate annual estimates of the economic impacts of recreational fishers in the Autonomous Region of Andalusia	Two approaches are underway: Sea angling APP: a record of the daily activity (spearfishers and boat anglers). Onsite survey. monthly visits to selected fishing sites for shore anglers and spearfishers.	Matias Lozano: matias.lozano@ieo.es
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 spearfishers 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 Country administration and additional vessel information including length, vessel and mooring were obtained from field sampling and google Earth. Three categories of vessels were defined: sailing, *txipironeras* (typical Basque vessel), and motor vessels. For the economic survey, the same methodology was used as described above.	Direct expenditure for the same sample. The raising was made using the statistically significant variables, such as port, and length of the 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 income, value-added, and employment were calculated. The direct impact was around 34 million € /year and the total impact including the induced effect was almost 54 million € and maintaining 624 FTE/year. No survey on WTP has been carried out. Only covers recreational boat owners. Spearfishing and shore fishing is not included.	Estanis Mugerza: emugerza@azti.es Lucia Zarauz: lzarauz@azti.es
Spain (Catalonia)	Participation is estimated using the licensed fisher registry and estimating the number of un-registered fishers based on a pilot study (ICATMAR, 2020). Estimates of CPUE, catch compositions and catch size distributions were generated using data from the onsite survey. Effort, effort distribution and expenses are estimated from the responses to the online survey. Data from all respondents are classified according to a four-tier avidity class. Total catch per species estimated for each season and for	A 2019 pilot study (ICATMAR, 2020) revealed recreational fishing total direct expenses in 30M€, and indirect associated expenses in an additional 60M€. Shore anglers spent a total 16M€ in direct expenses, and 30M€ in indirect expenses; for boat anglers in was 12 and 53M€ respectively and spearfishers spent a total 1M and 5M€ respectively. The average shore angler spent a 943€ annually, boat anglers spent 2937€. Spearfishers initiating the activity from land spent an annual 1020€, while those initiating the activity from a boat averaged 2906€.	Catalan Institute of Research for Ocean Governance (ICATMAR) dg.05.daam@gencat.cat ICATMAR (2020).

Country	Survey Methods (description of method, assumptions made, and applicable species)	Economic Value (direct, indirect, and induced), trip spend, and willingness to pay estimates	Contact and references
	each avidity class using participation, CPUE, catch compositions and effort data from the different sources.		
Spain (Galicia)	Online and face to face survey of 363 recreational fishers in 2017 from a total population of 60 000 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% = 2233–3502 €) per boat (Pita *et al.,* 2018). A relatively small number of interviews. Some problems derived from online interviews. However, avidity bias was corrected.	Pablo Pita pablo.pita@usc.es Pita *et al.* (2018).
Sweden	National postal survey, approximately 22 000 questionnaires (in 2019) sent three times a year (recall time four months) to randomly selected individuals (permanent residents of Sweden found in the Swedish population register).	1.6 million Swedes (age 16–80) engaged in recreational fishing at least once during 2019. The number of days fished in marine and coastal waters was 4.3 million days in 2019. The total number of fishing days (marine and freshwater combined) was approximately 12.7 million days. Total expenditures for recreational fishing during 2019 was 10.6 billion SEK. Short-term expenditures amounted to 5.0 billion SEK, while long-term investments amounted to 5.6 billion SEK.	Andreas Sundelöf: andreas.sundelof@slu.se Hege Sande: hege.sande@slu.se
UK	An economic survey was conducted with anglers who were part of the catch diary (see Table A3.1) in order to obtain estimates of annual expenditure on sea angling. Diarists provided expenditure on capital (major) items and a breakdown of spending on their most recent trip in the preceding month. The methodology used to estimate total economic impact, jobs, and GVA. Estimates of the numbers of anglers in the UK were combined with the spend diaries to estimate the total expenditure by UK sea anglers.	The total expenditure estimate per adult angler in the UK was £1108 in 2016 and £1318 in 2017 (Box 5). Removing imports and taxes and scaling to the UK gave total direct expenditure estimates of £696 million in 2016 and £847 million in 2017. This resulted in a total economic impact of sea angling in 2016 of £1.58 billion, providing £326 million of Gross Value Added (GVA) and supporting almost 13600 jobs. Total economic impact in 2017 was £1.94 billion, providing £388 million of GVA and supporting around 16300 jobs in 2017.	Kieran Hyder: kieran.hyder@cefas.co.uk Zachary Radford: zachary.radford@cefas.co.uk Armstrong *et al.* (2013); Roberts *et al.* (2017); Hyder *et al.* (2020).

Country	Survey Methods (description of method, assumptions made, and applicable species)	Economic Value (direct, indirect, and induced), trip spend, and willingness to pay estimates	Contact and references
	The total expenditures by sea anglers in the UK was calculated for each individual category of trip (effort-based) and capital (major item/investment). Taxes and imports were removed from the total expenditure by sea anglers in the UK and expenditure was split between industries. Standard errors were estimated for each category and the trips and capital expenditure was summed to give a total expenditure by sea anglers in the UK.		