WORKING GROUP ON BYCATCH OF PROTECTED SPECIES (WGBYC)

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Contents

i Executive summary

The Working Group on Bycatch of Protected Species (WGBYC) was established in 2007 and collates and analyses information from across the Northeast Atlantic and adjacent sea areas (Baltic, Mediterranean and Black Seas) related to the bycatch of marine mammals, seabirds, turtles, and sensitive fish species in commercial fishing operations. Sensitive fish species were not considered at the 2021 meeting pending approval from the ICES Advisory Committee (ACOM) on fish species lists of bycatch interest that were developed at the ICES Workshop on Fish of Conservation and Bycatch Relevance (WKCOFIBYC) in 2020. WGBYC seeks to describe and improve understanding of the likely impacts of fishing activities on affected populations at biologically relevant scales, to inform on the suitability of existing at-sea monitoring programmes for the quantification of robust bycatch estimates, and to collate information on and coordinate bycatch mitigation efforts at an international scale.

In 2021, the WG met by correspondence to address eight Terms of Reference (ToR), including a data scoping exercise as part of a special request on seabird bycatch from the North East Atlantic Fisheries Commission (NEAFC), which concluded that there was insufficient bycatch monitoring data from NEAFC waters to warrant further analyses at this time. The report also provides an overview of monitoring and fishing effort data contained in the WGBYC database for 2019 and 2020. This showed that during 2020, in most geographical areas of relevance, at-sea monitoring effort was significantly affected by the Covid-19 pandemic. Specific analyses were carried out to describe potential fisheries impacts (reported bycatch numbers, min/max bycatch rates and/or mortality estimates) for harbour seal in the Greater North Sea ecoregion and parts of the Baltic ecoregion, three turtle species in four Mediterranean ecoregions and in the Azores and Bay of Biscay and Iberian Coast ecoregions, and several seabird species in six ecoregions (Adriatic, Baltic, Bay of Biscay and Iberian Coast, Celtic Seas, Greater North Sea and Icelandic Waters). A risk-based approach, developed by WGBYC in 2020 to highlight monitoring gaps, was expanded using information from multiple sources and identified several high-risk métiers for bycatch which are relatively under-sampled by existing data collection programmes. Several members of WGBYC also participated simultaneously in the ICES Workshop on Estimation of Mortality of Marine Mammals due to Bycatch (WKMOMA) which ran over schedule due to data issues.

Data used by WGBYC on fishing effort, at-sea monitoring effort and bycatch records are primarily acquired through an ICES dedicated data call which has been issued annually to all ICES member states since 2018 and all non-ICES EU coastal states from 2021. Although data quality and quantity are improving, WGBYC reiterate that significant gaps remain in data collection efforts and in data resolution, that limits the Working Group's ability to provide useful assessments of the likely impacts of fishing activity across a wide range of protected species and areas. WGBYC note that broadscale low level monitoring programmes may be insufficient to highlight very rare bycatch occurrences for populations at low abundance and/or low susceptibility to bycatch, but which could have significant population levels impacts.

ii Expert group information

Expert group name	Working Group on Bycatch of Protected Species (WGBYC)
Expert group cycle	Annual
Year cycle started	2021
Reporting year in cycle	1/1
Chairs	Allen Kingston, UK
	Guðjón Már Sigurðsson, Iceland
Meeting venue and dates	28 September – 1 October 2021, by correspondence

1 Introduction

This report contains a number of acronyms, abbreviations, and initialisms. These can be found through the ICES vocabulary website here: https://vocab.ices.dk/

The ICES Working Group on Bycatch of Protected Species met remotely using Microsoft Teams, from 28 September to 1 October 2021. The meeting was attended by 29 scientists (either formal members or chair-invited experts) from ICES and/or EU member states, two observers from the European Commission and three ICES staff members. Two fishing industry representatives from France also joined the meeting temporarily to make a presentation (see section 2).

The group addressed eight Terms of Reference (ToRs):

a) Review and summarise data submitted through the annual data call and other means, and other data assembled by ICES WGs to collate protected species bycatch rates and mortality estimates;
b) Collate and review information from WGFTB national reports, other WGs and other recent published documents relating to the implementation of protected species bycatch mitigation measures and ongoing bycatch mitigation trials;
c) Evaluate the range of (minimum/maximum) impacts of bycatch on protected species populations, where possible, to assess likely conservation level threats, including feedback to the results from the Workshop on estimation of MOrtality of Marine MAmmals due to Bycatch (WKMOMA);
d) Review ongoing monitoring of different taxonomic groups in relation to spatial bycatch risk and fishing effort to inform coordinated sampling plans;
e) Coordinate with other ICES WGs to ensure complete compilation of data on protected species bycatch and to develop and improve on methods for bycatch monitoring, research and assessment;
f) Identify data requirements on fishing effort, monitoring effort, and bycatch incidents, by considering spatial, temporal and gear type aspects, for the special request advice on bird bycatch in the NEAFC Regulatory Area;
g) Identify potential research projects and funding opportunities to further understand PETS bycatch and its mitigation;
h) Continue, in cooperation with the ICES Data Centre, to develop, improve, populate through formal Data Call, and maintain the database on bycatch monitoring and relevant fishing effort in ICES and Mediterranean waters (Intersessional).

In addition to these eight ToRs, several members of the WG also continued with tasks from the ICES Workshop on Estimation of Mortality of Marine Mammals due to Bycatch (WKMOMA) which convened two weeks before WGBYC, which remained ongoing during the week of WGBYC due to numerous intractable data related issues. The reallocation of these members time away from the WGBYC meeting was agreed with ICES and the WGBYC chairs and was considered unavoidable given WKMOMA reporting schedules.

The meeting followed the standard WGBYC format of plenary based task agreement and allocation on the first day, then primarily subgroup working with short daily plenary sessions, and then final plenary sessions to agree text (including conclusions and recommendations), draft 2022 resolutions and decide the 2022 meeting venue. Due to the high workload resulting from the extended WKMOMA work and an increased number of ToRs for the 2021 meeting, some planned optional tasks under some ToRs were not achieved at the meeting. The additional workload also meant that a further plenary session was held on 6 October and a short wrap-up session on 8 October.

In addition to the ToRs specific subgroup work that is detailed in Sections 3 to 10, several presentations were also provided by WGBYC members and invited guests, and these are described in Section 2. Some quite lengthy plenary discussions on topics not directly related to the WGBYC ToRs but which are of general relevance also occurred and these are also briefly summarised in Section 2 for clarity.

2 Presentations and non-ToR related plenary discussions

During the meeting a number of short presentations were provided by participants covering a variety of topics ranging from updates on Joint Recommendations stemming from the 2019 Emergency Measures request on bycatch of common dolphins in the Bay of Biscay and harbour porpoise in the Baltic Sea, insights into cetacean bycatch from human echolocation, the development of reference lists for fish species of conservation and bycatch interest, industry lead efforts in bycatch mitigation and updates on bycatch policy and research from the Mediterranean Sea. Abstracts were requested from all presenters and those received in time for inclusion in the report are provided here.

Some unscheduled plenary discussions also occurred during the meeting related to policy objectives and the scientific basis for the implementation of mitigation measures and a short description of those discussions is also presented for completeness and to highlight current views on these areas.

WKCOFIBYC presentation (Ailbhe Kavanagh, Marine Institute, Ireland).

The Workshop on Fish of Conservation and Bycatch Relevance (WKCOFIBYC) was convened in November 2020 to develop a list of fish species of conservation and/or bycatch concern, that could be used to prioritise and plan for future work within ICES. WKCOFIBYC compiled a list of fish species (commercial and non-commercial) of conservation concern (threatened, sensitive, or already listed in legislation), termed the Comprehensive Species List (CSL). This list is composed of fish species found on regional seas convention lists, international agreements, international and national law, relevant red lists of extinction risk, and various scientific literature. From the CSL WKCOFIBYC developed ecoregion-level lists of priority sensitive species for future conservation/biodiversity-concern assessment (RALs), which excluded freshwater and non-indigenous species and those for which ICES or other bodies already provide quantitative assessments. From the RALs the group then compiled ecoregion-level bycatch lists (RBLs) of fish species of bycatch concern, excluding most remaining species already advised upon by ICES or equivalent bodies, and including species that are not advised upon anywhere and are listed as Data Deficient (DD) on red lists. In total, approximately 230 unique species remained across all RBLs, with numbers differing greatly in different ecoregions. The lists are hosted by ICES, and the intention is that they will be updated regularly. The various fish species lists developed at WKCOFIBYC are currently under review within ICES.

Update on mitigation work by French industry (Thomas Rimaud, Producer Organization Les Pêcheurs de Bretagne and Aurélien Henneveux, Producer Organization Pêcheurs d'Aquitaine, France*).*

In France, the issue of incidental catches of common dolphins in the Bay of Biscay has increased in recent years with an intensification of the phenomenon since the Winter 2016-2017. In this context, since 2018, fishers are truly involved on the important program of actions that has been put in place in France to 1: Quantify bycatches; 2: Better understand the interaction between common dolphins and fishing gears and 3: Develop and experiment technological devices to limit and reduce accidental catches.

To quantify bycatches, observation on board is the first step towards achieving it. Thus, there has been an increase of observers onboard for 3 years with dedicated programs (From 15/12/2020 to 30/04/2021, 500 Days at Sea (DaS) were observed on static netters (GNS), with 13 common dolphin and two harbour porpoise bycatches recorded, and 76 DaS were observed on midwater pair trawlers (PTM) with 23 common dolphin bycatches recorded (including 12 bycatches during the test of another kind of pinger). Furthermore, an experimentation of REM for cetacean bycatch (OBSCAMe Project) is carried out by the French Office of the Biodiversity. 5 static netters have been equipped with cameras since February 2021 (1 bycatch of harbour porpoise was observed from February to June 2021), and 15 more static netters will be equipped by the end of 2021.

To refine the relationship between strandings and bycatches, which is a second way to quantify bycatch levels, fishermen have tagged carcasses with classic marks from Pelagis (during winters 2018; 2019; 2020 and 2021: respectively 17; 25; 40 and 66 carcasses were tagged, for tagged carcasses stranding rate of 53%; 12%; 45% and 15%) and/or with telemetric tags (including BALPHIN project).

The third way to quantify bycatches is by mandatory reporting of bycatches which has been in force since 2019 in France and 2021 in Spain.

To better understand the interaction between common dolphins and fishing gears especially, passive acoustic devices will be used under the APOCADO projects carried out by French Office of Biodiversity, SEAPROVEN campaign expected in Autumn 2021, and dedicated actions of DELMOGES project which will start in 2022).

To Develop and experiment technological devices to limit and reduce accidental catches, in the PIC project, pingers DDD-03H were tested on PTM in 2018, and after scientific analyses, efficiency of this device was estimated at a 65% reduction in bycatch rates (https://www.pecheursdebretagne.eu/wp-content/uploads/2019/03/20190214_rapportPIC_VF.pdf). Nonetheless, for PTM, experimentations have still been continuing to improve pingers.

For static netters, after a scientific benchmark on available commercial deterrents, the scientists considered that it was more relevant to develop a specific adapted device for the common dolphin rather than testing commercial pingers unsuited to this species. That is why some devices were elaborated and tested for midwater pair trawlers and static netters in the LICADO and DOLPHINFREE projects (for more information, please go to the LICADO project presentation (https://octech.fr/en/project-licado- -2019-2022/).

Interview with Thomas Tvedt on echolocation (Lotte Kindt-Larsen, DTU Aqua, Denmark)

An understanding of echolocation and echolocation behaviour is crucial for the development of mitigation tools to avoid bycatch of cetaceans. To understand how the acoustic landscape is working in real life an interview was made with a human echolocator to get new insights and reveal new knowledge. The interview was made between Thomas Tvedt (http://visioneers.no/) a human echolocator based in Norway and Lotte Kindt-Larsen (DTU Aqua, DK). Thomas is able to navigate by using echolocation.

The interview focused on how the environment is perceived when sound is the only stimuli. Thomas described in detail how it is possible, even for the human ear to navigate and to distinguish between materials, both in shapes and distances. Ideas for mitigation were also discussed. The interview is available online (https://www.youtube.com/watch?v=wzqmuZWfx44)

Update on activities in the Mediterranean (Caterina Fortuna, ISPRA, Italy)

Caterina Fortuna gave a presentation highlighting some ongoing activities in the Mediterranean Sea, with a particular focus on Italian activities conducted on bycatch of PETs in the framework of the EU DCF, MSFD, HD, GFCM & ACCOBAMS cooperation and the Barcelona Convention EcAp/IMAP (equivalent of the EU MSFD).

Regarding DCF-related activities Italy ex Reg 812/2004 (PTM only in GSA 17 and 16) is still ongoing as dedicated study. In addition, in 2019 a pilot study was carried out on drifting longlines (GSA 9, 10, 11, 16, 18, 19) using observers & self-sampling. These data were included in the latest WGBYC data call. Concerning the work carried out to develop options and ideas on the implementation of the MSFD criterion D1C1 (mortality caused by incidental bycatch), Italy (National Institute for Environmental Protection and Research, ISPRA, Rome), in cooperation with experts from DCF (including CNR IRBIM, Ancona) is carrying out pilot studies in bottom trawlers, pelagic longlines and gillnets (small scale sector) (GFCM GSA9, GSA 17 and GSA 16) applying the logic framework identified by the STECF (2019). This initiative keeps into consideration also the ongoing discussion at Mediterranean level on the equivalent criterion of the Barcelona Convention (EcAp/IMAP Common Indicator 12). In this regard, the recommendation to align the approach to D1C1 will be considered not at the next COP22 (2021), but after the finalization of the UNEP MAP Quality Status Report (i.e. from 2024).

The LIFE DELFI Project (LIFE18 NAT/IT/000942) is relevant to WGBYC as it looks at mitigation of bycatch and depredation by testing DiDs, visual deterrent, alternative gears. Preliminary results from this project are expected from 2022 onward. Also, the ACCOBAMS/GFCM/MAVA MedBycatch project could provide bycatch data to WGBYC soon, particularly from non-EU Mediterranean countries.

From the FAO GFCM front there are two new potential sources of information: the annual FAO GFCM State of the Mediterranean and Black Sea fisheries and the recently published "Incidental catch of vulnerable species in Mediterranean and Black Sea fisheries: a review" (Carpentieri *et al*. 2021). More importantly, the GFCM has produced monitoring protocols (FAO GFCM 2019) suggesting an observation coverage of 0.5% for onboard observers (preliminarily accepted by the DCF M&BS RCG as appropriate). However, this very low observation coverage level has been suggested based on a wrong interpretation of observation coverage levels reported to this group. These protocols refer to 0.5% as "*often accepted (MARE/2014/19, 2016)*". The MARE/2014/19 (2016) project report uses 0.5% as target for its monitoring protocols stating that 0.5% is "*what is commonly achieved by the by-catch monitoring programmes carried out under the Regulation (EC) No. 812/2004 (see Northridge et al. 2015)*". However, both documents fail to clarify that (1) those were commonly achieved targets under the Habitat Directive, not 812/2004 and (2) Northridge and colleagues clearly state that those coverages are mostly relate to métiers for which they "*do not consider* [to] *have representative coverage*".

This example raises some concern on how this group has delivered its message until today. The WGBYC rightly puts an emphasis on the advice that can be provided (via carrying out full analysis on robust data, coming from robust observations), without devoting equal attention on explaining why in the majority of cases do not allow any analysis. There is agreement on the fact that the context in which bycatch rates are used for estimating total bycatch events and, subsequently, evaluating these against the Potential Biological Removal is complex. This includes, for example: (a) level of observation coverage, (b) stratification of observation coverage, (c) fishing effort data, (d) susceptibility of different species to different gear (in relation to their ecology/behaviour), (e) métier operativity, and (f) targeted precision (e.g. <30% CV in Reg 812/2004). However, among all these components a key one is the observer coverage, i.e. if there are not sufficient observations, there cannot be an appropriate stratification and design (also to obtain a desired estimate precision) nor a detection of bycatch event (especially for those species that are abundant but rarely caught or present at low densities). In fisheries covered by an inadequate number of observations and interacting with species whose populations are small and isolated (e.g. the Mediterranean Sperm whale, the Mexican Vaquita, etc.), there is a real risk of not detecting any bycatch event or few events and interpret those highly risky cases as "green lights" in terms of bycatch risk. On the other hand, unreliable observation coverages produce unreliable bycatch rates that could be used to obtain very high total estimates, over estimating bycatch risk.

Discussion on mitigation in the Bay of Biscay (Helene Peltier, Université de La Rochelle, France)

The aims of trials and pilot studies on new mitigation device development are to test their technical setting up, their efficiency and their potential impacts (positive and negative). Different projects presented were in line with some of these objectives. Testing at large scales will be required to ensure that devices are efficient, but in case of pingers specifically trials should consider that whether they reduce bycatch levels but without other negative effects on the marine environment. Efficiency testing of mitigation approaches should be based on robust and independent sampling protocols, appropriate statistical analyses and widescale implementation should be preceded by statistically significant results with agreed confidence intervals. The implementation of sampling strategies to test mitigation approaches by independent observers or REM is highly encouraged.

Potential negative effects on the marine environment should be evaluated too, considering a wider deployment and possible cumulative effects.

Summary of plenary discussions on the science/policy interface in the management of bycatch. (WGBYC chairs).

A plenary discussion occurred during the meeting regarding the difficult topic of the role of science in the development of policy objectives. Discussions of this nature have been occurring for several years in relation to bycatch and tend to become circular because different groups have different opinions on a complex issue. Here we briefly summarise the broad basis of the discussions at the meeting.

The general argument put forward by the members of WGBYC that participated in the discussion was based around the understanding that policy objectives are essentially a societal consideration and so should be developed and agreed by institutions that formally represent wider society, namely governments, and that the role of science, in this particular context, is to advise on how those societally agreed policy ambitions might best be achieved. In contrast to this stance, the position from more policy focussed attendees at the meeting was that the scientific community should play a more significant and direct role in informing the development of policy objectives from the outset.

As has been the case with previous discussions on this topic, no real consensus was found and this debate will no doubt continue into the future, particularly as the policy landscape, legislative background and scientific understanding of bycatch continues to evolve.

3 ToR A: Review and summarize data submitted through the annual data call and other means, and other data assembled by ICES WGs to collate protected species bycatch rates and mortality estimates in EU waters (ToR A)

3.1 Legislation concerning the bycatch of protected, endangered and threatened species (PETS)

The work of WGBYC from 2021 onwards is primarily driven by the current agreement between ICES and DG-Mare. Following this agreement ICES *"**will provide**, on the basis of data provided by Member States and any other relevant data sources, **annual estimates of the numbers of specimens of sensitive species** (as defined in Article 6(8) of Regulation (EU)2019/1241) **excluding fish species caught incidentally in fishing activities**, disaggregated **by sea area and type of fishing gear**. These estimates shall be accompanied with evaluations or estimates of their **accuracy where possible**. They shall be provided by December each year and shall cover incidental catches made until 31 December of the previous year. ICES shall progressively accompany these estimates with calculated values of potential biological removal (PBR), or alternative markers of sustainability where appropriate"*. In addition, ICES is asked to *"provide **warnings** of any **serious threats** (i.e. if there is at this moment, **a threat to the abundance posing a risk so serious that it would be unwise to postpone action**) from fishing activities alone or in conjunction with any other relevant activity to local ecosystems or species **as soon as ICES is aware of such threats**"*.

Regulation 812/2004 was repealed and replaced by Regulation (EU) 2019/1241 (hereafter referred to as Reg.2019/1241) of the European Parliament and of the Council *on the conservation of fisheries resources and the protection of marine ecosystems through technical measures (Technical Conservation Measures Regulation)*. The objectives of the new Regulation are: (a) to minimise, and where possible eliminate, incidental catches of sensitive species so that fishery-related mortality does not represent a threat to their conservation status; (b) to minimise negative impacts of fishing on marine habitats and (c) to put in place management measures for the purposes of complying with the Habitats, Birds, Water Framework and Marine Strategy Framework Directives. These measures shall ensure that bycatches of sensitive species do not exceed levels in Union legislation and international agreements. Member States are required to take the necessary steps to collect data on the relevant species. Provisions on vessel sizes, areas and fishing gears for mitigation and monitoring measures contained in Regulation 812/2004 are retained. Measures to monitor, manage and mitigate bycatches of sensitive species (including but not limited to cetaceans, seabirds and turtles) are subject to regional management through Joint Recommendations to the European Commission prepared by Member States.

Technical descriptions of Acoustic Deterrent Devices (ADDs) carried over from Regulation 812/2004 are contained in the Commission Implementing Regulation (EU) 2020/967 of 3 July 2020 *laying down the detailed rules on the signal and implementation characteristics of acoustic deterrent devices as referred to in Part A of Annex XIII of Regulation (EU) 2019/1241 of the European Parliament and of the Council on the conservation of fisheries resources and the protection of marine ecosystems through technical measures*. This Implementing Regulation mandates that ADDs be functional during the whole duration of the fishing operation, not only at the moment when nets are set. It also allows Member States '*to authorise the use of acoustic deterrent devices that do not fulfil the technical specifications or conditions of use defined in the Annex, provided that such devices are at least equally effective in the reduction of incidental catches of cetaceans as the acoustic deterrent devices with the technical specifications or conditions defined in the Annex, and this has been duly documented*'.

There are several other legislative instruments in ICES Member Countries, Regional Fisheries Management Organisations (RFMOs) and other European Union law concerning bycatch of PETS. For an overview of the main pieces of legislation see the section "Introduction to legislative background" of the *Roadmap for ICES bycatch advice on PETS*.

ICES gathers data on PETS bycatch through an annual data call. These data are most commonly linked to at-sea observations carried out for the purposes of fisheries monitoring in accordance with the EU Data Collection Framework Regulation 2017/1004 (DCF)[1]. While the collection of protected species bycatch data through the DCF as part of the Multiannual Plan (DC-/EU-MAP) may facilitate targeted sampling of métiers of concern, **the use of non-dedicated protected species bycatch observers may lead to downward bias in the number of recorded events** (see ICES 2015).

There are many obligations to monitor and introduce measures to reduce protected species bycatch within legislation specific to fisheries and the Common Fisheries Policy. As examples, MS have obligations under Council Directive 92/43/EEC[2] of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (the 'Habitats Directive'). The revised Commission Decision 2017/848[3] relating to the implementation of the MSFD specifies a primary criterion for the assessment of Good Environmental Status (GES) linked to the assessment of bycatch, Primary criterion: D1C1. Specific to seabirds, is the European Commission's 'Action Plan for reducing incidental catches of seabirds in fishing gears' (EU-POA) which was published in 2012. It seeks to provide a management framework to minimise seabird bycatch to as low levels as are practically possible. Robust data pertaining to fishing effort and bycatch monitoring data are required by MS to assess the impact of bycatch and work towards meeting the various legislative requirements and commitments.

3.2 Monitoring data submitted - Overview

ICES/WGBYC requested data from 27 countries through the 2021 data call. 22 countries responded and submitted data on fishing and sampling effort and bycatch observations from 2019 and 2020 (Table 3.1). Norway and Cyprus submitted data for the first time in 2021. One ICES member country has so far never reported data on PETS bycatch to ICES.

The quality and scope of the information provided in the WGBYC/ICES data call is variable but improving. Consistent with the annual content of WGBYC reports from previous years the data call has been reviewed for:

1. Implementation of monitoring of PETS bycatch, and information on mitigation and observation schemes (see Section **Error! Reference source not found.** for mitigation);
2. Information on PETS bycatch (including records of individual bycatch events and levels of monitoring coverage provided);
3. Other relevant issues emanating from the data call (e.g monitoring methods).

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[1] https://datacollection.jrc.ec.europa.eu/legislation/current/obligations

[2] https://ec.europa.eu/environment/nature/legislation/habitatsdirective

[3] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32017D0848

3.3 Monitoring, observed PETS specimens (not including fish), total and observed effort obtained from the ICES WGBYC data call by ecoregion.

Prior to the WGBYC 2021 meeting, a WGBYC/ICES data call (link) requesting 2019 and 2020 PETS bycatch data from dedicated (e.g. pilot projects) and non-dedicated/multi-purpose (e.g. DCF) monitoring programmes was issued. The data call requested information on marine mammals, birds and turtles but not on other marine vertebrates (i.e. fish) since the ICES lists of fish species of bycatch concern developed by WKCOFIBYC are still under review (see Section 2). The data call is issued to EU Member States and non-EU ICES Member States with coastal areas in the European Atlantic (e.g. Iceland, Norway and the UK), the Mediterranean Sea and Black Sea. This section summarises data obtained through the 2021 data call (covering fishing and monitoring activities in 2019 and 2020) which have been extracted from the WGBYC database (see Section 10).

The total number of specimens and/or number of bycatch incidents of marine mammal, seabird, and marine turtles, total fishing effort and observed effort aggregated by gear type (métier level 3), ecoregion (Figure) and ICES Division or GFCM Geographic Sub-Area (GSA) for 2019 and 2020 are summarised in tables 3.2a and 3.2b respectively. For strata without observed bycatch equivalent data are provided in tables 3.3a and 3.3b. Data were aggregated by ICES Division/GFCM GSA and/or Ecoregion for consistency across taxa and to improve the accessibility or transferability of these data to other ICES Working Groups (WGs).

A total of 440 seals (4 species) and 428 cetaceans (6 species) were observed bycaught in 2019 and 2020. A total of 2596 seabird specimens are reported covering at least 33 species, and a total of 114 marine turtles were reported for 3 species.

In this section, WGBYC has not calculated bycatch rates or estimates due to uncertainties associated with incomplete spatial/temporal dedicated monitoring coverage and total fishing effort data as reported to WGBYC. However, bycatch risk assessments based on observed specimens, observed days monitored and fishing effort are carried out by WGBYC where more data are available for specific species and métiers (see Section 5).

There is insufficient detail in the submitted data to provide separate and robust information on observed cetacean bycatch according to ADD functionality and/or presence/absence. Consequently, all observed bycaught cetacean specimens are combined to provide overall numbers of reported bycatch by stratum.

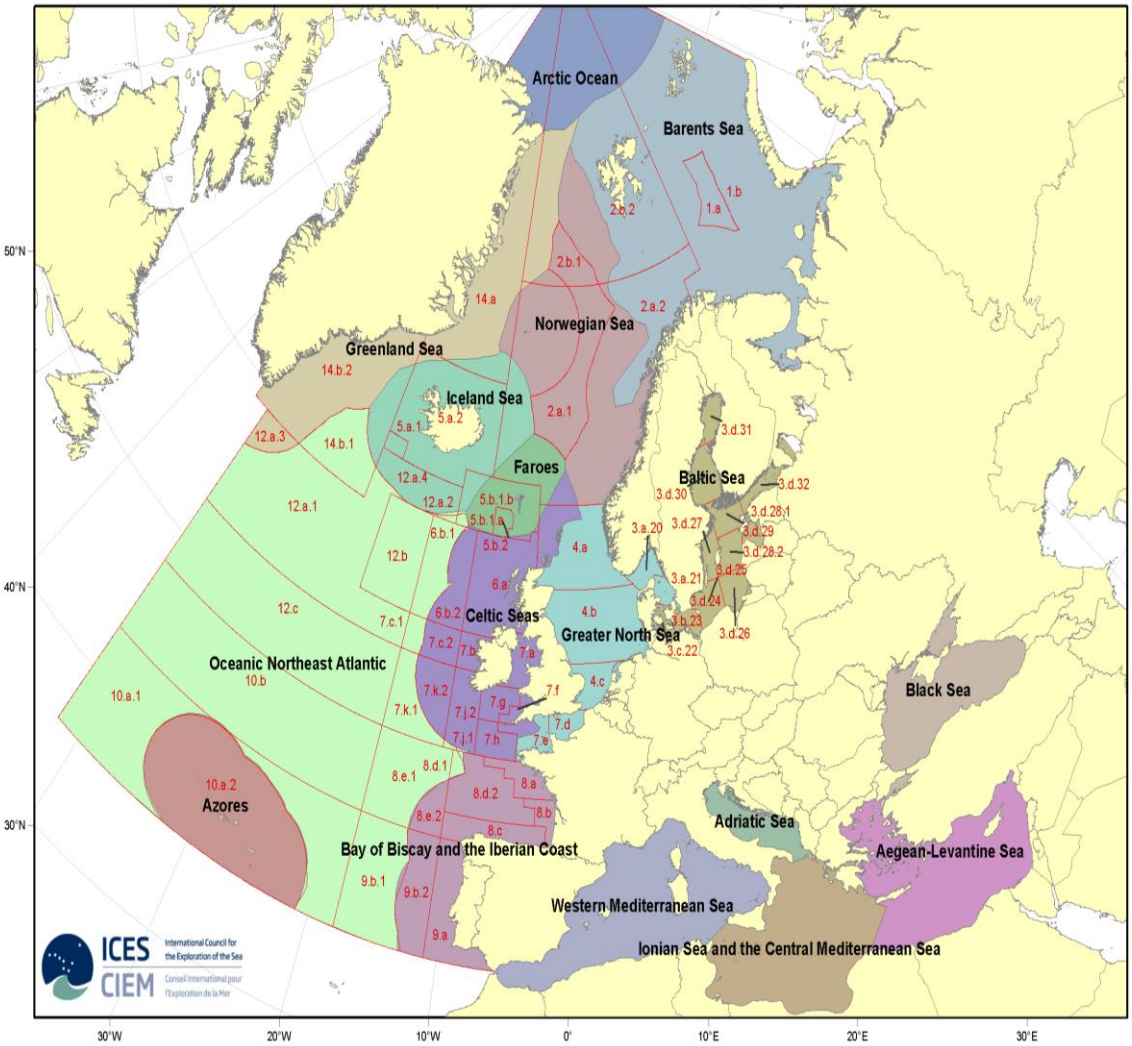

Figure 3.1. Map of ICES and Mediterranean Ecoregions including ICES Statistical Areas, February 2017.

In the **Western Mediterranean** ecoregion**,** data from monitoring of longline fisheries was received for 2019 and 2020 (GSA 6 and 11.2) and from bottom trawls for 2020 (GSA 7). Reported bycatch included four species of birds (four Scopoli's shearwaters *Calonectris diomedea*, one Audouin's gull *Larus audouinii*, two yellow-legged gulls, *Larus michahellis* and 4 balearic shearwaters *Puffinus mauretanicus)* in longlines, one species of sea turtle (4 loggerhead turtles *Caretta caretta:* 3 in longlines, 1 in bottom trawlers) and one species of cetacean (1 bottlenose dolphin *Tursiops truncatus* in bottom trawls). It should be noted that an issue with the reported data was highlighted for this ecoregion; fewer fishing days at sea than monitored days at sea were reported for the longline métier but could not be rectified during the meeting.

In the **Ionian Sea and the Central Mediterranean** ecoregion, a single record of loggerhead turtle bycatch was reported from surrounding nets in 2019.

In the **Adriatic Sea** ecoregion, bottom trawls (DCF monitoring), midwater trawls and longlines (specific studies on bycatch) were monitored in 2019. Midwater trawls were also monitored in 2020. One species of bird (1 common shag *Phalacrocorax aristotelis*) was reported in bottom trawls, one species of sea turtle (50 loggerhead turtles*:* 35 in midwater trawls, 15 in longlines) and one cetacean (1 bottlenose dolphin in midwater trawls) were reported as bycaught. It should be noted that an issue with data reported was highlighted for this ecoregion; no fishing days at sea were reported for the longline metier, despite the reporting of monitored days at sea.

In the **Aegean-Levantine Sea** ecoregion**,** loggerhead turtles represent the majority of reported bycatch incidents observed during 2019-2020 from monitoring of small-scale fisheries and particularly those using nets (Table 3.2a). A few specimens of green turtle (*Chelonia mydas*) and a single record of seabird bycatch (*Phalacrocorax aristotelis*) were also reported by nets in 2019 and 2020. No marine mammal bycatch was reported.

In the **Azores** ecoregion data were reported in 2019 and 2020 for areas 27.10.a and 27.10.a.2. In 2019, 89 days at sea were monitored in longlines in area 27.10.a, while 149, 24, 606, 16 and 9 days were monitored for longlines, nets, rods and lines, surrounding nets and traps respectively, in area 27.10.a.2. Bycatch in 2019 was only observed in area 27.10.a, with one leatherback turtle *Dermochelis coriacea* reported in longlines. In 2020, for longlines, 107 and 11 days at sea were monitored in areas 27.10.a and 27.10.a.2 respectively, while area 27.10.a.2 was also sampled in 442, 1, 4 and 3 days at sea for rod and lines, nets, surrounding nets and traps respectively. 26 loggerhead turtles and 3 leatherback turtles were observed bycaught in longlines in area 27.10.a, while 3 Cory shearwaters, 1 common dolphin and 2 great shearwaters *Ardenna gravis* were captured in rod and lines in area 27.10.a.2.

In the **Bay of Biscay and the Iberian Coast** ecoregion data were reported for 2019 and 2020 in areas 27.8.a, 27.8.b, 27.8.c, 27.8.d.2 and 27.9. In 2019, the highest numbers of monitored days were in nets, midwater trawls and bottom trawls in area 27.8.a (164, 167 and 125 respectively), for nets in area 27.8.b (162) and for nets and longlines in area 27.9.a (302 and 185 respectively). The lowest number of monitored days were for rod and lines, surrounding nets, traps, longlines and seines (3, 4, 7, 11 and 16 days respectively) in area 27.8.a, for traps, seines, rod and lines, and longlines (2, 10, 13, 13 respectively) in area 27.8.b, for nets in area 27.8.d.2 and for traps in area 27.9.a (4 and 2, respectively). Bycatch of seabirds was observed in all areas, mainly for nets in area 27.8.a (11 common guillemots *Uria aalge*), for nets and bottom trawls (439 common guillemots and 11 northern gannets *Morus bassanus*, respectively) in the area 27.8.b, and 11 specimens of northern gannets for longlines in area 27.9.a. For marine mammals, bycatch was observed in areas 27.8.a, 27.8.b and 27.9.a, with the largest number of specimens captured for midwater trawls in 27.8.a and 27.8.b (13 and 16 respectively). No turtle bycatch was observed in 2019.

In 2020, the highest numbers of observed days were in nets in the area 27.8.a (228), bottoms trawls and nets in area 8.b (118 and 81 respectively) and for longlines, nets and surroundings nets in area 27.9.a (617, 434 and 194 respectively). The lowest numbers of observed days were in surrounding nets, traps and rod and lines in area 27.8.a (2, 3 and 5 respectively), for traps, pelagic trawls, seines, longlines and surrounding nets in area 27.8.b (0.4, 1, 3, 5 and 9), for surrounding nets, rod and lines and longlines in area 27.8.c (1, 4 and 7 respectively), for nets in area 27.8.d.2 (6) and for seines and traps in area 27.9.a (1 in each). Bycatch of seabirds was observed in areas 27.8.a, 27.8.b, 27.8.c and 27.9.a, mainly for nets in area 27.8.a (22 common guillemots) and for longlines in area 27.9.a (26 northern gannets). The only marine mammal species reported as bycatch was the common dolphin, with reports from bottom trawls in areas 27.8.a, 27.8.c and 27.8.d (21, 1 and 4 respectively), pelagic trawls in 27.8.a (4), longlines in 27.8.b (1), nets in 27.8.b, 27.8.c and 27.9.a (2,1,6 respectively) and surrounding nets in 27.9.a (1). In 2020 2 specimens of loggerhead turtle were reported for nets in area 27.9.a.

In the **Baltic Sea** ecoregion, monitoring days were as follows: bottom trawls (175 in 2019, 126 in 2020), nets (48 in 2019, 3954 in 2020), pelagic trawls (583 in 2019, 1624 in 2020), longlines (81 in 2019, 117 in 2020), seines (35 in 2019, 50 in 2020) and traps (9 in 2019, 2490 in 2020).

In 2019 four species of mammals were reported as bycaught: one otter (*Lutra lutra*) captured in traps, 16 harbour porpoises captured in nets in Subdivions 22 and 23, 12 harbour seals in nets, and 62 grey seals in a variety of gears. At least 15 seabird species (734 individuals) were reported bycaught. From these at least 7 species (414 individuals) were anatids. All birds were taken by nets or traps except one incident involving a single common guillemot that was taken by longlines.

In 2020 six species of mammals were reported as bycaught in the Baltic Sea ecoregion; one otter and one beaver (*Castor fiber*) captured in traps, five harbour porpoises captured in nets in Subdivions 22 and 23, four ringed seals *Pusa hispida* and three harbour seals captured in nets, and 49 grey seals taken in traps and nets. At least 16 species of birds (393 individuals) were reported as bycaught. From these at least 10 species (167 individuals) were anatids. All birds were taken by nets or traps except one incident involving 10 cormorants in bottom trawls.

In the **Celtic Seas** ecoregion, monitoring days were as follows: bottom trawls (618 in 2019, 168 in 2020), nets (283 in 2019, 134 in 2020), pelagic trawls (135 in 2019, 175 in 2020), surrounding nets (11 in 2019) and longlines (31 in 2020) were observed. Four seabird species (13 birds) were recorded in 2019 and two in 2020 (33 specimens). In 2019 two cetacean species, common dolphin and harbour porpoise (5 animals in total) and one seal species (87 grey seals) were reported. In 2020 one cetacean species (3 pilot whales) and 2 seal species (99 seals) were reported.

In the **Greater North Sea** ecoregion, 1,057 fishing days were observed in 2019 on bottom trawlers and 200 in 2020, 884 observed fishing days on nets and 429 in 2020, 78 fishing days on longlines in 2019 and 22 fishing days on pelagic trawls in 2020. In 2019, 10 bird species were recorded bycaught (457 specimens) whereas only 4 species were observed in 2020 (33 specimens). High levels of common guillemot bycatch were reported from nets in 2019 (283 birds) as well as 92 northern fulmars in longlines. Most bycaught birds in 2020 were common guillemots in nets. Two cetacean species (81 individuals) and 2 seal species (29 animals) were recorded in 2019; 3 cetacean species (110 cetaceans) and 2 two seal species (31 seals) in 2020.

In the **Iceland Sea** ecoregion in 2019, 112 days at sea were observed on netters from a total of 8,242 fishing days and 105 were observed in 2020 from a total of 8,240 fishing days. Five bird species were recorded, including 36 common guillemots and 27 black guillemots. In 2020 highest bycatch levels were reported for common eider (105), black guillemots (82) and common guillemots (39). Harbour porpoise was the largest proportion of cetacean bycatches in 2019 and 2020 (21 and 23 respectively).

In the **Norwegian Sea** ecoregion, total netting fishing effort was 44,564 fishing days in 2019 and 43,997 in 2020. 1,416 days were observed in 2019 and 1,348 in 2020. Three marine mammal species were observed bycaught, including harbour porpoises (32 individuals in 2019 and 31 in 2020). Two bycaught seal species were also recorded, with 26 harbour seals, and 2 grey seals caught in 2019 and 2020 combined.

We note that data from 2019 and 2020 submitted through the 2021 WGBYC data call consisted of monitoring information collected by a number of different methods (at-sea-observers, electronic monitoring, port observers, and vessel crew observers). These data also included logbook data reported as monitored/observed data by two countries. For all data (including logbook data) the majority of data (DaS effort) was reported as recorded by a vessel-crew-observer. When the logbook data was removed, most data is reported as recorded by at-sea-observers (see Figure 3.2). The inclusion of logbook data has resulted in very high "observed" effort days for a number of fisheries in the Baltic Seas ecoregion (see Table 3.2a and 3.2b) and in some cases these logbook data were reported with no associated value for observed days at sea. As such caution is neededwhen interpreting observed effort in this ecoregion. For future data calls more detailed definitions of "monitored effort" should be included, to avoid situations as described above.

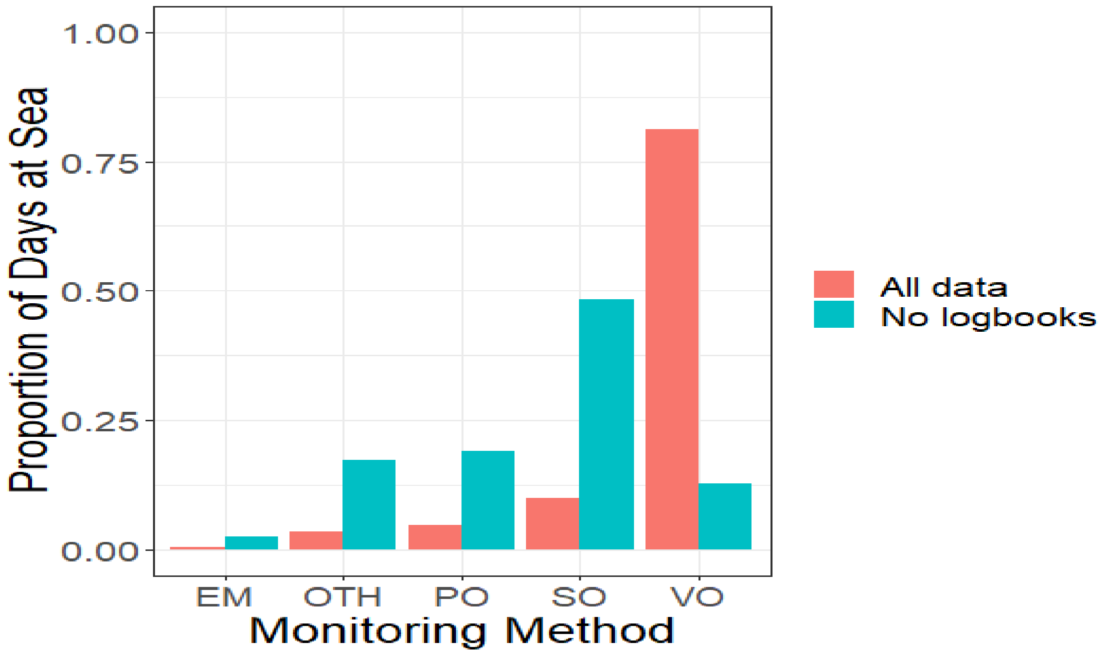

Figure 3.2. Proportion of monitored/observed days at sea reported per monitoring method (2019 and 2020 data combined): at-sea-observers (SO), electronic monitoring (EM), port observers (PO), and vessel crew observers (VO)

3.4 Summarise relevant rates/estimates from data assembled by other ICES working groups/wider literature for N. Atlantic and Mediterranean

In **France**, 2004-2020 bycatch data from the observer program on pair trawlers were analysed with fishing fleet effort data provided as days at sea by IFREMER (Institut Français de Recherche pour l'Exploitation de la Mer). Analyses were performed by *Observatoire Pelagis*, UMS 3462 University of La Rochelle/CNRS. Bycatch risk, haul duration, number of hauls per day at sea and the number of bycaught dolphins were estimated per week, year, and ICES Division. The estimated bycatch risk was highest for Divisions 27.8a and 27.8b for weeks 1 to 8 especially after 2016. The high estimated bycatch risk since 2016 was associated with a higher estimated haul duration. The number of estimated bycaught dolphins is two orders of magnitude higher on the continental shelf than in oceanic waters. In neritic Bay of Biscay, 1139 (CI95% [221; 2,678]) common dolphins were estimated as bycaught in 2017. Bycatch were also estimated at 62 (CI95% [0; 294]) common dolphins in 2018, 392 (CI95% [69; 823]) in 2019 and 98 (CI95% [1; 325]) in 2020. These results gave a new insight of pair trawlers contribution to common dolphin bycatch in the Bay of Biscay. It is proposed to investigate a limit of the haul duration under a threshold (5 hours) as a mitigation strategy, especially in winter.

Another study was conducted by *Observatoire Pelagis* aimed at improving understanding of the factors influencing common dolphin bycatch in Bay of Biscay net fisheries. Data from onboard observers provided by IFREMER were also used. They represented 13 years of monitoring, 16 400 fishing operations and 35 bycaught common dolphins. A logistic regression of hierarchical type using a Bayesian approach was used. This model improves the estimates in case of unbalanced sampling. A total of 71 variables were tested. Variables that are significantly associated with bycatches are the length of the net (the longer the net, the higher the risk of bycatch) and the area 27.7e (negatively correlated because of the absence of bycatch). Some variables are close to being significant and stand out from the group of non-significant variables: years 2018, 2019, 2020 and depth squared, with the highest risk between 25 m and 125 m. Out of 33 target species tested, 7 emerged as associated with bycatches such as hake, monkfish, pollack but not significantly. These results are very limited despite the use of the Bayesian approach. That can be explained by the very low number of bycatches observed and the large imbalance in the data set. In addition, the environmental variables that could have given us information are not usable with a large number of NA's. For more detailed information on the factors influencing bycatches by gillnetters, a higher coverage of fishing operations and more random sampling are necessary.

WGMME (ICES, 2021) summarised relevant recent literature on marine mammal bycatch rates in 2021, including Kerametsidis (2020) who estimated cetacean bycatch rates in the **Southern Adriatic Sea** based on interviews. Gillnets were identified as the main gear involved in fisheries-cetacean interactions. Based on interviews, Lopes et al. (2016) compared the frequency of bycatch of dolphins in artisanal and semi-industrial fisheries on around the island of Maio, **Cape Verde**. Semi-industrial fishers mainly use purse seines and surface longlines, and artisanal fishers mostly use hook and line gears. Dolphin bycatch was higher in semi-industrial fisheries than in artisanal fisheries. Based on interviews Ermolin and Svolkinas (2018) estimated Caspian seals (*Pusa caspica*) bycatch in sturgeon fisheries in the **Caspian Sea**. Between 2013 and 2016, 788 seals were estimated as bycaught from 15 boats and 35 trips lasting from one day up to one week.

In the last OSPAR Intermediate Assessment of 2017, only bycatch rates for harbour porpoises in the North Sea were available, but no assessment could be carried out because of a lack of agreed thresholds (OSPAR 2017). For the next Quality Status Report (QSR) of 2023, the OSPAR's Marine Mammal Expert Group (OMMEG) has already proposed several thresholds for the indicator M6 (bycatch mortality) and WKMOMA, following a special request from OSPAR, are currently working to produce bycatch estimates for common dolphin, harbour porpoise and grey seal.

No bycatch rates have been calculated under ASCOBANS, but a Joint Bycatch Working Group (JBWG) was established together with ACCOBAMS in 2019. The first meeting was held online in February 2021. Several recommendations on data collection and bycatch mitigation were produced, but the estimation of bycatch rates was not addressed (ACCOBAMS/ASCOBANS, 2021).

NAMMCO and the Norwegian Institute of Marine Research (IMR) organized in 2019 a joint international workshop on the status of harbour porpoises in the North Atlantic in which some bycatch rates were calculated (see North Atlantic Marine Mammal Commission and the Norwegian Institute of Marine Research, 2019).

3.5 Other monitoring programmes or additional projects to monitor bycatch of PETS and associated bycatch estimates

In **Portugal**, the University of Algarve and the Center of Marine Studies ran a recently finished project (iNOVPESCA – 2018-2021) and are partners in another continuing project (LIFE + Ilhas Barreira – 2019-2023) in the southern coast, to evaluate interactions between marine megafauna (especially focusing on cetaceans, marine turtles and seabirds), access bycatch and test mitigation measures. While the first project was more focused on cetaceans and the second project more dedicated to marine birds, both projects use the same methodology such as harbour enquiries, onboard observations, and pilot studies testing mitigation devices. iNOVPESCA tested ADDs (DiD and DDD 03H) in nets (GNS and GTR) to decrease bycatch of and depredation by bottlenose dolphins, and DDD 03N in purse seines to decrease bycatch of common dolphins (see Section 4 for discussions of preliminary results). LIFE + Ilhas Barreira is testing visual and acoustic devices to mitigate interactions with marine birds. From both projects, to date, more than 800 harbor inquiries and close to 200 fishing trips were monitored. Trip monitoring is accomplished by onboard observers and through the collection of data from logbooks filled in voluntarily by trained skippers

A pilot study concerning bycatch of sea birds has been recently completed in **Finland**. The survey examined the bycatches of the Finnish commercial coastal fishery in 2019. The study area includes the Finnish coast in ICES Divisions 29–32. The survey frame is the central register of commercial fishery, and the method is an inquiry sent by an email to all commercial marine fishers that have registered an email address in the register (n = 524). They comprised about half of all fishers reporting marine catches in the register in 2019 (n = 1,061).

A total of 15 bird species and 430 events of bird bycatch were reported by the survey respondents. A raised estimate is 1800 birds in the commercial coastal fishery in 2019.

A comparison between the survey output and bycatches reported in the catch register, that is the base data for the WGBYC data call, is indicating that the catch register is lacking a considerable fraction of bycatch. There are 389 bird bycatch events in the catch register in 2019, which represents one fifth of the total estimate of bird bycatch from the survey. Also, the catch register data did not include all species that were reported in the survey, such as razorbill, long-tailed duck, velvet scoter, common gull, black guillemot, red-necked grebe and graylag goose. In addition, the fraction of birds having the IUCN status was lower in the catch register data than in the survey data (34% vs. 49%). Finally, the survey data is indicating that birds are more vulnerable to trap nets than to gill nets. This result contradicts the data contained in the catch register data.

Considering bycatches of the recreational fleet is necessary to develop understanding of the total number of bird bycatch events and affected bird populations in Finland. A recent estimate derived from a national survey targeted at recreational fishers is suggesting that the recreational bird bycatch is markedly larger than the commercial one.

In **France** between January and June 2019, a significant observation effort dedicated to cetacean bycatch was deployed on French midwater pair trawlers operating in the Bay of Biscay, as 205 DaS were observed from a total of 740 fishing days (28%). All trawls were equipped with DDD-03H pingers. On 15 pairs operating in winter in the Bay of Biscay, 12 of them were observed at least once during winter 2019. The highest observation effort was deployed between weeks 7 to 16. A total of 31 common dolphins were observed bycaught. "Multilevel regression with post-stratification" (Mrp) modelling procedures suggested that highest bycatch risk occurred during weeks 1 to 5, and the raised the total mortality on PTM was estimated at 420 common dolphins (min = 70, max: 1030) between January and June 2019.

OBSCAMe is a **French** scientific program based on REM observation with the following objectives:

- to reinforce the observation of incidental bycatches of marine mammals, while diversifying the methods of data collection;
- to test the scientific contributions of on-board electronic observation, to better understand the interactions between gillnetters and common dolphins in the Bay of Biscay;
- to evaluate the cost/benefit ratio of these devices for the monitoring of marine mammal bycatches.

This project is coordinated by the French biodiversity agency (OFB), in partnership with French fishermen representatives' organizations, the scientific collaboration of IFREMER and *Observatoire Pélagis* (La Rochelle University-CNRS) and political supervision of the Ministries in charge of environment and fisheries. The REM system is composed of a central computer unit, a GPS antenna and a camera that records the images of the hauled net along the hull of the boat. In option, a second camera can record above the sorting table and pressure sensor can be install on the net hauler. The first phase, from January to May 2021 (5 voluntary vessels from 10 m to 18 m), permitted to validate the feasibility of REM for the purpose of protected species bycatch (e.g.

image quality, species identification, interest of second camera). A 4G system allowed to monitor in real-time the state of different sensors and camera, and to change the configuration remotely. 149 trips were observed corresponding to 1030 fishing hours (hauling). Only one harbour porpoise was observed. Birds and porbeagle shark were also observed bycaught, although not targeted in the context of the project. The second phase will start in October 2021 until December 2022 with 20 voluntary vessels (5 from the first phase and 15 new ones), and will try to cover the large diversity of fishing vessels, métiers and practices in the Bay of Biscay (see more: https://www.ascobans.org/fr/node/3062).

The Institute of Marine Research (IMR) in **Norway** reported that they have initiated a pilot project that is aimed at exploring the use of Remote Electronic Monitoring (REM) as a tool for registering marine mammal bycatches on Norwegian gillnet fishing vessels. Registrations will eventually be done automatically using a supervised machine learning approach. Initial results may be forthcoming by late 2022. If this kind of monitoring is successful, IMR plans to install REM on up to 30 gillnet vessels to supplement current bycatch monitoring efforts. It is expected that this will substantially increase (more than double) the overall sampling coverage for the gillnet fleet and provide important ancillary bycatch related data, e.g. net drop-out rates during hauling. It will also allow verification of fisher identifications of frequently misidentified species (harbour seals and young grey seals). It is likely that this system can also be used to monitor bycatches of other groups of animals, e.g. birds.

Azti institute in **Spain** is carrying out the MITICET pilot project, with a first phase conducted from February to May 2021 and will continue with a second phase from November 2021 until May 2022. It consists of the monitoring of cetacean bycatch with an Electronic Monitoring System (EMS) and evaluating the efficiency of pingers (DDD-03H) in bottom pair trawlers (PTB_MPD) in area 27.8.c in the Bay of Biscay. Although the pinger trials will be conducted during the project period, the EMS will be running from February 2021 to May 2022, which will provide over a year’s worth of data about the cetacean bycatch of this fleet.

The innovation of the MITICET project comes from the application of remote electronic monitoring on board fishing boats for the observation of the accidental capture of cetaceans, as well as taking advantage of the dynamics of alternating sets between the two vessels in the pair team to devise a simple and robust experimental design. This allows the application of an economic and affordable working method, based on the repetition of a high number of alternate fishing hauls (with and without ADDs), accompanied by a specific data treatment for data series with a high proportion of observations. The high number of observations of fishing operations to be observed with the EMS should allow statistically significant and therefore conclusive results on the effect of pingers under normal fishing conditions; With this, it will be possible to conclude on its real effectiveness in commercial fishing where such mitigation is sought.

Another **Spanish** on-board sampling program for monitoring the bycatch of marine mammals and other PETS (Protected, Endangered and Threatened Species), carried out by the Spanish General Secretariat for Fisheries of the Ministry of Agriculture, Fisheries and Food (SGP-MAPA) with the support of the Spanish Institute of Oceanography (IEO), arises as a result of the DGMARE's request for advice to ICES in relation to the analysis of certain measures aimed at reducing the mortality of the common dolphin in the Bay of Biscay.

It is focused on the observation of the Spanish bottom gillnet and pair trawling fleets in waters of the Cantabrian-Northwest national fishing ground (ICES Divisions 27.8.c and 27.9.a) and French waters of the Bay of Biscay (ICES Divisions 27.8.a.b.d). The initial duration of this first pilot program was 1 year, starting in September 2020.

The objective of this specific on-board observation program for marine mammals was two-fold:

- Firstly, to establish a program specifically aimed at monitoring the bycatch of vulnerable species, adding other species to cetaceans (elasmobranchs, turtles, birds and invertebrates) to optimize the investment required in the execution of the program;
- Secondly, to obtain data that can be compared with those collected by DCF monitoring program to statistically determine the possible discrepancy between the two, so that it allows determining the appropriate methodological changes and / or the increase in the coverage necessary for the on-board observation program to properly estimate bycatch.

Five sampling strata are established. The sampling will be stratified random with annotation of rejections. The sampling effort will be distributed among the strata, trying to cover 2% of the total number of trips in each stratum, the minimum level recommended by FAO for onboard sampling of vulnerable species (FAO, 2019).

The data collected in this program during 2020 were included in the Spanish data submitted to WGBYC in 2021.

The first pilot program was extended and continued without gaps from August 2021 (for one more year at the moment). In this second phase the observation coverage has been increased by 50%, new observation areas have been added (ICES Divisions 27.9.a and 27.8.c) and also new sampling strata (bottom otter trawl in 27.8.c, 27.9.a and 27.8.a.b.d.e, the small-scale fleet in 27.8.c and 27.9.a, and purse seines in 27.8.c and 27.9.a).

In Mediterranean **Spanish** waters following the 2016 Recommendation of RCM Med&BS-LP on pilot studies for the assessment of incidental catches of birds, mammals, reptiles and fish, the RCG Med&BS-LP 2017 agreed to carry out three pilot studies in the period 2018-2020.

The aim of the pilot studies is to assess the impact of the main fisheries on vulnerable species and to collect accurate information on these species in terms of quantities, gears, temporal and spatial areas.

Based on this list and end user needs, starting from 2018, Spain are carrying out three pilot studies on a yearly basis:

- 2018: Pilot study for assessing incidental catches of vulnerable species from bottom trawls. It has been carried out in all Spanish GSAs (GSA01, GSA02, GSA05, GSA06 and GSA07). This pilot study was implemented simultaneously with the onboard observer program to monitor and record data of retained catches and discards. Observers on board had instructions for also collecting data on incidental bycatch species. The mean sampling coverage was 1.3%.
- 2019: Pilot study for assessing incidental catches of vulnerable species from set longlines. It has only been carried out in the GSAs 01 and 02. In the others GSAs set longliners operating regularly in the sampling ports were not available. This pilot study has been planned and developed only focused on bycatch. The mean sampling coverage was 2.31% in GSA01 and 6.25% in GSA02.
- 2020: Pilot study for assessing incidental catches of vulnerable species from set nets initially planned for 2020 it only started in the 3rd/4th quarter because of the Covid pandemic. It has continued in 2021. The sampling was targeted at GSAs 01, 05 and 06. There are no results yet.

The proposed métiers and year of sampling are in agreement with the GFCM planned incidental catch sampling programme which would be performed in the period 2018-2020 (Mid-term strategy (2017-2020) towards the sustainability of Mediterranean and Black Sea fisheries). The data collected in this program during year 2019 and 2020 were included in the Spanish data submission to WGBYC in 2021.

In 2020 and 2021 in **Sweden**, Slu Aqua have been conducting research and monitoring of bycatch using various camera-based methods. The initial aims of one project component were to a) identify effective portable REM systems for use in Swedish small-scale fisheries monitoring of bycatch and b) run a monitoring program to test their utility compared to self-reported catch data. During early stages of sourcing and testing REM systems, it became clear that there were no suitable portable REM systems available. Portable REM systems are needed to achieve a randomized data collection where REM systems are swapped regularly between randomly selected boats. It can also be more cost effective to have smaller cheaper REM systems where technicians are not needed when installing the system on the boats. A number of portable systems were then developed in-house at SLU. Two of the systems have gone through multiple prototypes stages and have been in use on small-scale vessels since early 2020 gathering data on catch rates, bycatch rates and location of bycatch. Up to 11 fishermen are now using the portable REM systems continuously collecting data on bycatch of protected species in small scale fisheries.

In the southwest **United Kingdom** EM systems have been deployed on a few inshore netters as a way of validating skipper self-reporting of cetacean bycatch via a self-reporting app under the CleanCatch UK initiative. Results so far are promising and indicate that validated self-reporting may provide useable data for bycatch assessments, particularly on small boats and when suitably enthusiastic and committed skippers are found to participate. Unvalidated self-reporting data are also being collected on some other boats, but the accuracy of reporting rates is harder to evaluate, and no information is currently available on this data source.

The project "Addressing the interaction between Small Scale Fisheries (SSF) and marine megafauna in **Greece**" (INCA, 2020 - 2022), funded by the MAVA foundation, is carried out by WWF-Greece, HCMR and the Aristotle University. It is aiming to provide robust data for the assessment of the impact of fishing activities on key species of marine mammals, monk seal and sea turtles at selected areas of the Aegean and the eastern Ionian Seas. It will also contribute to the development of mitigation proposals including the establishment of a fair national compensatory system for small-scale fishers and incidental bycatch reduction measures. During the first phase of the project (July to October 2020), the projects 4 field teams visited more than 450 ports, recorded up to 5500 SSF vessels, and conducted 1000 interviews with fishers. During phase 2 (January to December 2021) 5 of the most important megafauna interaction hotspots will be sampled through onboard observations. Thanks to these on-the-ground field research, biological, and economic damages will be analyzed, and concrete solutions will be identified to mitigate SSF and marine megafaunal interactions.

The Cyprus Bycatch Project (2018-2022), funded by the MAVA Foundation, is coordinated by BirdLife International, BirdLife Cyprus, Enalia Physis Environmental Research Centre, the Society for the Protection of Turtles and the University of Exeter, closely with the regional MedBycatch project. It is linking efforts across the island of **Cyprus** to increase knowledge on the occurrence of bycatch and identify and implement measures to reduce the impact of bycatch on vulnerable species. The project is engaging on policy frameworks related to bycatch, including community-based management of MPAs. Following the standardized protocols of the General Fisheries Commission for the Mediterranean (GFCM) and using trained onboard observers and data self-reported by fishermen, project partners carried out research at sea to understand the spatio-temporal distribution of priority species and how these are affected by bycatch. The data gathered showed that turtles and elasmobranch species are the taxa most affected by fishing operations and that there is a need to invest more effort and time on these taxa during the next phase (2020-2022) (Cyprus Bycatch Projec, Website).

Apart from national projects a **multi-national** project, "Understanding Mediterranean multi-taxa bycatch of vulnerable species and testing mitigation: a collaborative approach" (the **MedBycatch** project) was established with the aim to support Mediterranean countries in developing a common standardized data collection methodology and in testing appropriate mitigation solutions to be potentially replicated at the regional level, with a view to providing elements for the formulation of national/regional strategies towards the reduction of the incidental catch of vulnerable species (including sea turtles, seabirds, cetaceans and seals, sharks and rays and corals & sponges) and the sustainability of fisheries. It is implemented by 7 organisations (Birldlife Europe & Central Asia, FAO, IUCN, ACCOBAMS RAC/SPA, WWF Med and MEDASSET) with 5 countries participating (Croatia, Italy, Morocco, Tunisia, Turkey) in three separate geographic areas of the Mediterranean Sea (Adriatic Sea; Alboran Sea; Sicily Channel; Central Aegean & Levantine Basin). The implementation of the MedBycatch project involves field observation programmes (onboard, at landing sites), interviews and self-sampling operations, across different types of fishing gear (i.e. bottom trawls, gillnets and demersal longlines), as well as training, awareness raising, identification and testing of mitigation techniques (Carpentieri *et al.*, 2021). The second phase of the MedBycatch project (July 2020-October 2022) aims to build on the results from the successful implementation of the observation programmes during the first phase (September 2017-June 2020) and to push forward to reduce bycatch in the Mediterranean, by testing mitigation tools and techniques. Existing mitigation tools, such as circular hooks for longline fishing, turtle excluder devices (TEDs) for trawls and LED lights for static nets will be tested for their efficiency per taxa and fishing gear. As well as modifications to fishing techniques, such as deployment methods and gear configurations will also be assessed in terms of their effectiveness.

A first effort to assess the actual extent, and the characteristics of accidental seabird bycatch in gillnets and longlines at 17 Special Protection Areas of the **Aegean and the Ionian Sea**, had been undertaken in 2009 by the Hellenic Ornithological Society in collaboration with HCMR (Hellenic Centre for Marine Research) and the University of Patras, within the framework of a LIFE-Nature project entitled “Conservation actions for the Mediterranean Shag and Audouin’s Gull in Greece, including the inventory of relevant marine IBAs” (LIFE07 NAT/GR/00285). Although no seabird bycatch has been recorded during 166 days of survey on board fishing vessels in the Aegean and Ionian Seas, 241 questionnaires filled in by fishermen indicated significant bycatch rates (LIFE07 NAT/GR/000285). The study indicated that, Audouin’s Gulls were caught primarily by longlines, Mediterranean shag in nets but to a lesser degree, while the most common victim of bycatch were Cory 's and Yelkouan Shearwaters which mostly get caught in bottom set longlines (Layman's Report. LIFE07 NAT/GR/000285)

A most recent study, entitled “Fishers, Sea turtles and Sharks: Alliance for Survival”, funded by the Green Fund, was carried out in 2018 in five important ports of **Greece**, by MEDASSET (Mediterranean Association to Save the Sea Turtles) in collaboration with the NGO i-Sea. A bottom-up approach was used to utilize fishers and fisheries stakeholders’ knowledge and perceptions of incidental capture. The majority of the surveyed fishers (65%) stated that they had at least one sea turtle incidental capture and/or shark species during the last year. Netters (GNS= Set Gillnets (anchored), GTN=Combined gillnets-trammel nets, GTR= Trammel nets) and bottom trawlers (OTB) mostly interacted with sea turtles. Seasonally, fishers stated that the highest frequency of sea turtle bycatch is from April to August (Touloupaki *et al.*, 2020).

3.6 Auxiliary data (i.e. strandings, interviews) indicative of the impact of bycatch

3.6.1 Strandings networks to inform on marine mammal bycatch

The analyses of strandings are an important source of biological data, species composition, and distribution, but also contribute to knowledge on cause of death, including bycatch. When deployment of observers can be challenging and observation effort below EU requirements, examination of stranded animals can provide relevant information on impact of fisheries on marine megafauna. They can be considered as another view of the bycatch process. Many countries provided data on strandings, from which bycatch can be identified as a cause of death. Along North-East Atlantic coasts, common dolphin was the most reported species, whereas harbour porpoises were commonly reported along the North Sea coasts in 2019 and 2020 (Table 4.ab).

Please note that only species including individuals presenting bycatch evidence were considered here.

In **Belgium**, the Royal Belgian Institute of Natural Sciences (RBNIS) organises the collection of strandings. In cooperation with the University of Liège, a single database can be consulted online (http://www.marinemammals.be/*)*. In 2019 and 2020 respectively, 52 and 67 harbour porpoises were recorded stranded along Belgian coasts, and 14% of examined carcasses presented evidence of death in fishing gears (Haelters *et al.*, 2020). This proportion ranged between 33 and 78% for seals.

Along the coasts of **Denmark,** the stranding network is run by the Danish Nature Agency in collaboration with the Fisheries and Maritime Museum and the Zoological Museum, Natural History Museum of Denmark. The increasing number of carcass examination by Danish network suggested that in 2019 and 2020 21% of examined carcasses died in fishing gears.

Along **French** coasts, 400 trained volunteers or employees constitute the French stranding network (Réseau National Echouage), co-ordinated by the Joint Service Unit *Observatoire Pelagis*, UMS 3462 University of La Rochelle/CNRS. It is funded by the Ministry in charge of the environment and the French Office for Biodiversity. The network collects standardized data following a common protocol, and a database can be consulted online (http://pelagis.in2p3.fr/public/histo-carto/index.php). Since the origin of the network in the 1980s, recently common dolphin strandings have reached unprecedent records with 1142 strandings collected in 2019 and 1289 in 2020. Between 64 and 72% of examined dolphins were attributed a cause of death as bycatch. Harbour porpoises were the second most frequent species found stranded (279 in 2019 and 215 in 2020), and bycatch evidence were detected on more than a quarter of examined porpoises. A few dozen striped and bottlenose dolphins were examined, and few individuals showed bycatch evidence. Correcting the stranding by drift conditions and probability of sinking (following Peltier *et al.*, 2016) provided bycatch estimates of 9700 (CI 95% [6890;14 200]) common dolphins in 2019 and 8700 (CI 95% [6320;13 050]) in 2020 in the Bay of Biscay and Western Channel.

In **Germany** (Schleswig-Holstein area), strandings are collected by National Park rangers who control the coastline throughout the year. Carcasses are collected and transported to the University of Veterinary Medicine in Hannover, where marine mammals are necropsied by official veterinarians. A large proportion of stranded marine mammals present advanced decomposition status which hinders the ability to define cause of death. In 2019 and 2020, only around forty carcasses were examined whereas more than 200 porpoises were recovered. Very few individuals presented bycatch evidence.

In **Greece** stranding records are systematically collected using specific protocols since 2010 by port authorities, who control the coastline along the mainland and Greek islands of the Ionian, Aegean and the Levantine Seas (Eastern Mediterranean). Although there is no official central database, under the auspices of the Ministry of Environment the records of the port authorities are reported to a specific Committee consisting of representatives of the Hellenic Centre for Marine Research, certain specialised NGOs and the Veterinary School of the Aristotle University. In 2019 and 2020, 206 records of cetaceans were recorded including bottlenose dolphin, common dolphin and stripped dolphin, as well as a small number of harbour porpoise, sperm whale and beaked whales. A large proportion of stranded marine mammals present advanced decomposition status that hinders the ability to define species and cause of death. In 2019 and 2020, only

24% of the records seem to be related to human interaction like vessel collision or fisheries like net or hook entanglement.

Italy has a centralised database on cetacean strandings hosted by the University of Pavia holding data systematically collected from 1986 (http://mammiferimarini.unipv.it/). Concerning cetacean specimens showing clear marks of fishing gears or found wrapped into nets along 8000+ km of Italian coasts, four bottlenose dolphins, one striped dolphin and two sperm whales were recorded in 2019; and three bottlenose dolphins in 2020. For the Italian data the relative weight of likely bycaught specimens provided in Table 4a does not include evidence from necropsies on fresh carcasses.

In **the Netherlands,** the strandings network consists of a consortium of a number of organizations and volunteers. The observation effort is unequal along Dutch coasts (approaching 100% in Western coasts, but very low in uninhabited Frisian islands and Wadden Sea). Approximately 10 to 20% of carcasses are necropsied every year at the Faculty of Veterinary Medicine of Utrecht University. In 2019 and 2020, respectively 429 and 508 harbour porpoises were recovered, and 2 to 11% of examined carcasses were considered bycaught.

The **Portuguese** stranding network is coordinated by the National Institute of Conservation of Nature and Forests (ICNF). Dedicated 24/7 on-call regional stranding teams have been in place continuously since 2000 in the Western North-Central coast (run by the Portuguese Wildlife Society), from 2010 to 2017 (run by the Portuguese Wildlife Society) and reactivated in 2020 (run by the University of the Algarve) in the Southern region. No stranding team existed in the Western Central-south region up to 2020. In areas where no stranding teams operate, only basic data (biometrics, species identification) are registered only by maritime authorities and Nature Protected Areas staff, but no necropsies are performed. The work of local stranding networks in some areas allows the analysis of carcasses to assess mortality caused by fisheries interactions. For instance, for 2019 in the North-Central western coast, of all animals stranded, about 50% were analysed and incidental capture was attributed in about 60% of cases. This was particularly evident for two species, common dolphin and harbour porpoise. In 2020, with a new local stranding network operating in the Southern coast, the level of sampling was maintained (50% of the strandings analysed by the local stranding teams), but about 76% of the analysed cetaceans were considered to have died due to interaction with fisheries, particularly evident for 3 species (common and bottlenose dolphin and harbour porpoise).

Along **Spanish** coasts, the NGO CEMMA is in charge of the coordination of the Galician stranding network since the early 1990s. Since 1999, the Ministry of Environment-Xunta de Galicia provide financial support and grant administrative authorizations to cover the 1,190km of the coast of Galicia. Common dolphins are the most commonly recovered species (≈200 dolphins every year). The proportion of bycaught animals in examined carcasses stands at around 60% in 2019 and 2020, and is much the same for common dolphin and harbour porpoise. A few dozen bottlenose dolphins were reported, and a large proportion of examined individuals presented bycatch evidence.

In **Sweden**, the National Veterinary Institute (SVA) and the Swedish Museum of Natural History perform post-mortem examinations on stranded and bycaught harbour porpoises from Swedish waters. From 2020, numbers of porpoises examined per year has increased to approximately 30. The vast majority originate from the west coast and only a small number are collected from the southwest coast were Belt Sea and Baltic Sea porpoise populations overlap. From 2006-2020, 140 porpoises were examined. Twelve of these were found entangled in fishing gear (known bycatch). The remaining 128 animals had stranded. Of the stranded animals, 13 (10%) were determined to have died in a fishery interaction and an additional 20 (16%) were diagnosed as probable bycatch.

The collaborative Cetacean Strandings Investigation Programme (CSIP) in the **United Kingdom** is a consortium of partner organizations (Zoological Society of London, Scottish Rural University College (Inverness), the Natural History Museum and Marine Environmental Monitoring) funded by Defra and the UK Devolved Governments of Scotland and Wales. The CSIP is collectively tasked with recording information on all cetaceans, marine turtles and basking sharks that strand around UK shores each year and with the routine investigation of causes of mortality through necropsy of suitable strandings. Harbour porpoises are the most commonly discovered species, as stranding levels were close to 400 carcasses both in 2019 and 2020.A few dozen were examined, and the proportion of bycaught porpoises was below 7%. This rate reached 30% for common dolphins in both years.

In 2019 and 2020, 10 countries provided information on stranded cetaceans. Bycatch evidence was recorded on 11 different species (9 cetaceans and 2 seals). Common dolphins were the most frequently recorded species (up to 2125 dolphins in 2020 from Portugal to UK coasts). They also highlighted highest proportions of bycaught animals as it reached an average of 61% in 2020 (highest proportion along the Iberian Peninsula and Bay of Biscay). A total of 1655 harbour porpoises were reported stranded from the Iberian Peninsula to Denmark, with probable bycatch proportions ranging from 0% in Germany in 2020 to 60% in Spain in 2019. Some very high ratios between bycaught individuals compared to all examined carcasses must be carefully interpreted, when they are based on very few examinations (e.g. Minke whales in Portugal and UK, or Risso's dolphins in Spain and France). In that case, they can't be considered as an indicator of bycatch intensity but only as general evidence of bycatch occurrence.

3.7 Impact of COVID-19

The effect of the COVID-19 pandemic on work practices have been far-reaching, including within the marine monitoring sector. Many WGBYC members have reported changes to data collection levels for DCF and bycatch monitoring programmes as a result of work restrictions imposed.

Overall, between 2019 and 2020 there was a notable decrease in the amount of at-sea-observer data reported to WGBYC, and a corresponding increase in data from all other observer categories, most notably a significant increase in port-observer and vessel-crew observer sampling (Fig 3.3).

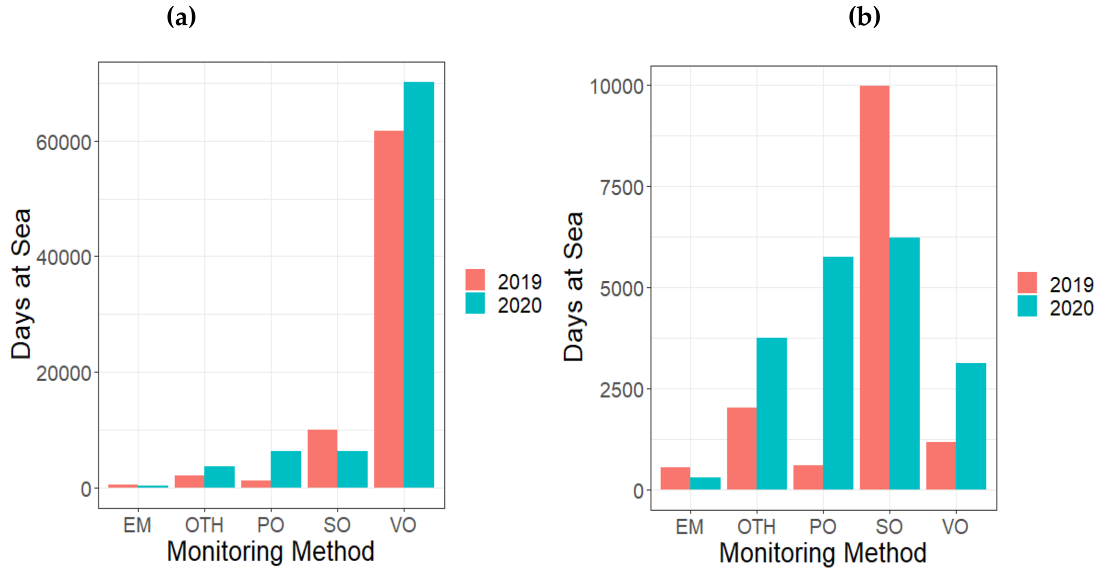

Figure 3.3. Total monitored/observed days at sea reported per monitoring method (2019 and 2020 data combined): at-sea-observers (SO), electronic monitoring (EM), port observers (PO), and vessel crew observers (VO). Data is summarised with (a) and without (b) the aformentioned logbook data, section 1.3.

Considering only monitored days at sea with at-sea-observers between 2019 and 2020, differences are noted for most gears (Figure 3.4), with a notable increase in nets (GN – métier level 3), while all other gears decreased effort. When we relate the monitoring effort with at-sea-observers in relevant gears such as nets (GN) and trawls (pelagic- PT and bottom -OT) by ecoregion (Figure 3.5), the increase in monitoring effort in nets in 2020 is from the Aegean Levantine Sea and Ionian Sea and the Central, while in other ecoregions monitoring effort in nets generally decreased. In trawl gears, the monitoring effort was notably affected and decreased in all regions, with the exception of Icelandic waters.

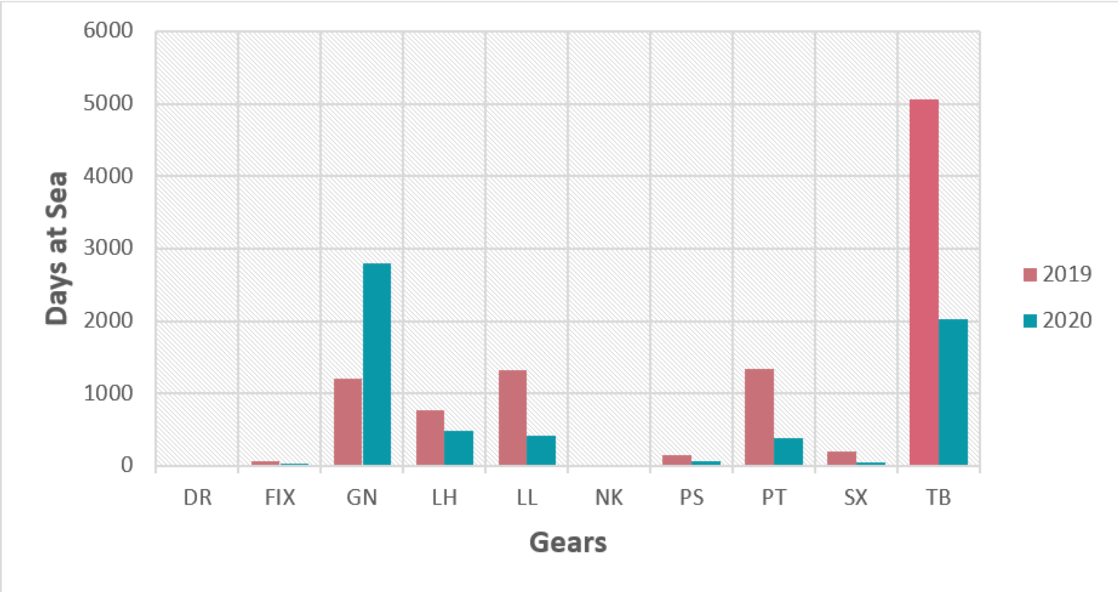

Figure 3.4. Monitored days at sea with onboard observers by gear type (métier level 3)

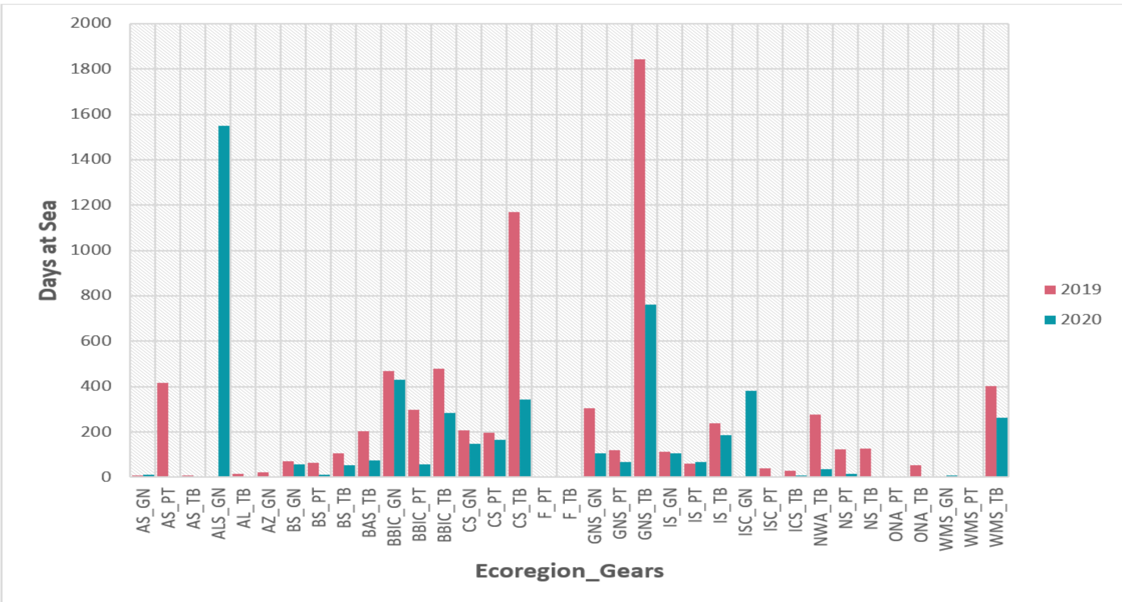

Figure 3.5. Monitored days at sea with onboard observers for metier level 3 in gears GN, PT and TB by ecoregion. AS-Adriatic Sea; ALS-Aegean Levantine Sea; AZ – Azores; BS -Baltic Sea; BAS-Barents Sea; BBIC – Bay of Biscay and Iberian Coast; CS-Celtic Sea; F- Faroes; GNS – Great North Sea; IS -Icelandic Sea; ISC – Ionian Sea and the Central; NWA – North-western Atlantic; Oceanic Northeastern Atlantic; VWS – Western Mediterranean Sea

3.8 Conclusions

- The quality and scope of the information provided by the WGBYC/ICES datacall for 2019 and 2020 was variable.
- Bycatch of marine mammals was observed in all but two ecoregions and across several gear types including nets, traps, longlines and trawls (pelagic and bottom trawl). Seabirds are reported as bycaught in all ecoregions, and depending on species specific feeding behaviour, are mainly taken in nets and longlines. In 2018 marine turtles were recorded primarily in nets, longlines and trawl gears in six ecoregions.

- Most countries rely on the DCF sampling programme to monitor marine mammal and other protected species bycatch. As the DCF sampling program has been shown to underestimate bycatch events in some métiers, a number of countries have been running pilot projects or dedicated programs to monitor bycatch of PETS to generate improved bycatch rate estimates.
- Relying exclusively on observations carried out under the DCF may lead to underestimation or at worst non-detection of bycatch events. WGBYC are aware of improvements to monitoring protocols within the DCF but reiterate that further consideration could be given to sampling designs and protocols moving forward to data collection driven by the EU-MAP and the Technical Conservation Measures Regulation.
- WGBYC continues to have insufficient data to provide bycatch rates according to pinger functionality and/or presence/absence in relevant métiers.
- Monitoring coverage per métier and vessel size was highly variable within each ecoregion and ICES Division, with some countries primarily monitoring vessel sizes and gear types only required under Reg. 2019/1241 (>15 m for set-nets and pelagic trawls). Increased sampling is required on smaller vessels, which make up most of the European fleet and would likely account for a significant proportion of bycatch.
- The use of strandings data highlighted probable bycatch between 11 species and fishing gears (9 cetacean species and 2 seal species) recorded by 10 countries. In certain areas when corrected by physical parameters such as drift conditions, strandings can provide bycatch estimates. However, in all cases, these data constitute an overview of an often scarcely observed process that should be encouraged.
- There was a notable change in the monitoring methods employed in data reported to WGBYC between 2019 and 2020. These differences were evident for most gears, with a notable increase in reporting of monitoring of nets, primarily driven by monitoring in the Aegean, Levantine Sea and Ionian Sea and the Central ecoregions. Monitoring effort from trawl gears decreased in all regions except Icelandic waters.
- Information provided through the WGBYC data call and other additional and relevant sources of information is limited. For many areas and métiers, there is insufficient monitored effort to enable any assessment of the overall impact of fisheries on most protected species.
- WGBYC expect that the consistency of bycatch data at a regional scale will be improved through EU-MAP and thereby ICES will be in a position to give more robust advice on the impact of fisheries on protected and vulnerable species. However, this will only be achieved if countries' take full account of the necessary sampling protocols for PETS and carry out bycatch monitoring in the relevant métiers with sufficient observer coverage.

Table 3.1. Summary table of countries providing data submissions to ICES WGBYC with data on fishing effort, observer effort (either days at sea or other measurement, e.g. effort per haul or set), and bycatch records. Green = Data submission received, Pale Green = data received, but no records, White = no data received.

	Fishing Effort				Monitoring Effort				Bycatch Events			
Country	**2017**	**2018**	**2019**	**2020**	**2017**	**2018**	**2019**	**2020**	**2017**	**2018**	**2019**	**2020**
Malta (MT)			Green	Green			Green	Green			Green	Pale Green
Cyprus (CY)		Green	Green	Green		Green	Green	Green		Green	Green	Green
Norway (NO)		Green	Green	Green		Green	Green	Green		Green	Green	Green
Belgium (BE)	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Pale Green	Pale Green
Denmark (DK)	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Estonia (EE)			Green	Green			Green	Green			Green	Green
Finland (FI)		Green	Green	Green		Green	Green	Green		Green	Green	Green
France (FR)		Green	Green	Green		Green	Green	Green		Green	Green	Green
Germany (DE)	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Pale Green
Greece (GR)		Green	Green	Green		Green	Green	Green		Green	Green	Green
Iceland (IC)		Green	Green	Green		Green	Green	Green		Green	Green	Green
Ireland (IE)		Green	Green	Green		Green	Green	Green		Green	Green	Green
Italy (IT)		Green	Green	Green		Green	Green	Green		Green	Green	Green
Latvia (LV)		Green	Green	Green		Green	Green	Green		Green	Green	Green
Lithuania (LT)				Green				Green				Pale Green
Netherlands (NL)		Green	Green	Green		Green	Green	Green		Green	Green	Green
Poland (PL)		Green	Green	Green		Green	Green	Green		Green	Green	Pale Green
Portugal (PT)		Green	Green	Green		Green	Green	Green		Green	Green	Green
Slovenia (SI)		Green	Green	Green		Green	Green	Green		Green	Green	Green
Spain (ES)		Green	Green	Green		Green	Green	Green		Green	Green	Green
Sweden (SE)		Green	Green	Green		Green	Green	Green		Green	Green	Green
United Kingdom (GB)		Green	Green	Green		Green	Green	Green		Green	Green	Green

Table 3.2a Reported fishing and monitoring days and number of bycatch specimens and incidents in 2019 provided through the ICES WGBYC 2021 data call by ecoregion.

Year	Ecoregion	ICES Area / GFCM GSA	Métier 3	Taxa	Species	Total Observed Effort (Days at Sea)	Fishing Days	Monitoring Coverage	Incidents	No. Specimens
2019	Azores	27.10.a	Longlines	Turtle	*Dermochelys coriacea*	89.00	556.00	16.01%	1	1
2019	Baltic Sea	27.3.b.23	Nets	Bird	*Alca torda*	224.00	6088.17	3.68%	1	1
2019	Baltic Sea	27.3.b.23	Nets	Bird	*Gavia arctica*	224.00	6088.17	3.68%	2	2
2019	Baltic Sea	27.3.b.23	Nets	Bird	*Melanitta fusca*	224.00	6088.17	3.68%	3	3
2019	Baltic Sea	27.3.b.23	Nets	Bird	*Melanitta nigra*	224.00	6088.17	3.68%	1	3
2019	Baltic Sea	27.3.b.23	Nets	Bird	*Phalacrocorax carbo*	224.00	6088.17	3.68%	10	10
2019	Baltic Sea	27.3.b.23	Nets	Marine mammal	*Phoca vitulina*	224.00	6088.17	3.68%	2	2
2019	Baltic Sea	27.3.b.23	Nets	Marine mammal	*Phocoena phocoena*	224.00	6088.17	3.68%	6	6
2019	Baltic Sea	27.3.b.23	Nets	Bird	*Podiceps cristatus*	224.00	6088.17	3.68%	1	1
2019	Baltic Sea	27.3.b.23	Nets	Bird	*Somateria mollissima*	224.00	6088.17	3.68%	30	45
2019	Baltic Sea	27.3.b.23	Nets	Bird	*Uria aalge*	224.00	6088.17	3.68%	35	50
2019	Baltic Sea	27.3.c.22	Nets	Bird	*Aves*	182.00	15191.00	1.20%	1	1
2019	Baltic Sea	27.3.c.22	Nets	Bird	*Phalacrocorax carbo*	182.00	15191.00	1.20%	1	2

Year	Ecoregion	ICES Area / GFCM GSA	Métier 3	Taxa	Species	Total Observed Effort (Days at Sea)	Fishing Days	Monitoring Coverage	Incidents	No. Specimens
2019	Baltic Sea	27.3.c.22	Nets	Marine mammal	*Phoca vitulina*	182.00	15191.00	1.20%	9	10
2019	Baltic Sea	27.3.c.22	Nets	Marine mammal	*Phocoena phocoena*	182.00	15191.00	1.20%	9	10
2019	Baltic Sea	27.3.c.22	Nets	Bird	*Somateria mollissima*	182.00	15191.00	1.20%	1	3
2019	Baltic Sea	27.3.d.24	Longlines	Bird	*Uria aalge*	6.00	847.00	0.71%	1	1
2019	Baltic Sea	27.3.d.25	Nets	Bird	*Uria aalge*	5.00	13991.00	0.04%	3	6
2019	Baltic Sea	27.3.d.26	Nets	Bird	*Melanitta fusca*	23.00	22356.72	0.10%	1	168
2019	Baltic Sea	27.3.d.28.1	Nets	Bird	*Anatidae*	12875.00	16009.75	80.42%	1	3
2019	Baltic Sea	27.3.d.28.1	Traps	Marine mammal	*Halichoerus grypus*	9314.00	11323.25	82.26%	1	1
2019	Baltic Sea	27.3.d.28.1	Traps	Bird	*Phalacrocorax carbo*	9314.00	11323.25	82.26%	4	10
2019	Baltic Sea	27.3.d.28.2	Nets	Bird	*Anatidae*	1452.00	2713.83	53.50%	1	3
2019	Baltic Sea	27.3.d.28.2	Traps	Marine mammal	*Halichoerus grypus*	501.00	644.58	77.73%	1	1
2019	Baltic Sea	27.3.d.29	Longlines	Marine mammal	*Halichoerus grypus*	38.00	164.00	23.17%	1	3
2019	Baltic Sea	27.3.d.29	Nets	Bird	*Aythya*	16798.00	27416.50	61.27%	2	4
2019	Baltic Sea	27.3.d.29	Nets	Bird	*Clangula hyemalis*	16798.00	27416.50	61.27%	1	1

Year	Ecoregion	ICES Area / GFCM GSA	Métier 3	Taxa	Species	Total Observed Effort (Days at Sea)	Fishing Days	Monitoring Coverage	Incidents	No. Specimens
2019	Baltic Sea	27.3.d.29	Nets	Marine mammal	*Halichoerus grypus*	16798.00	27416.50	61.27%	3	4
2019	Baltic Sea	27.3.d.29	Nets	Bird	*Mergus merganser*	16798.00	27416.50	61.27%	1	1
2019	Baltic Sea	27.3.d.29	Nets	Bird	*Mergus serrator*	16798.00	27416.50	61.27%	2	3
2019	Baltic Sea	27.3.d.29	Nets	Bird	*Phalacrocorax carbo*	16798.00	27416.50	61.27%	3	6
2019	Baltic Sea	27.3.d.29	Nets	Bird	*Podiceps cristatus*	16798.00	27416.50	61.27%	1	1
2019	Baltic Sea	27.3.d.29	Nets	Bird	*Somateria mollissima*	16798.00	27416.50	61.27%	4	24
2019	Baltic Sea	27.3.d.29	Traps	Marine mammal	*Halichoerus grypus*	5050.00	7773.00	64.97%	7	11
2019	Baltic Sea	27.3.d.29	Traps	Bird	*Phalacrocorax carbo*	5050.00	7773.00	64.97%	3	3
2019	Baltic Sea	27.3.d.30	Bottom trawls	Marine mammal	*Halichoerus grypus*	30.00	67.00	44.78%	1	1
2019	Baltic Sea	27.3.d.30	Nets	Bird	*Bucephala clangula*	43.00	24448.67	0.18%	1	1
2019	Baltic Sea	27.3.d.30	Nets	Marine mammal	*Halichoerus grypus*	43.00	24448.67	0.18%	2	2
2019	Baltic Sea	27.3.d.30	Nets	Bird	*Mergus*	43.00	24448.67	0.18%	2	12
2019	Baltic Sea	27.3.d.30	Nets	Bird	*Mergus merganser*	43.00	24448.67	0.18%	2	9
2019	Baltic Sea	27.3.d.30	Nets	Bird	*Mergus serrator*	43.00	24448.67	0.18%	1	1

Year	Ecoregion	ICES Area / GFCM GSA	Métier 3	Taxa	Species	Total Observed Effort (Days at Sea)	Fishing Days	Monitoring Coverage	Incidents	No. Specimens
2019	Baltic Sea	27.3.d.30	Nets	Bird	*Phalacrocorax carbo*	43.00	24448.67	0.18%	12	26
2019	Baltic Sea	27.3.d.30	Traps	Marine mammal	*Halichoerus grypus*	99.00	11450.83	0.86%	4	5
2019	Baltic Sea	27.3.d.30	Traps	Bird	*Mergus*	99.00	11450.83	0.86%	1	1
2019	Baltic Sea	27.3.d.30	Traps	Bird	*Phalacrocorax carbo*	99.00	11450.83	0.86%	6	9
2019	Baltic Sea	27.3.d.31	Nets	Bird	*Mergus*	8.00	15886.33	0.05%	3	25
2019	Baltic Sea	27.3.d.31	Nets	Bird	*Phalacrocorax carbo*	8.00	15886.33	0.05%	2	20
2019	Baltic Sea	27.3.d.31	Traps	Bird	*Gavia arctica*	60.00	15462.67	0.39%	1	1
2019	Baltic Sea	27.3.d.31	Traps	Marine mammal	*Halichoerus grypus*	60.00	15462.67	0.39%	14	20
2019	Baltic Sea	27.3.d.31	Traps	Bird	*Larus argentatus*	60.00	15462.67	0.39%	1	1
2019	Baltic Sea	27.3.d.31	Traps	Bird	*Mergus*	60.00	15462.67	0.39%	7	61
2019	Baltic Sea	27.3.d.31	Traps	Bird	*Mergus serrator*	60.00	15462.67	0.39%	1	1
2019	Baltic Sea	27.3.d.31	Traps	Bird	*Phalacrocorax carbo*	60.00	15462.67	0.39%	4	38
2019	Baltic Sea	27.3.d.32	Nets	Bird	*Anas platyrhynchos*	12823.00	19204.00	66.77%	7	58
2019	Baltic Sea	27.3.d.32	Nets	Bird	*Anatidae*	12823.00	19204.00	66.77%	3	7

Year	Ecoregion	ICES Area / GFCM GSA	Métier 3	Taxa	Species	Total Observed Effort (Days at Sea)	Fishing Days	Monitoring Coverage	Incidents	No. Specimens
2019	Baltic Sea	27.3.d.32	Nets	Bird	*Aythya*	12823.00	19204.00	66.77%	1	1
2019	Baltic Sea	27.3.d.32	Nets	Bird	*Clangula hyemalis*	12823.00	19204.00	66.77%	1	1
2019	Baltic Sea	27.3.d.32	Nets	Marine mammal	*Halichoerus grypus*	12823.00	19204.00	66.77%	1	12
2019	Baltic Sea	27.3.d.32	Nets	Bird	*Mergus*	12823.00	19204.00	66.77%	2	2
2019	Baltic Sea	27.3.d.32	Nets	Bird	*Mergus merganser*	12823.00	19204.00	66.77%	1	5
2019	Baltic Sea	27.3.d.32	Nets	Bird	*Phalacrocorax carbo*	12823.00	19204.00	66.77%	19	40
2019	Baltic Sea	27.3.d.32	Nets	Bird	*Somateria mollissima*	12823.00	19204.00	66.77%	4	4
2019	Baltic Sea	27.3.d.32	Traps	Bird	*Anas platyrhynchos*	1800.00	7153.00	25.16%	4	38
2019	Baltic Sea	27.3.d.32	Traps	Marine mammal	*Halichoerus grypus*	1800.00	7153.00	25.16%	1	2
2019	Baltic Sea	27.3.d.32	Traps	Marine mammal	*Lutra lutra*	1800.00	7153.00	25.16%	1	1
2019	Baltic Sea	27.3.d.32	Traps	Bird	*Mergus*	1800.00	7153.00	25.16%	1	1
2019	Baltic Sea	27.3.d.32	Traps	Bird	*Mergus serrator*	1800.00	7153.00	25.16%	1	1
2019	Baltic Sea	27.3.d.32	Traps	Bird	*Phalacrocorax carbo*	1800.00	7153.00	25.16%	8	15
2019	Bay of Biscay and the Iberian Coast	27.8.a	Nets	Bird	*Alca torda*	164.83	220741.60	0.07%	1	1

Year	Ecoregion	ICES Area / GFCM GSA	Métier 3	Taxa	Species	Total Observed Effort (Days at Sea)	Fishing Days	Monitoring Coverage	Incidents	No. Specimens
2019	Bay of Biscay and the Iberian Coast	27.8.a	Nets	Marine mammal	*Delphinus delphis*	164.83	220741.60	0.07%	4	4
2019	Bay of Biscay and the Iberian Coast	27.8.a	Nets	Bird	*Gavia stellata*	164.83	220741.60	0.07%	1	1
2019	Bay of Biscay and the Iberian Coast	27.8.a	Nets	Marine mammal	*Phocoena phocoena*	164.83	220741.60	0.07%	1	1
2019	Bay of Biscay and the Iberian Coast	27.8.a	Nets	Bird	*Uria aalge*	164.83	220741.60	0.07%	10	11
2019	Bay of Biscay and the Iberian Coast	27.8.a	Pelagic trawls	Marine mammal	*Delphinus delphis*	167.75	22886.82	0.73%	8	13
2019	Bay of Biscay and the Iberian Coast	27.8.b	Bottom trawls	Marine mammal	*Delphinus delphis*	164.07	123485.13	0.13%	4	8
2019	Bay of Biscay and the Iberian Coast	27.8.b	Bottom trawls	Bird	*Morus bassanus*	164.07	123485.13	0.13%	5	11
2019	Bay of Biscay and the Iberian Coast	27.8.b	Nets	Bird	*Melanitta nigra*	162.57	128345.78	0.13%	2	2
2019	Bay of Biscay and the Iberian Coast	27.8.b	Nets	Bird	*Morus bassanus*	162.57	128345.78	0.13%	2	3
2019	Bay of Biscay and the Iberian Coast	27.8.b	Nets	Bird	*Uria aalge*	162.57	128345.78	0.13%	12	439
2019	Bay of Biscay and the Iberian Coast	27.8.b	Pelagic trawls	Marine mammal	*Delphinus delphis*	50.95	8573.72	0.59%	4	16
2019	Bay of Biscay and the Iberian Coast	27.8.c	Rods and lines	Bird	*Morus bassanus*	32.00	7538.89	0.42%	1	9
2019	Bay of Biscay and the Iberian Coast	27.8.d.2	Rods and lines	Bird	*Morus bassanus*	75.00	2278.40	3.29%	1	2
2019	Bay of Biscay and the Iberian Coast	27.9.a	Longlines	Bird	*Morus bassanus*	185.00	29165.54	0.63%	10	11

Year	Ecoregion	ICES Area / GFCM GSA	Métier 3	Taxa	Species	Total Observed Effort (Days at Sea)	Fishing Days	Monitoring Coverage	Incidents	No. Specimens
2019	Bay of Biscay and the Iberian Coast	27.9.a	Longlines	Bird	*Puffinus mauretanicus*	185.00	29165.54	0.63%	1	1
2019	Bay of Biscay and the Iberian Coast	27.9.a	Nets	Bird	*Larus*	302.00	167598.46	0.18%	1	1
2019	Bay of Biscay and the Iberian Coast	27.9.a	Nets	Bird	*Larus michahellis*	302.00	167598.46	0.18%	3	4
2019	Bay of Biscay and the Iberian Coast	27.9.a	Nets	Bird	*Morus bassanus*	302.00	167598.46	0.18%	4	7
2019	Bay of Biscay and the Iberian Coast	27.9.a	Nets	Bird	*Phalacrocorax aristotelis*	302.00	167598.46	0.18%	1	1
2019	Bay of Biscay and the Iberian Coast	27.9.a	Nets	Marine mammal	*Tursiops truncatus*	302.00	167598.46	0.18%	1	1
2019	Bay of Biscay and the Iberian Coast	27.9.a	Surrounding nets	Marine mammal	*Delphinus delphis*	45.00	15715.00	0.29%	1	2
2019	Bay of Biscay and the Iberian Coast	27.9.a	Surrounding nets	Bird	*Larus michahellis*	45.00	15715.00	0.29%	1	5
2019	Celtic Seas	27.6.a	Bottom trawls	Bird	*Morus bassanus*	372.08	42212.44	0.88%	1	2
2019	Celtic Seas	27.6.a	Pelagic trawls	Marine mammal	*Halichoerus grypus*	109.00	3149.78	3.46%	3	3
2019	Celtic Seas	27.7.b	Pelagic trawls	Marine mammal	*Halichoerus grypus*	26.00	581.19	4.47%	4	4
2019	Celtic Seas	27.7.f	Bottom trawls	Bird	*Morus bassanus*	72.77	34875.60	0.21%	1	1
2019	Celtic Seas	27.7.f	Nets	Marine mammal	*Delphinus delphis*	59.33	2326.58	2.55%	2	2
2019	Celtic Seas	27.7.f	Nets	Marine mammal	*Halichoerus grypus*	59.33	2326.58	2.55%	5	7

Year	Ecoregion	ICES Area / GFCM GSA	Métier 3	Taxa	Species	Total Observed Effort (Days at Sea)	Fishing Days	Monitoring Coverage	Incidents	No. Specimens
2019	Celtic Seas	27.7.f	Nets	Bird	*Phalacrocorax carbo*	59.33	2326.58	2.55%	1	1
2019	Celtic Seas	27.7.f	Nets	Bird	*Uria aalge*	59.33	2326.58	2.55%	5	7
2019	Celtic Seas	27.7.f	Surrounding nets	Bird	*Larus argentatus*	11.00	209.50	5.25%	1	1
2019	Celtic Seas	27.7.g	Bottom trawls	Marine mammal	*Delphinidae*	172.93	65121.47	0.27%	1	1
2019	Celtic Seas	27.7.g	Bottom trawls	Marine mammal	*Delphinus delphis*	172.93	65121.47	0.27%	1	1
2019	Celtic Seas	27.7.g	Bottom trawls	Bird	*Morus bassanus*	172.93	65121.47	0.27%	1	1
2019	Celtic Seas	27.7.g	Bottom trawls	Marine mammal	*Phocoena phocoena*	172.93	65121.47	0.27%	1	1
2019	Celtic Seas	27.7.g	Nets	Marine mammal	*Phocoena phocoena*	52.00	3131.74	1.66%	1	1
2019	Celtic Seas	27.7.h	Nets	Marine mammal	*Delphinidae*	37.55	13539.73	0.28%	1	1
2019	Celtic Seas	27.7.j.2	Nets	Marine mammal	*Halichoerus grypus*	134.12	8231.76	1.63%	62	73
2019	Greater North Sea	27.3.a.20	Nets	Bird	*Alca torda*	311.00	9318.17	3.34%	1	1
2019	Greater North Sea	27.3.a.20	Nets	Bird	*Aves*	311.00	9318.17	3.34%	1	1
2019	Greater North Sea	27.3.a.20	Nets	Marine mammal	*Halichoerus grypus*	311.00	9318.17	3.34%	1	1
2019	Greater North Sea	27.3.a.20	Nets	Bird	*Phalacrocorax carbo*	311.00	9318.17	3.34%	1	1

Year	Ecoregion	ICES Area / GFCM GSA	Métier 3	Taxa	Species	Total Observed Effort (Days at Sea)	Fishing Days	Monitoring Coverage	Incidents	No. Specimens
2019	Greater North Sea	27.3.a.20	Nets	Marine mammal	*Phoca vitulina*	311.00	9318.17	3.34%	12	13
2019	Greater North Sea	27.3.a.20	Nets	Marine mammal	*Phocoena phocoena*	311.00	9318.17	3.34%	26	27
2019	Greater North Sea	27.3.a.20	Nets	Marine mammal	*Pinnipedia*	311.00	9318.17	3.34%	1	1
2019	Greater North Sea	27.3.a.20	Nets	Bird	*Somateria mollissima*	311.00	9318.17	3.34%	1	1
2019	Greater North Sea	27.3.a.20	Nets	Bird	*Uria aalge*	311.00	9318.17	3.34%	13	14
2019	Greater North Sea	27.3.a.21	Nets	Bird	*Alca torda*	51.00	3989.33	1.28%	15	35
2019	Greater North Sea	27.3.a.21	Nets	Bird	*Alcidae*	51.00	3989.33	1.28%	2	3
2019	Greater North Sea	27.3.a.21	Nets	Bird	*Gavia arctica*	51.00	3989.33	1.28%	1	1
2019	Greater North Sea	27.3.a.21	Nets	Bird	*Melanitta fusca*	51.00	3989.33	1.28%	4	4
2019	Greater North Sea	27.3.a.21	Nets	Bird	*Phalacrocorax carbo*	51.00	3989.33	1.28%	1	1
2019	Greater North Sea	27.3.a.21	Nets	Marine mammal	*Phoca vitulina*	51.00	3989.33	1.28%	3	4
2019	Greater North Sea	27.3.a.21	Nets	Marine mammal	*Phocoena phocoena*	51.00	3989.33	1.28%	26	33
2019	Greater North Sea	27.3.a.21	Nets	Bird	*Somateria mollissima*	51.00	3989.33	1.28%	2	2
2019	Greater North Sea	27.3.a.21	Nets	Bird	*Uria aalge*	51.00	3989.33	1.28%	39	283

Year	Ecoregion	ICES Area / GFCM GSA	Métier 3	Taxa	Species	Total Observed Effort (Days at Sea)	Fishing Days	Monitoring Coverage	Incidents	No. Specimens
2019	Greater North Sea	27.4.a	Bottom trawls	Bird	*Morus bassanus*	813.53	52396.73	1.55%	2	2
2019	Greater North Sea	27.4.a	Longlines	Bird	*Fulmarus glacialis*	78.00	8555.21	0.91%	28	92
2019	Greater North Sea	27.4.a	Longlines	Bird	*Morus bassanus*	78.00	8555.21	0.91%	1	1
2019	Greater North Sea	27.4.a	Longlines	Bird	*Stercorarius skua*	78.00	8555.21	0.91%	1	1
2019	Greater North Sea	27.4.a	Nets	Marine mammal	*Phocoena phocoena*	351.00	6547.34	5.36%	13	16
2019	Greater North Sea	27.4.c	Bottom trawls	Marine mammal	*Halichoerus grypus*	58.75	37545.88	0.16%	1	1
2019	Greater North Sea	27.4.c	Bottom trawls	Bird	*Morus bassanus*	58.75	37545.88	0.16%	1	8
2019	Greater North Sea	27.4.c	Traps	Marine mammal	*Phoca vitulina*	4.00	7936.63	0.05%	1	3
2019	Greater North Sea	27.7.d	Bottom trawls	Bird	*Morus bassanus*	185.21	180730.33	0.10%	1	1
2019	Greater North Sea	27.7.d	Seines	Marine mammal	*Phocoena phocoena*	8.00	15123.02	0.05%	1	1
2019	Greater North Sea	27.7.e	Nets	Marine mammal	*Delphinus delphis*	170.54	81971.71	0.21%	3	4
2019	Greater North Sea	27.7.e	Nets	Marine mammal	*Halichoerus grypus*	170.54	81971.71	0.21%	6	7
2019	Greater North Sea	27.7.e	Nets	Bird	*Phalacrocorax aristotelis*	170.54	81971.71	0.21%	2	2
2019	Greater North Sea	27.7.e	Nets	Bird	*Uria aalge*	170.54	81971.71	0.21%	3	3

Year	Ecoregion	ICES Area / GFCM GSA	Métier 3	Taxa	Species	Total Observed Effort (Days at Sea)	Fishing Days	Monitoring Coverage	Incidents	No. Specimens
2019	Iceland Sea	27.5.a	Nets	Bird	*Cepphus grylle*	112.00	8242.00	1.36%	6	27
2019	Iceland Sea	27.5.a	Nets	Bird	*Gavia immer*	112.00	8242.00	1.36%	1	1
2019	Iceland Sea	27.5.a	Nets	Marine mammal	*Halichoerus grypus*	112.00	8242.00	1.36%	2	5
2019	Iceland Sea	27.5.a	Nets	Marine mammal	*Pagophilus groenlandicus*	112.00	8242.00	1.36%	5	10
2019	Iceland Sea	27.5.a	Nets	Bird	*Phalacrocoracidae*	112.00	8242.00	1.36%	1	4
2019	Iceland Sea	27.5.a	Nets	Marine mammal	*Phoca vitulina*	112.00	8242.00	1.36%	3	3
2019	Iceland Sea	27.5.a	Nets	Marine mammal	*Phocoena phocoena*	112.00	8242.00	1.36%	12	21
2019	Iceland Sea	27.5.a	Nets	Bird	*Somateria mollissima*	112.00	8242.00	1.36%	5	20
2019	Iceland Sea	27.5.a	Nets	Bird	*Uria aalge*	112.00	8242.00	1.36%	15	36
2019	Norwegian Sea	27.2.a.2	Nets	Marine mammal	*Halichoerus grypus*	1416.00	44564.00	3.18%	1	1
2019	Norwegian Sea	27.2.a.2	Nets	Marine mammal	*Phoca vitulina*	1416.00	44564.00	3.18%	14	19
2019	Norwegian Sea	27.2.a.2	Nets	Marine mammal	*Phocoena phocoena*	1416.00	44564.00	3.18%	28	32
2019	Western Mediterranean Sea	6	Longlines	Bird	*Calonectris diomedea*	23.00	8736.13	0.26%	1	1
2019	Western Mediterranean Sea	6	Longlines	Bird	*Larus audouinii*	23.00	8736.13	0.26%	1	1

Year	Ecoregion	ICES Area / GFCM GSA	Métier 3	Taxa	Species	Total Observed Effort (Days at Sea)	Fishing Days	Monitoring Coverage	Incidents	No. Specimens
2019	Western Mediterranean Sea	6	Longlines	Bird	*Larus michahellis*	23.00	8736.13	0.26%	1	2
2019	Western Mediterranean Sea	6	Longlines	Bird	*Puffinus mauretanicus*	23.00	8736.13	0.26%	2	3
2019	Western Mediterranean Sea	11.2	Longlines	Turtle	*Caretta caretta*	86.00	30.00	na	3	3
2019	Ionian Sea and the Central	15	Surrounding nets	Turtle	*Caretta caretta*	10.00	248.96	4.02%	1	1
2019	Adriatic Sea	17	Bottom trawls	Bird	*Phalacrocorax aristotelis*	8.00	769.00	1.04%	1	1
2019	Adriatic Sea	17	Pelagic trawls	Turtle	*Caretta caretta*	417.00	12003.91	3.47%	21	25
2019	Adriatic Sea	18	Longlines	Turtle	*Caretta caretta*	167.00	na	na	15	15
2019	Aegean-Levantine Sea	25	Nets	Turtle	*Chelonia mydas*	266.00	73620.00	0.36%	1	1

Table 3.3b. Reported fishing and monitoring days and number of bycatch specimens and incidents in 2020 provided through the ICES WGBYC 2021 data call by ecoregion.

Year	Ecoregion	ICES Area/ GFCM GSA	Métier 3	Taxa	Species	Total Observed Effort (Days at Sea)	Fishing Days	Monitoring Coverage	Incidents	No. Specimens
2020	Azores	27.10.a	Longlines	Turtle	*Caretta caretta*	107.00	199.00	53.77%	12	26
2020	Azores	27.10.a	Longlines	Turtle	*Dermochelys coriacea*	107.00	199.00	53.77%	3	3
2020	Azores	27.10.a.2	Rods and lines	Bird	*Calonectris borealis*	442.00	25349.00	1.74%	1	3
2020	Azores	27.10.a.2	Rods and lines	Marine mammals	*Delphinus delphis*	442.00	25349.00	1.74%	1	1
2020	Azores	27.10.a.2	Rods and lines	Bird	*Puffinus gravis*	442.00	25349.00	1.74%	1	2
2020	Baltic Sea	27.3.b.23	Nets	Bird	*Alca torda*	76.00	4714.00	1.61%	2	2
2020	Baltic Sea	27.3.b.23	Nets	Bird	*Melanitta fusca*	76.00	4714.00	1.61%	1	1
2020	Baltic Sea	27.3.b.23	Nets	Bird	*Phalacrocorax carbo*	76.00	4714.00	1.61%	5	6
2020	Baltic Sea	27.3.b.23	Nets	Marine mammals	*Phoca vitulina*	76.00	4714.00	1.61%	1	1
2020	Baltic Sea	27.3.b.23	Nets	Marine mammals	*Phocoena phocoena*	76.00	4714.00	1.61%	2	2
2020	Baltic Sea	27.3.b.23	Nets	Bird	*Podiceps grisegena*	76.00	4714.00	1.61%	1	1
2020	Baltic Sea	27.3.b.23	Nets	Bird	*Somateria mollissima*	76.00	4714.00	1.61%	10	12
2020	Baltic Sea	27.3.b.23	Nets	Bird	*Uria aalge*	76.00	4714.00	1.61%	7	9

Year	Ecoregion	ICES Area/ GFCM GSA	Métier 3	Taxa	Species	Total Observed Effort (Days at Sea)	Fishing Days	Monitoring Coverage	Incidents	No. Specimens
2020	Baltic Sea	27.3.c.22	Nets	Marine mammals	*Phoca vitulina*	123.00	14509.00	0.85%	2	2
2020	Baltic Sea	27.3.c.22	Nets	Marine mammals	*Phocoena phocoena*	123.00	14509.00	0.85%	3	3
2020	Baltic Sea	27.3.d.28.1	Nets	Bird	*Aythya fuligula*	12760.00	16456.50	77.54%	1	1
2020	Baltic Sea	27.3.d.28.1	Traps	Marine mammals	*Halichoerus grypus*	11235.00	13239.50	84.86%	1	1
2020	Baltic Sea	27.3.d.28.1	Traps	Bird	*Phalacrocorax carbo*	11235.00	13239.50	84.86%	2	7
2020	Baltic Sea	27.3.d.29	Nets	Bird	*Anatidae*	18048.00	27780.00	64.97%	2	6
2020	Baltic Sea	27.3.d.29	Nets	Bird	*Aythya*	18048.00	27780.00	64.97%	3	5
2020	Baltic Sea	27.3.d.29	Nets	Marine mammals	*Halichoerus grypus*	18048.00	27780.00	64.97%	5	6
2020	Baltic Sea	27.3.d.29	Nets	Bird	*Melanitta fusca*	18048.00	27780.00	64.97%	4	4
2020	Baltic Sea	27.3.d.29	Nets	Bird	*Mergus*	18048.00	27780.00	64.97%	3	3
2020	Baltic Sea	27.3.d.29	Nets	Bird	*Mergus merganser*	18048.00	27780.00	64.97%	4	4
2020	Baltic Sea	27.3.d.29	Nets	Bird	*Mergus serrator*	18048.00	27780.00	64.97%	2	2
2020	Baltic Sea	27.3.d.29	Nets	Bird	*Phalacrocorax carbo*	18048.00	27780.00	64.97%	2	2
2020	Baltic Sea	27.3.d.29	Nets	Bird	*Somateria mollissima*	18048.00	27780.00	64.97%	5	26

Year	Ecoregion	ICES Area/ GFCM GSA	Métier 3	Taxa	Species	Total Observed Effort (Days at Sea)	Fishing Days	Monitoring Coverage	Incidents	No. Specimens
2020	Baltic Sea	27.3.d.29	Nets	Bird	*Uria aalge*	18048.00	27780.00	64.97%	2	2
2020	Baltic Sea	27.3.d.29	Traps	Other	*Castor fiber*	5991.00	8442.00	70.97%	1	1
2020	Baltic Sea	27.3.d.29	Traps	Marine mammals	*Halichoerus grypus*	5991.00	8442.00	70.97%	6	7
2020	Baltic Sea	27.3.d.29	Traps	Marine mammals	*Lutra lutra*	5991.00	8442.00	70.97%	1	1
2020	Baltic Sea	27.3.d.29	Traps	Bird	*Phalacrocorax carbo*	5991.00	8442.00	70.97%	1	1
2020	Baltic Sea	27.3.d.30	Bottom trawls	Bird	*Phalacrocorax carbo*	40.00	70.00	57.14%	1	10
2020	Baltic Sea	27.3.d.30	Nets	Bird	*Anas crecca*	38.00	22701.83	0.17%	2	2
2020	Baltic Sea	27.3.d.30	Nets	Bird	*Bucephala clangula*	38.00	22701.83	0.17%	1	3
2020	Baltic Sea	27.3.d.30	Nets	Bird	*Clangula hyemalis*	38.00	22701.83	0.17%	2	4
2020	Baltic Sea	27.3.d.30	Nets	Marine mammals	*Halichoerus grypus*	38.00	22701.83	0.17%	3	4
2020	Baltic Sea	27.3.d.30	Nets	Bird	*Melanitta nigra*	38.00	22701.83	0.17%	2	2
2020	Baltic Sea	27.3.d.30	Nets	Bird	*Mergus*	38.00	22701.83	0.17%	4	10
2020	Baltic Sea	27.3.d.30	Nets	Bird	*Mergus merganser*	38.00	22701.83	0.17%	6	13
2020	Baltic Sea	27.3.d.30	Nets	Bird	*Phalacrocorax carbo*	38.00	22701.83	0.17%	13	15

Year	Ecoregion	ICES Area/ GFCM GSA	Métier 3	Taxa	Species	Total Observed Effort (Days at Sea)	Fishing Days	Monitoring Coverage	Incidents	No. Specimens
2020	Baltic Sea	27.3.d.30	Nets	Bird	*Podiceps cristatus*	38.00	22701.83	0.17%	2	2
2020	Baltic Sea	27.3.d.30	Nets	Bird	*Somateria mollissima*	38.00	22701.83	0.17%	1	3
2020	Baltic Sea	27.3.d.30	Traps	Marine mammals	*Halichoerus grypus*	88.00	12188.17	0.72%	5	9
2020	Baltic Sea	27.3.d.30	Traps	Bird	*Phalacrocorax carbo*	88.00	12188.17	0.72%	1	1
2020	Baltic Sea	27.3.d.31	Nets	Bird	*Bucephala clangula*	7.00	13833.50	0.05%	2	2
2020	Baltic Sea	27.3.d.31	Nets	Marine mammals	*Halichoerus grypus*	7.00	13833.50	0.05%	1	1
2020	Baltic Sea	27.3.d.31	Nets	Bird	*Laridae*	7.00	13833.50	0.05%	1	1
2020	Baltic Sea	27.3.d.31	Nets	Bird	*Podiceps cristatus*	7.00	13833.50	0.05%	2	2
2020	Baltic Sea	27.3.d.31	Nets	Marine mammals	*Pusa hispida*	7.00	13833.50	0.05%	4	4
2020	Baltic Sea	27.3.d.31	Traps	Marine mammals	*Halichoerus grypus*	42.00	15653.50	0.27%	6	13
2020	Baltic Sea	27.3.d.31	Traps	Bird	*Mergus*	42.00	15653.50	0.27%	3	23
2020	Baltic Sea	27.3.d.31	Traps	Bird	*Phalacrocorax carbo*	42.00	15653.50	0.27%	3	88
2020	Baltic Sea	27.3.d.32	Nets	Bird	*Anatidae*	15239.00	20036.00	76.06%	14	56
2020	Baltic Sea	27.3.d.32	Nets	Bird	*Branta bernicla*	15239.00	20036.00	76.06%	1	1

Year	Ecoregion	ICES Area/ GFCM GSA	Métier 3	Taxa	Species	Total Observed Effort (Days at Sea)	Fishing Days	Monitoring Coverage	Incidents	No. Specimens
2020	Baltic Sea	27.3.d.32	Nets	Bird	*Bucephala clangula*	15239.00	20036.00	76.06%	1	1
2020	Baltic Sea	27.3.d.32	Nets	Bird	*Clangula hyemalis*	15239.00	20036.00	76.06%	2	2
2020	Baltic Sea	27.3.d.32	Nets	Bird	*Mergus merganser*	15239.00	20036.00	76.06%	3	4
2020	Baltic Sea	27.3.d.32	Nets	Bird	*Phalacrocorax carbo*	15239.00	20036.00	76.06%	12	26
2020	Baltic Sea	27.3.d.32	Nets	Bird	*Podiceps cristatus*	15239.00	20036.00	76.06%	1	1
2020	Baltic Sea	27.3.d.32	Nets	Bird	*Somateria mollissima*	15239.00	20036.00	76.06%	1	1
2020	Baltic Sea	27.3.d.32	Traps	Bird	*Anatidae*	1829.00	7292.00	25.08%	4	13
2020	Baltic Sea	27.3.d.32	Traps	Marine mammals	*Halichoerus grypus*	1829.00	7292.00	25.08%	5	8
2020	Baltic Sea	27.3.d.32	Traps	Bird	*Mergus merganser*	1829.00	7292.00	25.08%	2	5
2020	Baltic Sea	27.3.d.32	Traps	Bird	*Phalacrocorax carbo*	1829.00	7292.00	25.08%	7	7
2020	Baltic Sea	27.3.d.32	Traps	Bird	*Podiceps cristatus*	1829.00	7292.00	25.08%	1	1
2020	Bay of Biscay and the Iberian Coast	27.8.a	Bottom trawls	Marine mammals	*Delphinus delphis*	72.96	512675.85	0.01%	4	21
2020	Bay of Biscay and the Iberian Coast	27.8.a	Nets	Marine mammals	*Delphinus delphis*	228.98	206685.81	0.11%	3	3
2020	Bay of Biscay and the Iberian Coast	27.8.a	Nets	Bird	*Morus bassanus*	228.98	206685.81	0.11%	2	2

Year	Ecoregion	ICES Area/ GFCM GSA	Métier 3	Taxa	Species	Total Observed Effort (Days at Sea)	Fishing Days	Monitoring Coverage	Incidents	No. Specimens
2020	Bay of Biscay and the Iberian Coast	27.8.a	Nets	Bird	*Phalacrocorax carbo*	228.98	206685.81	0.11%	2	2
2020	Bay of Biscay and the Iberian Coast	27.8.a	Nets	Bird	*Uria aalge*	228.98	206685.81	0.11%	17	22
2020	Bay of Biscay and the Iberian Coast	27.8.a	Pelagic trawls	Marine mammals	*Delphinus delphis*	32.04	20388.26	0.16%	2	4
2020	Bay of Biscay and the Iberian Coast	27.8.b	Bottom trawls	Bird	*Morus bassanus*	118.62	96867.92	0.12%	2	3
2020	Bay of Biscay and the Iberian Coast	27.8.b	Longlines	Marine mammals	*Delphinus delphis*	5.13	20958.44	0.02%	1	1
2020	Bay of Biscay and the Iberian Coast	27.8.b	Nets	Marine mammals	*Delphinus delphis*	81.85	124019.86	0.07%	1	2
2020	Bay of Biscay and the Iberian Coast	27.8.b	Nets	Bird	*Morus bassanus*	81.85	124019.86	0.07%	1	1
2020	Bay of Biscay and the Iberian Coast	27.8.b	Nets	Bird	*Uria aalge*	81.85	124019.86	0.07%	3	6
2020	Bay of Biscay and the Iberian Coast	27.8.c	Bottom trawls	Marine mammals	*Delphinus delphis*	62.00	14730.24	0.42%	1	1
2020	Bay of Biscay and the Iberian Coast	27.8.c	Bottom trawls	Bird	*Morus bassanus*	62.00	14730.24	0.42%	1	1
2020	Bay of Biscay and the Iberian Coast	27.8.c	Nets	Marine mammals	*Delphinus delphis*	49.00	27969.71	0.18%	1	1
2020	Bay of Biscay and the Iberian Coast	27.8.c	Nets	Bird	*Morus bassanus*	49.00	27969.71	0.18%	1	3
2020	Bay of Biscay and the Iberian Coast	27.8.d.2	Bottom trawls	Marine mammals	*Delphinus delphis*	9.00	5295.43	0.17%	1	4
2020	Bay of Biscay and the Iberian Coast	27.9.a	Longlines	Bird	*Larus michahellis*	617.00	28721.71	2.15%	1	1

Year	Ecoregion	ICES Area/ GFCM GSA	Métier 3	Taxa	Species	Total Observed Effort (Days at Sea)	Fishing Days	Monitoring Coverage	Incidents	No. Specimens
2020	Bay of Biscay and the Iberian Coast	27.9.a	Longlines	Bird	*Morus bassanus*	617.00	28721.71	2.15%	11	26
2020	Bay of Biscay and the Iberian Coast	27.9.a	Nets	Bird	*Alcidae*	434.00	170840.28	0.25%	1	1
2020	Bay of Biscay and the Iberian Coast	27.9.a	Nets	Turtle	*Caretta caretta*	434.00	170840.28	0.25%	2	2
2020	Bay of Biscay and the Iberian Coast	27.9.a	Nets	Marine mammals	*Delphinus delphis*	434.00	170840.28	0.25%	4	6
2020	Bay of Biscay and the Iberian Coast	27.9.a	Nets	Bird	*Larus*	434.00	170840.28	0.25%	1	1
2020	Bay of Biscay and the Iberian Coast	27.9.a	Nets	Bird	*Larus michahellis*	434.00	170840.28	0.25%	3	3
2020	Bay of Biscay and the Iberian Coast	27.9.a	Nets	Bird	*Morus bassanus*	434.00	170840.28	0.25%	2	4
2020	Bay of Biscay and the Iberian Coast	27.9.a	Nets	Bird	*Phalacrocorax aristotelis*	434.00	170840.28	0.25%	2	2
2020	Bay of Biscay and the Iberian Coast	27.9.a	Surrounding nets	Marine mammals	*Delphinus delphis*	194.00	25571.00	0.76%	4	4
2020	Celtic Seas	27.6.a	Bottom trawls	Bird	*Morus bassanus*	168.18	37179.70	0.45%	8	14
2020	Celtic Seas	27.6.a	Longlines	Bird	*Fulmarus glacialis*	31.00	5549.26	0.56%	9	12
2020	Celtic Seas	27.6.a	Longlines	Bird	*Morus bassanus*	31.00	5549.26	0.56%	5	7
2020	Celtic Seas	27.6.a	Pelagic trawls	Marine mammals	*Halichoerus grypus*	117.00	2408.23	4.86%	5	6
2020	Celtic Seas	27.7.b	Pelagic trawls	Marine mammals	*Halichoerus grypus*	19.00	812.51	2.34%	2	2

Year	Ecoregion	ICES Area/ GFCM GSA	Métier 3	Taxa	Species	Total Observed Effort (Days at Sea)	Fishing Days	Monitoring Coverage	Incidents	No. Specimens
2020	Celtic Seas	27.7.f	Nets	Marine mammals	*Halichoerus grypus*	4.00	2144.08	0.19%	1	1
2020	Celtic Seas	27.7.f	Nets	Marine mammals	*Phoca vitulina*	4.00	2144.08	0.19%	1	1
2020	Celtic Seas	27.7.g	Nets	Marine mammals	*Halichoerus grypus*	7.00	2340.67	0.30%	2	5
2020	Celtic Seas	27.7.j.2	Nets	Marine mammals	*Halichoerus grypus*	123.00	10423.81	1.18%	67	84
2020	Celtic Seas	27.7.j.2	Pelagic trawls	Marine mammals	*Globicephala melas*	38.50	1613.55	2.39%	2	3
2020	Greater North Sea	27.3.a.20	Bottom trawls	Marine mammals	*Delphinus*	73.00	27250.70	0.27%	2	2
2020	Greater North Sea	27.3.a.20	Nets	Marine mammals	*Lagenorhynchus albirostris*	119.00	8210.50	1.45%	1	2
2020	Greater North Sea	27.3.a.20	Nets	Marine mammals	*Phoca vitulina*	119.00	8210.50	1.45%	3	4
2020	Greater North Sea	27.3.a.20	Nets	Marine mammals	*Phocoena phocoena*	119.00	8210.50	1.45%	8	8
2020	Greater North Sea	27.3.a.21	Bottom trawls	Marine mammals	*Phocoena phocoena*	61.00	13620.83	0.45%	1	1
2020	Greater North Sea	27.3.a.21	Nets	Bird	*Alca torda*	19.00	4567.17	0.42%	1	2
2020	Greater North Sea	27.3.a.21	Nets	Bird	*Melanitta fusca*	19.00	4567.17	0.42%	1	1
2020	Greater North Sea	27.3.a.21	Nets	Marine mammals	*Phoca vitulina*	19.00	4567.17	0.42%	1	1
2020	Greater North Sea	27.3.a.21	Nets	Bird	*Uria aalge*	19.00	4567.17	0.42%	4	26

Year	Ecoregion	ICES Area/ GFCM GSA	Métier 3	Taxa	Species	Total Observed Effort (Days at Sea)	Fishing Days	Monitoring Coverage	Incidents	No. Specimens
2020	Greater North Sea	27.4.a	Nets	Marine mammals	*Phoca vitulina*	148.00	5425.45	2.73%	2	2
2020	Greater North Sea	27.4.a	Nets	Marine mammals	*Phocoena phocoena*	148.00	5425.45	2.73%	6	6
2020	Greater North Sea	27.4.b	Nets	Bird	*Aves*	54.00	7848.00	0.69%	2	2
2020	Greater North Sea	27.4.b	Nets	Marine mammals	*Phoca vitulina*	54.00	7848.00	0.69%	9	12
2020	Greater North Sea	27.4.b	Nets	Marine mammals	*Phocoena phocoena*	54.00	7848.00	0.69%	35	91
2020	Greater North Sea	27.4.b	Nets	Marine mammals	*Pinnipedia*	54.00	7848.00	0.69%	1	1
2020	Greater North Sea	27.4.b	Nets	Bird	*Uria aalge*	54.00	7848.00	0.69%	2	2
2020	Greater North Sea	27.4.b	Pelagic trawls	Marine mammals	*Halichoerus grypus*	22.00	2332.61	0.94%	6	12
2020	Greater North Sea	27.7.d	Nets	Bird	*Phalacrocoracidae*	45.00	36571.26	0.12%	2	2
2020	Greater North Sea	27.7.e	Bottom trawls	Marine mammals	*Delphinus delphis*	65.92	249313.55	0.03%	1	1
2020	Greater North Sea	27.7.e	Bottom trawls	Bird	*Morus bassanus*	65.92	249313.55	0.03%	1	1
2020	Greater North Sea	27.7.e	Nets	Marine mammals	*Delphinus delphis*	44.12	64844.02	0.07%	1	1
2020	Greater North Sea	27.7.e	Nets	Bird	*Uria aalge*	44.12	64844.02	0.07%	1	1
2020	Iceland Sea	27.5.a	Nets	Bird	*Alca torda*	105.00	8240.00	1.27%	1	1

Year	Ecoregion	ICES Area/ GFCM GSA	Métier 3	Taxa	Species	Total Observed Effort (Days at Sea)	Fishing Days	Monitoring Coverage	Incidents	No. Specimens
2020	Iceland Sea	27.5.a	Nets	Bird	*Cepphus grylle*	105.00	8240.00	1.27%	25	82
2020	Iceland Sea	27.5.a	Nets	Bird	*Gavia immer*	105.00	8240.00	1.27%	1	1
2020	Iceland Sea	27.5.a	Nets	Marine mammals	*Halichoerus grypus*	105.00	8240.00	1.27%	3	5
2020	Iceland Sea	27.5.a	Nets	Marine mammals	*Megaptera novaeangliae*	105.00	8240.00	1.27%	2	2
2020	Iceland Sea	27.5.a	Nets	Marine mammals	*Pagophilus groenlandicus*	105.00	8240.00	1.27%	1	1
2020	Iceland Sea	27.5.a	Nets	Bird	*Phalacrocoracidae*	105.00	8240.00	1.27%	6	8
2020	Iceland Sea	27.5.a	Nets	Marine mammals	*Phoca vitulina*	105.00	8240.00	1.27%	8	10
2020	Iceland Sea	27.5.a	Nets	Marine mammals	*Phocoena phocoena*	105.00	8240.00	1.27%	11	23
2020	Iceland Sea	27.5.a	Nets	Bird	*Somateria mollissima*	105.00	8240.00	1.27%	22	105
2020	Iceland Sea	27.5.a	Nets	Bird	*Uria aalge*	105.00	8240.00	1.27%	20	39
2020	Norwegian Sea	27.2.a.2	Nets	Marine mammals	*Halichoerus grypus*	1348.00	43997.06	3.06%	1	1
2020	Norwegian Sea	27.2.a.2	Nets	Marine mammals	*Phoca vitulina*	1348.00	43997.06	3.06%	6	7
2020	Norwegian Sea	27.2.a.2	Nets	Marine mammals	*Phocoena phocoena*	1348.00	43997.06	3.06%	26	31
2020	Western Mediterranean Sea	6	Longlines	Bird	*Calonectris diomedea*	23.00	10434.26	0.22%	2	3

Year	Ecoregion	ICES Area/ GFCM GSA	Métier 3	Taxa	Species	Total Observed Effort (Days at Sea)	Fishing Days	Monitoring Coverage	Incidents	No. Specimens
2020	Western Mediterranean Sea	6	Longlines	Bird	*Puffinus mauretanicus*	23.00	10434.26	0.22%	1	1
2020	Western Mediterranean Sea	7	Bottom trawls	Turtle	*Caretta caretta*	113.00	256277.49	0.04%	1	1
2020	Western Mediterranean Sea	7	Bottom trawls	Marine mammals	*Tursiops truncatus*	113.00	256277.49	0.04%	1	1
2020	Adriatic Sea	17	Pelagic trawls	Turtle	*Caretta caretta*	261.00	9347.00	2.79%	9	10
2020	Adriatic Sea	17	Pelagic trawls	Marine mammals	*Tursiops truncatus*	261.00	9347.00	2.79%	1	1
2020	Aegean-Levantine Sea	25	Longlines	Turtle	*Caretta caretta*	149.00	34425.00	0.43%	1	1
2020	Aegean-Levantine Sea	25	Nets	Turtle	*Caretta caretta*	818.00	64971.00	1.26%	14	20
2020	Aegean-Levantine Sea	25	Nets	Turtle	*Chelonia mydas*	818.00	64971.00	1.26%	3	6
2020	Aegean-Levantine Sea	25	Nets	Bird	*Phalacrocorax aristotelis*	818.00	64971.00	1.26%	1	1

Table 3.3a. Summary of monitored effort (Days at Sea) reported by ICES division and métier (level 3) with no reported PETS bycatch (excluding fish) reported in 2019.

Year	Métier3	Total Observed Effort	Area	Fishing Effort (Days at Sea)
2019	Bottom trawls	173.12	27.7.h	176603.59
2019	Bottom trawls	123.00	6	75791.36
2019	Bottom trawls	120.00	27.1.a	980.00
2019	Bottom trawls	148.00	27.3.a.20	29885.71
2019	Bottom trawls	36.00	27.12.b	NULL
2019	Bottom trawls	2.00	27.1.b	656.07
2019	Bottom trawls	61.00	27.8.c	16099.51
2019	Bottom trawls	132.00	21.3.M	642.00
2019	Bottom trawls	39.00	27.3.d.25	3956.61
2019	Bottom trawls	17.00	27.6.b.1	184.11
2019	Bottom trawls	35.00	27.3.d.24	5122.00
2019	Bottom trawls	7.00	27.3.d.28.2	134.00
2019	Bottom trawls	7.00	27.3.d.32	NULL
2019	Bottom trawls	37.00	21.3.N	661.00
2019	Bottom trawls	43.00	21.3.O	170.00
2019	Bottom trawls	15.14	27.7.b	8819.96
2019	Bottom trawls	72.00	27.14.b.2	507.47
2019	Bottom trawls	16.00	25	377.00
2019	Bottom trawls	125.81	27.8.a	564780.09
2019	Bottom trawls	138.93	27.7.j.2	52911.52
2019	Bottom trawls	282.02	27.7.e	274738.43
2019	Bottom trawls	240.00	27.5.a	12452.00
2019	Bottom trawls	108.00	27.9.a	52637.70
2019	Bottom trawls	49.00	27.3.c.22	6563.00
2019	Bottom trawls	85.00	27.6.b.2	2816.54
2019	Bottom trawls	18.00	27.3.d.26	1529.89
2019	Bottom trawls	30.00	21.1.C	98.00
2019	Bottom trawls	67.64	27.7.a	13937.60

Year	Métier3	Total Observed Effort	Area	Fishing Effort (Days at Sea)
2019	Bottom trawls	128.00	7	265656.48
2019	Bottom trawls	81.00	27.2.b.2	721.63
2019	Bottom trawls	279.96	27.4.b	70033.57
2019	Bottom trawls	44.15	27.7.k.2	5665.46
2019	Bottom trawls	74.00	27.3.a.21	14357.67
2019	Bottom trawls	31.00	15	1042.00
2019	Bottom trawls	28.93	27.7.c.2	10676.07
2019	Bottom trawls	13.00	27.3.d.31	431.00
2019	Bottom trawls	39.00	5	8094.64
2019	Bottom trawls	19.81	27.8.d.2	4815.46
2019	Bottom trawls	27.00	2	1202.00
2019	Bottom trawls	66.00	21.3.L	291.00
2019	Bottom trawls	7.00	27.3.d.29	NULL
2019	Bottom trawls	86.00	1	22003.00
2019	Bottom trawls	127.31	27.2.a.2	1732.51
2019	Dredges	1.00	27.4.b	5549.25
2019	Dredges	11.00	27.7.e	30777.04
2019	Dredges	1.00	27.7.h	179.48
2019	Dredges	4.00	27.7.d	48391.77
2019	Longlines	149.00	27.10.a.2	3990.00
2019	Longlines	13.74	27.8.b	20273.36
2019	Longlines	419.00	22	218212.00
2019	Longlines	65.00	16	226.00
2019	Longlines	85.00	19	230.00
2019	Longlines	1.25	27.7.e	7652.29
2019	Longlines	4.00	15	5317.50
2019	Longlines	6.00	27.5.a	12869.00
2019	Longlines	146.00	23	23363.00
2019	Longlines	1.00	7	9970.19

Year	Métier3	Total Observed Effort	Area	Fishing Effort (Days at Sea)
2019	Longlines	70.00	27.3.d.28.1	72.00
2019	Longlines	11.98	27.8.a	49563.63
2019	Longlines	85.00	1	5817.00
2019	Longlines	108.00	20	52969.00
2019	Longlines	69.00	9	NULL
2019	Longlines	11.00	2	122.00
2019	Longlines	45.00	25	32797.00
2019	Longlines	17.00	21	342.33
2019	Longlines	11.00	27.3.d.32	137.00
2019	Nets	7.00	17	4130.00
2019	Nets	48.00	27.3.d.24	21327.50
2019	Nets	5.00	15	3486.00
2019	Nets	14.00	27.4.c	10181.08
2019	Nets	48.00	27.8.c	33665.40
2019	Nets	17.14	27.7.c.2	1683.76
2019	Nets	4.00	27.8.d.2	1479.74
2019	Nets	24.00	27.10.a.2	2375.00
2019	Nets	98.89	27.7.d	43884.32
2019	Other gear	0.73	27.8.a	9278.41
2019	Other gear	0.50	27.7.e	5273.01
2019	Other gear	1.92	27.8.b	13167.49
2019	Pelagic trawls	5.00	27.3.d.29	2136.89
2019	Pelagic trawls	6.00	21.6.G	1070.00
2019	Pelagic trawls	56.12	27.8.d.2	2235.07
2019	Pelagic trawls	12.00	27.14.b.2	13.00
2019	Pelagic trawls	31.00	27.3.d.30	2450.00
2019	Pelagic trawls	29.40	27.7.d	12284.42
2019	Pelagic trawls	3.00	27.14.b.1	20.00
2019	Pelagic trawls	46.00	27.3.d.25	4578.74

Year	Métier3	Total Observed Effort	Area	Fishing Effort (Days at Sea)
2019	Pelagic trawls	7.00	27.7.g	101.56
2019	Pelagic trawls	13.00	27.7.a	630.91
2019	Pelagic trawls	3.00	27.4.b	1970.16
2019	Pelagic trawls	62.00	27.5.a	1579.00
2019	Pelagic trawls	285.00	27.3.d.28.1	3010.00
2019	Pelagic trawls	23.00	27.3.d.24	1285.50
2019	Pelagic trawls	4.00	27.3.d.32	2196.00
2019	Pelagic trawls	0.20	27.4.c	553.38
2019	Pelagic trawls	41.00	27.7.j.2	1743.83
2019	Pelagic trawls	1.00	27.3.d.28	509.65
2019	Pelagic trawls	2.00	27.5.b.1.b	43.24
2019	Pelagic trawls	7.00	27.7.e	3874.26
2019	Pelagic trawls	122.00	27.2.a.1	638.79
2019	Pelagic trawls	0.60	27.7.h	529.49
2019	Pelagic trawls	38.00	16	3005.60
2019	Pelagic trawls	22.20	27.8.c	1896.64
2019	Pelagic trawls	3.00	7	1508.01
2019	Pelagic trawls	147.00	27.3.d.28.2	2681.00
2019	Pelagic trawls	40.00	27.3.d.26	4369.85
2019	Pelagic trawls	80.00	27.4.a	2208.14
2019	Pelagic trawls	1.00	27.3.c.22	32.00
2019	Pelagic trawls	1.00	27.7.f	35.78
2019	Rods and lines	606.00	27.10.a.2	28788.00
2019	Rods and lines	2.00	27.4.c	297.05
2019	Rods and lines	180.00	27.9.a	2234.00
2019	Rods and lines	1.00	27.7.h	1185.93
2019	Rods and lines	1.00	27.8.d.1	NULL
2019	Rods and lines	13.00	27.8.b	1508.57
2019	Rods and lines	3.77	27.8.a	10400.24

Year	Métier3	Total Observed Effort	Area	Fishing Effort (Days at Sea)
2019	Rods and lines	6.00	27.7.j.2	231.00
2019	Rods and lines	2.00	7	1615.66
2019	Rods and lines	20.00	27.5.a	20014.00
2019	Rods and lines	6.00	27.7.e	12995.67
2019	Seines	16.01	27.8.a	23542.99
2019	Seines	1.00	27.3.d.28.1	87.50
2019	Seines	25.00	27.3.d.29	28.00
2019	Seines	19.00	27.5.a	4070.00
2019	Seines	10.00	27.7.g	1395.00
2019	Seines	10.46	27.8.b	10995.46
2019	Seines	4.00	27.3.c.22	186.00
2019	Seines	1.80	27.4.c	3677.28
2019	Seines	5.00	27.3.d.28.2	17.00
2019	Seines	5.00	27.3.a.20	2185.27
2019	Seines	58.00	27.4.a	4002.77
2019	Seines	13.00	27.7.j.2	805.06
2019	Seines	2.00	27.6.b.2	10.75
2019	Surrounding nets	4.00	27.8.a	2952.40
2019	Surrounding nets	3.00	27.7.e	2622.79
2019	Surrounding nets	16.00	27.10.a.2	3749.00
2019	Surrounding nets	30.00	27.9.a	26697.50
2019	Surrounding nets	28.00	27.8.b	4900.36
2019	Surrounding nets	43.00	27.8.c	20143.69
2019	Traps	7.01	27.8.a	30543.06
2019	Traps	1.11	27.7.d	36692.24
2019	Traps	4.25	27.7.e	66312.91
2019	Traps	2.00	27.3.d.24	7988.50
2019	Traps	1.00	27.7.f	6914.90
2019	Traps	2.00	27.9.a	108467.00

Year	Métier3	Total Observed Effort	Area	Fishing Effort (Days at Sea)
2019	Traps	2.33	27.8.b	2610.89
2019	Traps	9.00	27.3.a.20	11675.00
2019	Traps	7.00	27.3.d.26	7188.20
2019	Traps	9.00	27.10.a.2	762.00

Table 3.3b. Summary of monitored effort (Days at Sea) reported by ICES division and métier (level 3) with no reported PETS bycatch (excluding fish) reported in 2020.

Year	Métier3	Total Observed Effort	Area	Fishing Effort (Days at Sea)
2020	Bottom trawls	10.00	15	667.00
2020	Bottom trawls	40.00	27.2.b.2	1233.36
2020	Bottom trawls	34.00	27.3.c.22	5091.00
2020	Bottom trawls	85.00	27.6.b.2	2507.40
2020	Bottom trawls	79.91	27.7.d	157410.61
2020	Bottom trawls	42.00	27.7.k.2	5024.63
2020	Bottom trawls	31.26	27.7.c.2	10525.81
2020	Bottom trawls	17.00	27.4.c	40076.44
2020	Bottom trawls	30.00	27.3.d.26	175.00
2020	Bottom trawls	14.00	27.3.d.31	646.00
2020	Bottom trawls	14.00	5	7590.08
2020	Bottom trawls	48.00	2	805.00
2020	Bottom trawls	18.00	27.3.d.29	NULL
2020	Bottom trawls	3.74	27.2.a.2	994.76
2020	Bottom trawls	22.00	1	18626.00
2020	Bottom trawls	54.49	27.7.a	10585.12
2020	Bottom trawls	129.00	27.4.b	65149.15
2020	Bottom trawls	185.00	27.5.a	12622.00
2020	Bottom trawls	23.00	27.9.a	51618.98
2020	Bottom trawls	26.11	27.7.f	29539.79
2020	Bottom trawls	4.00	27.5.b.1.b	1140.35
2020	Bottom trawls	24.37	27.7.j.2	45777.85

Year	Métier3	Total Observed Effort	Area	Fishing Effort (Days at Sea)
2020	Bottom trawls	5.00	27.3.d.25	1899.17
2020	Bottom trawls	12.00	27.3.d.24	3818.00
2020	Bottom trawls	16.37	27.7.b	9046.58
2020	Bottom trawls	65.00	6	69188.92
2020	Bottom trawls	12.00	25	621.00
2020	Bottom trawls	10.90	27.7.h	152070.32
2020	Bottom trawls	84.68	27.7.g	47888.70
2020	Bottom trawls	4.00	17	879.00
2020	Bottom trawls	19.00	21.3.N	833.00
2020	Bottom trawls	503.00	27.1.a	1511.00
2020	Bottom trawls	82.00	27.1.b	737.06
2020	Bottom trawls	336.15	27.4.a	44557.75
2020	Bottom trawls	3.00	27.3.d.32	NULL
2020	Bottom trawls	10.00	27.3.d.28.2	70.00
2020	Bottom trawls	17.00	21.3.O	260.00
2020	Dredges	1.00	27.7.e	26932.17
2020	Longlines	19.00	12	32.00
2020	Longlines	14.78	27.8.a	46793.82
2020	Longlines	62.00	27.3.d.28.1	62.00
2020	Longlines	64.00	11.1	88.00
2020	Longlines	16.00	27.3.d.29	18.00
2020	Longlines	46.00	1	5951.00
2020	Longlines	26.00	27.3.d.32	61.00
2020	Longlines	7.00	27.8.c	15297.97
2020	Longlines	6.00	21	326.30
2020	Longlines	6.00	21	222.00
2020	Longlines	9.00	27.3.d.26	440.50
2020	Longlines	2.00	7	7522.94
2020	Longlines	33.00	19	401.25

Year	Métier3	Total Observed Effort	Area	Fishing Effort (Days at Sea)
2020	Longlines	4.00	27.3.d.28.2	53.90
2020	Longlines	4.00	27.5.a	10795.00
2020	Longlines	11.00	27.10.a.2	5730.00
2020	Nets	6.00	27.8.d.2	1448.24
2020	Nets	8.86	27.7.c.2	2722.60
2020	Nets	2447.00	27.3.d.26	14224.47
2020	Nets	6.52	27.7.h	16396.08
2020	Nets	1.00	27.10.a.2	1936.00
2020	Nets	1083.00	22	687168.00
2020	Nets	373.00	20	403720.00
2020	Nets	49.00	27.3.d.24	15345.00
2020	Nets	1456.00	27.3.d.28.2	2830.07
2020	Nets	11.00	17	3875.00
2020	Nets	7.00	1	11578.00
2020	Nets	2.00	27.3.d.25	9961.83
2020	Nets	11.00	27.4.c	6842.57
2020	Nets	467.00	23	64021.00
2020	Nets	9.00	15	3840.00
2020	Other gear	10.00	27.8.b	14689.48
2020	Other gear	0.22	27.8.a	12848.06
2020	Pelagic trawls	1.00	27.3.d.28	641.37
2020	Pelagic trawls	72.00	27.4.a	3078.87
2020	Pelagic trawls	54.03	27.8.c	2195.52
2020	Pelagic trawls	7.00	27.3.d.32	2007.00
2020	Pelagic trawls	9.75	27.7.h	361.81
2020	Pelagic trawls	113.00	27.2.a.2	443.35
2020	Pelagic trawls	600.00	27.3.d.28.2	2672.25
2020	Pelagic trawls	25.00	27.7.c.2	593.35
2020	Pelagic trawls	2.00	27.6.b.2	100.50

Year	Métier3	Total Observed Effort	Area	Fishing Effort (Days at Sea)
2020	Pelagic trawls	15.00	27.5.b.1.b	84.86
2020	Pelagic trawls	4.00	7	1334.74
2020	Pelagic trawls	618.00	27.3.d.26	4659.74
2020	Pelagic trawls	13.00	27.2.a.1	361.70
2020	Pelagic trawls	1.43	27.8.b	9442.85
2020	Pelagic trawls	7.20	27.4.c	746.58
2020	Pelagic trawls	163.00	27.3.d.28.1	3362.00
2020	Pelagic trawls	18.00	27.3.d.30	1891.00
2020	Pelagic trawls	60.00	27.14.b.1	60.00
2020	Pelagic trawls	1.00	27.7.g	37.56
2020	Pelagic trawls	67.00	27.5.a	1747.00
2020	Pelagic trawls	4.00	27.3.d.29	1995.94
2020	Pelagic trawls	6.00	27.7.k.2	364.89
2020	Pelagic trawls	177.00	27.3.d.25	5274.56
2020	Pelagic trawls	36.00	27.3.d.24	768.00
2020	Pelagic trawls	16.25	27.8.d.2	1311.17
2020	Pelagic trawls	12.40	27.7.d	9338.26
2020	Rods and lines	3.00	7	1409.30
2020	Rods and lines	1.00	27.5.a	3162.00
2020	Rods and lines	5.18	27.8.a	12265.86
2020	Rods and lines	2.09	27.7.e	13580.23
2020	Rods and lines	1.00	27.7.h	1160.29
2020	Rods and lines	4.00	27.8.c	14554.40
2020	Rods and lines	1719.00	27.9.a	3740.00
2020	Seines	14.00	27.7.j.2	615.00
2020	Seines	18.00	27.4.a	3692.78
2020	Seines	1.00	27.3.c.22	106.00
2020	Seines	3.83	27.8.b	8876.12
2020	Seines	1.80	27.4.c	4283.05

Year	Métier3	Total Observed Effort	Area	Fishing Effort (Days at Sea)
2020	Seines	9.00	27.3.a.20	1987.67
2020	Seines	4.00	27.5.a	3591.00
2020	Seines	1.00	27.9.a	15836.00
2020	Seines	25.00	27.7.g	1378.00
2020	Seines	4.58	27.8.a	21134.68
2020	Seines	49.00	27.3.d.29	49.00
2020	Surrounding nets	10.00	15	213.27
2020	Surrounding nets	1.00	27.8.c	23599.00
2020	Surrounding nets	9.00	27.8.b	4131.69
2020	Surrounding nets	1.00	27.7.e	3799.14
2020	Surrounding nets	2.00	27.8.a	1471.25
2020	Surrounding nets	4.00	27.10.a.2	3604.00
2020	Surrounding nets	8.00	27.7.f	298.00
2020	Traps	1820.00	27.3.d.26	4471.53
2020	Traps	3.00	27.10.a.2	540.00
2020	Traps	3.00	27.3.a.20	11627.17
2020	Traps	2.00	27.4.c	7749.85
2020	Traps	0.40	27.8.b	2796.35
2020	Traps	1.00	27.9.a	82672.00
2020	Traps	2.69	27.7.e	55798.28
2020	Traps	12.00	27.3.d.24	4956.00
2020	Traps	2.00	27.3.c.22	1561.00
2020	Traps	656.00	27.3.d.28.2	864.20
2020	Traps	3.03	27.8.a	24064.71

Table 3.4a. 2019 strandings of marine mammals, number of examinations on fresh and slightly decomposed carcasses, and proportion of examined stranded animals with evidence of fishery interaction (carcasses with bycatch evidence/ examinations). (Atl = Atlantic coasts, Med = Mediterranean coasts, SH=Schleswig-Holstein)

Species	Country	Strandings (n)	Examinations on fresh or slightly decomposed carcasses (n)	Bycatch evidence / examinations (%)
Phocoena phocoena	Belgium	52	22	3/22 (14%)
	Denmark	60	14	3/14 (21%)
	France (Atl)	276	134	34/134 (26%)
	Germany (SH)	237	46	4/46 (9%)
	Netherlands	508	57	6/57 (11%)
	Portugal*	45	25	12/25 (50%)
	Spain (Galicia)	12	5	3/5 (60%)
	United Kingdom	465	60	3/60 (5%)
Delphinus delphis	France (Atl)	1,142	574	368/574 (64%)
	Portugal*	279	110	72/110 (65%)
	Spain (Galicia)	261	53	30/53 (57%)
	United Kingdom	254	43	13/43 (30%)
Stenella coeruleoalba	France (Atl)	36	19	2/19 (10%)
	Italy	83	49	1/49 (2%)
Tursiops truncatus	France (Atl)	41	16	3/16 (19%)
	France (Med)	8	3	1/3 (33%)
	Italy	93	50	4/50 (8%)
	Spain (Galicia)	31	10	3/10 (30%)
Grampus griseus	Spain (Galicia)	5	3	1/3 (33%)
Balaenoptera acutorostrata	Spain (Galicia)	6	3	2/3 (67%)
Megaptera novaeangliae	Denmark	1	1	1/1 (100%)
	United Kingdom	5	3	2/3 (67%)

Species	Country	Strandings (n)	Examinations on fresh or slightly decomposed carcasses (n)	Bycatch evidence / examinations (%)
Mesoplodon bidens	United Kingdom	4	3	1/3 (33%)
Physeter macrocephalus	Italy	16	6	2/6 (33%)
Halichoerus grypus	Belgium	17	9	4/9 (44%)
	France (Atl)	159	64	9/64 (14%)
Phoca vitulina	Belgium	10	9	3/9 (33%)
	France (Atl)	94	42	3/42 (7%)

*The only stranding network in place in 2019 covered north-western coasts. In central-western and southern Portugal, strandings were occasionally reported but without any examination.

Table 3.4b. 2020 strandings of marine mammals, number of examinations on fresh and slightly decomposed carcasses, and proportion of examined stranded animals with evidence of fishery interaction (carcasses with bycatch evidence/ examinations) (Atl = Atlantic coasts, Med = Mediterranean coasts, SH=Schleswig-Holstein).

Species	Country	Strandings (n)	Examinations on fresh or slightly decomposed carcasses (n)	Bycatch evidence / examinations (%)
Phocoena phocoena	Belgium	67	35	5/35 (14%)
	Denmark	182	28	6/28 (21%)
	France (Atl)	215	96	27/96 (28%)
	Germany (SH)	215	39	0/39 (0%)
	Netherlands	429	49	1/49 (2%)
	Portugal (Western coast)	40	20	10/20 (50%)
	Spain (Galicia)	23	7	4/7 (57%)
	United Kingdom	428	30	2/30 (7%)
Delphinus delphis	France (Atl)	1,289	704	504/704 (72%)
	Portugal (Western coast)	311	132	115/132 (87%)
	Portugal (Southern coast)	23	6	3/6 (50%)
	Spain / Galicia	184	48	32/48 (67%)
	United Kingdom	318	49	14/49 (29%)
Stenella coeruleoalba	France (Atl)	42	17	6/17 (35%)
	France (Med)	45	23	4/23 (17%)
	Portugal (Western coast)	11	5	1/5 (20%)
Tursiops truncatus	France (Atl)	50	14	8/14 (57%)
	France (Med)	8	4	2/4 (50%)
	Italy	72	24	3/24 (13%)
	Portugal (Western coast)	8	2	1/2 (50%)

Species	Country	Strandings (n)	Examinations on fresh or slightly decomposed carcasses (n)	Bycatch evidence / examinations (%)
	Portugal (Southern coast)	4	1	1/1 (100%)
	Spain (Galicia)	24	6	3/6 (50%)
Grampus griseus	France (Atl)	8	1	1/1 (100%)
	Spain (Galicia)	4	1	1/1 (100%)
Balaenoptera acutorostrata	Portugal (Western coast)	10	2	2/2 (100%)
	United Kingdom	36	1	1/1 (100%)
Halichoerus grypus	Belgium	14	9	7/9 (78%)
	France (Atl)	224	102	14/102 (14%)
Phoca vitulina	Belgium	17	13	5/13 (38%)
	Denmark	337	45	5/45 (11%)
	France (Atl)	97	40	5/40 (13%)

4 ToR B: Mitigation

Prior to this year WGBYC had routinely collated and summarised mitigation efforts by Member States reported under (EC) Reg.812/2004 and through a comprehensive online literature search of papers and reports published in the relevant year. As (EC) Reg.812/2004 is no longer in place and because some WGBYC members felt that a literature review was not the best use of WGBYC's time, this year the group has used a different approach to describing relevant mitigation studies and has summarised work related directly or indirectly to PETs bycatch reported to ICES and contained in the national reports to the Working Group on Fishing Technology and Fish Behaviour (WGFTFB). In 2020 nine national reports were submitted to WGFTFB from Canada, France, Germany, Iceland, Norway, Scotland, Spain, and United States of America, and in 2021 fifteen national reports were submitted from Argentina, Belgium, Canada, Denmark, Finland, France, Germany, Iceland, Japan, Norway, Portugal, Scotland, Spain, Sweden and United States of America reported. An overview of PETs related mitigation work, by country and taxa, from these reports is presented in Section 4.1 below.

We also provide summary information about mitigation studies from the wider literature indicating the geographic scope, approach and results of the studies in Table 4.1 (Section 4.2), and a description of mitigation trials being conducted with direct involvement of members of WGBYC is provided in section 4.3.

4.1 Summaries from national reports submitted to WGFTFB

Marine mammals

From 2019-2020 in **Canada,** the project "Evaluating Weak Links" aims to measure tensions in the vertical ropes of snow crab traps, in all fishing situations encountered by fishermen in the Gulf of St. Lawrence. The data collected will be used to determine the minimal breaking load of the rope for use without risk of trap loss. Other mounting configurations of the fishing gear will be tested to try to decrease the tension in the vertical rope. These data will be compared with theoretical tensions that a North Atlantic right whale (*Eubalaena glacialis*) would impose on the rope in its efforts to disentangle itself from ropes. In case of compatibility between the data, the next step will be to size and configure a weak link system and carry out sea trials in fishing situations.

Denmark is from 2017-2021 conducting the project "Porpoises and pingers". The trials will investigate both short- and long-term behavioural responses of porpoises to pinger sounds started in 2019 and continuing in 2021. All technologies are tested under commercial conditions in co-operation with commercial gillnet fishers by use of REM (Remote Electronic Monitoring) where bycatches of other protected species are also being recorded.

From 2019-2021 **France** is conducting the project "Giving Artificial Monitoring intElligence tO Fishing (GAME OF TRAWLS)". The project aims to prevent bycatch of fish species. The project proposes several approaches, including computer vision and deep learning to be able to detect and identify in real time the species that enter the fishing gear. Such systems could allow fishermen to detect in real time high abundance of bycatch in their trawls so they could operate an escape device (diversion hatch, bright flash, acoustic signals ...) or they could change of fishing area.

Germany is from 2017-2020 conducting the project "Stella" (Development of alternative management approaches and fishing techniques to minimize conflicts between conservation objectives and gillnet fisheries). The project aims to minimize bycatch of harbour porpoises. The project comprises the following: 1) estimating fishing effort of the local gillnet fisheries and identifying behaviour patterns of different fisherman groups, 2) development of gillnet modifications to minimize bycatch of marine mammals and seabirds, 3) development of alternative fishing gears, 4) analyse motives of fishermen and identify incentives that may lead to enhanced acceptance of mitigation methods. At this stage field experiments to determine reaction of porpoise to pearl nets need to be repeated. Pearl nets were tested in the turbot fishery in the Black Sea (Turkey) with promising, but not yet statistically significant results (in 10 hauls 5 individuals were bycaught in the standard net, 2 in pearl nets).

From 2018-2020 **Iceland** is conducting the project "New harvest technology for lumpfish". The aim is to develop and implement a new fishing method feasible for the fleet of small vessels currently engaged in the lumpfish fishery to try and eliminate bycatch of marine mammals and seabirds in that fishery. Notably there has been an effort to evaluate market ready technologies to eliminate bycatch of small cetaceans from the Icelandic gillnet fishery. Both the Banana Pinger and the PAL porpoise alerting device have been tested with mixed results that failed to replicate the success of those devices claimed in other regions. Tests with PAL pingers with modified signals will be repeated in 2020.

Ireland has in 2020 conducted the project "New Guide on Technical Solutions to reduce unwanted catches". The guide outlines 20 solutions developed by BIM in close collaboration with the Irish fishing industry which address challenges posed by the landing obligation. Many of the solutions are included in EU legislation and implemented as management measures which drive uptake and feeds into improved fish stock sustainability. The guide is available at: https://tinyurl.com/3ac33nzt.

From January 2020 until December 2020 **Italy** will conduct the project LIFE DELFI which aims at reducing interactions between dolphins and fishing activities by introducing mitigation devices and technical measures. Different types of pinger will be used according to the species and fishing gear. More than 300 new generation pingers with variable frequencies will be mounted on the nets of at least 100 Italian vessels. A DiD (Dolphin interactive Deterrent) will be used in active and passive nets. The DiD is similar to the DDD but only produces the ultrasounds when it detects the presence of the dolphins in the area. Flashing lamps and LED lamps will also be tested to discourage approaches by dolphins or act as a passive method of increasing net visibility for dolphins. Around 350 visual deterrents will be mounted on the nets of at least 30 vessels, for a total of 300 fishing days and 100 fishermen involved. To mitigate depredation the use of alternative gears will be tested. The idea is to shift fishing from traditional passive nets to traps. According to the combination of target species/season/area, different types of trap will be developed and disseminated among fishers to discourage the use of passive nets, at least during periods of high dolphin presence in those areas.

From 2018-2020 the **United States** is conducting the project "Ropeless fishing" to test a ropeless fishing prototype for eliminating large whale entanglements in pot fishing gear. The aim was to test one or more on-call buoys secured at depth until they are acoustically released for hauling. The objective is to create a mechanically practical way to fish with pots that eliminates vertical lines from the water column, which create entanglement risk to North Atlantic right whales and other non-target species. All deployments to date have had 100% successful retrieval of a bottom-attached flotation rope spool. Testing will continue throughout 2020.

In **Spain**, the project "MITICET" is testing the effectiveness of pingers in bottom pair trawlers. The type of pinger is unfortunately not stated. Bycatches both in pingered and non-pingered trawls will be monitored by use of EM systems.

Seabirds

From 2020 to 2022 **Denmark** is conducting the project "Interactions between protected species and fisheries". Here LED lights will be tested in gillnets aiming to prevent bycatch of seabirds and Looming eyes buoys will be tested to investigate if they scare seabirds away from fishing gear that could lead to a reduction in bycatch rates.

Turtles

To reduce turtle bycatch the **United States of America** is testing if lowering net height by use of tie downs can reduce the amount of sea turtle bycatch. The trials were conducted in waters off Cape Hatteras, North Carolina, due to the high densities of sea turtles in the area. Preliminary results showed a bycatch reduction of approximately 68%.

Protected fish species

Many projects in the WGFTFB reports are focussed on fish discards and selectivity. In this summary we focus on elasmobranch fish species (sharks, skates and rays). There might be relevant projects ongoing related to teleost fish species which are not summarised here.

Belgium is conducting the project "Raywatch" from 2020 to 2021. Raywatch will focus on collecting biological, catch and survival data for seven ray species; thornback ray (*Raja clavata*), blonde ray (*Raja brachyura*), spotted ray (*Raja montagui*), undulate ray (*Raja undulata*), small eyed ray (*Raja microocellata*), sandy ray (*Leucoraja circularis*) and cuckoo ray (*Leucoraja naevus*) in Western Waters and English Channel. With this biological data, more insight will be gained into the distribution of rays, seasonal patterns, the proportion of landings and discards as well as the length, age and maturity structure of the ray populations. This data will provide a basis for stock assessment models for rays and will result in improved catch advice for these species.

From 2020-2021 **Norway** is running a project "Selectivity in pelagic and industrial trawls". The project focuses on development of technology that can help reduce unwanted bycatch in pelagic and industrial trawls, namely various shark species. This project will focus on solid and flexible selection systems, with a special focus on excluder devices.

Ireland has conducted the project "Staggering the fishing line: a key bycatch reduction option for whitefish trawlers". The project aims to reduce bycatch of skates, rays and dogfish in trawls by attaching 1 m long droppers between the fishing line and the ground gear. The results were very encouraging and a requirement to incorporate one meter spacing between the fishing line and ground gear was subsequently introduced (from 1st June 2020) as part of the remedial measures for cod and whiting in the Celtic Sea (EU 2020/123)

From January 2018 until April 2019 **Spain** conducted a project "HELEA" to design, construct and test new shark and manta ray release equipment for large-scale tropical tuna purse seiners to maximize bycatch species survival during release operations from deck. Several prototypes such as sorting grids, release ramps, holding gadgets and other implements have been constructed and tested. In addition, the efficiency of hoppers as a tool to release more efficiently sharks from the top deck was checked in four tuna purse seiners. No results are reported.

Alternative gears

Denmark is from 2017-2021 collecting the project "seal-safe fishing gear". The project aims to develop and test innovative fishing gears which can serve as alternatives to conventional longlines and set gillnets in areas where seal populations cause damage to the catch of those passive gears. Potential alternatives need to be able to be operated from the smaller vessels typical involved in those fisheries. In particular a small-scale Danish seine will be tested. Parameters to be looked at here include catch efficiency, handling, catch quality and the resulting final income for the fishermen.

In **Germany** parts of the "STELLA" project are focussing on development/optimisation of alternative gear. One is a development of a pontoon trap. The original design of the pontoon trap was not ideal for shallow water conditions and hence a new pontoon version was developed and tested; this new version performed well in field test 2019. Furthermore, several studies have shown that entrance type and funnels are a central factor for fish pot catchability. An optimal cod pot entrance for the (German) Baltic Sea cod pot fishery was identified. (https://doi.org/10.1093/icesjms/fsaa214).

Between 2019–2021 **Norway** conducted the project "Artificial Light in Fish Pots Project" which has the objective to test if using artificial light in pots can replace traditional bait types. Earlier studies have shown that artificial light in pots attracts krill, which acts as a motivating factor for cod to enter the pot. These studies have shown that pots with artificial light in combination with bait caught significantly more cod than pots with bait only. In this project we compared the catching efficiency of pots with light only, with that of pots with bait only. The pots with light gave much higher catch rates than the pots with bait; three times more for cod above minimum landing size (MLS) and ten times more for cod below MLS.

In **Scotland,** the project "FIS commercial viability of fish traps" investigates the potential for a whitefish trap fishery in the West of Scotland. At-sea deployment of newly designed gear will trial the use of baited fish traps at depth. A novel way to harvest whitefish. The research asks how this might be achieved on a commercial scale and whether the approach could be used to survey whitefish stocks.

In the project "SOLART" conducted by **Spain,** the aim is to reduce unwanted catches of mackerel and horse mackerel during some periods of the year in the sole fishery. This will be done by lowering the net height. Information on the catches of new designs of trammel nets and gillnets will be collected to assess impacts on the wanted and unwanted catch to perform an economic study to assess the sustainability of the technical measures suggested. This is very valuable information as it has been discussed that lower net-height potentially can reduce the amount of bycatch of other PET species.

Sweden has several projects working on alternative fishing gear, both to avoid seal depredation but also to mitigate bycatch of harbour porpoises. Pontoon traps have replaced traditional trap-nets and have thereby sustained a coastal fishery for salmonids in the northern Baltic Sea. Pontoon traps have also been developed for other species such as vendace and cod. Seal-safe pot designs are made easy to handle and are equipped with seal exclusion devices. Trials have shown that pots are selective and have comparable catch rates to gillnets. Furthermore, a small-scale seine net for coastal fisheries has been developed as an alternative to gillnet fisheries for flat fish, whitefish and vendace. The studies on seine nets have shown promising results and commercial use of small-scale seines are expected.

4.2 Mitigation studies from Published literature

Table 4.1. Available literature on mitigation studies is collected, sorted by species groups.

Literature	Group of species	Species	Gear	Area	Year	Method	Outcome
Tulloch, V., Grech, A., Jonsen, I., Pirotta, V., & Harcourt, R. (2020). Cost-effective mitigation strategies to reduce bycatch threats to cetaceans identified using return-on-investment	cetaceans	all species of dolphins and whales	all	Australia	2019	trawl-net modifications, closures, acoustic detterents	Trawl-net modifications are cheapest but not the most effective. Closures have higher cost but most cost-

Literature	Group of species	Species	Gear	Area	Year	Method	Outcome
analysis. *Conservation Biology*, *34*(1), 168-179.							effective solution.
Seventh Meeting of the Parties to ACCOBAMS Istanbul, Republic of Turkey, 5 - 8 November 2019	cetaceans	all species			2019	review of the different methods used	Suggested that it is not species that should be managed but fishing activities (métiers) that should be the target of the technical or management measures that are required to reduce the negative impacts of interactions with fisheries.
Popov, D. V., Meshkova, G. D., Hristova, P. D., Gradev, G. Z., Rusev, D. Z., Panayotova, M. D., & Dimitrov, H. A. (2020). Pingers as Cetacean Bycatch Mitigation Measure in Bulgarian Turbot Fishery. *ACTA ZOOLOGICA BULGARICA*, 235-242.	cetaceans	*Phocoena phocoena relicta* and *Tursiops truncatus*	Gillnet	Black Sea	2020	Future Oceans pingers (10kHz and 70kHz)	Not effective method in harbour porpoises.
Omeyer, L., Doherty, P. D., Dolman, S., Enever, R., Reese, A., Tregenza, N., ... & Godley, B. J. (2020). Assessing the Effects of Banana Pingers as a Bycatch Mitigation Device for Harbour Porpoises (Phocoena phocoena). *Frontiers in Marine Science*, *7*, 285.	cetaceans	*Phocoena phocoena*		UK	2020	banana pingers	Reduced the net-porpoise interactions.

Literature	Group of species	Species	Gear	Area	Year	Method	Outcome
Sacchi, J. 2021. Overview of mitigation measures to reduce the incidental catch of vulnerable species in fisheries. Studies and Reviews No. 100 (General Fisheries Commission for the Mediterranean). Rome, FAO. https://doi.org/10.4060/cb5049en	cetaceans (and other marine species)			Mediterranean Sea	2021	review on the use of BRDs	Further technical improvements are suggested, such as modified BRDs .
Chladek, J., Culik, B., Kindt-Larsen, L., Albertsen, C. M., & von Dorrien, C. (2020). Synthetic harbour porpoise (*Phocoena phocoena*) communication signals emitted by acoustic alerting device (Porpoise ALert, PAL) significantly reduce their bycatch in western Baltic gillnet fisheries. Fisheries Research, 232, 105732. https://doi.org/10.1016/j.fishres.2020.105732	small cetaceans	*Phocoena phocoena*	gill-nets	Baltic Sea	2020	new type of acoustic alerting device (Porpoise Alert, PAL) that emits synthetic porpoise communication signals	PAL reduced bycatch rates by 64.9% (95% CI 8.7-88.7%)
Özsandikçi, U., & Gönener, S. (2020). Effectiveness of Pingers on the Harbour Porpoise Phocoena phocoena relicta Abel, 1905 (Cetacea: Phocoenidae) in Turkey as Revealed by Shore-based Observations. ACTA ZOOLOGICA BULGARICA, 72(1), 155-159. http://www.acta-zoologica-bulgarica.eu/002292	small cetaceans	*Phocoena phocoena*	gill-nets	Black Sea	2020	Dukane NetMark 1000 pingers	Concluded that porpoises keep away from pingers, but that a possible habituation effect may be seen from long-term pinger use
Kratzer, I. M., Schäfer, I., Stoltenberg, A., Chladek, J. C., Kindt-Larsen, L., Larsen, F., & Stepputtis, D. (2020). Determination of optimal acoustic passive reflectors to reduce bycatch of odontocetes in	small cetaceans	all odontocetes	gill-nets	Germany	2020	net modifications	Found that 8mm acrylic glass spheres attached to gillnets at intervals less than 0.5m have the same

Literature	Group of species	Species	Gear	Area	Year	Method	Outcome
gillnets. *Frontiers in Marine Science*, *7*, 539. https://doi.org/10.3389/fmars.2020.00539							target strength at 130 kHz as the floatline
Kindt-Larsen, L., Berg, C. W., Northridge, S., & Larsen, F. (2019). Harbor porpoise (*Phocoena phocoena*) reactions to pingers. Marine Mammal Science, 35(2), 552-573. Harbor porpoise (*Phocoena phocoena*) reactions to pingers https://doi-org.ezproxy.uio.no/10.1111/mms.12552	small cetaceans	*Phocoena phocoena*	gillnets	Denmark and UK	2019	AQUAmark100 (20–160 kHz) and AQUAmark300 (10 kHz)	Both types of pingers had some effect, at least up to 300m, but also found evidence of habituation
Zaharieva, Z. O. R. N. I. T. S. A., Yordanov, N. E. L. K. O., Racheva, V. E. N. I. S. L. A. V. A., & Delov, V. E. N. T. S. E. S. L. A. V. (2019). The effect of pingers on cetaceans bycatch and target catch in the turbot gillnets in Bulgarian Black sea. ZooNotes, 150, 1-4.	small cetaceans	*Phocoena phocoena*	gillnets	Black Sea	2019	Future-Oceans 10kHz pinger	Pingers reduced porpoise bycatch rates, and had no effect on turbot catch rates
Hamilton, S., & Baker, G. B. (2019). Technical mitigation to reduce marine mammal bycatch and entanglement in commercial fishing gear: lessons learnt and future directions. Reviews in Fish Biology and Fisheries, 29(2), 223-247. https://doi.org/10.1007/s11160-019-09550-6	marine mammals	all	miscellaneous		2019	literature review of mitigation methods	Points generally to pingers as an effective tool to reduce small cetacean bycatch in gillnets and notes that there are no good tools to prevent small cetacean bycatch in trawl nets, but that loud pingers show some potential

Literature	Group of species	Species	Gear	Area	Year	Method	Outcome
Read, F.L. (2021). Cost-benefit Analysis for Mitigation Measures in Fisheries with High Bycatch. ASCOBANS Secretariat, Bonn, Germany. 81 pages. ASCOBANS Technical Series No.2. https://www.ascobans.org/en/publication/cost-benefit-analysis-mitigation-measures-fisheries-high-bycatch.	marine mammals	all	all	all	2021	literature review of mitigation methods	The report reviews different mitigation measures (acoustic deterrent devices, porpoise alerting devices, reflective nets, acrylic echo enhancers, lights and various technical modifications and changes to fishing practices) that have been trialled in the ASCOBANS region. The cost of implementation and pros and cons of each method are discussed.
Lucchetti, A., Bargione, G., Petetta, A., Vasapollo, C., & Virgili, M. (2019). Reducing sea turtle bycatch in the mediterranean mixed demersal fisheries. *Frontiers in Marine Science*, *6*, 387.	sea turtles	*Caretta caretta*	Mixed demersal fisheries	Central Mediterranean	2019	TEDs	potential to provide a substantial contribution to the conservation of C. caretta in the whole Mediterranean
Vasapollo, C., Virgili, M., Petetta, A., Bargione, G., Sala, A., & Lucchetti, A. (2019). Bottom trawl catch comparison in the Mediterranean Sea: Flexible Turtle Excluder Device (TED) vs traditional gear. *PloS one*, *14*(12), e0216023.	sea turtles	*Caretta caretta*	Bottom trawl	Central Mediterranean	2019	TEDs	may reduce the bycatch of threatened species in coastal Mediterranean demersal multispecies fisheries.

Literature	Group of species	Species	Gear	Area	Year	Method	Outcome
Kakai, T. M. (2019). Assessing the effectiveness of LED lights for the reduction of sea turtle bycatch in an artisanal gillnet fishery-a case study from the north coast of Kenya. *Western Indian Ocean Journal of Marine Science*, *18*(2), 37-44.	sea turtles	*Chelonia mydas, Eretmochelys imbricata, Caretta caretta, Lepidochelys olivacea, Dermochelys coriacea*	Gillnet	Kenya	2019	LEDs	n LEDs attached to bottom-set gillnets in northern Kenya considerably reduce sea turtle bycatch, without adversely affecting target species catch rates.
Lucchetti, A., Bargione, G., Petetta, A., Vasapollo, C., & Virgili, M. (2019). Reducing sea turtle bycatch in the mediterranean mixed demersal fisheries. *Frontiers in Marine Science*, *6*, 387.	sea turtles	*Caretta caretta*	Mixed demersal fisheries	Central Mediterranean	2020	UV-LED lamps	effective tool to deter sea turtles from fishing nets.
Darquea, J. J., Ortiz-Alvarez, C., Córdova-Zavaleta, F., Medina, R., Bielli, A., Alfaro-Shigueto, J., & Mangel, J. C. (2020). Trialing net illumination as a bycatch mitigation measure for sea turtles in a small-scale gillnet fishery in Ecuador. *Latin american journal of aquatic research*, *48*(3), 446-455.	sea turtles	*Lepidochelys olivacea*	Gillnet	Equador	2020	LEDs	no effective results were observed.
Darquea, J. J., Ortiz-Alvarez, C., Córdova-Zavaleta, F., Medina, R., Bielli, A., Alfaro-Shigueto, J., & Mangel, J. C. (2020). Trialing net illumination as a bycatch mitigation measure for sea turtles in a small-scale gillnet fishery in Ecuador. *Latin american journal of aquatic research*, *48*(3), 446-455.	sea turtles	*Chelonia mydas*		Equador	2020		reduced numbers of turtle entanglement were recorded when LEDs were used.

Literature	Group of species	Species	Gear	Area	Year	Method	Outcome
Darquea, J. J., Ortiz-Alvarez, C., Córdova-Zavaleta, F., Medina, R., Bielli, A., Alfaro-Shigueto, J., & Mangel, J. C. (2020). Trialing net illumination as a bycatch mitigation measure for sea turtles in a small-scale gillnet fishery in Ecuador. *Latin american journal of aquatic research*, *48*(3), 446-455.	sea turtles	*Dermochelys coriacea*		Equador	2020	LEDs	The simultaneous use of branch line weighting, a BSL and night setting resulted in zero seabird bycatch
Bielli, A. et al. (2020) 'An illuminating idea to reduce bycatch in the Peruvian small-scale gillnet fishery', Biological Conservation, 241, p. 108277. doi:10/ggkz79 .	birds, turtles, small cetacean		Gill-net	Peru	2015-2018	LEDs	bycatch probability per set was reduced by up to 74.4 % for sea turtles and 70.8 % for small cetaceans in comparison to non-illuminated, control nets. For seabirds, nominal BPUEs decreased by 84.0 % in the presence of LEDs. Target species CPUE was not negatively affected by the presence of LEDs
Cantlay, J.C. et al. (2020) 'Ineffectiveness of light emitting diodes as underwater deterrents for long-tailed ducks Clangula hyemalis', Global Ecology and Conservation, p. e01102. doi:10/ggvm6t.	birds	Long-tailed Ducks *Clangula hyemalis*	Tank study			LEDs	No light treatment significantly reduced the foraging success of ducks. LED lights did not inhibit the feeding of Long-tailed Ducks. Such lights may be ineffective as underwater visual deterrents when

Literature	Group of species	Species	Gear	Area	Year	Method	Outcome
							deployed on gillnets, while white flashing lights may make foraging sites more attractive to Long-tailed Ducks
Hansen, K.A. et al. (2020) 'The common murre (*Uria aalge*), an auk seabird, reacts to underwater sound', The Journal of the Acoustical Society of America, 147(6), pp. 4069–4074. doi:10.1121/10.0001400.	birds	common murres (*Uria aalge*)	Tank study	Denmark	2018	Underwater sound	The authors' findings indicate that common murres may be affected by, and therefore potentially also vulnerable to, underwater noise. But in terms of mitigation pingers could have an effect on this species
McGrew, K. (2019) Reducing Gillnet Bycatch: Seaduck Underwater Hearing Thresholds and Auditory Deterrent Devices. M.S. University of Delaware. Available at: https://search.proquest.com/docview/2307477076/abstract/60A79EA3A2444693PQ/1	birds	long-tailed duck (*Clangula hyemalis*), surf scoter (*Melanitta perspicillata*), and common eider (*Somateria mollissima*)	Tank study	United States	2016-2018	Underwater sound	a lower frequency pinger in the 2–3 kHz range would fall within sea duck sensitivity and may be a viable option for field testing. While a pinger that emits tones under 3 kHz would be ideal for species with lower frequency sensitivity like surf scoters

Literature	Group of species	Species	Gear	Area	Year	Method	Outcome
Rouxel, Y. et al. (2021) 'Buoys with looming eyes deter seaducks and could potentially reduce seabird bycatch in gillnets', Royal Society Open Science, 8(5), p. 210225. doi:10.1098/rsos.210225.	birds	long-tailed duck *Clangula hyemalis*	Gillnet			'Looming eyes buoy' (LEB)	abundance declined by approximately 20–30% within a 50 m radius of the LEB and that the presence of LEBs was the most important variable explaining this decline. We found no evidence for a memory effect on long-tailed ducks but found some habituation to the LEB within the time frame of the project (62 days).
Jiménez S, Domingo A, Forselledo R, Sullivan B, Yates O (2019) Mitigating bycatch of threatened seabirds: the effectiveness of branch line weighting in pelagic longline fisheries. Anim Conserv 22: 376–385,	birds		Pelagic longline	Uruguay	2018	Increasing the sink rate of baited hooks by reducing the distance between the hook and the weight of the branch lines (leader length)	The simultaneous use of branch line weighting, a BSL and night setting resulted in zero seabird bycatch
Towards mitigation of seabird bycatch: Large-scale effectiveness of night setting and Tori lines across multiple pelagic longline fleets	birds	Albatrosses, petrels and others		south Atlantic and south-western Indian Oceans	2020 (studies carried out before 2011 but results in recent years)	night setting and Tori lines	In practice

Literature	Group of species	Species	Gear	Area	Year	Method	Outcome
Field et al (2019). High contrast panels and lights do not reduce bird bycatch in Baltic Sea gillnet fisheries. Global Ecology and conservation, Vol 18. https://doi.org/10.1016/j.gecco.2019.e00602	birds	Long- tailed Ducks (*Clangula hyemalis*) and Velvet Scoters (*Melanitta fusca*)	Gill-net	Baltic sea	2019	High contrast panels	Non effective
https://sustainable-fisheries-uw.org/hookpod-seabird-bycatch-conservation/	birds		Long-lines	New Zealand	2020	Hookpods	Effective and implementing
https://www.birdlife.org/worldwide/news/namibian-fishery-reduces-seabird-deaths-98	birds	Yellow-nosed Albatross Thalassarche chlororhynchos (Endangered) and White-chinned Petrel Procellaria aequinoctialis (Vulnerable). And other birds.	hake trawl and long-line	Namibia	2020	Bird scaring lines	Effective. A new paper shows that seabird deaths in the Namibian demersal longline fishery have been reduced by 98%, which equates to 22,000 birds saved every year.
https://www.fisheries.noaa.gov/alaska/bycatch/seabird-avoidance-gear-and-methods	Birds		Long-lines	Alaska	2020	Streamer lines	Effective
Grande M, et al. Bycatch mitigation actions on tropical tuna purse seiners : best practices program and bycatch releasing tools. In: IATTC - 9th Meeting of the Working Group on Bycatch San Diego, California, 2019. HELEA project	Fish	Sharks and rays	Tropical tuna Purse seine	Tropical seas	2019	shark release velcros and manta sorting grids were developed	Continues with ongoing projects with some promising results. (SGP-HOP-NEXT, LIBECERCO, SGP-DISLIB, OPA-HOPPER).
Murua J. F, J.M., Grande, M., Onandia, M., and Santiago, J. (2021) Improving on deck best handling and release practices for sharks in tuna purse seiners using hopper with ramp	Fish	Sharks end rays	Tropical tuna Purse seine	Tropical seas	2021	hoppers with ramps in facilitating rapid release of sharks	more than 95 per cent of sharks were detected and released from the top deck (Murua *et al.,* 2021)

Literature	Group of species	Species	Gear	Area	Year	Method	Outcome
devices. Seventeenth Regular Session of the Scientific Committee, WCPFC, SC17-EB-IP-13 HOPPER							

4.3 Studies in progress within the group

In **France**, the LICADO project funded by the European Maritime and Fisheries Fund and France Filière Peche (2019-2022), aimed at improving the knowledge and reducing bycatch of common dolphins in fishing gears in the Bay of Biscay. The project is carried out by the committee for marine fisheries and fish farming (*Comité National des Pêches Maritimes et des Elevages Marins* - CNPMEM) and involved grouping of professional fishermen (Les Pêcheurs de Bretagne and AGLIA), a fishery technology company (OCTECH) and scientists (IFREMER and *Observatoire Pelagis*, La Rochelle University-CNRS). The first objective of LICADO is to provide new knowledge on common dolphin bycatch by analysing observer data, fishing effort data and interview. The second objective is to develop mitigation techniques for midwater pair trawlers and netters. New effective acoustic signals were tested on common dolphin groups and used in a new Cetasaver pinger. This pinger should produce signals that can either be sent in one single direction or several and only when dolphins are detected to avoid useless emissions, acoustic disturbance outside of fishing gears and dolphin habituation. This signal was validated during a dedicated campaign in summer 2020. On midwater pair trawlers, tests were conducted in winter 2021 to compare efficiency of Cetasaver compared to DDD-03H: 137 hauls were observed (107 retained: 46 with Cetasaver and 61 with DDD-03) and 3 bycatches were recorded. The low number of hauls and by-catch observed will require more experiments in winter 2022 to be statistically conclusive.

Feasibility studies were conducted on netters with two types of pingers: pingers on nets and pingers on vessel hulls that are triggered during net deployment only. Static Cetasaver pingers adapted to netters were tested on 7 vessels and 173 fishing operations were observed, 3 dolphin bycatches recorded (2 with pinger and one without). Pingers at setting were tested on three netters, covering 105 fishing operation. Only one porpoise bycatch was recorded during a fishing operation without pinger. As for PTM, experiments will be continued and extended in 2022.

Acoustic reflectors were tested on a gillnetter (26 fishing operations, 250m length, no bycatch) to improve the detectability of nets by common dolphins. Measurements have shown that common dolphins can detect the headrope and footrope but probably can’t detect the nylon meshes. These reflectors are two parallel lines of Polysteel 3mm included in the netting. In the context of LICADO project, the use of reflectors remains at feasibility stage.

The Institute of Marine Research (IMR) in **Norway** reported that they have finished two years of field trials to determine the effect of pingers on harbour porpoise, and harbour and grey seal bycatch in commercial coastal gillnet fisheries. Catch data on 3,500 net-km-days were collected by 8 fishing vessels operating gillnets in high bycatch regions. A total of 20 harbour porpoises and 9 harbour seals were bycaught, with 19 harbour porpoises and 6 harbour seals taken in control (non-pingered) nets. Pingers had no significant effect on catch rates of or fish or harbour/grey seals, but reduced harbour porpoise bycatch rates by 95%. Trials showed that the extra time cost incurred by pinger use was low, averaging about 2.8 minutes per haul, or 5.5 hours per year, for a typical gillnet fisher. A manuscript describing the trials and their results has been submitted to Fisheries Research.

After unsuccessful trials with banana pingers and PALs in 2016-2018, PALs with a modified signal were tested in the **Icelandic** cod gillnet fishery in 2020. These PALs had a signal developed to emulate the signal of an out of production pinger, the Dukane 1000. The random wide-band sweep characteristic of the original PAL was maintained. Signal peaks are at 10, 50, 70 and 130kHz with a source level of 157dB. This signal is aimed at deterring porpoise rather than communicating with them as in the original PALs. The device was tested over two weeks, where over 3000 50m nets were hauled. Half of the net sets were equipped with the devices, while the other half acted as control. A total of 15 marine mammals were caught in the trial, 14 harbour porpoises and one harbour seal. Significant difference in the number of harbour porpoises was observed between the two treatments ($t = 3.78$, $p = 0.00017$), as all 14 of the harbour porpoises were caught in the control sets, while none were caught in the PAL equipped sets. The single harbour seal bycaught was caught in a PAL equipped set. These results suggest that this configuration of the PAL might be effective in reducing harbour porpoise bycatch in Icelandic waters.

In **Portugal**, mitigation trials within one project led by CCMAR/University of Algarve (Mar 2020-iNOVPESCA) taking place in the Portuguese Southern coast (Algarve), using DDD´s and DiD´s (Dolphin deterrent devices, STM Industrial Electronics, Italy) took place from 2019 to March 2021 (Marçalo et al. 2021, in Portuguese), and ongoing with the support of the CetAMBICion project referred above. These trials occurred in GNS/ GTR and purse seine nets. In GNS/GTR, 77 hauls for DiD testing (25 control and 52 with alarms) and 482 hauls for DDD-03N testing (228 control and 254 with alarms) were analysed for boats larger or smaller than 12 m. No incidental captures were observed in GNS/GTR in control or nets equipped with alarms, but depredation from bottlenoses was significantly reduced when using alarms for all vessel sizes, especially in gears targeting European hake, *Merluccious merluccious*. In purse seining, 216 hauls for DDD testing (127 control and 77 using DDD) were analysed. Incidental captures of 22 common dolphins (80 % released live) were observed in control nets and none in nets using alarms. Monitoring in these trials is performed by onboard observations and logbook registrations from skippers.

Furthermore, in Portugal and specifically for the beach seine fishery, a total of 384 Future Oceans pingers operating at 10kHz and 70kHz (respectively, 132 and 145dbs) were made available through project ConMar (led by the University of Aveiro) to 26 beach seiners in 2019. These beach seiners corresponded to 100% of the fleet licensed between Nazaré and Porto (coastal area with representative cetacean bycatch) and to 65% of the national fleet, considering licensed beach seiners in 2019. However, in the following beach seine seasons, the application of pingers was not monitored due to lack of funding and COVID 19 constraints.

In **Spain**, the project "MERMA CIFRA" (Monitoring, Assessment and Reduction of Accidental Mortality of Cetaceans due to Interactions with the Spanish Fleet - Review and Action), coordinated by the IIM-CSIC, also includes a WP focused on mitigation: **"Technical measures for the reduction of accidental capture of cetaceans in Spanish fisheries in the Atlantic-Northwest national fishing ground"** led by the IEO, which comprises 3 sub-tasks: a) to evaluate the technical fishing measures available to reduce the accidental capture of cetaceans in Spanish fisheries in the Atlantic-northwest national fishing ground; b) to carry out experimental reduction tests in the fisheries with the highest catch rate (trawl and gillnet); and c) to propose the most appropriate technical measures for the fisheries and the fishing ground based on the results and the best available scientific information.

One project including mitigation of cetacean bycatches is currently being conducted by **Spain, France and Portugal:** The international project "CetAMBICion" (Coordinated Cetacean

Assessment, Monitoring and Management strategy in the Bay of Biscay and Iberian Coast subregion), coordinated by the IIM-CSIC, includes a work package focused on mitigation: **"Proposal of coordinated measures to address cetacean bycatch"**, led by the Spanish Institute of Oceanography (IEO), will address several mitigation measures within the following tasks: a) Compilation of the available information on cetacean bycatch reduction devices and highlight weaknesses and knowledge gaps, led by the French Office of the Biodiversity (OFB); b) Pilot project: Trawling (Cetacean Excluder Devides CEDs and pingers), led by IEO; c) Pilot project: Fixed and seine nets (DDD and DiD´s pingers), led by the University of Algarve in Portugal; d) Feasibility study to go to move-on rule measure applied to mitigate cetaceans bycatch, led by the OFB; e) Efficiency of the different technical measures tested in the Bay of Biscay and Iberian coasts, led by the IEO; f) Proposal of common/coordinated measures among the subregion, for the reduction of bycatch in the framework of MSFD Programmes of Measures, led by the Spanish and French Ministries of Ecologic Transition.

In **Portugal**, the LIFE + Ilhas-Barreira (2019-2023) project funded by the EU´s LIFE program, in one of its actions aims to improve knowledge on the bycatch assessment of seabirds in coastal southern Portuguese fisheries, as to test mitigation measures to decrease bycatch. Ongoing trials at the most problematic detected gears (purse seine and nets) in the area are led by the partner CCMAR/University of Algarve using acoustic (megaphone) and visual (scary bird repeller) devices. Results on these trials will be discussed in future reports.

4.4 Conclusions

- For the first time WGBYC has collated information on mitigation projects through the national reports submitted to WGFTFB. This new approach is considered by the WG to be very useful, and in particular the new version of the WGFTFB national report format from 2021 where it is indicated if the project has relevance for PETS species or not. One point to highlight is that most contributors to the WGFTFB national reports come from fishing gear related institutes so there might be studies conducted by other institutes who are conducting relevant bycatch mitigation studies, but which are not reported to WGFTFB.
- The second task under TOR B has been changed to a table format (Table 4.1) in order to save time as mentioned above and in the conclusion in the 2019 WGBYC report. This change saved valuable time and the table format will be used for future summaries in WGBYC reports.
- In the WGBYC data call, member states can indicate in fleet effort and monitored effort if this is with/without pingers. But no notation on whether pingers are implemented and controlled. Finding a way for member states to report on pinger use requirements would be valuable.
- From the tabulated list of literature in Section 4.2 the mitigation tools on especially turtle, and seabird bycatch in longline fisheries, have shown promising results. The use of turtle excluder devises, hookpods and scaring lines have shown reductions in a variety of fisheries.
- For most cases the effect on porpoise bycatch with pingers has shown reductions, however not all models are effective in all areas, especially in Iceland where there have been challenges to reduce bycatch of porpoises. However, a new trial with a new version of the old Dukane pinger showed promising results. Many southern European countries are focusing on testing the DDD models to reduce bycatch of dolphins and it will be interesting to follow these studies in the coming years. So far, DDD´s in Portuguese southern waters tested in purse seine fisheries show promising results to that could significantly reduce bycatch of common dolphins.

5 TOR C: Evaluate the range of (minimum/maximum) impacts of bycatch on protected species populations, where possible, to assess likely conservation level threats, including feedback to the results from the Workshop on estimation of Mortality of Marine Mammals dur to Bycatch (WKMOMA)

In previous WGBYC reports, under ToR A, data on bycatch rates and mortality estimates were presented for a single reporting year. Those single year bycatch rates provide only a snapshot of the data used by WGBYC for mortality assessments. Consequently, such data could provide a misleading representation of the "true" estimated rates in different métiers that are used in assessments, due to variable monitoring coverage (or sub-optimal sampling protocols) in particular years and/or métiers. During the preparation of the tables for ToR A at the 2021 WGBYC meeting, the utility of presenting single year bycatch rates was raised and after lengthy discussions it was agreed that single year bycatch rates would be removed and that only single year monitoring and fishing effort levels would be presented in Table 3.3a and 3.3b in ToR A.

Further discussions also concluded that it would be more informative to present bycatch rate data under ToR C (where mortality assessments are conducted) for multiple years starting from 2017, when WGBYC issued its first data call. The WG considered that these multi-annual bycatch rates when shown alongside monitoring and fishing effort data would be useful as a basis for selecting candidate species/metier combinations for more detailed analysis, in a more formal and justifiable way than had previously been done by WGBYC.

Table 5.1 presents data from 2017–2020 by Ecoregion from the WGBYC database for marine mammal, seabird and turtle species. Although this table was not used directly to inform the choice of mortality assessments undertaken at the 2021 meeting, our intention is to update this table annually as additional new data are received, and to use the output to select some species/metier combinations that have sufficient data for more detailed analysis, and where appropriate the production of mortality estimates, based on available information about the scale of the fishery, monitoring levels and the observed number of bycaught specimens.

This evolving table will help WGBYC select and prioritise areas for future mortality assessments, and also highlight areas/métiers with known bycatch but currently insufficient data for more detailed analysis. As the table is simply a description of the data contained in the WGBYC database over a given period, it should not be used as "evidence" that no other bycatch issues exist in European waters. For example, because broad scale and fairly low-level monitoring programmes such as those that contribute most of the data to the WGBYC database, are probably not sufficient to consistently highlight extremely rare bycatch occurrences, either because of low population abundance or low susceptibility of bycatch for some species, but which nonetheless may have significant conservation implications if the species abundance, reproductive dynamics and/or societal structuring mean they are likely to be disproportionately affected by even very low level additional mortality.

Table 5.1. Data from 2017-2020 describing monitoring effort, fishing effort, monitoring coverage, bycatch numbers and bycatch rates by Ecoregion from the WGBYC database, for all métiers with at least one recorded bycatch of marine mammal, seabird or turtle during that period.

Ecoregion	ICES/GFCM Area	Métier Level 3	Taxa	Species Group	Species	Total Observed Effort (Days at Sea)	Fishing Days (Days at Sea)	Monitoring Coverage	Incidents	No. Specimens	Bycatch Rate
Azores	27.10.a	Longlines	Turtle	Turtle	*Caretta caretta*	107.00	199.00	0.5377	12	26	0.2430
Azores	27.10.a	Longlines	Turtle	Turtle	*Dermochelys coriacea*	196.00	755.00	0.2596	4	4	0.0204
Azores	27.10.a.2	Longlines	Marine mammal	Cetacean	*Globicephala melas*	1226.00	10392.00	0.1180	1	1	0.0008
Azores	27.10.a.2	Longlines	Turtle	Turtle	*Caretta caretta*	363.00	6981.00	0.0520	1	1	0.0028
Azores	27.10.a.2	Longlines	Turtle	Turtle	*Dermochelys coriacea*	363.00	6981.00	0.0520	2	2	0.0055
Azores	27.10.a.2	Rods and lines	Bird	Bird	*Calonectris borealis*	442.00	25349.00	0.0174	1	3	0.0068
Azores	27.10.a.2	Rods and lines	Bird	Bird	*Puffinus gravis*	442.00	25349.00	0.0174	1	2	0.0045
Azores	27.10.a.2	Rods and lines	Marine mammal	Cetacean	*Delphinus delphis*	2018.00	51806.00	0.0390	2	2	0.0010
Baltic Sea	27.3.b.23	Nets	Bird	Bird	*Alca torda*	317.00	16293.17	0.0195	4	6	0.0189
Baltic Sea	27.3.b.23	Nets	Bird	Bird	*Aythya fuligula*	17.00	5491.00	0.0031	1	1	0.0588
Baltic Sea	27.3.b.23	Nets	Bird	Bird	*Gavia arctica*	224.00	6088.17	0.0368	2	2	0.0089
Baltic Sea	27.3.b.23	Nets	Bird	Bird	*Melanitta fusca*	300.00	10802.17	0.0278	4	4	0.0133

Ecoregion	ICES/GFCM Area	Métier Level 3	Taxa	Species Group	Species	Total Observed Effort (Days at Sea)	Fishing Days (Days at Sea)	Monitoring Coverage	Incidents	No. Specimens	Bycatch Rate
Baltic Sea	27.3.b.23	Nets	Bird	Bird	*Melanitta nigra*	224.00	6088.17	0.0368	1	3	0.0134
Baltic Sea	27.3.b.23	Nets	Bird	Bird	*Phalacrocorax carbo*	330.00	21269.67	0.0155	19	21	0.0636
Baltic Sea	27.3.b.23	Nets	Bird	Bird	*Podiceps cristatus*	224.00	6088.17	0.0368	1	1	0.0045
Baltic Sea	27.3.b.23	Nets	Bird	Bird	*Podiceps grisegena*	76.00	4714.00	0.0161	1	1	0.0132
Baltic Sea	27.3.b.23	Nets	Bird	Bird	*Somateria mollissima*	330.00	21269.67	0.0155	42	59	0.1788
Baltic Sea	27.3.b.23	Nets	Bird	Bird	*Uria aalge*	330.00	21269.67	0.0155	45	63	0.1909
Baltic Sea	27.3.b.23	Nets	Marine mammal	Cetacean	*Phocoena phocoena*	330.00	21269.67	0.0155	11	12	0.0364
Baltic Sea	27.3.b.23	Nets	Marine mammal	Seal	*Phoca vitulina*	300.00	10802.17	0.0278	3	3	0.0100
Baltic Sea	27.3.c.22	Nets	Bird	Bird	*Aves*	182.00	15191.00	0.0120	1	1	0.0055
Baltic Sea	27.3.c.22	Nets	Bird	Bird	*Aythya marila*	15.30	59801.00	0.0003	1	8	0.5229
Baltic Sea	27.3.c.22	Nets	Bird	Bird	*Phalacrocorax carbo*	182.00	15191.00	0.0120	1	2	0.0110
Baltic Sea	27.3.c.22	Nets	Bird	Bird	*Somateria mollissima*	182.00	15191.00	0.0120	1	3	0.0165
Baltic Sea	27.3.c.22	Nets	Marine mammal	Cetacean	*Phocoena phocoena*	305.00	29700.00	0.0103	12	13	0.0426

Ecoregion	ICES/GFCM Area	Métier Level 3	Taxa	Species Group	Species	Total Observed Effort (Days at Sea)	Fishing Days (Days at Sea)	Monitoring Coverage	Incidents	No. Specimens	Bycatch Rate
Baltic Sea	27.3.c.22	Nets	Marine mammal	Seal	*Phoca vitulina*	305.00	29700.00	0.0103	11	12	0.0393
Baltic Sea	27.3.d.24	Longlines	Bird	Bird	*Uria aalge*	6.00	847.00	0.0071	1	1	0.1667
Baltic Sea	27.3.d.25	Longlines	Bird	Bird	*Uria aalge*	7.00	2178.27	0.0032	4	4	0.5714
Baltic Sea	27.3.d.25	Nets	Bird	Bird	*Uria aalge*	5.00	13991.00	0.0004	3	6	1.2000
Baltic Sea	27.3.d.26	Nets	Bird	Bird	*Melanitta fusca*	23.00	22356.72	0.0010	1	168	7.3043
Baltic Sea	27.3.d.27	Traps	Bird	Bird	*Phalacrocorax carbo*	3.00	3938.08	0.0008	1	1	0.3333
Baltic Sea	27.3.d.28	Nets	Bird	Bird	*Aythya fuligula*	10.00	423.50	0.0236	2	2	0.2000
Baltic Sea	27.3.d.28	Nets	Bird	Bird	*Aythya marila*	10.00	423.50	0.0236	1	1	0.1000
Baltic Sea	27.3.d.28	Nets	Bird	Bird	*Phalacrocorax carbo*	10.00	423.50	0.0236	4	6	0.6000
Baltic Sea	27.3.d.28	Nets	Bird	Bird	*Uria aalge*	10.00	423.50	0.0236	1	1	0.1000
Baltic Sea	27.3.d.28.1	Nets	Bird	Bird	*Anatidae*	12875.00	16009.75	0.8042	1	3	0.0002
Baltic Sea	27.3.d.28.1	Nets	Bird	Bird	*Aythya fuligula*	12760.00	16456.50	0.7754	1	1	0.0001
Baltic Sea	27.3.d.28.1	Traps	Bird	Bird	*Phalacrocorax carbo*	20549.00	24562.75	0.8366	6	17	0.0008

Ecoregion	ICES/GFCM Area	Métier Level 3	Taxa	Species Group	Species	Total Observed Effort (Days at Sea)	Fishing Days (Days at Sea)	Monitoring Coverage	Incidents	No. Specimens	Bycatch Rate
Baltic Sea	27.3.d.28.1	Traps	Marine mammal	Seal	*Halichoerus grypus*	20584.00	32263.75	0.6380	5	5	0.0002
Baltic Sea	27.3.d.28.1	Traps	Marine mammal	Seal	*Phoca hispida*	22.00	5086.00	0.0043	2	2	0.0909
Baltic Sea	27.3.d.28.2	Nets	Bird	Bird	*Anatidae*	1452.00	2713.83	0.5350	1	3	0.0021
Baltic Sea	27.3.d.28.2	Traps	Marine mammal	Seal	*Halichoerus grypus*	501.00	644.58	0.7772	1	1	0.0020
Baltic Sea	27.3.d.29	Longlines	Marine mammal	Seal	*Halichoerus grypus*	38.00	164.00	0.2317	1	3	0.0789
Baltic Sea	27.3.d.29	Nets	Bird	Bird	*Anatidae*	18048.00	27780.00	0.6497	2	6	0.0003
Baltic Sea	27.3.d.29	Nets	Bird	Bird	*Aves*	77.00	12058.17	0.0064	1	1	0.0130
Baltic Sea	27.3.d.29	Nets	Bird	Bird	*Aythya*	34846.00	55196.50	0.6313	5	9	0.0003
Baltic Sea	27.3.d.29	Nets	Bird	Bird	*Aythya fuligula*	77.00	12058.17	0.0064	5	13	0.1688
Baltic Sea	27.3.d.29	Nets	Bird	Bird	*Bucephala clangula*	77.00	12058.17	0.0064	1	1	0.0130
Baltic Sea	27.3.d.29	Nets	Bird	Bird	*Clangula hyemalis*	16798.00	27416.50	0.6127	1	1	0.0001
Baltic Sea	27.3.d.29	Nets	Bird	Bird	*Melanitta fusca*	18125.00	39838.17	0.4550	5	7	0.0004
Baltic Sea	27.3.d.29	Nets	Bird	Bird	*Mergus*	18125.00	39838.17	0.4550	8	16	0.0009

Ecoregion	ICES/GFCM Area	Métier Level 3	Taxa	Species Group	Species	Total Observed Effort (Days at Sea)	Fishing Days (Days at Sea)	Monitoring Coverage	Incidents	No. Specimens	Bycatch Rate
Baltic Sea	27.3.d.29	Nets	Bird	Bird	*Mergus merganser*	34846.00	55196.50	0.6313	5	5	0.0001
Baltic Sea	27.3.d.29	Nets	Bird	Bird	*Mergus serrator*	34846.00	55196.50	0.6313	4	5	0.0001
Baltic Sea	27.3.d.29	Nets	Bird	Bird	*Phalacrocorax carbo*	34946.00	81907.67	0.4267	11	19	0.0005
Baltic Sea	27.3.d.29	Nets	Bird	Bird	*Podiceps cristatus*	16875.00	39474.67	0.4275	2	2	0.0001
Baltic Sea	27.3.d.29	Nets	Bird	Bird	*Somateria mollissima*	34869.00	69849.50	0.4992	13	63	0.0018
Baltic Sea	27.3.d.29	Nets	Bird	Bird	*Uria aalge*	18048.00	27780.00	0.6497	2	2	0.0001
Baltic Sea	27.3.d.29	Nets	Marine mammal	Seal	*Halichoerus grypus*	34846.00	55196.50	0.6313	8	10	0.0003
Baltic Sea	27.3.d.29	Pelagic trawls	Marine mammal	Seal	*Halichoerus grypus*	32.00	2324.00	0.0138	1	1	0.0313
Baltic Sea	27.3.d.29	Traps	Bird	Bird	*Phalacrocorax carbo*	11041.00	16215.00	0.6809	4	4	0.0004
Baltic Sea	27.3.d.29	Traps	Marine mammal	Seal	*Halichoerus grypus*	11041.00	16215.00	0.6809	13	18	0.0016
Baltic Sea	27.3.d.29	Traps	Other	Other	*Castor fiber*	5991.00	8442.00	0.7097	1	1	0.0002
Baltic Sea	27.3.d.29	Traps	Other	Other	*Lutra lutra*	5991.00	8442.00	0.7097	1	1	0.0002
Baltic Sea	27.3.d.30	Bottom trawls	Bird	Bird	*Phalacrocorax carbo*	40.00	70.00	0.5714	1	10	0.2500

Ecoregion	ICES/GFCM Area	Métier Level 3	Taxa	Species Group	Species	Total Observed Effort (Days at Sea)	Fishing Days (Days at Sea)	Monitoring Coverage	Incidents	No. Specimens	Bycatch Rate
Baltic Sea	27.3.d.30	Bottom trawls	Marine mammal	Seal	*Halichoerus grypus*	30.00	67.00	0.4478	1	1	0.0333
Baltic Sea	27.3.d.30	Nets	Bird	Bird	*Anas crecca*	38.00	22701.83	0.0017	2	2	0.0526
Baltic Sea	27.3.d.30	Nets	Bird	Bird	*Aves*	25.00	29431.00	0.0008	1	1	0.0400
Baltic Sea	27.3.d.30	Nets	Bird	Bird	*Aythya fuligula*	25.00	29431.00	0.0008	1	1	0.0400
Baltic Sea	27.3.d.30	Nets	Bird	Bird	*Bucephala clangula*	81.00	47150.50	0.0017	2	4	0.0494
Baltic Sea	27.3.d.30	Nets	Bird	Bird	*Clangula hyemalis*	63.00	52132.83	0.0012	3	6	0.0952
Baltic Sea	27.3.d.30	Nets	Bird	Bird	*Melanitta nigra*	38.00	22701.83	0.0017	2	2	0.0526
Baltic Sea	27.3.d.30	Nets	Bird	Bird	*Mergus*	106.00	76581.50	0.0014	8	35	0.3302
Baltic Sea	27.3.d.30	Nets	Bird	Bird	*Mergus merganser*	150.00	103067.25	0.0015	16	35	0.2333
Baltic Sea	27.3.d.30	Nets	Bird	Bird	*Mergus serrator*	43.00	24448.67	0.0018	1	1	0.0233
Baltic Sea	27.3.d.30	Nets	Bird	Bird	*Phalacrocorax carbo*	150.00	103067.25	0.0015	42	79	0.5267
Baltic Sea	27.3.d.30	Nets	Bird	Bird	*Podiceps cristatus*	82.00	49187.58	0.0017	3	3	0.0366
Baltic Sea	27.3.d.30	Nets	Bird	Bird	*Somateria mollissima*	107.00	78618.58	0.0014	5	15	0.1402

Ecoregion	ICES/GFCM Area	Métier Level 3	Taxa	Species Group	Species	Total Observed Effort (Days at Sea)	Fishing Days (Days at Sea)	Monitoring Coverage	Incidents	No. Specimens	Bycatch Rate
Baltic Sea	27.3.d.30	Nets	Marine mammal	Seal	*Halichoerus grypus*	125.00	73636.25	0.0017	6	7	0.0560
Baltic Sea	27.3.d.30	Traps	Bird	Bird	*Mergus*	99.00	11450.83	0.0086	1	1	0.0101
Baltic Sea	27.3.d.30	Traps	Bird	Bird	*Phalacrocorax carbo*	187.00	23639.00	0.0079	7	10	0.0535
Baltic Sea	27.3.d.30	Traps	Bird	Bird	*Somateria mollissima*	14.00	12848.00	0.0011	1	1	0.0714
Baltic Sea	27.3.d.30	Traps	Marine mammal	Seal	*Halichoerus grypus*	280.00	34611.25	0.0081	10	15	0.0536
Baltic Sea	27.3.d.31	Nets	Bird	Bird	*Anas platyrhynchos*	7.00	16123.83	0.0004	1	4	0.5714
Baltic Sea	27.3.d.31	Nets	Bird	Bird	*Bucephala clangula*	7.00	13833.50	0.0005	2	2	0.2857
Baltic Sea	27.3.d.31	Nets	Bird	Bird	*Laridae*	7.00	13833.50	0.0005	1	1	0.1429
Baltic Sea	27.3.d.31	Nets	Bird	Bird	*Mergus*	15.00	32010.17	0.0005	4	26	1.7333
Baltic Sea	27.3.d.31	Nets	Bird	Bird	*Mergus merganser*	7.00	16123.83	0.0004	1	1	0.1429
Baltic Sea	27.3.d.31	Nets	Bird	Bird	*Phalacrocorax carbo*	15.00	32010.17	0.0005	4	23	1.5333
Baltic Sea	27.3.d.31	Nets	Bird	Bird	*Podiceps cristatus*	7.00	13833.50	0.0005	2	2	0.2857
Baltic Sea	27.3.d.31	Nets	Marine mammal	Seal	*Halichoerus grypus*	7.00	13833.50	0.0005	1	1	0.1429

Ecoregion	ICES/GFCM Area	Métier Level 3	Taxa	Species Group	Species	Total Observed Effort (Days at Sea)	Fishing Days (Days at Sea)	Monitoring Coverage	Incidents	No. Specimens	Bycatch Rate
Baltic Sea	27.3.d.31	Nets	Marine mammal	Seal	*Phoca hispida*	7.00	13833.50	0.0005	4	4	0.5714
Baltic Sea	27.3.d.31	Traps	Bird	Bird	*Anas platyrhynchos*	41.00	16757.17	0.0024	1	1	0.0244
Baltic Sea	27.3.d.31	Traps	Bird	Bird	*Gavia arctica*	60.00	15462.67	0.0039	1	1	0.0167
Baltic Sea	27.3.d.31	Traps	Bird	Bird	*Larus argentatus*	60.00	15462.67	0.0039	1	1	0.0167
Baltic Sea	27.3.d.31	Traps	Bird	Bird	*Mergus*	143.00	47873.33	0.0030	11	89	0.6224
Baltic Sea	27.3.d.31	Traps	Bird	Bird	*Mergus serrator*	60.00	15462.67	0.0039	1	1	0.0167
Baltic Sea	27.3.d.31	Traps	Bird	Bird	*Phalacrocorax carbo*	143.00	47873.33	0.0030	8	127	0.8881
Baltic Sea	27.3.d.31	Traps	Marine mammal	Seal	*Halichoerus grypus*	143.00	47873.33	0.0030	21	34	0.2378
Baltic Sea	27.3.d.32	Nets	Bird	Bird	*Anas platyrhynchos*	12831.00	28065.00	0.4572	9	60	0.0047
Baltic Sea	27.3.d.32	Nets	Bird	Bird	*Anatidae*	28062.00	39240.00	0.7151	17	63	0.0022
Baltic Sea	27.3.d.32	Nets	Bird	Bird	*Aythya*	12823.00	19204.00	0.6677	1	1	0.0001
Baltic Sea	27.3.d.32	Nets	Bird	Bird	*Aythya marila*	8.00	8861.00	0.0009	1	1	0.1250
Baltic Sea	27.3.d.32	Nets	Bird	Bird	*Branta bernicla*	15239.00	20036.00	0.7606	1	1	0.0001

Ecoregion	ICES/GFCM Area	Métier Level 3	Taxa	Species Group	Species	Total Observed Effort (Days at Sea)	Fishing Days (Days at Sea)	Monitoring Coverage	Incidents	No. Specimens	Bycatch Rate
Baltic Sea	27.3.d.32	Nets	Bird	Bird	*Bucephala clangula*	15297.00	26741.00	0.5720	3	3	0.0002
Baltic Sea	27.3.d.32	Nets	Bird	Bird	*Clangula hyemalis*	28070.00	48101.00	0.5836	4	5	0.0002
Baltic Sea	27.3.d.32	Nets	Bird	Bird	*Melanitta nigra*	58.00	6705.00	0.0087	1	1	0.0172
Baltic Sea	27.3.d.32	Nets	Bird	Bird	*Mergus*	12831.00	28065.00	0.4572	4	10	0.0008
Baltic Sea	27.3.d.32	Nets	Bird	Bird	*Mergus merganser*	28070.00	48101.00	0.5836	7	18	0.0006
Baltic Sea	27.3.d.32	Nets	Bird	Bird	*Phalacrocorax carbo*	28128.00	54806.00	0.5132	45	108	0.0038
Baltic Sea	27.3.d.32	Nets	Bird	Bird	*Podiceps cristatus*	15305.00	35602.00	0.4299	5	6	0.0004
Baltic Sea	27.3.d.32	Nets	Bird	Bird	*Somateria mollissima*	28128.00	54806.00	0.5132	9	10	0.0004
Baltic Sea	27.3.d.32	Nets	Marine mammal	Seal	*Halichoerus grypus*	12831.00	28065.00	0.4572	2	14	0.0011
Baltic Sea	27.3.d.32	Traps	Bird	Bird	*Anas platyrhynchos*	1872.00	14064.00	0.1331	6	58	0.0310
Baltic Sea	27.3.d.32	Traps	Bird	Bird	*Anatidae*	1829.00	7292.00	0.2508	4	13	0.0071
Baltic Sea	27.3.d.32	Traps	Bird	Bird	*Mergus*	1800.00	7153.00	0.2516	1	1	0.0006
Baltic Sea	27.3.d.32	Traps	Bird	Bird	*Mergus merganser*	1841.00	14212.00	0.1295	3	6	0.0033

Ecoregion	ICES/GFCM Area	Métier Level 3	Taxa	Species Group	Species	Total Observed Effort (Days at Sea)	Fishing Days (Days at Sea)	Monitoring Coverage	Incidents	No. Specimens	Bycatch Rate
Baltic Sea	27.3.d.32	Traps	Bird	Bird	*Mergus serrator*	1800.00	7153.00	0.2516	1	1	0.0006
Baltic Sea	27.3.d.32	Traps	Bird	Bird	*Phalacrocorax carbo*	3713.00	28276.00	0.1313	24	45	0.0121
Baltic Sea	27.3.d.32	Traps	Bird	Bird	*Podiceps cristatus*	1829.00	7292.00	0.2508	1	1	0.0005
Baltic Sea	27.3.d.32	Traps	Marine mammal	Seal	*Halichoerus grypus*	3713.00	28276.00	0.1313	12	18	0.0048
Baltic Sea	27.3.d.32	Traps	Other	Other	*Lutra lutra*	1800.00	7153.00	0.2516	1	1	0.0006
Barents Sea	27.1.b	Nets	Marine mammal	Cetacean	*Phocoena phocoena*	9.00	6185.00	0.0015	2	2	0.2222
Barents Sea	27.1.b	Nets	Marine mammal	Seal	*Halichoerus grypus*	9.00	6185.00	0.0015	1	1	0.1111
Barents Sea	27.1.b	Nets	Marine mammal	Seal	*Phoca vitulina*	9.00	6185.00	0.0015	3	3	0.3333
Bay of Biscay and the Iberian Coast	27.8.a	Bottom trawls	Marine mammal	Cetacean	*Delphinus delphis*	72.96	512675.85	0.0001	4	21	0.2878
Bay of Biscay and the Iberian Coast	27.8.a	Bottom trawls	Marine mammal	Cetacean	*Phocoena phocoena*	123.03	47999.69	0.0026	1	1	0.0081
Bay of Biscay and the Iberian Coast	27.8.a	Nets	Bird	Bird	*Alca torda*	164.83	220741.60	0.0007	1	1	0.0061
Bay of Biscay and the Iberian Coast	27.8.a	Nets	Bird	Bird	*Gavia stellata*	164.83	220741.60	0.0007	1	1	0.0061
Bay of Biscay and the Iberian Coast	27.8.a	Nets	Bird	Bird	*Morus bassanus*	374.85	217106.92	0.0017	4	4	0.0107

Ecoregion	ICES/GFCM Area	Métier Level 3	Taxa	Species Group	Species	Total Observed Effort (Days at Sea)	Fishing Days (Days at Sea)	Monitoring Coverage	Incidents	No. Specimens	Bycatch Rate
Bay of Biscay and the Iberian Coast	27.8.a	Nets	Bird	Bird	*Phalacrocorax carbo*	398.38	237435.38	0.0017	3	4	0.0100
Bay of Biscay and the Iberian Coast	27.8.a	Nets	Bird	Bird	*Uria aalge*	563.22	458176.98	0.0012	29	37	0.0657
Bay of Biscay and the Iberian Coast	27.8.a	Nets	Marine mammal	Cetacean	*Delphinus delphis*	709.08	468598.09	0.0015	9	9	0.0127
Bay of Biscay and the Iberian Coast	27.8.a	Nets	Marine mammal	Cetacean	*Phocoena phocoena*	164.83	220741.60	0.0007	1	1	0.0061
Bay of Biscay and the Iberian Coast	27.8.a	Nets	Marine mammal	Seal	*Halichoerus grypus*	145.87	10421.11	0.0140	2	2	0.0137
Bay of Biscay and the Iberian Coast	27.8.a	Pelagic trawls	Bird	Bird	*Morus bassanus*	50.34	1562.06	0.0322	1	1	0.0199
Bay of Biscay and the Iberian Coast	27.8.a	Pelagic trawls	Marine mammal	Cetacean	*Delphinus delphis*	294.63	50574.24	0.0058	17	67	0.2274
Bay of Biscay and the Iberian Coast	27.8.b	Bottom trawls	Bird	Bird	*Morus bassanus*	282.69	220353.05	0.0013	7	14	0.0495
Bay of Biscay and the Iberian Coast	27.8.b	Bottom trawls	Marine mammal	Cetacean	*Delphinus delphis*	164.07	123485.13	0.0013	4	8	0.0488
Bay of Biscay and the Iberian Coast	27.8.b	Longlines	Marine mammal	Cetacean	*Delphinus delphis*	5.13	20958.44	0.0002	1	1	0.1951
Bay of Biscay and the Iberian Coast	27.8.b	Nets	Bird	Bird	*Melanitta nigra*	162.57	128345.78	0.0013	2	2	0.0123
Bay of Biscay and the Iberian Coast	27.8.b	Nets	Bird	Bird	*Morus bassanus*	416.77	259645.62	0.0016	6	7	0.0168
Bay of Biscay and the Iberian Coast	27.8.b	Nets	Bird	Bird	*Puffinus mauretanicus*	221.25	20898.74	0.0106	2	4	0.0181

Ecoregion	ICES/GFCM Area	Métier Level 3	Taxa	Species Group	Species	Total Observed Effort (Days at Sea)	Fishing Days (Days at Sea)	Monitoring Coverage	Incidents	No. Specimens	Bycatch Rate
Bay of Biscay and the Iberian Coast	27.8.b	Nets	Bird	Bird	*Uria aalge*	638.02	280544.36	0.0023	30	485	0.7602
Bay of Biscay and the Iberian Coast	27.8.b	Nets	Marine mammal	Cetacean	*Delphinus delphis*	475.45	152198.58	0.0031	11	14	0.0294
Bay of Biscay and the Iberian Coast	27.8.b	Nets	Marine mammal	Cetacean	*Phocoena phocoena*	393.59	28178.72	0.0140	5	5	0.0127
Bay of Biscay and the Iberian Coast	27.8.b	Pelagic trawls	Marine mammal	Cetacean	*Delphinus delphis*	59.45	10321.46	0.0058	10	24	0.4037
Bay of Biscay and the Iberian Coast	27.8.b	Pelagic trawls	Marine mammal	Cetacean	*Delphinus delphis*	4.00	24.00	0.1667	2	0	0.0000
Bay of Biscay and the Iberian Coast	27.8.b	Pelagic trawls	Marine mammal	Cetacean	*Phocoena phocoena*	8.50	1747.74	0.0049	1	1	0.1176
Bay of Biscay and the Iberian Coast	27.8.b	Pelagic trawls	Marine mammal	Cetacean	*Phocoena phocoena*	4.00	24.00	0.1667	1	0	0.0000
Bay of Biscay and the Iberian Coast	27.8.c	Bottom trawls	Bird	Bird	*Morus bassanus*	62.00	14730.24	0.0042	1	1	0.0161
Bay of Biscay and the Iberian Coast	27.8.c	Bottom trawls	Marine mammal	Cetacean	*Delphinus delphis*	62.00	14730.24	0.0042	1	1	0.0161
Bay of Biscay and the Iberian Coast	27.8.c	Nets	Bird	Bird	*Morus bassanus*	49.00	27969.71	0.0018	1	3	0.0612
Bay of Biscay and the Iberian Coast	27.8.c	Nets	Marine mammal	Cetacean	*Delphinus delphis*	49.00	27969.71	0.0018	1	1	0.0204
Bay of Biscay and the Iberian Coast	27.8.c	Pelagic trawls	Marine mammal	Cetacean	*Delphinus delphis*	10.53	187.84	0.0560	1	1	0.0950
Bay of Biscay and the Iberian Coast	27.8.c	Pelagic trawls	Marine mammal	Cetacean	*Globicephala melas*	86.00	3399.53	0.0253	1	5	0.0581

Ecoregion	ICES/GFCM Area	Métier Level 3	Taxa	Species Group	Species	Total Observed Effort (Days at Sea)	Fishing Days (Days at Sea)	Monitoring Coverage	Incidents	No. Specimens	Bycatch Rate
Bay of Biscay and the Iberian Coast	27.8.c	Rods and lines	Bird	Bird	*Morus bassanus*	32.00	7538.89	0.0042	1	9	0.2813
Bay of Biscay and the Iberian Coast	27.8.d.2	Bottom trawls	Marine mammal	Cetacean	*Delphinus delphis*	9.00	5295.43	0.0017	1	4	0.4444
Bay of Biscay and the Iberian Coast	27.8.d.2	Rods and lines	Bird	Bird	*Morus bassanus*	75.00	2278.40	0.0329	1	2	0.0267
Bay of Biscay and the Iberian Coast	27.9.a	Longlines	Bird	Bird	*Larus michahellis*	617.00	28721.71	0.0215	1	1	0.0016
Bay of Biscay and the Iberian Coast	27.9.a	Longlines	Bird	Bird	*Morus bassanus*	802.00	57887.25	0.0139	21	37	0.0461
Bay of Biscay and the Iberian Coast	27.9.a	Longlines	Bird	Bird	*Puffinus mauretanicus*	185.00	29165.54	0.0063	1	1	0.0054
Bay of Biscay and the Iberian Coast	27.9.a	Nets	Bird	Bird	*Alcidae*	434.00	170840.28	0.0025	1	1	0.0023
Bay of Biscay and the Iberian Coast	27.9.a	Nets	Bird	Bird	*Larus*	736.00	338438.74	0.0022	2	2	0.0027
Bay of Biscay and the Iberian Coast	27.9.a	Nets	Bird	Bird	*Larus michahellis*	736.00	338438.74	0.0022	6	7	0.0095
Bay of Biscay and the Iberian Coast	27.9.a	Nets	Bird	Bird	*Morus bassanus*	736.00	338438.74	0.0022	6	11	0.0149
Bay of Biscay and the Iberian Coast	27.9.a	Nets	Bird	Bird	*Phalacrocorax aristotelis*	736.00	338438.74	0.0022	3	3	0.0041
Bay of Biscay and the Iberian Coast	27.9.a	Nets	Marine mammal	Cetacean	*Delphinus delphis*	434.00	170840.28	0.0025	4	6	0.0138
Bay of Biscay and the Iberian Coast	27.9.a	Nets	Marine mammal	Cetacean	*Tursiops truncatus*	323.00	277467.92	0.0012	2	2	0.0062

Ecoregion	ICES/GFCM Area	Métier Level 3	Taxa	Species Group	Species	Total Observed Effort (Days at Sea)	Fishing Days (Days at Sea)	Monitoring Coverage	Incidents	No. Specimens	Bycatch Rate
Bay of Biscay and the Iberian Coast	27.9.a	Nets	Turtle	Turtle	*Caretta caretta*	434.00	170840.28	0.0025	2	2	0.0046
Bay of Biscay and the Iberian Coast	27.9.a	Seines	Bird	Bird	*Larus michahellis*	113.00	29389.00	0.0038	2	6	0.0531
Bay of Biscay and the Iberian Coast	27.9.a	Seines	Marine mammal	Cetacean	*Delphinus delphis*	45.00	15715.00	0.0029	1	2	0.0444
Bay of Biscay and the Iberian Coast	27.9.a	Surrounding nets	Marine mammal	Cetacean	*Delphinus delphis*	194.00	25571.00	0.0076	4	4	0.0206
Celtic Seas	27.7	Bottom trawls	Marine mammal	Cetacean	*Delphinus delphis*	117.00	na	na	1	1	0.0085
Celtic Seas	27.6.a	Bottom trawls	Bird	Bird	*Larus argentatus*	539.79	2914.15	0.1852	1	1	0.0019
Celtic Seas	27.6.a	Bottom trawls	Bird	Bird	*Morus bassanus*	540.26	79392.14	0.0068	9	16	0.0296
Celtic Seas	27.6.a	Bottom trawls	Marine mammal	Seal	*Phoca vitulina*	259.16	23117.75	0.0112	1	1	0.0039
Celtic Seas	27.6.a	Bottom trawls	Marine mammal	Seal	*Phocidae*	539.79	2914.15	0.1852	1	1	0.0019
Celtic Seas	27.6.a	Longlines	Bird	Bird	*Fulmarus glacialis*	31.00	5549.26	0.0056	9	12	0.3871
Celtic Seas	27.6.a	Longlines	Bird	Bird	*Morus bassanus*	80.00	8354.43	0.0096	9	12	0.1500
Celtic Seas	27.6.a	Pelagic trawls	Marine mammal	Seal	*Halichoerus grypus*	447.00	9997.65	0.0447	10	11	0.0246
Celtic Seas	27.7.b	Pelagic trawls	Bird	Bird	*Morus bassanus*	12.00	457.87	0.0262	1	1	0.0833

Ecoregion	ICES/GFCM Area	Métier Level 3	Taxa	Species Group	Species	Total Observed Effort (Days at Sea)	Fishing Days (Days at Sea)	Monitoring Coverage	Incidents	No. Specimens	Bycatch Rate
Celtic Seas	27.7.b	Pelagic trawls	Marine mammal	Seal	*Halichoerus grypus*	58.00	1894.97	0.0306	7	7	0.1207
Celtic Seas	27.7.f	Bottom trawls	Bird	Bird	*Morus bassanus*	72.77	34875.60	0.0021	1	1	0.0137
Celtic Seas	27.7.f	Bottom trawls	Marine mammal	Cetacean	*Delphinus delphis*	157.31	12068.51	0.0130	1	1	0.0064
Celtic Seas	27.7.f	Nets	Bird	Bird	*Phalacrocorax carbo*	125.33	5021.66	0.0250	3	3	0.0239
Celtic Seas	27.7.f	Nets	Bird	Bird	*Uria aalge*	187.80	5021.66	0.0374	17	22	0.1171
Celtic Seas	27.7.f	Nets	Marine mammal	Cetacean	*Delphinus delphis*	121.80	2326.58	0.0524	3	3	0.0246
Celtic Seas	27.7.f	Nets	Marine mammal	Cetacean	*Phocoena phocoena*	62.47	na	na	3	4	0.0640
Celtic Seas	27.7.f	Nets	Marine mammal	Seal	*Halichoerus grypus*	191.80	7165.74	0.0268	8	10	0.0521
Celtic Seas	27.7.f	Nets	Marine mammal	Seal	*Phoca vitulina*	4.00	2144.08	0.0019	1	1	0.2500
Celtic Seas	27.7.f	Surrounding nets	Bird	Bird	*Larus argentatus*	24.00	313.00	0.0767	4	4	0.1667
Celtic Seas	27.7.g	Bottom trawls	Bird	Bird	*Morus bassanus*	1053.21	118595.87	0.0089	3	3	0.0028
Celtic Seas	27.7.g	Bottom trawls	Marine mammal	Cetacean	*Delphinidae*	172.93	65121.47	0.0027	1	1	0.0058
Celtic Seas	27.7.g	Bottom trawls	Marine mammal	Cetacean	*Delphinus delphis*	1053.21	118595.87	0.0089	8	8	0.0076

Ecoregion	ICES/GFCM Area	Métier Level 3	Taxa	Species Group	Species	Total Observed Effort (Days at Sea)	Fishing Days (Days at Sea)	Monitoring Coverage	Incidents	No. Specimens	Bycatch Rate
Celtic Seas	27.7.g	Bottom trawls	Marine mammal	Cetacean	*Phocoena phocoena*	556.94	93357.63	0.0060	2	2	0.0036
Celtic Seas	27.7.g	Nets	Bird	Bird	*Uria aalge*	63.00	2302.47	0.0274	2	12	0.1905
Celtic Seas	27.7.g	Nets	Marine mammal	Cetacean	*Delphinus delphis*	63.00	2302.47	0.0274	2	2	0.0317
Celtic Seas	27.7.g	Nets	Marine mammal	Cetacean	*Phocoena phocoena*	115.00	5434.21	0.0212	2	2	0.0174
Celtic Seas	27.7.g	Nets	Marine mammal	Seal	*Halichoerus grypus*	7.00	2340.67	0.0030	2	5	0.7143
Celtic Seas	27.7.h	Bottom trawls	Marine mammal	Cetacean	*Delphinus delphis*	252.08	12857.45	0.0196	1	1	0.0040
Celtic Seas	27.7.h	Bottom trawls	Marine mammal	Cetacean	*Phocoena phocoena*	863.97	11747.64	0.0735	1	1	0.0012
Celtic Seas	27.7.h	Nets	Marine mammal	Cetacean	*Delphinidae*	37.55	13539.73	0.0028	1	1	0.0266
Celtic Seas	27.7.h	Nets	Marine mammal	Cetacean	*Delphinus delphis*	41.99	2117.66	0.0198	1	1	0.0238
Celtic Seas	27.7.h	Nets	Marine mammal	Seal	*Halichoerus grypus*	29.58	1168.51	0.0253	1	1	0.0338
Celtic Seas	27.7.j	Bottom trawls	Marine mammal	Cetacean	*Delphinus delphis*	312.84	11512.02	0.0272	1	1	0.0032
Celtic Seas	27.7.j	Bottom trawls	Marine mammal	Cetacean	*Phocoena phocoena*	312.84	11512.02	0.0272	1	1	0.0032
Celtic Seas	27.7.j	Nets	Bird	Bird	*Uria aalge*	190.70	1606.00	0.1187	1	3	0.0157

Ecoregion	ICES/GFCM Area	Métier Level 3	Taxa	Species Group	Species	Total Observed Effort (Days at Sea)	Fishing Days (Days at Sea)	Monitoring Coverage	Incidents	No. Specimens	Bycatch Rate
Celtic Seas	27.7.j	Nets	Marine mammal	Cetacean	*Delphinus delphis*	190.70	1606.00	0.1187	1	1	0.0052
Celtic Seas	27.7.j	Nets	Marine mammal	Seal	*Halichoerus grypus*	365.70	4806.80	0.0761	39	45	0.1231
Celtic Seas	27.7.j	Nets	Marine mammal	Seal	*Phocidae*	190.70	1606.00	0.1187	2	2	0.0105
Celtic Seas	27.7.j.2	Nets	Marine mammal	Seal	*Halichoerus grypus*	257.12	18655.57	0.0138	129	157	0.6106
Celtic Seas	27.7.j.2	Pelagic trawls	Marine mammal	Cetacean	*Globicephala melas*	38.50	1613.55	0.0239	2	3	0.0779
Greater North Sea	27.3.a.20	Bottom trawls	Marine mammal	Cetacean	*Delphinus*	73.00	27250.70	0.0027	2	2	0.0274
Greater North Sea	27.3.a.20	Nets	Bird	Bird	*Alca torda*	311.00	9318.17	0.0334	1	1	0.0032
Greater North Sea	27.3.a.20	Nets	Bird	Bird	*Aves*	311.00	9318.17	0.0334	1	1	0.0032
Greater North Sea	27.3.a.20	Nets	Bird	Bird	*Melanitta nigra*	91.00	11942.58	0.0076	1	1	0.0110
Greater North Sea	27.3.a.20	Nets	Bird	Bird	*Phalacrocorax carbo*	402.00	21260.75	0.0189	2	2	0.0050
Greater North Sea	27.3.a.20	Nets	Bird	Bird	*Somateria mollissima*	311.00	9318.17	0.0334	1	1	0.0032
Greater North Sea	27.3.a.20	Nets	Bird	Bird	*Uria aalge*	311.00	9318.17	0.0334	13	14	0.0450
Greater North Sea	27.3.a.20	Nets	Marine mammal	Cetacean	*Lagenorhynchus albirostris*	119.00	8210.50	0.0145	1	2	0.0168

Ecoregion	ICES/GFCM Area	Métier Level 3	Taxa	Species Group	Species	Total Observed Effort (Days at Sea)	Fishing Days (Days at Sea)	Monitoring Coverage	Incidents	No. Specimens	Bycatch Rate
Greater North Sea	27.3.a.20	Nets	Marine mammal	Cetacean	*Phocoena phocoena*	682.00	41555.25	0.0164	58	71	0.1041
Greater North Sea	27.3.a.20	Nets	Marine mammal	Seal	*Halichoerus grypus*	311.00	9318.17	0.0334	1	1	0.0032
Greater North Sea	27.3.a.20	Nets	Marine mammal	Seal	*Phoca vitulina*	521.00	29471.25	0.0177	20	26	0.0499
Greater North Sea	27.3.a.20	Nets	Marine mammal	Seal	*Pinnipedia*	311.00	9318.17	0.0334	1	1	0.0032
Greater North Sea	27.3.a.21	Bottom trawls	Marine mammal	Cetacean	*Phocoena phocoena*	61.00	13620.83	0.0045	1	1	0.0164
Greater North Sea	27.3.a.21	Nets	Bird	Bird	*Alca torda*	70.00	8556.50	0.0082	16	37	0.5286
Greater North Sea	27.3.a.21	Nets	Bird	Bird	*Alcidae*	51.00	3989.33	0.0128	2	3	0.0588
Greater North Sea	27.3.a.21	Nets	Bird	Bird	*Gavia arctica*	51.00	3989.33	0.0128	1	1	0.0196
Greater North Sea	27.3.a.21	Nets	Bird	Bird	*Melanitta fusca*	70.00	8556.50	0.0082	5	5	0.0714
Greater North Sea	27.3.a.21	Nets	Bird	Bird	*Phalacrocorax carbo*	51.00	3989.33	0.0128	1	1	0.0196
Greater North Sea	27.3.a.21	Nets	Bird	Bird	*Somateria mollissima*	51.00	3989.33	0.0128	2	2	0.0392
Greater North Sea	27.3.a.21	Nets	Bird	Bird	*Uria aalge*	70.00	8556.50	0.0082	43	309	4.4143
Greater North Sea	27.3.a.21	Nets	Marine mammal	Cetacean	*Phocoena phocoena*	51.00	3989.33	0.0128	26	33	0.6471

Ecoregion	ICES/GFCM Area	Métier Level 3	Taxa	Species Group	Species	Total Observed Effort (Days at Sea)	Fishing Days (Days at Sea)	Monitoring Coverage	Incidents	No. Specimens	Bycatch Rate
Greater North Sea	27.3.a.21	Nets	Marine mammal	Seal	*Phoca vitulina*	70.00	8556.50	0.0082	4	5	0.0714
Greater North Sea	27.4.a	Bottom trawls	Bird	Bird	*Morus bassanus*	1349.34	59852.44	0.0225	8	18	0.0133
Greater North Sea	27.4.a	Bottom trawls	Marine mammal	Seal	*Phocidae*	535.81	7455.70	0.0719	1	1	0.0019
Greater North Sea	27.4.a	Longlines	Bird	Bird	*Fulmarus glacialis*	136.00	13511.02	0.0101	33	110	0.8088
Greater North Sea	27.4.a	Longlines	Bird	Bird	*Morus bassanus*	136.00	13511.02	0.0101	2	3	0.0221
Greater North Sea	27.4.a	Longlines	Bird	Bird	*Stercorarius skua*	78.00	8555.21	0.0091	1	1	0.0128
Greater North Sea	27.4.a	Nets	Marine mammal	Cetacean	*Phocoena phocoena*	1013.00	23578.77	0.0430	39	42	0.0415
Greater North Sea	27.4.a	Nets	Marine mammal	Seal	*Phoca vitulina*	491.00	10876.45	0.0451	13	13	0.0265
Greater North Sea	27.4.b	Nets	Bird	Bird	*Aves*	54.00	7848.00	0.0069	2	2	0.0370
Greater North Sea	27.4.b	Nets	Bird	Bird	*Uria aalge*	54.00	7848.00	0.0069	2	2	0.0370
Greater North Sea	27.4.b	Nets	Marine mammal	Cetacean	*Phocoena phocoena*	54.00	7848.00	0.0069	35	91	1.6852
Greater North Sea	27.4.b	Nets	Marine mammal	Seal	*Phoca vitulina*	54.00	7848.00	0.0069	9	12	0.2222
Greater North Sea	27.4.b	Nets	Marine mammal	Seal	*Pinnipedia*	54.00	7848.00	0.0069	1	1	0.0185

Ecoregion	ICES/GFCM Area	Métier Level 3	Taxa	Species Group	Species	Total Observed Effort (Days at Sea)	Fishing Days (Days at Sea)	Monitoring Coverage	Incidents	No. Specimens	Bycatch Rate
Greater North Sea	27.4.b	Pelagic trawls	Marine mammal	Seal	*Halichoerus grypus*	52.83	2999.09	0.0176	15	23	0.4353
Greater North Sea	27.4.c	Bottom trawls	Bird	Bird	*Morus bassanus*	58.75	37545.88	0.0016	1	8	0.1362
Greater North Sea	27.4.c	Bottom trawls	Marine mammal	Seal	*Halichoerus grypus*	58.75	37545.88	0.0016	1	1	0.0170
Greater North Sea	27.4.c	Nets	Bird	Bird	*Gavia stellata*	23.00	5342.24	0.0043	1	4	0.1739
Greater North Sea	27.4.c	Nets	Bird	Bird	*Uria aalge*	23.00	5342.24	0.0043	1	2	0.0870
Greater North Sea	27.4.c	Nets	Marine mammal	Cetacean	*Phocoena phocoena*	18.00	3983.78	0.0045	1	1	0.0556
Greater North Sea	27.4.c	Rods and lines	Bird	Bird	*Morus bassanus*	3.00	86.25	0.0348	1	1	0.3333
Greater North Sea	27.4.c	Traps	Marine mammal	Seal	*Phoca vitulina*	4.00	7936.63	0.0005	1	3	0.7500
Greater North Sea	27.7.d	Bottom trawls	Bird	Bird	*Morus bassanus*	185.21	180730.33	0.0010	1	1	0.0054
Greater North Sea	27.7.d	Nets	Bird	Bird	*PHALACROCORACIDAE*	45.00	36571.26	0.0012	2	2	0.0444
Greater North Sea	27.7.d	Nets	Bird	Bird	*Uria aalge*	252.83	22440.76	0.0113	2	2	0.0079
Greater North Sea	27.7.d	Pelagic trawls	Bird	Bird	*Larus argentatus*	74.52	3383.88	0.0220	1	1	0.0134
Greater North Sea	27.7.d	Seines	Marine mammal	Cetacean	*Phocoena phocoena*	8.00	15123.02	0.0005	1	1	0.1250

Ecoregion	ICES/GFCM Area	Métier Level 3	Taxa	Species Group	Species	Total Observed Effort (Days at Sea)	Fishing Days (Days at Sea)	Monitoring Coverage	Incidents	No. Specimens	Bycatch Rate
Greater North Sea	27.7.e	Bottom trawls	Bird	Bird	*Morus bassanus*	65.92	249313.55	0.0003	1	1	0.0152
Greater North Sea	27.7.e	Bottom trawls	Marine mammal	Cetacean	*Delphinus delphis*	510.68	281579.40	0.0018	3	4	0.0078
Greater North Sea	27.7.e	Bottom trawls	Marine mammal	Seal	*Halichoerus grypus*	444.76	32265.85	0.0138	1	1	0.0022
Greater North Sea	27.7.e	Nets	Bird	Bird	*Phalacrocorax aristotelis*	170.54	81971.71	0.0021	2	2	0.0117
Greater North Sea	27.7.e	Nets	Bird	Bird	*Phalacrocorax carbo*	363.03	24005.45	0.0151	4	6	0.0165
Greater North Sea	27.7.e	Nets	Bird	Bird	*Uria aalge*	577.69	170821.18	0.0034	9	11	0.0190
Greater North Sea	27.7.e	Nets	Marine mammal	Cetacean	*Delphinus delphis*	413.16	159379.02	0.0026	5	6	0.0145
Greater North Sea	27.7.e	Nets	Marine mammal	Cetacean	*Phocoena phocoena*	198.50	12563.29	0.0158	1	1	0.0050
Greater North Sea	27.7.e	Nets	Marine mammal	Seal	*Halichoerus grypus*	533.56	105977.16	0.0050	12	13	0.0244
Iceland Sea	27.5.a	Nets	Bird	Bird	*Alca torda*	105.00	8240.00	0.0127	1	1	0.0095
Iceland Sea	27.5.a	Nets	Bird	Bird	*Cepphus grylle*	217.00	16482.00	0.0132	31	109	0.5023
Iceland Sea	27.5.a	Nets	Bird	Bird	*Gavia immer*	217.00	16482.00	0.0132	2	2	0.0092
Iceland Sea	27.5.a	Nets	Bird	Bird	*Phalacrocoracidae*	217.00	16482.00	0.0132	7	12	0.0553

Ecoregion	ICES/GFCM Area	Métier Level 3	Taxa	Species Group	Species	Total Observed Effort (Days at Sea)	Fishing Days (Days at Sea)	Monitoring Coverage	Incidents	No. Specimens	Bycatch Rate
Iceland Sea	27.5.a	Nets	Bird	Bird	*Somateria mollissima*	217.00	16482.00	0.0132	27	125	0.5760
Iceland Sea	27.5.a	Nets	Bird	Bird	*Uria aalge*	217.00	16482.00	0.0132	35	75	0.3456
Iceland Sea	27.5.a	Nets	Marine mammal	Cetacean	*Megaptera novaeangliae*	105.00	8240.00	0.0127	2	2	0.0190
Iceland Sea	27.5.a	Nets	Marine mammal	Cetacean	*Phocoena phocoena*	217.00	16482.00	0.0132	23	44	0.2028
Iceland Sea	27.5.a	Nets	Marine mammal	Seal	*Halichoerus grypus*	217.00	16482.00	0.0132	5	10	0.0461
Iceland Sea	27.5.a	Nets	Marine mammal	Seal	*Pagophilus groenlandicus*	217.00	16482.00	0.0132	6	11	0.0507
Iceland Sea	27.5.a	Nets	Marine mammal	Seal	*Phoca vitulina*	217.00	16482.00	0.0132	11	13	0.0599
Iceland Sea	27.5.a.2	Bottom trawls	Marine mammal	Seal	*Pagophilus groenlandicus*	377.00	9407.00	0.0401	1	1	0.0027
Iceland Sea	27.5.a.2	Longlines	Bird	Bird	*Fulmarus glacialis*	226.00	26521.00	0.0085	14	139	0.6150
Iceland Sea	27.5.a.2	Longlines	Bird	Bird	*Larus argentatus*	132.00	13372.00	0.0099	1	35	0.2652
Iceland Sea	27.5.a.2	Longlines	Bird	Bird	*Larus fuscus*	132.00	13372.00	0.0099	1	5	0.0379
Iceland Sea	27.5.a.2	Longlines	Bird	Bird	*Morus bassanus*	226.00	26521.00	0.0085	4	25	0.1106
Iceland Sea	27.5.a.2	Nets	Bird	Bird	*Alca torda*	360.00	20447.00	0.0176	2	2	0.0056

Ecoregion	ICES/GFCM Area	Métier Level 3	Taxa	Species Group	Species	Total Observed Effort (Days at Sea)	Fishing Days (Days at Sea)	Monitoring Coverage	Incidents	No. Specimens	Bycatch Rate
Iceland Sea	27.5.a.2	Nets	Bird	Bird	*Cepphus grylle*	360.00	20447.00	0.0176	30	73	0.2028
Iceland Sea	27.5.a.2	Nets	Bird	Bird	*Clangula hyemalis*	360.00	20447.00	0.0176	4	4	0.0111
Iceland Sea	27.5.a.2	Nets	Bird	Bird	*Fratercula arctica*	229.00	7634.00	0.0300	2	2	0.0087
Iceland Sea	27.5.a.2	Nets	Bird	Bird	*Fulmarus glacialis*	360.00	20447.00	0.0176	4	5	0.0139
Iceland Sea	27.5.a.2	Nets	Bird	Bird	*Gavia immer*	131.00	12813.00	0.0102	1	1	0.0076
Iceland Sea	27.5.a.2	Nets	Bird	Bird	*Morus bassanus*	360.00	20447.00	0.0176	4	4	0.0111
Iceland Sea	27.5.a.2	Nets	Bird	Bird	*Phalacrocoracidae*	360.00	20447.00	0.0176	21	41	0.1139
Iceland Sea	27.5.a.2	Nets	Bird	Bird	*Somateria mollissima*	360.00	20447.00	0.0176	38	174	0.4833
Iceland Sea	27.5.a.2	Nets	Bird	Bird	*Uria aalge*	360.00	20447.00	0.0176	27	216	0.6000
Iceland Sea	27.5.a.2	Nets	Bird	Bird	*Uria lomvia*	360.00	20447.00	0.0176	4	4	0.0111
Iceland Sea	27.5.a.2	Nets	Marine mammal	Cetacean	*Lagenorhynchus albirostris*	229.00	7634.00	0.0300	2	2	0.0087
Iceland Sea	27.5.a.2	Nets	Marine mammal	Cetacean	*Phocoena phocoena*	360.00	20447.00	0.0176	73	90	0.2500
Iceland Sea	27.5.a.2	Nets	Marine mammal	Seal	*Halichoerus grypus*	360.00	20447.00	0.0176	14	25	0.0694

Ecoregion	ICES/GFCM Area	Métier Level 3	Taxa	Species Group	Species	Total Observed Effort (Days at Sea)	Fishing Days (Days at Sea)	Monitoring Coverage	Incidents	No. Specimens	Bycatch Rate
Iceland Sea	27.5.a.2	Nets	Marine mammal	Seal	*Pagophilus groenlandicus*	360.00	20447.00	0.0176	10	18	0.0500
Iceland Sea	27.5.a.2	Nets	Marine mammal	Seal	*Phoca hispida*	131.00	12813.00	0.0102	2	2	0.0153
Iceland Sea	27.5.a.2	Nets	Marine mammal	Seal	*Phoca hispida*	229.00	7634.00	0.0300	2	2	0.0087
Iceland Sea	27.5.a.2	Nets	Marine mammal	Seal	*Phoca vitulina*	360.00	20447.00	0.0176	46	95	0.2639
Norwegian Sea	27.2.a.2	Nets	Marine mammal	Cetacean	*Phocoena phocoena*	5785.00	182936.06	0.0316	124	146	0.0252
Norwegian Sea	27.2.a.2	Nets	Marine mammal	Seal	*Halichoerus grypus*	2764.00	88561.06	0.0312	2	2	0.0007
Norwegian Sea	27.2.a.2	Nets	Marine mammal	Seal	*Phoca vitulina*	5785.00	182936.06	0.0316	45	54	0.0093
Mediterranean Sea	1~5~6	Longlines	Bird	Bird	*Larus audouinii*	570.00	7789.00	0.0732	3	5	0.0088
Mediterranean Sea	1~5~6	Longlines	Bird	Bird	*Larus michahellis*	570.00	7789.00	0.0732	2	2	0.0035
Mediterranean Sea	1~5~6	Longlines	Bird	Bird	*Puffinus mauretanicus*	570.00	7789.00	0.0732	3	3	0.0053
Mediterranean Sea	1~5~6	Longlines	Bird	Bird	*Puffinus yelkouan*	570.00	7789.00	0.0732	1	2	0.0035
Mediterranean Sea	1~5~6	Longlines	Turtle	Turtle	*Caretta caretta*	570.00	7789.00	0.0732	8	10	0.0175
Mediterranean Sea	1~5~6	Longlines	Turtle	Turtle	*Dermochelys coriacea*	570.00	7789.00	0.0732	1	1	0.0018

Ecoregion	ICES/GFCM Area	Métier Level 3	Taxa	Species Group	Species	Total Observed Effort (Days at Sea)	Fishing Days (Days at Sea)	Monitoring Coverage	Incidents	No. Specimens	Bycatch Rate
Adriatic Sea	17	Bottom trawls	Bird	Bird	*Phalacrocorax aristotelis*	280.00	77404.00	0.0036	3	3	0.0107
Adriatic Sea	17	Bottom trawls	Marine mammal	Seal	*Pagophilus groenlandicus*	272.00	76635.00	0.0035	2	2	0.0074
Adriatic Sea	17	Bottom trawls	Turtle	Turtle	*Caretta caretta*	272.00	76635.00	0.0035	9	23	0.0846
Adriatic Sea	17	Pelagic trawls	Marine mammal	Cetacean	*Tursiops truncatus*	820.00	33145.00	0.0247	4	6	0.0073
Adriatic Sea	17	Pelagic trawls	Turtle	Turtle	*Caretta caretta*	1237.00	45148.91	0.0274	57	67	0.0542
Adriatic Sea	18	Bottom trawls	Turtle	Turtle	*Caretta caretta*	392.00	60436.00	0.0065	33	54	0.1378
Adriatic Sea	18	Longlines	Turtle	Turtle	*Caretta caretta*	167.00	na	na	15	15	0.0898
Aegean-Levantine Sea	22	Bottom trawls	Turtle	Turtle	*Caretta caretta*	198.00	38161.00	0.0052	1	1	0.0051
Aegean-Levantine Sea	22	Nets	Turtle	Turtle	*Caretta caretta*	426.00	401221.00	0.0011	1	1	0.0023
Aegean-Levantine Sea	25	Longlines	Turtle	Turtle	*Caretta caretta*	149.00	34425.00	0.0043	1	1	0.0067
Aegean-Levantine Sea	25	Nets	Bird	Bird	*Phalacrocorax aristotelis*	818.00	64971.00	0.0126	1	1	0.0012
Aegean-Levantine Sea	25	Nets	Turtle	Turtle	*Caretta caretta*	818.00	64971.00	0.0126	14	20	0.0244
Aegean-Levantine Sea	25	Nets	Turtle	Turtle	*Chelonia mydas*	1084.00	138591.00	0.0078	4	7	0.0065

Ecoregion	ICES/GFCM Area	Métier Level 3	Taxa	Species Group	Species	Total Observed Effort (Days at Sea)	Fishing Days (Days at Sea)	Monitoring Coverage	Incidents	No. Specimens	Bycatch Rate
Aegean-Levantine Sea	25	Nets	Turtle	Turtle	*Cheloniidae*	503.00	61933.00	0.0081	1	1	0.0020
Ionian Sea and the Central	15	Surrounding nets	Turtle	Turtle	*Caretta caretta*	10.00	248.96	0.0402	0	0	0.0000
Ionian Sea and the Central	16	Bottom trawls	Marine mammal	Cetacean	*Tursiops truncatus*	1000.00	55516.00	0.0180	1	1	0.0010
Ionian Sea and the Central	16	Bottom trawls	Turtle	Turtle	*Caretta caretta*	1000.00	55516.00	0.0180	7	7	0.0070
Ionian Sea and the Central	19	Bottom trawls	Turtle	Turtle	*Caretta caretta*	225.00	34139.00	0.0066	1	1	0.0044
Western Mediterranean Sea	1	Longlines	Bird	Bird	*Larus audouinii*	459.00	5590.00	0.0821	1	1	0.0022
Western Mediterranean Sea	1	Longlines	Marine mammal	Seal	*Grampus griseus*	459.00	5590.00	0.0821	1	1	0.0022
Western Mediterranean Sea	6	Bottom trawls	Marine mammal	Cetacean	*Stenella coeruleoalba*	253.00	78740.44	0.0032	1	1	0.0040
Western Mediterranean Sea	6	Bottom trawls	Turtle	Turtle	*Caretta caretta*	212.00	74820.00	0.0028	2	2	0.0094
Western Mediterranean Sea	6	Longlines	Bird	Bird	*Calonectris diomedea*	46.00	19170.40	0.0024	3	4	0.0870
Western Mediterranean Sea	6	Longlines	Bird	Bird	*Larus audouinii*	23.00	8736.13	0.0026	1	1	0.0435
Western Mediterranean Sea	6	Longlines	Bird	Bird	*Larus michahellis*	23.00	8736.13	0.0026	1	2	0.0870
Western Mediterranean Sea	6	Longlines	Bird	Bird	*Puffinus mauretanicus*	46.00	19170.40	0.0024	3	4	0.0870

Ecoregion	ICES/GFCM Area	Métier Level 3	Taxa	Species Group	Species	Total Observed Effort (Days at Sea)	Fishing Days (Days at Sea)	Monitoring Coverage	Incidents	No. Specimens	Bycatch Rate
Western Mediterranean Sea	7	Bottom trawls	Marine mammal	Cetacean	*Delphinidae*	277.00	15177.70	0.0183	1	1	0.0036
Western Mediterranean Sea	7	Bottom trawls	Marine mammal	Cetacean	*Tursiops truncatus*	390.00	271455.19	0.0014	2	2	0.0051
Western Mediterranean Sea	7	Bottom trawls	Turtle	Turtle	*Caretta caretta*	113.00	256277.49	0.0004	1	1	0.0088
Western Mediterranean Sea	7	Longlines	Bird	Bird	*Puffinus mauretanicus*	28.00	10416.18	0.0027	1	1	0.0357
Western Mediterranean Sea	7	Pelagic trawls	Marine mammal	Cetacean	*Stenella coeruleoalba*	6.00	370.45	0.0162	1	2	0.3333
Western Mediterranean Sea	9	Bottom trawls	Turtle	Turtle	*Caretta caretta*	1373.00	44322.00	0.0310	5	5	0.0036
Western Mediterranean Sea	11.2	Bottom trawls	Turtle	Turtle	*Caretta caretta*	1245.00	21239.00	0.0586	8	8	0.0064
Western Mediterranean Sea	11.2	Longlines	Turtle	Turtle	*Caretta caretta*	86.00	30.00	2.8667	3	3	0.0349

5.1 Bycatch of birds

The risk of seabird bycatch in different types of fisheries is generally considered to be closely linked with the foraging behaviour of the species (ICES 2013). For example, surface-feeding seabirds, and particularly those species that actively forage around fishing boats, are more at risk of suffering from bycatch during line setting operations in longline fisheries when the birds are attracted by baited hooks or when gear is being deployed or hauled in other gear types such as gillnets or purse seine (ICES 2013). Conversely, diving species are generally more at risk of bycatch in gears such as static nets and traps while the gear is actively fishing (ICES 2013). Thus, the list of potentially affected bird species is broad and includes ducks, shearwaters, petrels, alcids, gulls, fulmars, and cormorants among many others (ICES 2013).

Although some information on seabird bycatch at the species level within different métiers is available in the WGBYC database, producing robust mortality estimates and assessing population level effects from these data is challenging. There are multiple variables that will influence bycatch rates and interpreting what that mortality means at a population level can be difficult. For example, during the non-breeding period many seabird species forage over very large areas, such that multiple breeding populations can overlap at feeding grounds far away from the colonies. It is not possible to discern population impacts without specifically addressing this through detailed analysis of the spatial distribution of the population or by determining the population origin of the bycaught individuals using genetic methods. Furthermore, seabird bycatch events often occur infrequently in many fisheries, but individual events may involve multiple bycatches. This distribution of bycatch occurrence is due to the varying degree of overlap between fishing operations and bird abundance and behavior. These characteristics (the aggregation of multiple populations at feeding grounds; the different foraging strategies of different species; the clumping of both fishing activity and bird densities in space and time; other usually unknown processes that may drive variation in bycatch rates such as the influence of weather conditions, light, the effect of mitigation tactics; the population size of affected populations), all demand a detailed and comprehensive monitoring effort to robustly account for the effect of bycatch at the population level.

In the available data for seabird bycatch in the WGBYC database, the resolution is too coarse (e.g. aggregated across multiple days at sea/fishing operations) to precisely estimate bycatch rates and to explore the drivers of variability in rates, other than by assuming a mean constant rate aggregated over large areas and time periods. However, in reality we expect there to be large spatio-temporal variation in the rates at finer scales than is available in the current data. To address this bycatch data at haul level including confirmed true zero bycatch would be needed.

Consequently, here we present simple mean rates (observed bycatch numbers per observed day at sea), based on the available data across multiple species and areas. We stress that these rates are only indicative and might not be representative of the true underlying rates given possible data deficiencies as described above.

To assess seabird bycatch rates and possible population consequences we used data from 2017-2020 based on several criteria:

1. The observer effort (days at sea) and total fishing effort (days at sea) were aggregated per country, year, month, métier level 4 and area code.
2. From the monitoring and fishing effort we calculated the observer coverage (% of total fishing effort observed) and excluded observations where the monitoring effort was below an arbitrarily set limit of 1% of the total fishing effort. This does not mean, however, that the group considered this a sufficient coverage to explore rates or population effects.

3. Data from Finland and Estonia were removed as there were many incidents where observer effort was higher than the recorded total fishing effort (i.e. exceeding 100% coverage), or where observer effort was recorded as zero. This is partly because self-reporting by fishermen in their logbooks has been provided as "observer" effort.

The resulting selection from the four-year time series included 290 bycatch events with 580 bycaught individuals of 24 species. Most individual birds and bycatch incidents were reported in 2019 and 2020 (see Figure 6.1). We calculated a simple bycatch per observed day at sea rate across all reported species, ecoregions, métier and season. From these basic analyses, 8 species were represented within the 20 highest calculated bycatch rates: Northern fulmar (*Fulmar glacialis*), common guillemot (*Uria aalge*), common eider (*Somateria mollissima*), northern gannet (*Morus bassanus*), European shag (*Phalacrocorax aristotelis*), great commorant (*Phalacrocorax carbo),* red-necked grebe (*Podiceps grisegena*) and black guillemot (*Cepphus grylle*).

The rates vary spatially and temporally, and between métiers (Figure 6.2). However, given the limited data available (few datapoints per species) we were not able to estimate variation or confidence limits within reasonable limits, while taking the observed variation into account. Furthermore, bycatch rates alone cannot be used for understanding seabird mortality and potential effect if not compared against fishery effort, or population abundance of the affected species. For example, a small or very large fishery could have the same bycatch rate but the total mortality estimate would be very different. Furthermore, an endangered population containing few individuals might have a low bycatch rate due to the very limited numbers of birds present, but the effect of a few individuals removed from the population by bycatch might be more significant at the population level, compared to a high observed bycatch rate affecting a very large population. These aspects are not taken into account in the presented bycatch rates and assessments of potential mortality.

As an indication of potential mortality, we calculated a mortality across the four observed years in the data, based on an extrapolation of the simple calculation of observed bycatch rates to fishing effort. The extrapolated mortality could be expressed as:

$$M_{ijxy} = BR_{ijxy} \text{ x } FE_{ijxy}$$

where M is the mortality, BR is the bycatch rate per days at sea and FE fishing effort in days at sea, all stratified by area code (i), metierL4 (j), seasons (x) and species (y).

Based on these extrapolated mortality rates we identified six species and six areas that had an extrapolated mortality of over 300 individuals across the period (see table 6.2). We did not extrapolate based on ecoregion as we would not expect uniform bycatch rate across this geographic scale. Instead, we extrapolated over ICES Division level which represents a finer scale while acknowledging that a uniform bycatch rate across even that smaller scale also seems unlikely due to patchiness of bird occurrence and fishing effort. The presented numbers are thus to be treated with caution. Also, the observer effort in some of these areas is very low compared to the total fishing effort so it is possible that the calculated rates are not wholly representative of the true underlying rates. It is important to reiterate that the extrapolated mortality is not the same as expected population level consequences, as we do not have information about the populations these recorded bycatches may have originated from, as detailed above.

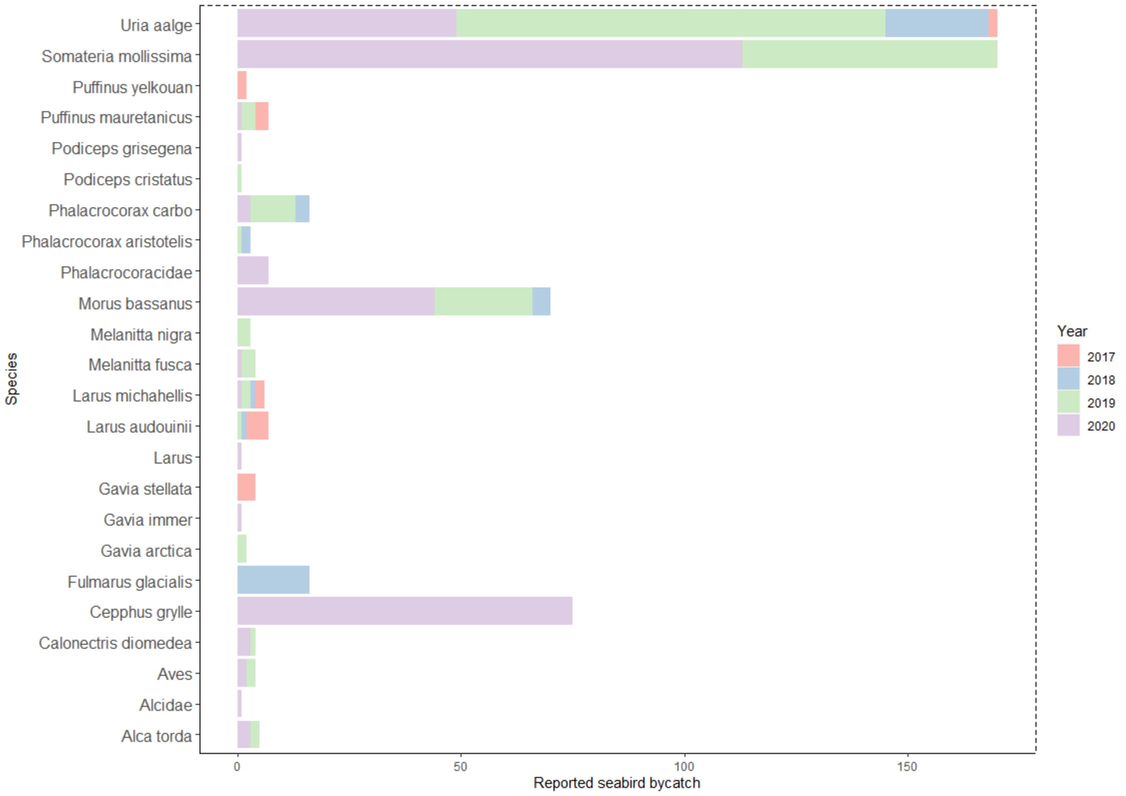

Figure 5.1. Observed bycatch in the subset of data extraction used for analyses, across all seabird species, years, métiers and areas represented in the data.

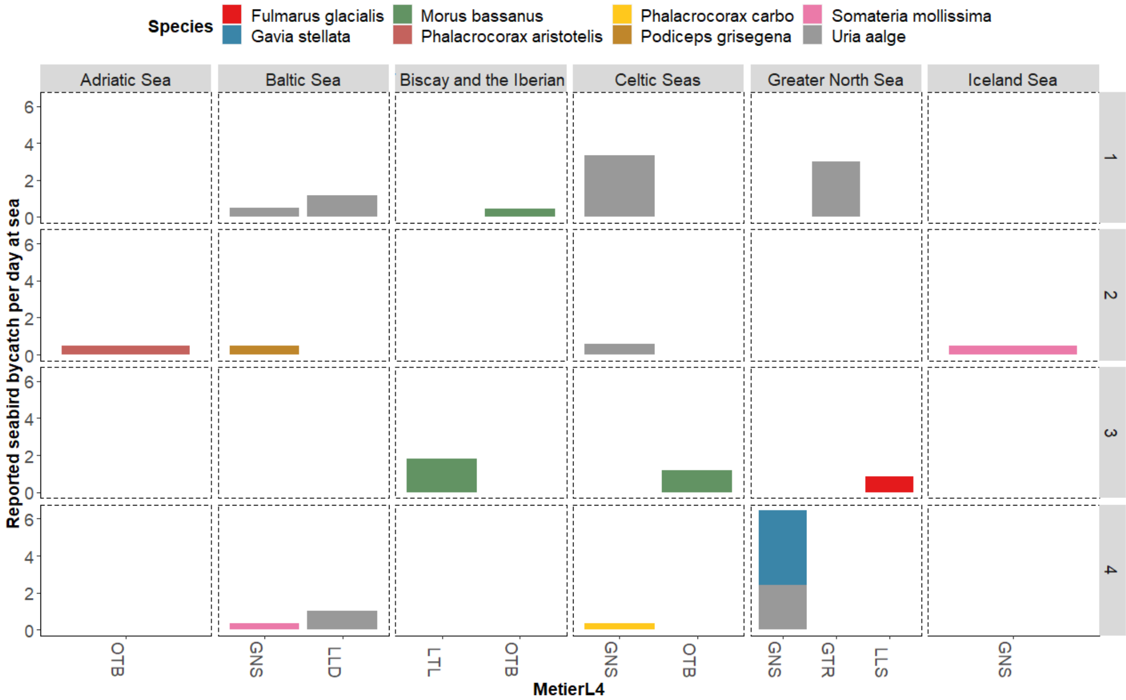

Figure 5.2. The plots show the 20 highest bycatch rates (observed seabird bycatch per day at sea, y-axis) in the data, aggregated over species (colours), ecoregion (x-panes), quarter of the year (y-panes) and métier level 4.

Table 5.2. Seabird mortality sorted by species, area code, quarter and MetierL4 for all combinations where the extrapolated bycatch was above 300 individuals. The orange colour palette for the extrapolated mortality indicates the severity of the mortality (normalized within the values of the table).

Species ↑	AreaCode ↑	Quarter	MetierL4	Observed number of bycatch events	Observed number of birds caught	Observed bycath rate per day at sea	Total fishing effort (days at sea)	Extrapolated mortality
Cepphus grylle	27.5.a	2	GNS	22	75	0.22	29228	6372
Fulmarus glacialis	27.4.a	3	LLS	4	16	0.84	1103	929
Morus bassanus	27.9.a	3	LLS	5	13	0.06	6487	403
Phalacrocora cidae	27.5.a	2	GNS	5	7	0.09	6754	598
Somateria mollissima	27.3.b.23	1	GNS	36	53	0.19	2294	444
Somateria mollissima	27.5.a	2	GNS	24	111	0.19	35901	6812
Uria aalge	27.3.a.20	4	GNS	13	14	0.34	1451	495
Uria aalge	27.3.b.23	1	GNS	40	54	0.22	2076	463
Uria aalge	27.5.a	2	GNS	30	67	0.03	71824	2218
Uria aalge	27.7.g	1	GNS	2	12	1.5	227	340

Conclusions:

- There is not enough information to assess possible population consequences of bycatch, other than by producing crude mortality estimates, highly aggregated across time and space.
- We cannot produce reliable maximum or minimum estimates of mortality, as we do not have detailed enough information on how the variation around the mean estimates is produced. For more reliable bycatch rates and mortality estimates, data on the haul level is required, as well as data on confirmed zero and positive bycatch events.
- More standardised ways to report bycatch observations across countries and areas would improve our understanding of the processes producing seabird bycatch, and thus make more reliable estimates possible.
- Databases containing detailed information on fishing effort, the spatial dispersal, abundance and population dynamics of bird populations, and bycatch monitoring/bycatch records need to be combined to fully assess the population consequences of seabird bycatch.

5.2 Bycatch of turtles

This short review is based on 2017-2020 data on sea turtle bycatch contained in the WGBYC database.

Only three species were recorded as bycatch over the period: the loggerhead turtle (*Caretta caretta*), the leatherback turtle (*Dermochelys coriacea*) and the green turtle (*Chelonia mydas*). The loggerhead turtle was the most frequently captured species in the widest range of métiers (eight different métiers), with the highest number of bycatches occurring in bottom otter trawls. Trammel nets for demersal fish captured all three species. Leatherback turtles were caught only in pelagic longlines.

Table 5.3. Number of bycaught individuals per sea turtle species per métier

Species	GNS DEF	GTR DEF	LLD LPF	LLS DEF	OTB DEF	OTT DEF	PS SPF	PTM SPF	*Total*
Leatherback turtle			7						*7*
Loggerhead turtle	4	19	55	1	101	1	1	67	*248*
Green turtle		7							*7*
Chelonidae		1							*1*
TOTAL	*4*	*27*	*62*	*1*	*101*	*1*	*0*	*67*	*263*

In terms of ecoregions, particularly high numbers were recorded in the Adriatic, which are well-known fishing grounds for midwater and bottom trawlers. In 3 of 4 Mediterranean ecoregions bottom otter trawls had the highest number of bycaught individuals of loggerhead turtles. Although this could be a result of the observation coverage on this metier in the Aegean-Levantine Sea (see Figure 6.1).

Table 5.4. Number of bycaught individuals in different ecoregions per sea turtle species per metier (only reported métiers with events)

RFMO	Ecoregion	Metier	*Dermochelys coriacea*	*Caretta caretta*	*Chelonia mydas*	Chelonidae
ICES	Azores	LLD_ LPF	6	26		
	Bay of Biscay and the Iberian Coast	GNS_DEF		2		
GFCM	Western Mediterranean Sea	LLD_LPF	1	13		
		OTB_DEF		15		
		OTT_DEF		1		
	Adriatic Sea	LLD_LPF		15		
		OTB_DEF		77		
		PTM_SPF		67		
	Ionian Sea & Central Mediterranean Sea	GTR_GTR		1		
		OTB_DEF		9		
		PS_SPF		1		
	Aegean-Levantine Sea	GNS_DEF		2		1
		GTR_DEF		18	7	
		LLS_DEF		1		

Unfortunately, given the overall low observation coverage in most of the monitored fisheries, it is not possible to tell if zero bycatch events in some of the reported fisheries truly correspond to "no bycatch events", hence "no risk", or are simply a function of observer coverage levels and sampling design/protocol issues.

Species and populations affected

Some MS provided "Monthly Total Bycatch Estimates" for some of their monitored fisheries (e.g. the Spanish otter trawlers in the Western Mediterranean Sea and the Italian midwater trawlers in the Adriatic Sea). These numbers are potentially concerning and would require an in-depth analysis, possibly at the next WGBYC meeting.

Given that (a) the loggerhead turtle is a priority species of the Habitat Directive, (b) there is a recent abundance estimate (uncorrected for availability bias) for the Mediterranean Sea of 310-360 000 individuals (ACCOBAMS 2021), and (c) there are several indications from the data that trawlers are unintentionally catching it in large numbers, there is a need to conduct a Mediterranean risk assessment on loggerhead turtle bycatch combining various methods. Thereafter implementation of excluder devices, especially for fisheries operating in known neritic feeding grounds (e.g. northern Adriatic, Tunisian plateau, etc.) to ensure the environmental sustainability of these fisheries could be considered.

In addition, at the next WGBYC meeting, based on the received information on observed bycatch rates and observation coverage, it might be possible to calculate relatively accurate bycatch totals (with CVs <30% or <40%, depending on the species) for some métiers and ecoregions (e.g. the leatherback and loggerhead turtles in the Azores and western Mediterranean pelagic longline fisheries and the loggerhead turtles in the Adriatic trawl fisheries).

5.3 Bycatch of marine mammals

5.3.1 Harbour seal in the Greater North Sea and part of the Baltic ecoregion

Data from 2017 to 2020 contained in the WGBYC database was evaluated to find areas, métiers and species where there is sufficient observer effort and bycatch records to carry out an assessment on marine mammal mortality rates. The decision to use the 2017-2020 data rather than earlier data that WGBYC hold (from 2005) was based on the incompatibility of the pre/post 2017 annual datasets. Submission of data to WGBYC prior to 2017 was less controlled than it has been in recent years when data has been acquired through ICES data calls which uses a data submission template with mandatory fields and fixed vocabularies.

When evaluating the 2017-2020 pooled data it was apparent that the only mammal species bycaught with more than 50 reported records over the period were harbour seal, common dolphin, grey seal, and harbour porpoise. Since common dolphin, harbour porpoise and grey seals were assessed within WKMOMA, a workshop working in parallel with WGBYC, WGBYC decided to focus their work in 2021 on assessing bycatch rates for harbour seal. Evaluating the observed métiers in different areas revealed low observer coverage for many métier/area combinations (Table 6.5). This limits the métiers and areas where assessment of bycatch of marine mammals can be made.

The ToR C subgroup focused during on deriving bycatch rates for harbour seal in the Greater North Sea ecoregion (ICES Divisions 27.4.a.b.c, 27.7d.e and 27.3.a.20.21) and Baltic Sea ecoregion (Areas III.b.22. III.c.23 and III.d.24). It was not possible to derive bycatch rate estimates throughout all Ecoregions mainly because the observed effort is limited despite data being pooled over several years. The métiers which included bycatch of harbour seal and where bycatch rates were derived were: GNS for the Baltic and GNS and GTR for the Greater North Sea. Table 5.5 presents fishing effort, observed effort, number of bycaught harbour seals and range of bycatch rates by métier and ecoregion. All métiers with less than 10 Days at Sea (DaS) observed were excluded from Table 5.5. Since the observed effort was pooled over several years, there can be métiers with observed days even though there is no fishing effort in 2020 for the same area and métier.

A binomial probability density function (Source excel code: John Pezzullo–Kissimmee, Florida USA, CJ Clopper and ES Pearson, 1934) was used to calculate the range (lower and upper) of bycatch rates from an expected 95% confidence interval (CI). Bycatch events of harbour seals were treated as binomial for the purposes of calculating confidence intervals around the bycatch rate. Observed DaS are either seal positive or negative with a maximum of one animal observed in any one day (it is unusual to observe more than one animal bycaught in a single day). The estimate of the 95% confidence intervals around harbour seal bycatch rates is also presented in Table 5.5.

The fishing effort presented was submitted through the 2021 ICES WGBYC data call. In earlier work carried out by WGBYC it was described how German effort data from small vessels are exaggerated due to the effort reporting system which is based on monthly landings notes and where even a single landing note is multiplied by the number of days that particular month leading to overestimates of effort. Thereby the effort data from Germany has been excluded in the table for the Baltic which mostly concerns small boats. In the Greater North Sea it is mainly larger vessels operating and so the effort in this area is not over-estimated to the same degree.

The data indicate that bycatch of harbour seal does not occur frequently in active gears such as OTB, OTT, OTM, PTB and TBB, where there are many DaS observed but no reported bycatch. This may be because the vessels are not operating in areas where harbour seals occur or that harbour seals do not interact in active fishing gear.

Table 5.5. Estimates of lower and upper 95% bycatch rates (individual/DaS) for harbour seals in the Greater North Sea ecoregion and part of the Baltic ecoregion. Estimates were derived from data on observed effort and bycatch as well as fishing effort data submitted to WGBYC from 2017 to 2020. The observed DaS are pooled from 2017 to 2020, the presented fishing effort is from 2020. The fishing effort marked with a * do not include fishing effort from Germany.

Ecoregion	Metier L4	Fishing effort (2020)	Sum of Obs DaS	Sum of No of seals	Individual/DaS Low CI	Individual/DaS High CI
Baltic Sea area	GNS	1699*	282	12	0,022	0,073
(III.b. 22, III.c.23, III.d.24)	GTR	556*	59	0		
Greater North Sea	DRB	5328	46	0		
	FPO	22886	52	0		
	GND	280	39	0		
	GNS	36371	2722	57	0,016	0,027
	GTR	2189	437	1	0,000	0,013
	LHM	6610	54	0		
	LLS	2957	147	0		
	OTB	53753	3157	0		
	OTM	4389	563	0		
	OTT	2885	957	0		
	PS	645	10	0		
	PTB	97	544	0		
	PTM	789	26	0		
	SDN	2771	73	0		
	SSC	1616	113	0		
	TBB	21624	1236	0		

In the Greater North Sea there are 12 harbour seal assessment areas (AUs), see Table 5.6. Harbour seal abundance has increased over both the short and long term in all AUs along the coast of continental Europe and along the east coast of England (OSPAR Commision, 2017). In the Wadden Sea, which holds over 40% of harbour seals in the total area, numbers have tripled since 1992. However even if the abundance estimates have increased, if there is high bycatch in a local area this can affect the populations in that specific area significantly. Since bycatch is the result of the distribution and behaviour of the animals along with fisheries distribution, it is important to understand (changes in) abundance and behaviour if estimating bycatch at finer levels and thereafter managing fisheries to avoid bycatch occurring in specific areas. To produce reliable fine-scale estimates of seal bycatch we would need to know more about the distribution of fishing effort and the distribution of the bycatch sampling. The data submitted to ICES WGBYC are not currently at a resolution that allows more than a broadscale overview of bycatch.

Table 5.6. The counted number of seals in assessment areas within the Greater North Sea.

Region	Survey Year(s)	Moult (all seals)	Breeding Season (Pups)	Reference
Norway south of 62ºN	2016-18	1054		Nilssen & Bjørge 2019
Wadden Sea (4c)	2020	28352	9954	Galatius *et al.,* 2020
Dutch Delta Area (4c)	2018-19	1184	119	ICES 2021
UK N Coast/Orkney (4a)	2016-19	1405		SCOS 2020
Shetland (4a)	2016-19	3180		SCOS 2020
Moray Firth (4a)	2016-19	1077		SCOS 2020
East Scotland (4b)	2016-19	343		SCOS 2020
NE England (4b)	2016-19	79		SCOS 2020
SE England (4c)	2016-19	3752		SCOS 2020
Skagerakk (III.a.20) Sweden	2017	6500		Ahola, M 2017
Kattegatt (III.a.21) Sweden	2017	10500		Ahola, M 2017
Belt Sea (III. C.22, III.d.24) Sweden	2017	1000		Ahola, M 2017

5.3.2 Harbour porpoise, grey seal and Harbour seal in Barents, Norwegian and North Sea.

Within the 2021 ICES WGBYC data call data from the Barents Sea, Norwegian Sea and the Greater North Sea was submitted in the same format for the years 2006–2020. The data received covered monitoring effort at métier level 5 for gillnets targeting demersal fish (GNS DEF) and for the bycatch species grey seal, harbour porpoise and harbour seal. A summary of the observed effort over that 15-year period and the total number of incidents and individuals bycaught for the three species are shown in Table 5.7. The level of monitoring effort is relatively high because it is based on a reference fleet that is frequently visited by observers collecting catch and bycatch data.

Table 5.7. The summary of fishing effort monitored effort and number of individuals and incidents of bycatch in the Barents Sea, the Norwegian sea and the Greater North sea.

				Halichoerus grypus		*Phoca vitulina*		*Phocoena phocoena*	
Ecoregion	**AreaCode**	**Fishing effort (DaS)**	**Observed effort (DaS)**	**# Individuals**	**# Incidents**	**# Individuals**	**# Incidents**	**# Individuals**	**# Incidents**
Barents Sea/Norwegian Sea	27.2.a.2	43 990	18892	22	22	195	177	947	714
Barents Sea	27.1.b	4466	615	11	10	7	7	5	5
Greater North Sea	27.3.a.20	2277	2274	0	0	22	16	119	101
	27.4.a	4428	3569	1	1	32	26	127	109
Total		55 161	25350	34	33	256	226	1198	929

5.4 Summary of WKMOMA

The Workshop on Estimation of Mortality of Marine Mammals due to Bycatch (WKMOMA), a workshop to address the special request to ICES from OSPAR on mortality of marine mammals (harbour porpoise (*Phocoena phocoena)*; common dolphin (*Delphinus delphis)*; and grey seal (*Halichoerus grypus*)) due to bycatch within the OSPAR maritime area took place online between 13 and 20 September 2021. The workshop had four ToRs:

a) Generate bycatch rates (e.g. specimens per day at sea) and associated confidence intervals for static and towed gears (at least Metier Level 4) for relevant species and assessment units.

b) Generate assessment unit and metier specific bycatch mortality estimates for each species and their associated confidence intervals. For harbour porpoise the assessment units will correspond to those defined in North Atlantic Marine Mammal Commission and the Norwegian Institute of Marine Research (2019) report in OSPAR Regions II, III and IV. For common dolphin, assessment units are OSPAR Regions III and IV. For grey seal, assessment should be made for OSPAR Regions II and III.

c) Compare the bycatch mortality estimates against thresholds for the relevant species/assessment units as provided by OSPAR and identify any critical issues (such as biases in the bycatch estimates) relevant for the comparison.

d) Data available within OSPAR Region I will be evaluated and, if feasible, processed to generate bycatch rate and mortality estimates for harbour porpoise and grey seal using the relevant country/NAMMCO advised assessment units.

A separate data call was issued for the workshop, and data was provided by all relevant member countries, except for Norway, Russia, and the Faroes. Bycatch could therefore not be estimated for assessment units entirely within those countries' waters.

Before bycatch modelling occurred, statistical tests were run on the three datasets (harbour porpoise, common dolphin, and grey seal) to test the effect of various factors in the dataset on the bycatch rates. A generalized additive model with poisson distribution and log-link function was used to see if year, month, vessel size, ICES sub-area, and métier (level 4) affected the observed bycatch rates. Results varied between the three species, with all three species having higher bycatch rates in more recent years (2015-2020) and significant effects of Subareas and métiers, while month was rarely a significant factor. Vessel size was a significant factor for harbour porpoise with larger vessels (12-15m or larger) having higher bycatch rates, while the opposite was true for grey seals were smaller vessels (up to 12 m) had higher bycatch rates.

A Gamma Hurdle model was used to estimate bycatch rates per day at sea. This two-step process first estimates the probability of a bycatch occurring, and then the intensity (number of animals being caught) (Hilborn and Mangel, 1997). Multiplying those values together results in an overall bycatch rate for the observed day at sea.

Bycatch probability (i.e. probability of a bycatch occurring) was estimated with a binomial generalized additive model with logit-link function. Similarly, the bycatch intensity (number of animals) was estimated with a gamma generalized additive model with log-link function.

The data was generally stratified by both métier level 4 and ICES Subarea, and bycatch rates were generated for each métier/Subarea combination. In the case of grey seals and harbour porpoises, the data was further stratified by vessel size (smalland large). In a few cases, there were too few observations to allow the models to be run on a particular métier/Subarea combination. In those cases, several métiers or Subareas were aggregated to allow the models to be run.

The bycatch rates were estimated using bycatch observations from the period 2015-2020 and were extrapolated to both 2019 and 2020 fishing effort, in case the 2020 fishing effort was affected by the covid-19 pandemic. The bycatch rates were estimated and raised for each métier/Subarea combination.

The bycatch rates are under discussion in ICED Advice Drafting Group WKMOMA and cannot be presented until the WKMOMA Advice is published. However, considering the low thresholds set by OSPAR and previous assessment work carried out on common dolphins and harbour porpoises the likelihood that estimated mortality due to bycatch will be above the thresholds is high.

6 ToR D Review ongoing monitoring of different taxonomic groups in relation to spatial bycatch risk and fishing effort to inform coordinated sampling plans.

There is a growing requirement for guidance on the development of monitoring plans to ensure that the quantification of PETs bycatch is improved across a wide range of fishery métiers. Historically, the fishing effort and monitoring data used by WGBYC for bycatch assessments was largely obtained from national Regulation 812/2004 annual reports which covered a limited range of métiers. Regulation 812/2004 was repealed in 2019 and prior to that, in 2017, WGBYC began developing a data call to replace the 812/2004 reports which would no longer be available post repeal, and more generally to improve overall data acquisition. Since 2017, most of the data submitted to WGBYC comes from national at-sea data collection efforts under the DCF, though data from dedicated bycatch monitoring programmes and bycatch focussed research projects are also obtained.

Over the last few years, following regular collaboration between WGBYC and WGCATCH, significant improvements have been made to data collection protocols (how data are collected) and data handling processes (how data are managed) within national DCF programmes and in some cases also to sampling designs (which métiers are monitored). Despite these various improvements, there remains a consensus that current sampling designs within the DCF, which are deliberately structured primarily to quantify commercial species discard rates in certain métiers, are not always adequate for quantifying robust (howsoever that is defined) bycatch rates across a wider range of métiers. Metier specific bycatch rates are used in mortality estimates and then form part of wider assessments of the population level impacts of bycatch, so future improvements in sampling designs (within the DCF and/or any other relevant data collection efforts) will undoubtedly help ensure those assessments are more comprehensive and reliable.

In 2013, WKBYC developed a risk-based approach combining species “abundance”, bycatch rates, fishing effort and monitoring levels to identify areas and fishing gears in need of further monitoring. This methodology was further developed and applied by the project fishPi (Mugerza *et al.*, 2017) to produce a risk index by estimating the bycatch risk of a range of taxa based on the métier, fishing effort level and species “abundance” in different fishing regions across ICES Subareas 5, 6, 7, 8, and 9.

During 2020, WGBYC used the metier specific risk index produced by fishPi and data on 2018 fishing and monitoring effort submitted to the WGBYC database through the 2020 data call, to provide an overview of how metier level sampling coverage in 2018 related to the fishPi risk scores (see ICES 2020), thus building on the work conducted in WKBYC and fishPi. Following that analysis, WGBYC agreed that this was a useful undertaking that could be informative in terms of highlighting those métiers that are considered to be of relatively higher risk in relation to PETs bycatch, but which are currently relatively under-monitored, and consequently proposed a new Term of Reference for 2021 to build on this approach to help inform future sampling designs.

During the 2021 WGBYC meeting, the approach used in 2020 was repeated but using more recent data obtained through the WGBYC 2021 data call (which included data on fishing effort, monitoring effort and bycatch events from 2019 and 2020), and expanded on by also incorporating recent bycatch “risk” maps produced by Evans *et al.*, 2021.

This section provides a short summary of the methodology used, including a brief description of the fishPi and Evans *et al.* (2021) methodologies, data checks and preparation, maps of fishing effort, monitoring effort and monitoring intensity at metier level 3. Then for those métiers included in the fishPi risk scoring index we provide a table comparing the fishPi risk scores against 2019 fishing and monitoring coverage and a preliminary comparison of the fishPi scores against "risk" as estimated using the overlap of fishing effort and species distribution from Evans *et al*. (2021). We provide some discussion about the utility of this approach for identifying métiers that may currently be considered to be high-risk in relation to protected species bycatch but receive relatively low monitoring coverage, and conclude that this analysis could be further expanded and improved, and if repeated on a regular basis would provide a rational basis for the prioritization of candidate métiers for increased monitoring as well as a way of tracking developments in sampling designs in relation to PETs bycatch.

6.1 The fishPi risk index

The fishPi index was produced using the following steps as summarised in WGBYC 2020:

1. Define the risk of bycatch for each species/species group by each métier. A system of three categories (1: low risk, 2: some risk, 3: high risk) is employed where risk represents the likelihood of bycatch and does not signify the population level risk.
2. Identify the presence of the species/groups within the different fishing grounds (presence=1; absence = 0).
3. The species presence matrix and the risk of bycatch for species by each métier is combined resulting in a potential risk matrix, and indicating which species have a potential risk [of bycatch] in which fishing ground.
4. Because fishing intensity of the different métiers differs in each region, the fishing effort of the different métiers was taken into account. Therefore, the fourth step is to combine the potential risk matrix with the fishing effort of the different métiers (in days-at-sea) by the different areas of interest. To calculate these tables, the effort by métier and area reported in DCF National Plans is used and indexed with five levels of effort from low to high. The resulting matrix gives a risk index for each species based on the métier fishing effort and abundance in each different fishing ground.
5. Those index numbers are then summed across all species for each fishing ground and métiers to provide an index of which areas and fishing gears are most at risk of having significant bycatch of all sensitive taxa, and therefore areas and métiers most in need of sampling. The higher the index, the greater the risk.

6.2 Details of risk categories as derived from Evans et al. (2021)

The aim of the risk mapping exercise undertaken by Evans *et al.* (2021) was to predict the degree of spatial and temporal overlap between fishing effort of "high-risk" métiers and the density distributions of 25 cetacean and seabird species, so that monitoring and mitigation action by EU member states could be targeted more effectively. Fishing effort was calculated as the estimated number of hours of fishing per time-period by metier using AIS data and algorithms developed by Global Fishing Watch (GFW). A comparison of relative fishing effort was made with VMS maps produced by ICES for different gear types within three ecoregions and showed good correspondence. Specific maps were then prepared using the AIS fishing effort data by season, by year, and by EU member state for ten general gear types (pelagic trawls, pelagic seines, demersal trawls, demersal seines, driftnets, static gillnets, trammel nets, set longlines, drifting longlines, pots and traps) for the Atlantic area from southern Norway to Portugal covering the years 2015 to 2018.

Thirteen seabird species (red-throated diver, Manx shearwater, Balearic shearwater, Cory's shearwater, northern fulmar, northern gannet, European shag, herring gull, lesser black-backed gull, black-legged kittiwake, common guillemot, razorbill, and Atlantic puffin) and twelve cetacean species (harbour porpoise, bottlenose dolphin, common dolphin, striped dolphin, white-beaked dolphin, Atlantic white-sided dolphin, Risso's dolphin, killer whale, long-finned pilot whale, sperm whale, minke whale and fin whale) were selected on the basis of their regular occurrence in a significant portion of the study area. Maps of density distributions of each species were prepared by season using a modelling approach that incorporated environmental variables applying to two oceanographic domains: southern Scandinavia to NW France (northern) and NW France to southern Portugal (southern). These distribution maps were based upon 1.25 million kilometres of dedicated sightings survey effort for the northern domain, and 0.82 million kilometres for the southern domain, provided by 47 research groups. Surveys were undertaken across the period 2005 to 2020.

To create maps of relative risk of bycatch for cetacean and seabird species, standardised AIS effort rasters and animal density rasters were multiplied to create new rasters of relative bycatch risk. Values approaching 1 would indicate that the highest densities of animals correspond with the highest density of fishing pressure, representing the greatest risk; those approaching 0 would indicate that the lowest densities of animals correspond with the lowest density of fishing pressure, representing the lowest risk. Intermediate scores could represent high densities but low effort or vice versa. Overlap for every species-gear type combination was mapped separately for northern and southern domains on a seasonal basis, and with overlays of protected areas. Pelagic trawls and seines were combined, as were set gillnets, trammel nets and drift nets because of uncertainties in the fishing effort data whether the gear type had been correctly ascribed across the entire region, due largely to the polyvalent nature of fishing gear registered in some areas. Risk maps were prepared for all twenty-five species.

6.3 Data checks and preparation

6.3.1 Comparison of WGBYC data with the fishPi risk index.

An extraction of the fishing effort and monitoring effort tables from the WGBYC database was made for the years 2019 and 2020. Initial checks indicated that monitoring levels across several countries were quite significantly reduced in 2020 compared to 2019. This was not unexpected as it was known that the Covid-19 pandemic had severely limited at-sea data collection efforts since early 2020. Consequently, 2020 data were considered atypical of normal monitoring levels and were not included in this analysis.

Further screening was then carried out on the 2019 fishing effort and monitoring effort data to check for obvious errors with unexpectedly high or low values. It should be noted that the accuracy of all reasonable looking entries cannot be determined except by checking against alternative data sources. There was insufficient time during the meeting to carry out such a task.

A table of 2019 fishing effort and monitoring effort in Days at Sea (DaS) by Metier Level 3 and ICES Division was produced and used to calculate a % monitoring coverage by metier level 3. Metier level 3 was chosen to maintain consistency with the maps provided in the 2020 WGBYC report, and to keep the number of maps to a useful minimum. The finished table is not presented here but was used as the input data for the maps in figures 6.1, 6.2, and 6.3.

The maps were produced in ArcGISPro, using shapefiles available for the ICES Area and Mediterranean Sea from the ICES (https://gis.ices.dk/sf/) and the GFCM (http://www.fao.org/gfcm/data/maps/gsas/es/) websites.

Next, a table detailing all 293 metier combinations (ICES division and gear type at metier level 4) that were allocated scores in fishPi was produced from the fishPi scoring matrix to allow linkage and comparison with the metier level 4 fishing and monitoring effort from the WGBYC database.

Then a table including the metier specific fishPi risk scores (Note: only for those métiers that had at least some monitoring effort in 2019), fishing effort, bycatch monitoring (defined as having a reported sampling protocol in the 2019 data submission as: "all", "protected species", "seabirds", "turtles" or "cetaceans") and non-bycatch monitoring (defined as having a reported sampling protocol of "fish") was produced. Three additional calculated columns were then added: "Total Monitoring Effort" which was the sum of the bycatch and non-bycatch monitored days; "Monitoring Coverage %" which was the % of total effort in that metier monitored by bycatch and non-bycatch monitoring combined; and a column called "combined score", which was calculated as the product of the fishPi score and the inverse of the total monitoring coverage % (so that métiers with high fishPi risk scores and low monitoring coverage result in a high "combined score" and vice versa). This table was then sorted in decreasing order based on the "combined score" column and is presented as Table 6.3.

6.3.2 Risk Mapping Exercise

From the species maps derived showing overall density distributions and taking account of seasonal variation, those species occurring regularly within each ICES Division under consideration are listed in Table 6.1.

Table 6.1: Seabird and cetacean species present at moderate to high densities by ICES Division, derived from species maps (Evans et al. 2021)

Taxa	ICES Division	Species Code	Number
Seabirds	6a	MSH, FUL, GAN, SHAG, KIT, CG, RAZ, PUF	8
	7a	RTD, GAN, HG, LBB, KIT, CG, RAZ	7
	7b	MSH, FUL, GAN, SHAG, KIT, CG, RAZ	7
	7e	GAN, HG, LBB, KIT, CG, RAZ	6
	7f	RTD, GAN, HG, LBB, KIT, CG, RAZ	7
	7g	RTD, GAN, HG, KIT, CG, RAZ	6
	7h	GAN, HG, LBB, KIT	4
	7j	MSH, FUL, GAN, HG, LBB, KIT, CG, RAZ, PUF	9
	8a	MSH, BSH, FUL, GAN, HG, LBB, KIT, CG, RAZ, PUF	10
	8b	BSH, GAN, LBB, RAZ, PUF	5
	8c	BSH, FUL, GAN, HG, LBB, KIT, RAZ, PUF	8
	9a	BSH, CSH, GAN, SHAG, HG, LBB, RAZ, PUF	8
Cetaceans	6a	HP, BND, CD, WBD, AWSD, RD, KW, LFPW, SPW, MW	10
	7a	HP, CD, RD, MW	4

Taxa	ICES Division	Species Code	Number
	7b	HP, BND, CD, WBD, AWSD, RD, KW, LFPW, SPW, MW, FW	11
	7e	HP, CD, RD, MW	4
	7f	HP, CD	2
	7g	BND, CD, MW	3
	7h	BND, CD, RD	3
	7j	HP, BND, CD, RD, LFPW, MW	6
	8a	HP, BND, CD, RD, LFPW, SPW, MW, FW	8
	8b	BND, CD, SD, LFPW	4
	8c	HP, BND, CD, SD, RD, LFPW, SPW, FW	8
	9a	HP, BND, CD, SD, RD, LFPW	6

Key: RTD = Red throated diver, MSH = Manx shearwater, BSH = Balearic shearwater, CSH = Cory's shearwater, FUL = Northern fulmar, GAN = Northern gannet, SHAG = European shag, HG = Herring gull, LBB = Lesser black-backed gull, KIT = Kittiwake, CG = Common guillemot, RAZ = Razorbill, PUF = Atlantic puffin, HP = Harbour porpoise, BND = Bottlenose dolphin, CD = Common dolphin, SD = Striped dolphin, WBD = White-beaked dolphin, AWSD = Atlantic white-sided dolphin, RD = Risso's dolphin, KW = Killer whale, LFPW = Long-finned pilot whale, SPW = Sperm whale, MW = Minke whale, FW = Fin whale.

The susceptibility to bycatch for each species and gear type were scored, based upon a review of 105 bycatch publications, assessments by the ICES fishPi project, ICES WGBYC annual reports, and expert elicitation. Table 6.3 lists those bird and mammal species under consideration identified as at high risk (reported in multiple publications) and those at medium risk of bycatch from each of the specified métiers. As with the fishPi index, the risk categories represent the perceived likelihood of bycatch occurring and do not directly signify a risk of population level impacts. This approach did not incorporate reported bycatch rates as they would likely be correlated in some way with population size.

Using the number of species identified as moderate or high risk of bycatch from each metier (from Table 6.2) combined with their regular presence (from Table 6.1), the number of moderate/high risk bird and mammal species is calculated (Table 6.4). Since total annual fishing effort for each metier and ICES Division was not calculated from the AIS data, the values of days at sea from VMS were used and multiplied by the total number of species at moderate/high risk. The higher the value, the greater the need for monitoring. Those index values greater than 1 000 000 were classified as high, and those between 100 000 and 1 000 000 as moderate.

Table 6.2. Bycatch Risk of Marine Birds & Cetacean Species (from Table 12, Evans et al., 2021)

Taxa		Species	
	Metier 4	High Risk	Medium Risk
Seabirds	PTM	GAN	MSH, CSH, CG, RAZ, PUF
	OTM	GAN	MSH, CSH, CG, RAZ, PUF
	PTB		GAN
	OTB		GAN
	OTT		GAN
	PS		MSH, BSH, CSH
	SDN		GAN
	GNS	RTD, FUL, GAN, SHAG, CG, RAZ, PUF	MSH, BSH, CSH
	GTR	RTD, FUL, GAN, SHAG, CG, RAZ, PUF	MSH, BSH, CSH
	GND	CG, RAZ, PUF	RTD, CSH, GAN, SHAG, HG, LBB
	LLS	MSH, BSH, CSH, FUL	GAN, SHAG, HG, LBB, KIT, CG, RAZ, PUF
	FPO	SHAG	RTD, GAN
Cetaceans	PTM	CD, SD, AWSD	HP, BND, WBD, LFPW, SPW
	OTM	CD, SD, AWSD	HP, BND, WBD, LFPW, SPW
	PTB	CD, SD, RD	HP, BND, WBD, AWSD, LFPW, SPW
	OTB	CD, SD, RD	HP, BND, WBD, AWSD, LFPW, SPW
	OTT	CD, SD, RD	HP, BND, WBD, AWSD, LFPW, SPW
	PS	CD, SD	HP, BND, WBD, AWSD, RD, LFPW, SPW
	SDN		HP, BND, CD, SD, WBD, AWSD, RD, LFPW, SPW
	GNS	HP, BND, CD, SD, WBD, AWSD, RD	LFPW, SPW, MW, FW
	GTR	HP, BND, CD, SD, WBD, AWSD, RD	LFPW, SPW, MW, FW
	GND	HP, BND, CD, SD, WBD, AWSD, LFPW, SPW	RD, MW, FW
	LLS	RD, LFPW, SPW	HP, BND, CD, SD, MW, FW
	FPO		KW, LFPW, SPW, MW, FW

Key: RTD = Red throated diver, MSH = Manx shearwater, BSH = Balearic shearwater, CSH = Cory's shearwater, FUL = Northern fulmar, GAN = Northern gannet, SHAG = European shag, HG = Herring gull, LBB = Lesser black-backed gull, KIT = Kittiwake, CG = Common guillemot, RAZ = Razorbill, PUF = Atlantic puffin, HP = Harbour porpoise, BND = Bottlenose dolphin, CD = Common dolphin, SD = Striped dolphin, WBD = White-beaked dolphin, AWSD = Atlantic white-sided dolphin, RD = Risso's dolphin, KW = Killer whale, LFPW = Long-finned pilot whale, SPW = Sperm whale, MW = Minke whale, FW = Fin whale.

6.4 Maps of 2019 fishing effort, monitoring effort and monitoring intensity (% coverage).

Figures 6.1 to 6.3. show the 2019 metier level 3 fishing effort, monitoring effort and monitoring coverage data by ICES Division, as submitted to the WGBYC database through the 2021 ICES/WGBYC data call. The maps provide a useful visual overview of the data and highlight the relative sparsity of monitoring effort in several métiers, and the generally low monitoring coverage in most métiers. Apparently high monitoring coverage (%) in parts of the Baltic in Figure 6.3. is explained by the fact that some countries in that region include vessel self-reporting via logbooks in their data submissions to WGBYC and these were not filtered out for this analysis. There are also some discrepancies, such as monitoring effort in some ICES Divisions where there is no reported fishing effort, or monitoring effort exceeding reported fishing effort, but these are relatively minor and do not detract from the overall composition of fishing effort and monitoring coverage provided by the maps.

In the fishing effort and monitoring effort maps, demersal trawl effort has the largest spatial footprint and highest total effort levels, reflecting both the ubiquitous nature and high effort associated with this gear type across most of the ICES area and the fact that this broad gear type forms the primary focus within the DCF at-sea sampling programme (which provides most of the data obtained through the WGBYC data call). At the resolution the maps are presented, several other métiers including nets (GN), longlines (LL), pelagic trawls (PT), traps (FIX) and dredges (DR) are used quite widely but at generally lower levels. The remaining métiers, surrounding nets (PS), rods and lines (LH) and seines (SX) are less widespread and in most areas are associated with relatively low total fishing and monitoring effort.

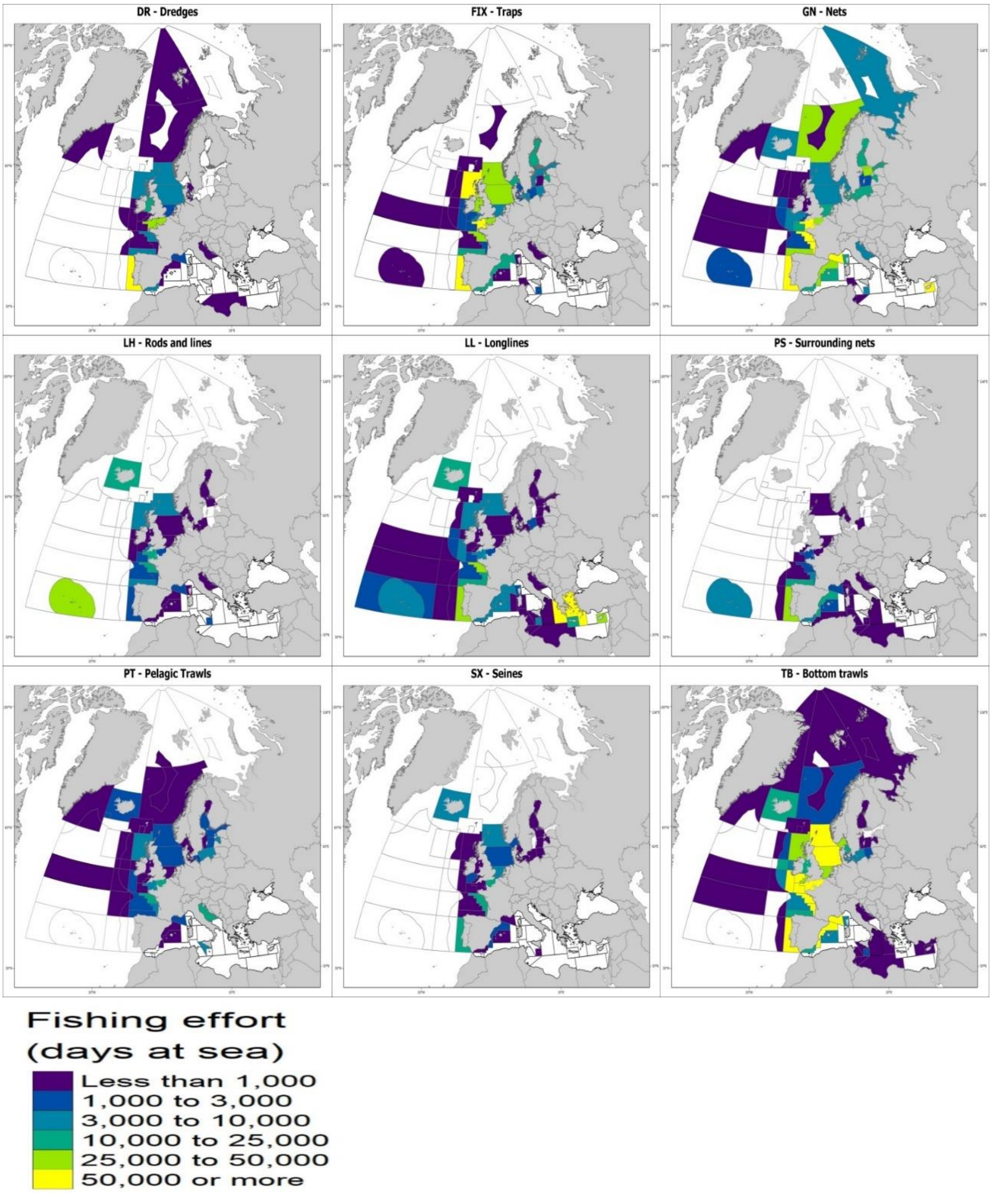

Figure 6.1. Maps of 2019 Metier Level 3 fishing effort (Days at Sea) submitted to the WGBYC database.

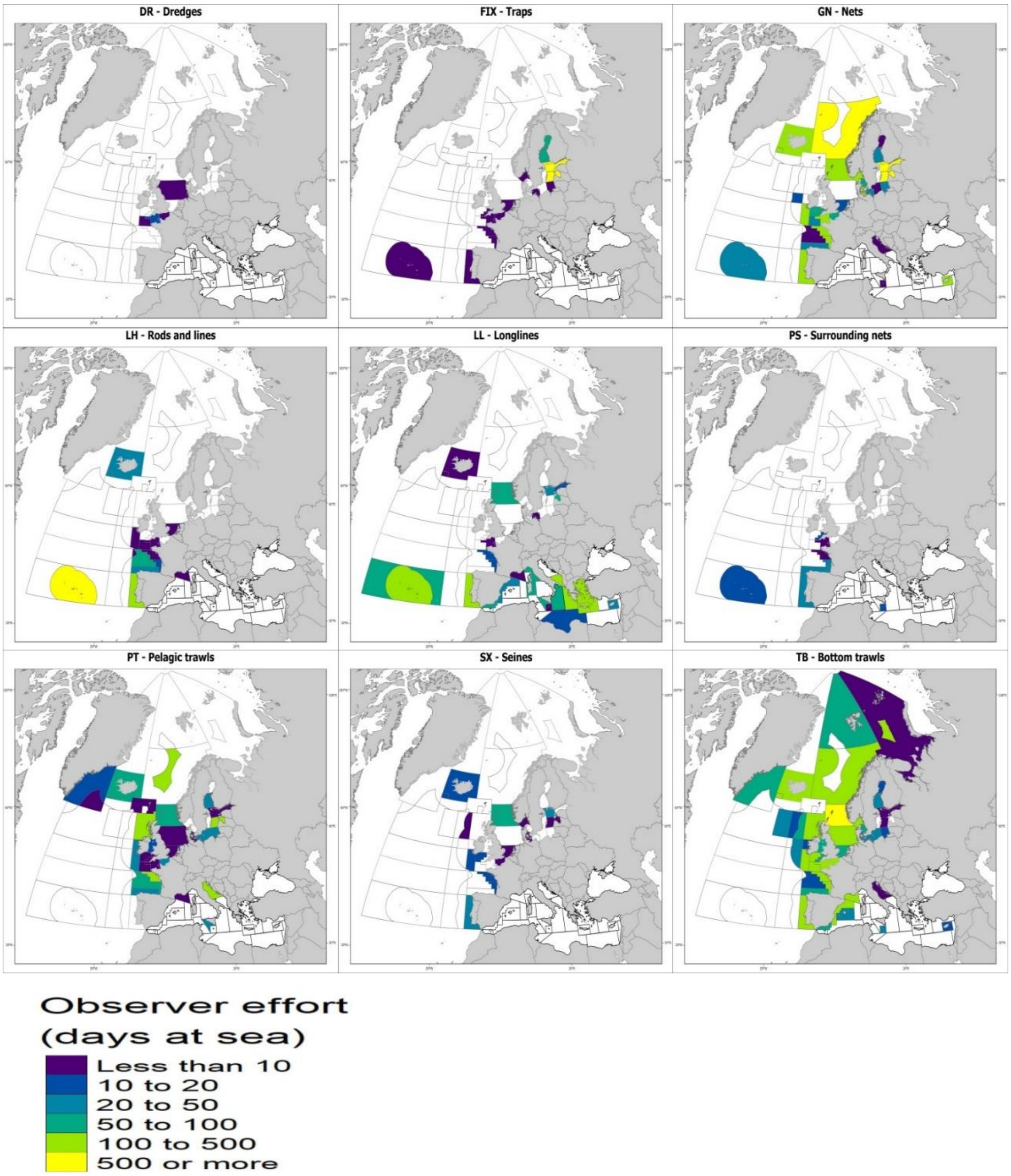

Figure 6.2. Maps of 2019 Metier Level 3 monitoring effort (Days at Sea) submitted to the WGBYC database.

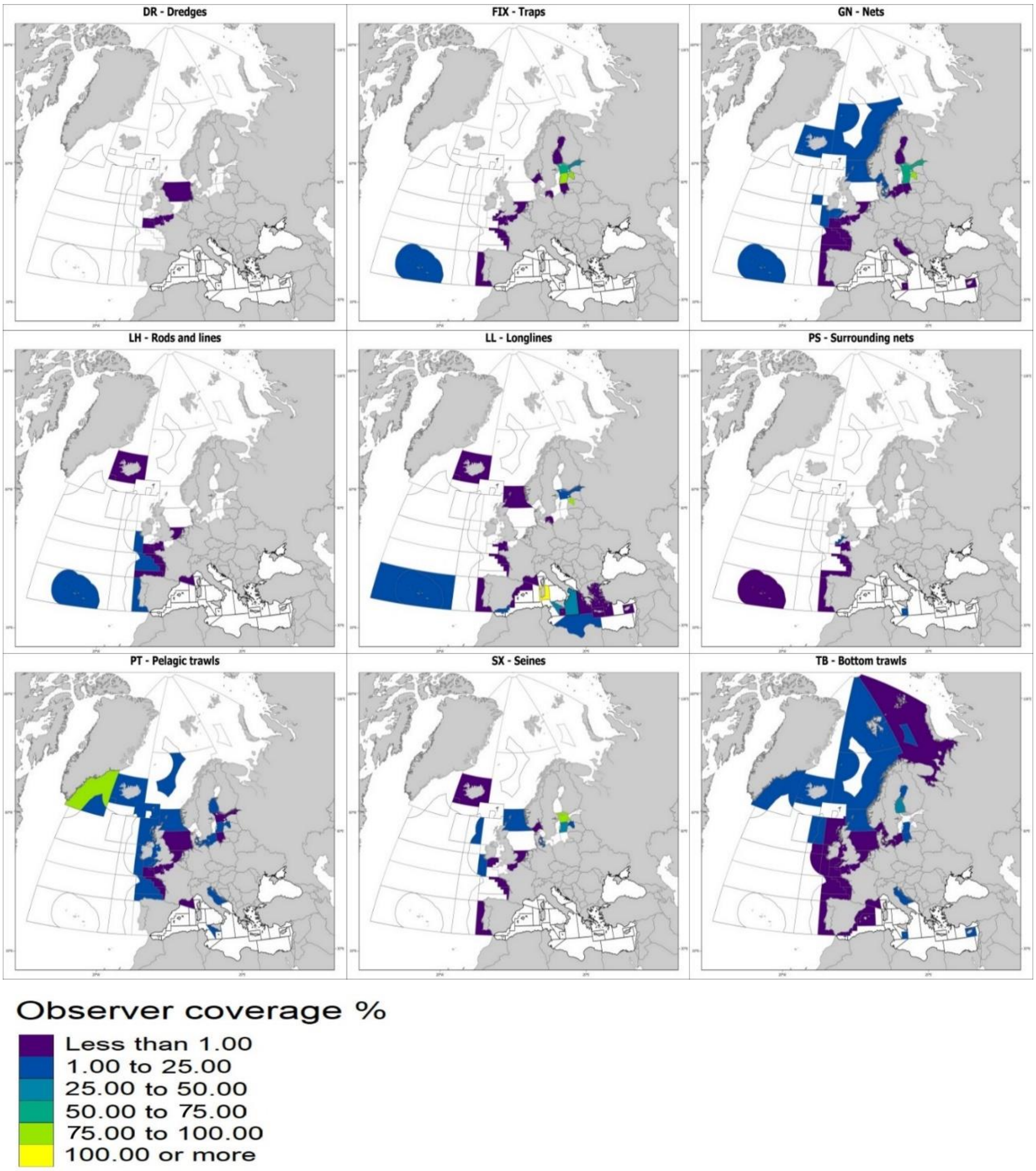

Figure 6.3. Maps of 2019 monitoring coverage (%) based on data submitted to the WGBYC database and presented in Figures 6.1 and 6.2.

6.5 Comparison of monitoring coverage with the fishPi index.

Table 6.3 shows the fishPi risk scores, fishing and monitoring effort, monitoring coverage and combined score (as described in section 6.1) for 2019. The table is sorted in descending order by the combined score column, so métiers considered higher risk (because of higher fishPi scores combined with relatively lower monitoring effort) are positioned towards the top of the table. Data bars are provided for the fishing effort and monitoring coverage columns, and this enables quicker visual appraisal of the details of the table.

Some general insights are easily seen, for example, several netting métiers (GNS / GTR) in Subareas 8 and 9 (e.g. rows 2,3,4,6) are considered to have a high risk based on the combined score and are relatively large fisheries in terms of total effort, so using this fairly simple comparative approach might be considered as sensible initial candidate fisheries for increased monitoring. Further down the table there are also some large effort bottom trawl fisheries (OTB/OTT) in the Western English Channel (7.e) and Bay of Biscay (8.a) that are relatively high risk based on the combined score, and which might also be considered to be of interest for additional monitoring efforts in relation to bycatch. Conversely, towards the bottom of the table there are several métiers with quite high monitoring coverage and quite low risk scores, and these could be considered to be of relatively low priority for increased monitoring in relation to PETs bycatch but are likely of relatively high importance in terms of the quantification of commercial species discard rates given the reported monitoring levels.

Table 6.3. Comparison of fishPi risk scores, 2019 fishing effort and 2019 monitoring effort by metier.

Metier (L4)	ICES Subarea	ICES Division	Risk Factor (fishPi)	Fishing Effort (DaS)	Bycatch Monitoring (DaS)	Non-Bycatch Monitoring (DaS)	Total Monitoring Effort (DaS)	Monitoring Coverage %	Combined Score
GTR	8	27.8.c	105	10360	5.5	0.0	5.5	0.05	104.9
GTR	8	27.8.a	84	131882	81.7	0.0	81.7	0.06	83.9
GNS	8	27.8.a	84	84242	80.1	0.0	80.1	0.10	83.9
GTR	8	27.8.b	84	95095	90.8	0.0	90.8	0.10	83.9
GNS	8	27.8.c	84	23218	42.5	0.0	42.5	0.18	83.8
GNS	9	27.9.a	84	138764	302.0	0.0	302.0	0.22	83.8
GNS	8	27.8.b	84	24422	71.5	0.0	71.5	0.29	83.8
GNS	7	27.7.e	84	34636	100.6	50.0	150.6	0.43	83.6
GND	8	27.8.b	75	8650	0.3	0.0	0.3	0.00	75.0
GND	8	27.8.a	75	3379	3.0	0.0	3.0	0.09	74.9
LLS	8	27.8.a	64	47985	9.5	0.0	9.5	0.02	64.0
LLS	8	27.8.b	64	19781	12.9	0.0	12.9	0.07	64.0
LLS	9	27.9.a	64	28646	185.0	0.0	185.0	0.65	63.6
GTR	7	27.7.e	63	45821	26.9	0.0	26.9	0.06	63.0
GTR	7	27.7.h	63	10532	13.0	0.0	13.0	0.12	62.9
GNS	7	27.7.h	63	3008	3.6	14.0	17.6	0.58	62.6
GNS	7	27.7.g	63	2782	17.0	20.0	37.0	1.33	62.2
GNS	7	27.7.f	63	2261	34.9	19.0	53.9	2.38	61.5
FPO	9	27.9.a	60	108467	2.0	0.0	2.0	0.00	60.0
OTB	7	27.7.f	56	32180	4.7	0.0	4.7	0.01	56.0
OTB	8	27.8.a	56	209445	37.7	0.0	37.7	0.02	56.0
OTB	7	27.7.e	56	261212	91.8	40.0	131.8	0.05	56.0
OTB	7	27.7.h	56	95663	45.4	3.0	48.4	0.05	56.0
OTB	8	27.8.b	56	112330	115.8	0.0	115.8	0.10	55.9
OTB	7	27.7.b	56	8051	8.0	7.0	15.0	0.19	55.9
OTB	9	27.9.a	56	40221	107.0	0.0	107.0	0.27	55.9
OTB	7	27.7.a	56	11671	14.0	18.0	32.0	0.27	55.8
OTB	7	27.7.g	56	26702	75.6	25.0	100.6	0.38	55.8
OTB	8	27.8.c	56	8941	48.0	0.0	48.0	0.54	55.7
OTB	6	27.6.a	56	32960	220.2	10.0	230.2	0.70	55.6
GTR	7	27.7.f	63	17	2.5	0.0	2.5	14.19	54.1
OTT	8	27.8.a	52	353795	77.3	0.0	77.3	0.02	52.0
PTB	9	27.9.a	52	2035	1.0	0.0	1.0	0.05	52.0
PTB	8	27.8.c	52	6783	13.0	0.0	13.0	0.19	51.9
GND	7	27.7.e	50	330	0.0	1.0	1.0	0.30	49.8
FPO	7	27.7.e	48	66313	4.3	0.0	4.3	0.01	48.0
FPO	7	27.7.f	48	6915	0.0	1.0	1.0	0.01	48.0
LLS	7	27.7.e	48	7634	1.3	0.0	1.3	0.02	48.0
FPO	8	27.8.a	48	30395	7.0	0.0	7.0	0.02	48.0
FPO	8	27.8.b	48	2396	2.3	0.0	2.3	0.10	48.0
OTM	8	27.8.a	48	2600	2.8	0.0	2.8	0.11	47.9
PTM	8	27.8.b	48	6670	50.9	0.0	50.9	0.76	47.6
PTM	8	27.8.a	48	20287	165.0	0.0	165.0	0.81	47.6
OTM	7	27.7.e	48	843	6.0	1.0	7.0	0.83	47.6
PS	9	27.9.a	44	38406	75.0	0.0	75.0	0.20	43.9
PS	8	27.8.c	44	20144	43.0	0.0	43.0	0.21	43.9
LHM	8	27.8.c	40	6579	5.0	0.0	5.0	0.08	40.0
LHM	7	27.7.e	40	5512	0.0	5.0	5.0	0.09	40.0
OTT	7	27.7.f	39	1001	0.3	0.0	0.3	0.03	39.0
OTT	7	27.7.g	39	34746	26.7	0.0	26.7	0.08	39.0
OTT	7	27.7.h	39	79977	77.7	1.0	78.7	0.10	39.0
OTT	7	27.7.e	39	5088	9.2	9.0	18.2	0.36	38.9
OTT	7	27.7.b	39	769	7.1	0.0	7.1	0.93	38.6
OTT	6	27.6.a	39	8749	136.0	0.0	136.0	1.55	38.4
LHM	9	27.9.a	40	2230	180.0	0.0	180.0	8.07	36.8
DRB	7	27.7.e	36	30777	0.0	12.0	12.0	0.04	36.0
TBB	7	27.7.e	36	8384	12.1	147.0	159.1	1.90	35.3
TBB	7	27.7.g	36	3674	22.7	48.0	70.7	1.92	35.3
TBB	7	27.7.f	36	1694	20.7	47.0	67.7	4.00	34.6
TBB	7	27.7.h	36	963	0.0	49.0	49.0	5.09	34.2
PS	7	27.7.e	33	2623	3.0	0.0	3.0	0.11	33.0
PS	8	27.8.a	33	2952	4.0	0.0	4.0	0.14	33.0
PS	8	27.8.b	33	4900	28.0	0.0	28.0	0.57	32.8
PTM	7	27.7.h	32	483	0.6	0.0	0.6	0.12	32.0
PTM	6	27.6.a	32	1633	23.0	0.0	23.0	1.41	31.5
PTM	8	27.8.c	32	1848	22.2	33.0	55.2	2.99	31.0
PTM	7	27.7.b	32	415	13.0	0.0	13.0	3.13	31.0
OTM	7	27.7.f	32	26	1.0	0.0	1.0	3.80	30.8
PTM	7	27.7.a	32	282	13.0	0.0	13.0	4.60	30.5
OTM	6	27.6.a	32	1517	86.0	0.0	86.0	5.67	30.2
OTM	7	27.7.b	32	166	13.0	0.0	13.0	7.82	29.5
PTM	7	27.7.g	32	78	7.0	0.0	7.0	8.97	29.1
PTB	8	27.8.a	26	1391	6.8	0.0	6.8	0.49	25.9
PTB	8	27.8.b	26	1152	28.3	0.0	28.3	2.46	25.4
TBB	7	27.7.a	24	1568	39.6	0.0	39.6	2.53	23.4
TBB	8	27.8.a	24	149	4.1	0.0	4.1	2.72	23.3
TBB	8	27.8.b	24	448	20.0	0.0	20.0	4.45	22.9
SDN	8	27.8.a	22	23537	16.0	0.0	16.0	0.07	22.0
SDN	8	27.8.b	22	10995	10.5	0.0	10.5	0.10	22.0
SSC	7	27.7.g	22	1395	10.0	13.0	23.0	1.65	21.6
GND	7	27.7.f	25	48	0.0	7.0	7.0	14.58	21.4
DRB	7	27.7.h	18	179	0.0	1.0	1.0	0.56	17.9
PTB	6	27.6.a	13	492	15.9	0.0	15.9	3.24	12.6
PS	7	27.7.f	11	210	11.0	0.0	11.0	5.25	10.4

Based on the broad patterns in Table 6.3, and notwithstanding other possible issues related to the adequacy of sampling protocols etc, it is likely that managing monitoring programmes to fulfil multiple objectives simultaneously within existing budgets and human resources would require some trade-offs in precision levels between discard estimates and sensitive species bycatch estimates, as some monitoring effort might need to be diverted from currently relatively well sampled métiers of interest to commercial species into relatively poorly sampled métiers that are considered to be of higher risk for PETs bycatch.

The most obvious way to avoid such trade-offs would be to ensure that sufficient additional resources are available to estimate both elements effectively by increasing monitoring in métiers currently under-sampled with respect to PETs bycatch and not reducing monitoring levels in métiers of interest to commercial discard rates.

Effective combined sampling of the commercial and bycatch components of the catch may be possible in some métiers, particularly those such as trawl fisheries where the gear retrieval operation (which is of primary interest in bycatch monitoring of several taxa) is generally distinct from the catch sorting and processing process (which is when most fish catch sampling occurs), meaning that data on both these catch components could be collected within the same monitored trips. In other métiers (e.g. net fisheries) where gear retrieval and catch sorting/processing occur more or less simultaneously, there may be less scope to effectively carry out the necessary data collection for both components within the same fishing operation, but consideration could be given to hybrid type monitoring trips, where some fishing operations are sampled for commercial discards and others are primarily monitored for PETs bycatch, or providing observers with equipment (small cameras) that would permit both activities to be carried out. This hybrid approach may also have the benefit of providing additional data on commercial discard rates from métiers that are generally considered lower priority for this data collection type, whilst improving the quantification of bycatch rates in métiers that are considered high-risk with respect to PETs bycatch.

This quite simple tabulated approach allows the identification of métiers that are considered high-risk for PETs bycatch, have high fishing effort and low current monitoring coverage and so provides a rational and defensible basis for the selection of candidate métiers for increased monitoring to help address data gaps in bycatch mortality assessments.

The methodology used here could be improved quite easily in several ways:

1. All métiers that received fishPi risk scores could be presented whether any monitoring occurred in a particular year or not.
2. Risk scores could be developed for other regions beyond Subareas 5,6,7,8,9 and so would provide a broader picture of monitoring requirements across the ICES area and potentially even in adjacent sea areas such as the Mediterranean.
3. A mean of fishing effort and monitoring effort over several years would potentially provide a more useful picture by smoothing out any interannual changes in effort and monitoring levels that can occur for a variety of reasons.

Consideration could also be given to the production of risk indices using a "per unit" of fishing effort approach, rather than by incorporating fishing effort into the scoring system. The benefit of this would be that the risk indices would remain the same unless significant operational changes occurred within métiers, and then actual fishing effort levels could be incorporated into a second step of the risk calculation. This may better reflect overall changes in risk as fishing effort levels evolve in different métiers over time.

6.4 Comparison of "combined risk scores" with other risk assessments

The mapping of overlap between species density distributions and fishing effort by gear type grouping (Evans *et al.*, 2021) uses a different approach to the fishPi project in line with its specific aims and thus cannot be compared directly with the fishPi index. However, it offers a separate comparison to assess whether areas and métiers identified as high-risk to a suite of species are similar between the two methodologies, and to consider where monitoring effort needs to be markedly increased.

Table 6.4. Bycatch Risk of Marine Bird & Mammal Species assessed by the two methods (fishPi & risk mapping)

Metier (L4)	ICES Subarea	ICES Division	Risk Factor (fishPi)	Fishing Effort (DaS)	AIS Fishing Effort	No. bird species with mod/high overlap	No. mammal species with mod/high overlap	Total No. Birds/Mammals with mod/high overlap	No. species at risk x DaS
GTR	8	27.8.c	105	10360	M	5	8	13	134680
GTR	8	27.8.a	84	131882	M	5	8	13	1714466
GNS	8	27.8.a	84	84242	M	5	8	13	1095146
GTR	8	27.8.b	84	95095	M	1	4	5	475475
GNS	8	27.8.c	84	23218	M	4	8	12	278616
GNS	9	27.9.a	84	138764	H	6	6	12	1665168
GNS	8	27.8.b	84	24422	M	1	4	5	122110
GNS	7	27.7.e	84	34636	M	3	3	6	207816
GND	8	27.8.b	75	8650	L	1	4	5	43250
GND	8	27.8.a	75	3379	L	6	5	11	37169
LLS	8	27.8.a	64	47985	M	2	8	10	479850
LLS	8	27.8.b	64	19781	M	1	4	5	98905
LLS	9	27.9.a	64	28646	M	6	6	12	343752
GTR	7	27.7.e	63	45821	L	3	3	6	274926
GTR	7	27.7.h	63	10532	L	1	3	4	42128
GNS	7	27.7.h	63	3008	L	1	3	4	12032
GNS	7	27.7.g	63	2782	L	3	3	6	16692
GNS	7	27.7.f	63	2261	L	3	2	5	11305
FPO	9	27.9.a	60	108467	L	2	1	3	325401
OTB	7	27.7.f	56	32180	M	0	2	2	64360
OTB	8	27.8.a	56	209445	H	1	7	8	1675560
OTB	7	27.7.e	56	261212	H	1	3	4	1567272
OTB	7	27.7.h	56	95663	M	1	3	4	382652
OTB	8	27.8.b	56	112330	L	1	4	5	561650
OTB	7	27.7.b	56	8051	M	1	8	9	45459
OTB	9	27.9.a	56	40221	H	1	6	7	281547
OTB	7	27.7.a	56	11671	M	1	3	4	46684
OTB	7	27.7.g	56	26702	M	1	2	3	80106
OTB	8	27.8.c	56	8941	L	1	7	8	71528
OTB	6	27.6.a	56	32960	M	1	7	8	263680
GTR	7	27.7.f	63	17	L	1	2	3	51
OTT	8	27.8.a	52	353795	H	1	7	8	2830360
PTB	9	27.9.a	52	2035	L	1	6	7	14245
PTB	8	27.8.c	52	6783	L	1	7	8	54264
GND	7	27.7.e	50	330	L	5	2	7	2310
FPO	7	27.7.e	48	66313	H	1	2	3	265252
FPO	7	27.7.f	48	6915	H	2	0	2	13830
LLS	7	27.7.e	48	7634	L	0	3	3	22902
FPO	8	27.8.a	48	30395	M	0	4	4	121580
FPO	8	27.8.b	48	2396	L	0	1	1	2396
OTM	8	27.8.a	48	2600	L	6	5	11	28600
PTM	8	27.8.b	48	6670	L	1	4	5	33350
PTM	8	27.8.a	48	20287	H	1	5	6	121722
OTM	7	27.7.e	48	843	L	5	2	7	5901
PS	9	27.9.a	44	38406	H	3	6	9	345654
PS	8	27.8.c	44	20144	H	2	7	9	181296
LHM	8	27.8.c	40	6579					
LHM	7	27.7.e	40	5512					
OTT	7	27.7.f	39	1001	L	1	2	3	3003
OTT	7	27.7.g	39	34746	M	1	2	3	104238
OTT	7	27.7.h	39	79977	H	1	3	4	319908
OTT	7	27.7.e	39	5088	M	1	3	4	20352
OTT	7	27.7.b	39	769	L	1	8	9	6921
OTT	6	27.6.a	39	8749	M	1	6	7	61243
LHM	9	27.9.a	40	2230					
DRB	7	27.7.e	36	30777					
TBB	7	27.7.e	36	8384					
TBB	7	27.7.g	36	3674					
TBB	7	27.7.f	36	1694					
TBB	7	27.7.h	36	963					
PS	7	27.7.e	33	2623	L	1	3	4	10492
PS	8	27.8.a	33	2952	L	2	6	8	23616
PS	8	27.8.b	33	4900	M	2	4	6	29400
PTM	7	27.7.h	32	483	L	1	2	3	1449
PTM	6	27.6.a	32	1633	L	5	6	11	17963
PTM	8	27.8.c	32	1848	L	3	6	9	16632
PTM	7	27.7.b	32	415	L	4	7	11	4565
OTM	7	27.7.f	32	26	L	3	2	5	130
PTM	7	27.7.a	32	282	L	3	2	5	1410
OTM	6	27.6.a	32	1517	L	5	6	11	16687
OTM	7	27.7.b	32	166	L	4	7	11	1826
PTM	7	27.7.g	32	78	M	3	2	5	390
PTB	8	27.8.a	26	1391	M	1	6	7	9737
PTB	8	27.8.b	26	1152	M	1	4	5	5760
TBB	7	27.7.a	24	1568					
TBB	8	27.8.a	24	149					
TBB	8	27.8.b	24	448					
SDN	8	27.8.a	22	23537	H	1	2	3	70611
SDN	8	27.8.b	22	10995	L	1	2	3	32985
SSC	7	27.7.g	22	1395	L	1	2	3	4185
GND	7	27.7.f	25	48	L	7	2	4	192
DRB	7	27.7.h	18	179					
PTB	6	27.6.a	13	492	L	1	8	9	4428
PS	7	27.7.f	11	210	L	1	2	3	630

For each level 4 metier, ICES Subarea and Division, Table 6.4 shows the fishPi risk scores, 2019 VMS fishing effort (expressed as Days at Sea) from the WGBYC database, and fishing effort (in categories of high, medium and low, from the number of fishing hours calculated from GFW algorithms of AIS fishing effort averaged across four years, 2015-2018). Columns 7 and 8 indicates the number of bird and mammal species respectively, for each metier and division. Column 9 presents the total number of species combined across the two major taxa whilst column 10 multiplies these by the calculated total number of Days at Sea from VMS (from Table 6.1).

Table 6.4 allows a comparison to be made of perceived risk of bycatch using two different methods to see if similar or contrasting patterns emerge in terms of which métiers may be relatively under-sampled with respect to PETs bycatch.

a) The fishPi method indicates greatest discrepancy between the amount of monitoring required (taking account of the level of risk and amount of fishing effort) and the actual amount of monitoring in the following métiers (combined scores 70.0-105.0):

7e: GNS

8a: GNS, GTR, GND

8b: GNS, GTR, GND

8c: GNS, GTR

9a: GNS

followed by:

6a: OTB

7a: OTB

7b: OTB

7e: GTR

7f: GNS, GTR, OTB

7g: GNS, OTB

7h: GNS, GTR

8a: LLS, OTB, OTT

8b: LLS, OTB

8c: PTB, OTB

9a: LLS, PTB, OTB, FPO

with combined scores of 50.0-69.9

b) The risk mapping results indicate the following métiers as requiring highest levels of monitoring:

7e: OTB

8a: GNS, GTR, OTB, OTT

9a: GNS

followed by:

6a: OTB

7e: GNS, GTR, FPO

7g: OTT

7h: OTB, OTT

8a: LLS, PTM, FPO

8b: GTR, GNS, OTB

8c: GNS, GTR, PS

9a: LLS, PS, OTB, FPO

with these level four métiers showing moderate risk

Ten metier-division combinations showed close correspondence between the two assessment approaches scoring high or medium risk, requiring greater monitoring effort. Seven metier-division combinations corresponded between the two approaches as high in one and medium risk in the other. Twenty-four combinations were highlighted in one but not in the other. Some of the discrepancies were due to the weighting in the risk mapping scoring after multiplying by the number of days at sea of fishing effort from the VMS data. The most notable differences were in 8.a and 8.b where the fishPi approach gave GND a high combined score; the risk mapping approach did not, due to relatively low fishing effort recorded as days at sea in those ICES Divisions. Similarly, in Divisions 7.f, 7.g, and 7.h, GNS and GTR had a high combined score in the fishPi approach but were relatively low from the risk mapping scores, largely due to their low fishing effort when calculated as days at sea. Risk mapping highlighted OTB in the western Channel (7.e) as high risk requiring increased monitoring due primarily to its high fishing effort whereas the combined score from fishPi did not.

Points to note

Fishing effort measures by metier: In general, there was good concordance between those métiers showing greatest fishing effort (measured as DaS) from VMS in 2019 for particular ICES Divisions and those derived from AIS data (measured as hours of fishing) for the years 2015-2018, despite several differences in how fishing effort has been determined. For example, only vessels of >15 m length are required to carry AIS whereas VMS is required for all fishing vessels >12 m length. On the other hand, some small vessels may carry AIS but not VMS. There can be incorrect assignment of gear type used from the EU vessel register, and this may apply to both datasets, whilst some fisheries (e.g. around the Iberian Peninsula and in southern Ireland) are polyvalent and may switch gear types in different seasons or different years.

Division 7j (southwest and south of Ireland) has not been included in Table 6.1 and yet has both a number of bird and mammal species at risk (Table 6.3) but also overlaps with several high-risk métiers (see maps in Evans *et al.*, 2021).

GTR effort in Division 8.a and FPO in 9.a appear to be much higher in the 2019 VMS dataset than in the AIS dataset, whereas in 8.c, GTR effort, are higher in the AIS data. Some of these differences may relate to whether or not small vessels (<15 m length) were carrying AIS. In 8.b, there was lower OTB effort recorded in the AIS dataset whereas in 7.g, there was higher PTM effort; trawlers switch gears seasonally in that area and this may account for the difference.

The GFW data, using AIS, combined some métiers and so in this comparison, local information on fishing effort and the VMS estimates of days at sea were used to inform how gear type groupings were likely split across métiers (e.g. PTM and OTM for pelagic trawls; PTB, OTB and OTT for demersal trawls). This may also account for the relatively lower SDN effort in 8.b.

Protected, endangered and threatened species considered: Although 25 species were considered in the EU risk mapping project, the following marine bird species known to occur in the region and also to experience bycatch, were not included: great northern diver, red-breasted merganser great cormorant, European eider, common scoter, and black guillemot. Amongst marine mammals, fishing effort overlap with grey seal and harbour seal at-sea densities were not available for mapping and therefore were not included.

Métiers considered:

In the EU risk mapping study, the following métiers were not considered: DRB, TBB, and LHM as they were believed to have low bycatch risk for cetaceans and seabirds. On the other hand, set longlines (LLS) were considered as a high-risk fishery particularly in Divisions 6.a, 7.b, 7.j, 8.a, 8.b, and 8.c, and yet monitoring was low or entirely absent. The fishPi approach operates at a relatively broad scale (by Subarea or Division). To aid the targeting of monitoring, it may be more appropriate to examine bycatch risk at a finer spatial scale. For example, within Subarea 8, the risk mapping study identified Division 8.a as having higher bycatch risk than 8..b, and within Division 8c, it identified the region around Galicia as much higher risk than the southern Bay of Biscay (coastal region north of Spain). Such variation in likely risk occurs in other areas.

Number of species at risk:

For GTR in Divisions 7.f and 8.b, the EU risk mapping study had a relatively low number of species considered at risk compared with when fishPi was used. On the other hand, a high number of species at risk was found for several métiers in Division 9.a, and for OTM & PTM in Divisions 6..a and 7b.

6.5 Conclusions

- The two methods described here provide a useful way of judging which potentially high-risk métiers are currently relatively under-monitored with respect to PETs bycatch.
- Based on this approach there are several metier-area combinations that stand out as suitable candidate areas for increased monitoring effort with respect to PETs bycatch quantification.
- The approach is currently limited to some ICES Subareas but could be expanded quite easily if equivalent risk-scores were calculated for other ICES Subareas or adjacent regions (e.g. Mediterranean).
- Table 6.1 should be expanded to include all fishPi métiers regardless of whether monitoring occurred in a particular year or not, to provide a more comprehensive view of monitoring coverage.
- Table 6.1 could be based on the mean of multiple years fishing and monitoring effort which would provide a better overall picture of recent monitoring effort levels which can change between individual years for various reasons.
- Comparison between the fishPi and risk mapping approaches (Table 6.4) could be more closely aligned by revisiting how the fishPi risk scores were calculated, taking account of spatial and temporal variations in fishing effort within ICES Divisions, the species composition, and overlap with collective seasonal density distributions of the higher risk species.
- If estimates of average annual fishing effort (number of fishing hours) by ICES Division were calculated and applied to the risk mapping approach, this would yield a better comparison with the days at sea measures of fishing effort used in Table 6.3.

7 ToR E: Coordinate with other ICES WGs to ensure complete compilation of data on protected species bycatch and to develop and improve on methods for bycatch monitoring, research and assessment.

Several ICES WGs are described in the ICES Roadmap for Bycatch Advice who work on topics of considerable relevance to WGBYC. In addition, the EU Regional Coordination Groups (RCGs) are responsible for the coordination of fisheries sampling programmes within the EU under the EU MAP Regulation, where data collection related to PETS is also included. Under this ToR these groups are identified and a brief description of their relevant work and their possible contribution to the objectives of WGBYC described.

Working Group on Commercial Catches (WGCATCH) & Regional Data Base and Estimation System (RDBES).

Since the monitoring of PETS bycatch has been required in the on-board sampling schemes of EU Member States under EU MAP, the cooperation between WGCATCH and WGBYC has intensified. During the 2020 WGCATCH meeting, it was decided to focus on the RDBES development to ensure that bycatch data is appropriately held in the RDBES. In addition, due to problems and differences found in the effort data between the WGBYC database and the Regional Database (RDB) (ICES 2020a), it was decided to develop a questionnaire to be circulated to those responsible for responding to the data calls, in order to identify the possible reasons for these differences. Comparisons were made using 2017 and 2018 effort data from the WGBYC and RDB databases for three broad métiers (nets, midwater trawls and bottom trawls) to try and understand any possible biases in reported effort levels. As with previous comparisons (ICES 2018, ICES 2019) several discrepancies were found. In general, there was more variability in each dataset between countries but less variability between years of submission for each country indicating that discrepancies may be country specific. The detailed information from this analysis and the outcomes from the questionnaire can be found in WGCATCH 2020 report (In prep.)

WGCATCH and WGBYC members are also working to organise a relevant workshop (WKRARE: Workshop on Estimation of Rare Events) that will be held in 2022 and will be led by members of these two groups.

Finally, it was agreed to update an inventory of sampling programmes conducted that collect PETS bycatch data. WKPETSAMP (ICES 2019) initially compiled an inventory of the various sampling programmes that provide information on incidental bycatch at the national level. These programmes include regular Data Collection Framework (DCF) at-sea sampling programmes as well as other national monitoring programmes and directed studies that focus on PETS bycatch. The inventory provides an opportunity to get an overview of all programmes and studies collecting information on protected species bycatch. The existence of such an overview provides end users of the data, such as ICES WGBYC, the potential to assess what data should be available and to identify gaps to help further improve data collection efforts.

However, it is important that the inventory is managed and kept up to date to maximise its utility. WGCACTH will be the group responsible for updating and maintaining this inventory. This inventory will be accessible at an ICES specific github and members of both WGs will have access to it. In addition, WGBYC will cooperate by reviewing this inventory on an annual basis to include any new programmes that WGBYC members are aware of.

Workshop on Fish of Conservation and Bycatch Relevance (WKCOFIBYC)

WKCOFIBYC was an ICES workshop held remotely in November 2020. The workshop was convened to develop a list of fish species of conservation and/or bycatch interest, that could be used to prioritise and plan for future work within ICES (ICES, 2021a). WKCOFIBYC compiled a list of fish species (non-commercial and commercial) of conservation concern (threatened, sensitive, or already listed in legislation), termed the Comprehensive Species List (CSL). This list is composed of fish species found on (1) regional seas convention lists (ex. OSPAR Commission, Helsinki Commission), (2) international agreements (ex. CMD, The Bern Convention), (3) international and national law (ex. Habitats directive, CFP, NEAFSC), (4) relevant red lists of extinction risk (ex. European Red List) and (5) various scientific and academic exercises to identify sensitive species (ex. Greenstreet et al. 2012, ICES working groups). At this stage, species not present or at the edge of their distributions were removed from the list. From this CSL, WKCOFIBYC developed ecoregion-level lists of priority sensitive species for future conservation/biodiversity-concern assessment, termed the regional assessment lists (RALs). The RALs excluded freshwater and non-indigenous species. In addition, to avoid duplication, the RALs exclude species for which ICES or other bodies already provide quantitative assessments. Finally, from the RALs the group compiled ecoregion-level bycatch lists (RBLs) of fish species of bycatch concern. The RBLs exclude most remaining species already advised-upon by ICES or equivalent bodies. Species that are not advised upon anywhere and are listed as Data Deficient (DD) on red lists, were included in RBLs.

The process began by identifying 597 species from the Northeast Atlantic and the Mediterranean Sea, including some freshwater, brackish water, and diadromous species. However, a significant proportion of these species were deemed not relevant mainly due to being unrepresentative of the main fish fauna of the regions. In total, approximately 230 unique species remained across all RBLs, with numbers differing greatly in different regions, ranging from 134 species on the Western Mediterranean region to 2 species in the Arctic Sea ecoregion. The lists are structured by relevance, geography and according to which legal, scientific or other designations of being sensitive to over-exploitation were relevant. The ICES ecoregions or Mediterranean sub-regions where the species occur is indicated. In addition, the listing of each species in international law and where species are listed, and various Red Lists of extinction risk are also noted. The lists are hosted by ICES, and it is the intention that they will be updated every few years. Lists are currently under review within ICES.

ICES-FAO Working Group on Fishing Technology and Fish Behaviour (WGFTFB)

In the last few years communications between WGBYC and WGFTFB have improved and in the last 12 months several positive developments have occurred. Firstly, under ToR B WGBYC now review WGFTFB national reports for information related to mitigation studies of direct or indirect relevance to PETS bycatch (this work is described in Section 4 of this report). Secondly, members of WGBYC were invited to attend some topic groups at the 2021 WGFTFB remote meeting and several WGBYC members attended the groups.

The Passive Topic group of WGFTFB focussed mainly on cetacean and seabird bycatch and has the Terms of Reference to:

1. Summarize current and past work in relation to fish pot and trap development, plus gillnet and longline modifications in order to avoid bycatch of protected species (hereunder marine mammals, sea birds and sea turtles).
2. Discuss and describe methods and their limitations, hereunder catch efficiency and depredations risks. Furthermore compare newly developed bycatch mitigation efforts and their efficiency to standard gear and compare different types of passive gears (e.g. gillnets vs. fish pots/traps) and the processes of depredation.

3. Identify and make recommendations on how to improve passive gears including unwanted bycatch, high variability in catches and mitigation of depredation from different predators.
4. Identify potential synergies in developing new approaches to promote sustainability (economically and ecologically) of passive gears.

The Pelagics Topic Group of WGFTFB was formed in 2019. The purpose of the topic group is to assemble open-source databases to support fisheries synthesis science, including meta-analyses of bycatch mitigation of vulnerable species in pelagic fisheries. This group was attended by members of WGFTFB and a member of WGBYC also participated to get acquainted with this analytical methodology.

Meta-syntheses, such as meta-analyses used pooled estimates from multiple studies addressing the same question. Due to the larger sample size plus the number of independent studies, correctly designed meta-analytic assessments can provide estimates with increased precision/accuracy compared to estimates from single studies, with increased statistical power to detect a real effect. By synthesizing estimates from a mixture of independent, small and context-specific studies, the overall estimated effect from meta-analyses is generalizable and relevant over diverse settings.

Several studies have been carried out in which there is evidence of the benefits of using meta-analysis, such as Gilman, E. *et al* (2016), Musyl, M. and Gilman, E. (2019) and Gilman, E. *et al* (2020). However, given the multiple advantages of meta-analysis, it is worth highlighting the difficulty in gathering the data necessary to carry them out.

The work agenda contained the following ToRs:

- Assemble a database and conduct a global meta-analysis of existing estimates of the relative risk of capture on different bait types in pelagic longline fisheries. Different species and sizes of pelagic marine predators have different prey, and hence bait, preferences. Managing bait type offers one tool to control species selectivity, including to mitigate vulnerable bycatch. The database will be open source, making it efficient to conduct updated meta-analyses as new records accumulate.
- Identify priority research questions that could be addressed through meta-synthesis approaches of relevance to the ICES-FAO WGFTFB. Through a collaborative research prioritisation process, conduct a survey of WGFTFB members and other relevant stakeholders to identify a tentative list of hypotheses suitable for testing by meta-synthesis approaches related to mitigating vulnerable bycatch and mortality risk in pelagic fisheries of relevance to the ICES-FAO WGFTFB.

Regarding ToR 1, the presented results shown how managing longline bait type could offer one tool to control species selectivity, mainly for turtles and sharks. In the case of seabird, clear significant effect of longline bait type was not found. However, the paucity of studies on longline bait effects on seabird catch risk was highlighted and it was identified as a high research priority.

The steps to carry out the identification of priority research questions (ToR 2) are:

- Solicitation of research topics. Consulting a wide range of stakeholders using online questionnaires.
- Topic processing and collation. Submitted topics are processed and grouped by theme.
- Prioritisation of research topics. Participants will “score” topics.
- Dissemination of research priorities. A report will be published.

The next steps are:

- Identify topics. Survey has been sent out, continue to circulate it.

- Create sub-group. Expressions of interest for collation and prioritisation of topics.
- Prioritize topics. 2 virtual meetings in June.

Working Group on Marine Mammal Ecology (WGMME)

Each year, the ICES Working Group on Marine Mammal Ecology reviews population structure, abundance and trends as well as human pressures and their effects on vital rates for the major marine mammal species occurring in its ecoregions. It does this through data collected from sightings, acoustic detections, and examination of dead animals from strandings and bycatch.

In 2021, the group met online (1-4 February) and addressed the following Terms of Reference of relevance to bycatch:

ToR A: Review and report on any new information on seal and cetacean population abundance, population/stock structure, management frameworks (including indicators and targets for MSFD assessments), and anthropogenic threats to individual health and population status.

ToR C: Review selected aspects of marine mammal-fishery interactions, assemble data and qualitative information available from other sources not fully covered by WGBYC (including strandings, entanglement, interviews, research projects, national/local monitoring) on marine mammals.

For ToR A, the emphasis was upon marine mammal population abundance and trends. No new information on management frameworks (common indicators and targets for MSFD assessments, were presented from 2020, although current seal management frameworks under OSPAR and HELCOM were summarised, and Potential Biological Removal (PBR) methods used to estimate the number of grey seals that may be removed from a population (by any anthropogenic source) without impacting its viability, were considered.

The emphasis for ToR C was on reviewing data from strandings networks, and for this a questionnaire was developed and circulated to each scheme, and the results summarised in the WGMME report. The relative importance of bycatch as a cause of death was generally assessed although no attempt was made to quantify this.

A review was also undertaken of the structure and working of the various international organisations addressing marine mammal bycatch in the NE Atlantic (ICES, HELCOM, OSPAR, NAMMCO, EC Regional Coordination Groups, ASCOBANS, IWC, NOA, NAFO), the regulations in different countries on the use of acoustic deterrent devices (ADDs) for marine mammal bycatch mitigation, as well as of EU and US legislation requirements for monitoring marine mammal bycatch. A number of reports relating to bycatch monitoring and mitigation were also reviewed along with three current initiatives to reduce bycatch: the Scottish entanglement alliance project to reduce bycatch of baleen whales (minkes and humpbacks) in creel lines; the Cetambicion project (Coordinated Cetacean Assessment, Monitoring and Management strategy in the Bay of Biscay and Iberian Coast sub-region); and bycatch projects in the Mediterranean region. A new bycatch risk assessment (ByRA) tool box developed in the US was introduced, and the role of social media as a data source on bycatch was considered. Finally, issues relating to marine mammal entanglement (as well as acoustic disturbance) in aquaculture operations with emphasis upon Scotland were reviewed.

The Joint OSPAR/HELCOM Expert Group on Seabirds (JWGBIRD)

Joint ICES/OSPAR/HELCOM Working Group on Seabirds (JWGBIRD) objectives are to develop and implement indicators for seabirds under the Marine Strategy Framework Directive (MSFD), as well as to review and discuss seabird-related issues relevant for human uses of the sea. As such, JWGBIRD propose an indicator that compare occurrence of seabird bycatch in bottom trawling and gillnet fishing against the spatio-temporal distribution of seabirds to be considered within the criterion D1C5 (MSFD). JWGBIRD members attended a joint OSPAR-HELCOM workshop in Copenhagen, Denmark on 3-5 September 2019 where the workshop proposed an assessment method for birds related to the conservation objective to "minimize and eliminate where possible incidental catches of marine birds". This is in line with the prohibition of deliberate killing or capture of birds according to Article 5 of EU Directive 2009/147/EC (Birds Directive). The assessment method includes a proposed threshold including a "mortality rate from incidental bycatch equivalent to 1% of natural annual adult mortality of the species". The working group recommends this threshold to be tested with PVA modeling, to assess whether or not the added mortality would affect the population trajectories. The working group recognizes the need for targeted monitoring programs to fill the data requirements for bird bycatch and fishing effort. For data-poor bird species, with known bycatch problems it is suggested that the assumption is that the species is not in GES unless the opposite is proven by monitoring data.

Of direct relevance to the work of WGBYC is a proposed workflow described in the Roadmap for ICES bycatch advice which indicates that JWGBIRD should assemble data and qualitative information available from other sources not fully covered by WGBYC (incl. strandings, entanglement, interviews, research projects, national/local monitoring) for birds and if possible report this information to WGBYC annually.

Working Group on Spatial Fisheries Data (WGSFD)

WGSFD, beside other tasks, worked during its recent (online) meeting (07-11 June 2021) on the development of spatial effort indicators for static gears. The development of a consistent approach to estimate the fishing effort by vessels using static gears is a key challenge. WGSFD has investigated whether such information is available, however the overall conclusion has been that it is not, and therefore WGSFD has not been able to progress this term of reference to a satisfactory conclusion during its present term. Efforts instead have focussed on identifying shortcomings and areas where additional data is required and proposing potential solutions. A follow-up term of reference on static gears has been proposed for the next term of the group.

WGSFD carried out a scoping exercise to assess the availability of additional static gear fisheries data that revealed that data available for static gear fisheries vary from country to country, but are in no way comprehensive or uniformly available. It has become apparent that although VMS data can be used to highlight locations where fishing with static gears takes place, and to perform some relative analysis of areas of higher and lower effort, its low polling frequency means is not an appropriate tool to make quantitative conclusions about effort distributions. WGSFD cannot answer questions about effort metrics for static gear fisheries with the data which is available to the group.

During the recent meeting, participants initiated the establishment of a Workshop on Geo-Spatial Data for Small-Scale Fisheries (WKSSFGEO). The aim of the workshop is to discuss and apply methods for identifying trips/hauls in small-scale fisheries using high resolution geo-spatial data, define best practice and assess advantages and disadvantages of methods and tools. The workshop will take place 29 November–3 December 2021. More information can be found here https://www.ices.dk/community/groups/Pages/WKSSFGEO.aspx.

Working Group on Elasmobranch Fishes (WGEF)

ICES WGEF meets annually and is responsible for providing assessments and advice on the state of 55 stocks of sharks, skates, and rays throughout the ICES area (assessments quadrennial: 10, biennial: 45). In 2021, WGEF provided advice for 16 stocks of rays and skates distributed the North Sea ecoregion, the Azores and MAR; catsharks (Scyliorhinidae) in the Greater North Sea, Celtic Seas and Bay of Biscay and Iberian Coast ecoregions; smoothhounds in the Northeast Atlantic; and tope shark in the Northeast Atlantic. In 2020, WGEF provided advice for 28 stocks of rays and skates distributed in two ecoregions: the Celtic Seas and the Bay of Biscay and Iberian coast. Only one stock of shark, spurdog (*Squalus acanthias*) was subject to advice this year. Group members are experts in the fields of fisheries management, modelling, biology, tagging studies, deepwater fisheries, conservation, and taxonomy.

Assessments are carried out on stocks and fisheries from the Arctic to the Azores. WGEF collaborates with other Regional Fisheries Management Organizations (RFMOs) such as the General Fisheries Commission for the Mediterranean (GFCM) and the International Commission for the Conservation of Atlantic Tuna (ICCAT) where stocks are wide-ranging and extend outside the ICES areas.

The EU requires Member States to collect discard data on elasmobranchs. This discarding may include both regulatory discarding, when quota is limited, as well as the discarding of smaller and less marketable individuals. Whilst WGEF want to make progress from 'landings' to 'catch'-based advice, data from discard observer programmes has, to date, mostly been used in exploratory and descriptive analyses and, in a few cases only, for advice purpose.

In 2017, ICES WKSHARK3 (ICES, 2017) reviewed i) the suitability of national sampling programs to estimate elasmobranch discards (including rare species), ii) the discard information available and iii) the procedures/methods to calculate population level estimates of discards removals for different countries (UCES, 2017), and another one in 2020, WKSHARK5 (ICES, 2020b. One of the recurring issues in WGEF is however the uncertainty in discard data as a result of the high number of discrepancies between years and inconsistent or missing data. In addition, given the expected high survival of elasmobranchs, catch data (i.e. landings and estimated discards) will not equal dead removals. Hence the importance to understand the survival rate of discarded elasmobranchs to obtain separate estimates for dead and surviving discards. WGEF recommends initiating a collaborative effort to address issues about the collection and registration of discard data and to evaluate the use of discard data, including survivability, for the application in future stock assessments. Workshop on the Inclusion of Discard Survival in Stock Assessments (WKSURVIVE, ICES, 2021b).

More information can be found here: https://www.ices.dk/community/groups/pages/wgef.aspx

The Joint ICES/NAFO/NAMMCO Working Group on Harp and Hooded Seals (WGHARP)

The ICES/NAFO/NAMMCO Working Group on Harp and Hooded Seals compiles and analyses data on harp and hooded seals to provide the basis for ICES advice on the stocks' status and its fisheries. A benchmark of the assessment models for 3 seal stocks: Harp seals (*Pagophilus groenlandicus*) in the Barents and White Sea, Harp seals in the Greenland Sea, and Hooded seals (*Cystophora cristata*) in the Greenland Sea, is planned to take place in December 2022. Among other tasks, the benchmark will re-examine and update (if necessary) the methods for setting biological limits for seal harvest as defined by ICES in 2005[4]. The expert group will also evaluate whether the current harvest control rules (see section 6.3. of ICES 2005)[5] are precautionary. Since the benchmark will explore the application of thresholds to marine mammal anthropogenic removals it will be of relevance to WGBYC.

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[4] Request from the Norwegian Government regarding Greenland Sea harp and hooded seals and White Sea/Barents Sea harp seals. *In* Report of the ICES Advisory Committee on Fishery Management, Advisory Committee on the Marine Environment and Advisory Committee on Ecosystems, 2005. ICES Advice 2005, Volume 3, Section 1.4.1.2. http://www.ices.dk/sites/pub/Publication%20Reports/ICES%20Advice/2005/ICES%20Advice%202005%20Volume%203.pdf

[5] ICES. 2005. Report of the ICES/NAFO Working Group on Harp and Hooded Seals (WGHARP), 30 August–3 September 2005, St Johns, Newfoundland, Canada. ICES CM 2006/ACFM:06. 54 pp. http://ices.dk/sites/pub/CM%20Doccuments/2006/ACFM/ACFM0606.pdf

The roadmap for ICES advice on bycatch of PETS includes among the objectives to collect information and determine methods to assess the resilience of protected species to bycatch (with the involvement of WGMME, WGHARP, JWGBIRD, WGEF). The roadmap also includes the following item under 'Strategic developments': *methodological work towards setting threshold values for incidental bycatch, derived based on the conservation/management objectives (when available), and testing to ascertain their ecological relevance*. At the same time DGMare communicated to ICES that they are interested in an ICES product (independent from Member Countries) outlining potential and appropriate PETS bycatch threshold methods to be used for each relevant taxa (birds, mammals, reptiles, fish). ICES sees these developments as an iterative process that will evolve in upcoming years as advances are made. To start planning activities and advance ICES bycatch advice on PETS a meeting took place in May 2021 including the chairs (or nominated representatives) of WGBYC, WGEF, WGHARP, JWGBIRD, WGMME, ICES Secretariat and ACOM leadership. One of the main conclusions of the meeting was that before starting the work on methods there should be an agreement on which management objective to use for each taxa. In the absence of a clear objective by managers ICES WGs may refer to existing environmental and fisheries legislation and the proposed general objective was: '*to minimize and where possible eliminate bycatch*'. Dialogue between ICES and DGMare to clarify conservation objectives is ongoing.

Working Group on Technology Integration for Fishery Dependent Data (WGTIFD)

The Working Group on Technology Integration for Fishery-Dependent Data (WGTIFD) examines electronic technologies and applications developed to support fisheries-dependent data collection, both on shore and at sea, including electronic reporting (ER), electronic monitoring (EM), positional data systems, and observer data collection. This group provided an inventory and review the various hardware, software applications, and approaches to fisheries-dependent data collection. The report identifies the challenges and successes of electronic technology programmes worldwide; reviews the technical, policy, and analytical considerations for utilizing data from electronic technologies; and reports on the developments in machine learning and computer vision technologies and their applications in fisheries dependent data collection.

WGTIFD also started to examine the risks and benefits of different technologies and how to integrate data from technologies; these topics will be examined further by the working group in the following years. There are a number of tools that are being adopted more widely across a range of fisheries, vessel sizes, etc., including ER systems that allow for self-reporting to meet certain data requirements and positional data systems such as vessel monitoring systems (VMS), which can provide near-real time location of fishing fleets. EM has been gaining interest very rapidly over the last five years, but there are some challenges in terms of inadequate funding, lack of clear policies and standards, and the costs of manual video review and data transmission. In almost every instance of an EM program or project, computer vision (CV) and machine learning (ML) applications are being developed to reduce costs and improve the timeliness and accuracy of information. While CV/ML alone will not lower the barrier entirely for much wider adoption of EM, these technology developments are advancing in the marine sciences and will help shape fisheries monitoring in the future.

Regional Coordination Groups (RCGs)

Under the previous Data Collection Framework (Council regulation (EC) No. 199/2008), there were no binding obligations for Member States (MS) to collect data on species other than commercial fish species and certain invertebrate species. When the reviewed DCF (Regulation (EU) 2017/1004) came into force in 2017, collection of data on PETS bycatch when observers are onboard became mandatory. Therefore, Member States have begun to implement new data collection protocols in their at-sea observer programmes following guidelines developed by ICES Expert Working Groups (WGBYC, WGCATCH) to improve the collection and quality of data on PETS bycatch. However, sampling designs remain focused primarily on active gears. In addition, under several EU instruments (Regulation 2019/1241 on technical measures, Habitats Directive 92/43/EEC, and Birds Directive 2009/147/EC) MS are required to monitor and report on bycatch of protected species, including cetaceans, seabirds and marine turtles.

The overall aim for RCG NA NS&EA and the RCG Baltic is to review the status of current issues, achievements and developments of regional coordination and identify future needs in line with DCF requirements and wider European environmental monitoring and management. With this aim in mind several Intersessional Subgroups (ISSGs) were created trying to cover different topics related to different needs in line with the DCF requirements, including PETS bycatch issues.

During the last three years the ISSG PETS work has been focused on conducting a risk-based assessment for the different PETS groups or species and identify the sampling coverage of the high-risk fisheries with scientific observers at sea under the DCF sampling programmes. In addition, potential gaps and improvements were identified and a workplan defined for this group.

During the RCG NA NS&EA and RCG Baltic 2021 progress of work of ISSG on PETS bycatch was presented. The ISSG PETS report can be found in part III of the final report. The Bay of Biscay and the high-risk fisheries concerning common dolphin bycatch were used as a case study to analyse the coverage of these risky fisheries under the DCF at sea sampling programmes. The coverage of these fisheries is less than 1.5% of the total effort and lower in the case of trips using passive gears. In addition to the coverage it is also important to analyse the quality of the data collected. It was discussed the possible differences in the quality of the data between those trips with observers focused on bycatch data against observers collecting biological data, discards etc. Spain and France are carrying out specific at sea sampling data collection to collect bycatch data. The results obtained on these trips will also be analysed to identify if differences occur and how this could be improved.

Finally, the ISSG reviewed the HELCOM roadmap. This roadmap and ASCOBANS view about bycatch issues was also discussed during the meeting in a specific session. Some of the issues highlighted by these two end-users are related to the role of the RCGs to improve the coordination to collect bycatch data. It was mentioned that it would be important the participation and collaboration of these end-users with this ISSG. In the next work period, HELCOM and ASCOBANS will be contacted and invited to participate in the work to be carried out by this ISSG. Another important point highlighted by the group was that although the DCF and the RCGs have an important role on the data collection of bycatch data, not everything could be covered under this regulation and by this group. Another potential funding should also be considered to improve the data collection on PETS bycatch. With this aim in mind, it is essential to have a discussion about how much effort is needed to provide robust bycatch estimates, how to improve the quality of the data collected and the resources needed and if this is feasible and realistic.

8 ToR F: NEAFC special request - data scoping (bird bycatch)

ToR F) consisted of identifying data requirements on fishing effort, monitoring effort, and bycatch incidents, by considering spatial, temporal and gear type aspects, for the special request advice on bird bycatch in the NEAFC Regulatory Area (figure 8.1);

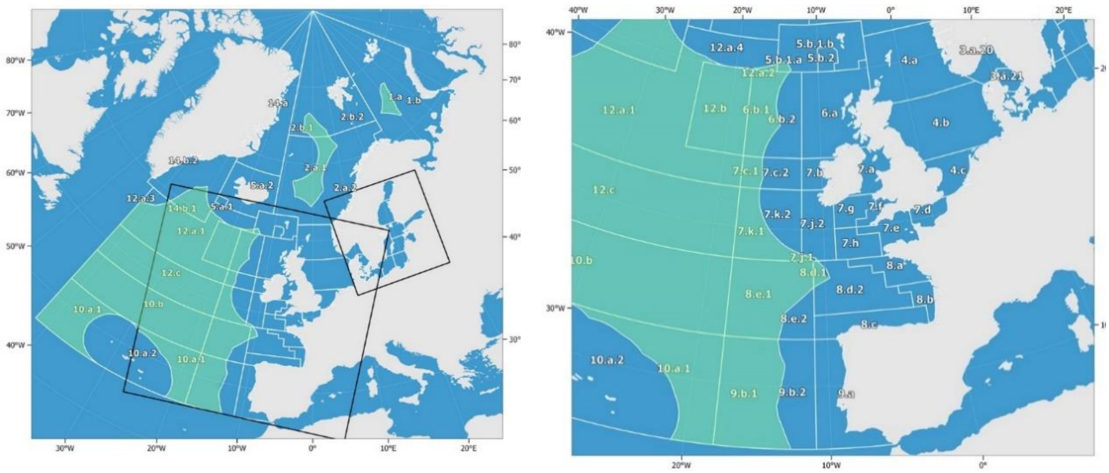

Figure 8.1. Maps of the ICES areas in the NEAFC Regulatory Areas (marked light green), general view (left) and detail (right). ***FAO.org*.**

In 2021, ICES received a special request for advice from the North East Atlantic Fisheries Commission (NEAFC) on bird bycatch (see Annex 4). NEAFC stated that according to anecdotal information bird bycatch is considered low in the fisheries conducted in the NEAFC regulatory area (RA). ICES was requested to compile and aggregate available data (spatially and temporally distributed, as well as per gear) and to advise upon what is necessary in order to provide annual advice on bird bycatch. As an initial step to determine whether data on bird bycatch in the NEAFC RA do exist, WGBYC carried out a scoping exercise in 2021.

Based on a signed agreement, NEAFC provides ICES with data on VMS and catches in the NEAFC RA. These data are used, among other things, to feed into the ICES annual advisory process on Vulnerable Marine Ecosystems (VME). For VME work the main gears of interest are those that have physical contact with the sea floor. For PETS bycatch work all gears are relevant. Although the raw fishing effort data are available to ICES, workload and time constraints prevented the processing of the NEAFC total fishing effort data in advance of WGBYC 2021.

The WGBYC 2021 data call was sent to all NEAFC contracting parties. In relation to the special request from NEAFC, data from ICES Divisions containing both National EEZ and NEAFC Regulatory Area waters was requested with the appropriate ICES/NEAFC Subdivision code (e.g. 7.k.1 (NEAFC RA) or 7.k.2 (National EEZ), and not just 7.k).

All NEAFC contracting parties except one submitted data in response to the WGBYC 2021 data call. However, only a few EU countries reported any monitoring effort data within the NEAFC RA.

Table 8.1. NEAFC contracting parties and their contribution to the WGBYC 2021 data call.

NEAFC contracting parties	Submitted data to the WGBYC 2021 data call	Submitted monitoring effort data within the NEAFC RA to the WGBYC 2021 data call
Denmark (in respect of the Faroe Islands & Greenland)	Yes	No
EU	Yes	Partly (Estonia, Germany, Lithuania, Netherlands, Spain)
Iceland	Yes	No
Norway	Yes	No
Russian Federation	No	No
UK	Yes	No

Not all states have reported their monitoring data. Of the states that have reported monitoring data, not all identified the ICES Subdivisions in sufficient detail, making it impossible to determine their monitoring effort specifically within the NEAFC regulatory area. Furthermore, no data were available on fishing effort. Because of all these data gaps, it did not make sense to indicate the extent of the reported but incomplete monitoring data here.

In the incomplete data reported to WGBYC, no bycatch of seabirds was reported in any fishery in the NEAFC RA. However, it is clear from the monitoring data that not all states reported their data. In addition, it was not possible to deduce from the reported data whether monitoring had actually taken place in the NEAFC RA. Therefore, it cannot be deduced that no bycatch of seabirds occurs in fisheries in the NEAFC RA.

According to the information available, there are currently no regulations in the NEAFC Statutes that require a monitoring programme for the recording of bycatch of protected species such as seabirds. NEAFC rules for Recording of Catch and Fishing Effort (Article 9) do not require to record data about bycatch of seabirds in the logbook. Even if such monitoring is or would be requested for fishing fleets flying the flags of EU Member States, for example under EU Data Collection Framework (DCF) or EU Marine Strategy Framework Directive (MSFD), the data would be incomplete unless non-EU countries such as Russia or Norway had similar rules for their fleets.

For robust bycatch rate calculations including error estimates, the data need to be provided for each bycatch event (i.e. per haul rather than aggregated), including the number of zero-bycatch events. A time-series of data allows more robust estimates and evaluation of trends for seabird bycatch (and other taxa) and the ability to generate stratified bycatch estimates at finer temporal resolutions is important (ICES, 2020). This cannot be achieved currently with the available data.

<u>Conclusions and recommendations to enhance the monitoring of bycatch of seabirds in fisheries in the NEAFC RA</u>

Systematic collection and reporting of data on seabird bycatch are essential to tackling seabird bycatch. The EU's *Action Plan for reducing incidental catches of seabirds in fishing gears* states that a precautionary approach should be adopted where information is lacking or uncertain on seabird bycatch and a more extensive monitoring of fisheries falling into this category (a minimum 10% observer coverage in the short term should be aimed for) should be undertaken (European Commission, 2012).

Thus, in order to identify whether seabird bycatch is a problem at all, sufficient monitoring should be established as soon as possible, recording both its effort and any bycatch at species level that occurs. It is recommended to ensure that observer data is routinely submitted to scientific bodies to facilitate analysis of observer programme data. Using a standard reporting format for recording seabird bycatch and to compile this as soon as possible in one place, e.g. in a database of seabird bycatch, would facilitate the analysis by relevant experts.

In its last report, WGBYC stated further important issues concerning the thorough monitoring of seabird bycatch (ICES, 2020):

"Many seabird species often have a clumped distribution during foraging activities due to the dispersion of their prey. Thus, there is a considerable probability that multiple seabird individuals are involved if a bycatch event occurs during a haul or a fishing trip (see for example (Bærum *et al.,* 2019)). However, seabird bycatch events (i.e. occurrence of seabird bycatch during a fishing activity) might still be relatively rare. These aspects of seabird bycatch need to be taken into account when estimating mean bycatch with accompanying uncertainties. This presents challenges both for obtaining good monitoring data and estimates as the data need to be representative for the frequency of zero bycatch events, and also for the rarer bycatch events including representative numbers of bycaught individuals. This is especially true in areas and fisheries with low observer coverage. In some species/areas, bird bycatch can be considered mainly seasonal. For this reason, observer data cannot simply be extrapolated from observer effort to total fishing effort but a monthly presentation would be needed. "

To monitor bycatch of seabirds on all vessels fishing in the NEAFC RA, observers (and perhaps ship crews in the case self-sampling) might make use of the draft list of seabirds of bycatch concern by ICES Ecoregion that was established by WGBYC in 2020 (Table 26 in ICES, 2020). Based on this draft a final list of seabirds of bycatch concern will be adopted by ICES ACOM at the end of 2021.

9 ToR G: Identify potential research projects and funding opportunities to further understand PETs bycatch and its mitigation.

LIFE EU Bycatch project 'CIBBRiNA'

Coordinated Development and Implementation of Best Practice in Bycatch Reduction in the North Atlantic Region

By initiative of the Dutch Ministry of Agriculture, Nature & Food Quality an EU LIFE proposal is developed that will be submitted by the end of November 2021. The main objective of this project is to minimise and, where possible, eliminate bycatch of marine protected species in the North-Atlantic including the Baltic. This will be achieved through EU cross-border and cross-sectoral cooperation, involving industry, scientists (many of whom are members of WGBYC), authorities and other relevant stakeholders, to establish regionally coordinated mitigation, monitoring and assessment programmes. For this, a toolbox will be developed, which builds on a review of current approaches and existing national programmes. This will involve:

- participatory approaches to finding solutions for bycatch which focus on the fishers practical constraints, combining results from previous work with targeted pilot schemes within the project;
- a focus on socio-economic aspects and long-term funding mechanisms, to address financial constraints and opportunities with regards to bycatch monitoring and mitigation
- development, testing, and implementation of effective mitigation measures to reduce the incidental bycatch of marine mammals, birds, turtles and non-commercial fish in the gear types with a high bycatch risk including both static and pelagic gears;
- innovative approaches to monitoring (e.g. use of REM and apps to estimate bycatch and integration of information from strandings and interviews in data-poor situations), to obtain the best possible abundance estimates and to achieve a step change in the reliability of bycatch rate estimates;
- building on current practice (e.g. in OSPAR) to develop methods to assess the conservation implications of bycatch in data-rich and data-poor situations, taking a realistic approach to identifying baselines and setting ambitious targets for population recovery and applying the precautionary principle.

CIBBRiNA will work jointly with fishers, scientists, fisheries and environment ministries and NGOs to minimize bycatch in fisheries which have a high risk of incidental catch of marine mammals, birds, turtles and sharks and rays and to work towards transparent and sustainable fisheries. A prerequisite for all participants is an open mind towards possible solutions. Existing and trialled monitoring and mitigation methods need to be assessed for suitability use by fishers and applicability to multiple gears, regions and species. Consistent with the principles of Responsible Research and Innovation (RRI), cooperation and co-creation with the fisheries industry from early on is a key principle of this project, in which mutual trust, respect and understanding of different perspectives are considered essential. Another fundamental principle for this project and its objectives is to avoid repetition and to build upon existing work, while remaining sensitive to possible limitations of earlier approaches, aiming for practical outcomes and measurable deliverables. In addition, it should be seen as acceptable and valuable to report on what does not work as much as what is successful.

For more information, please contact Anne-Marie Svoboda, programme manager (a.m.svoboda@minlnv.nl) or Marije Siemensma (m.siemensma@msandc.nl)

10 ToR H: Continue, in cooperation with the ICES Data Centre, to develop, improve, populate through formal Data Call, and maintain the database on bycatch monitoring and relevant fishing effort in ICES and Mediterranean waters (Intersessional)

10.1 Introduction

European Council Regulation 812/2004 was officially repealed on 13 August 2019. Many of the monitoring and mitigation requirements of Regulation 812/2004 were transposed into Regulation (EU) 2019/1241 (hereafter termed the Technical Measures Regulation / TMR) which came into force on 20 June 2019.

The repeal of Regulation 812/2004 was expected for some years by WGBYC members and so, since 2017, the group had been preparing for transitioning away from using Member States' annual Regulation 812/2004 reports as the main source of bycatch data as these would no longer be available once Regulation 812/2004 was repealed. The first step in this transition was the development and issuing of an informal ICES/WGBYC data call in 2017 to obtain data on fishing effort, monitoring effort and bycatch records from EU and other ICES Member States to be hosted in a standalone WGBYC database. Subsequent formal data calls have been issued on an annual basis since then.

A subgroup within WGBYC called the Database Subgroup (DbSg) was established in 2016 to develop the first data call and maintains an active role in all WGBYCs activities related to data acquisition, preparation and quality checks. The DbSg is comprised of several long-term members of WGBYC and has significant support from staff at the ICES secretariat and ICES data centre. Much of the DbSg's work occurs inter-sessionally, to prepare and where necessary modify the annual data call. The group also meets prior to the WGBYC meeting each year to review and check the national annual data submissions to ensure that the working group have a clean dataset to work with during the meeting.

This section provides a summary of the 2021 data call and describes some minor changes that were made to the data format since the 2020 data call.

Some other tasks tentatively planned under ToR H for the 2021 meeting were not undertaken due to time limitations, as many members of the DbSg participated in the work of various other ToRs throughout the meeting and also in WKMOMA which started two weeks before WGBYC but due to unexpected data issues was still ongoing during the WGBYC meeting.

10.2 ICES WGBYC data call

On 25 May 2021, WGBYC issued an official data call for the fourth time (https://www.ices.dk/sites/pub/Publication%20Reports/Data%20calls/Data-call.2021.WGBYC.pdf). The data call aimed to collect data describing total fishing effort, monitoring/sampling effort and protected species bycatch records for marine mammals, seabirds and turtles (fish species of relevance to bycatch advice were not included pending sign off by ACOM of fish species reference lists developed by ICES WKCOFIBYC in 2020) from the calendar years 2019 and 2020. In the past WGBYC has worked with data collected two years prior to the meeting due to the Regulation 812/2004 reporting deadline and the group's normal spring-time meeting. Consequently, the 2021 WGBYC meeting was deliberately moved from a spring to autumn schedule to enable the group to work with data collected in the previous calendar year. The 2021 data call requested data from two calendar year to address this time lag in data acquisition and means that all future data calls will now request data from the single preceding calendar year, which will ensure that the groups work and the advice that stems from it is timelier.

The data obtained through the annual WGBYC data calls support ICES annual advice on the impact of bycatch on a range of protected or sensitive marine species/taxa, to answer a standing request from the European Commission for advice on the impacts of fisheries on the wider marine environment.

Data were formally requested from 18 of the 20 ICES countries (all except USA and Canada). In addition, six EU Mediterranean non-ICES countries were included in the call (Croatia, Cyprus, Greece, Italy, Malta, and Slovenia) and two EU Black Sea non-ICES countries (Bulgaria and Romania). Two countries, France and Spain, have fisheries operating in both the ICES and GFCM areas and data were provided by each country for both regions.

In addition, ICES received a special request for advice from the Northeast Atlantic Fisheries Commission (NEAFC) to assess seabird bycatch rates in the NEAFC regulatory area and the initial stages of this work were incorporated into the routine work of WGBYC under ToR F. To facilitate this work data were requested from submitting nations specifically for that regulatory area by including ICES Subdivision as a mandatory reporting requirement.

Most of the contacted countries submitted data (23[6] of 26 countries; Russia, Bulgaria and Romania did not submit any data). The consistency of the data provided by different countries was an improvement over previous data calls, possibly reflecting improved instructions within the data call text, and a growing familiarity of data submitters with the required format. However, some countries only provided partial data related to specific gear types, and others included vessel self-reporting requirements for bycatch as part of their submission, but the accuracy of these records cannot be independently verified.

WGBYC reiterates that to facilitate efficient data submission, processing and analysis it is recommended that each nation strictly adheres to the specified data call format and nominates a single organization to coordinate and provide bycatch data in future ICES data calls. The data submission template includes fixed/mandatory vocabularies for several data fields, which facilitates efficient data collation across countries but can give rise to submission challenges, particularly for nations that submit data for the first time, and for which tailored vocabularies may be needed.

In the latest data call some minor modifications were made to the submission format compared to the 2020 data call and these were highlighted in the data call instructions to submitters to ensure they were easily identified. Some of the data field explanations in the data call text were also improved after several submitters raised important questions about the ambiguity of some of the definitions in the 2020 call.

Developments to the database template are ongoing and will in particular be mindful of data collection under the EU-MAP and the fact that the 2019 data (assessed at WGBYC 2021) will be the last time data collected under Regulation 812/2004 were submitted to the group. As a result, some of the fields and vocabularies in the 2022 data call will be modified or deleted which should further improve consistency in the data submission process.

[6] This sentence was updated in March 2022 as it was stated in the initial version that Lithuania did not submit data in response to the data call.

In the 2021 data call, WGBYC requested, for all EU and all non-EU ICES member countries (except the U.S.A and Canada):

A) all fishing effort (for all gear types even if no at-sea monitoring has occurred in the relevant period),

B) all at-sea monitoring/sampling effort (for all gear types whether or not incidental bycatch has been recorded during the relevant time period),

C) all recorded incidental bycatches of marine mammals (cetaceans, phocids etc), seabirds and sea turtles. (Reminder: WGBYC will not be working with protected/sensitive fish species data during the 2021 meeting, pending guidance from ICES ACOM).

A brief overview summary of the 2021 data call submission is provided in Table 8.1. The presented data describes the number of submitted metier specific fishing effort, monitoring effort and bycatch records by country. The associated number of fishing effort and monitoring effort days at a sea are also provided. The very high monitoring levels in Estonia and Finland are explained by the fact that those countries interpret and submit vessel self-reported data as part of national monitoring levels, though WGBYC treat these data with caution because they cannot be independently verified. Norway submitted data from 2006 to 2020 but only for net (GNS) fisheries. Belgium submitted data for 2018 to 2020 and Lithuania submitted data only for 2020. All other countries submitted data according to the 2021 data call specification.

Table 10.1. Data submissions by country to the 2021 data call. Reported fishing effort and monitored effort are presented as Days at Sea (DaS).

Country	Years submitted	Fishing Effort Records	Fishing Effort DaS	Monitoring Effort Records	Monitored Effort DaS	ByCatch Records
BELGIUM	2018/2020	717	40260	96	587	
CYPRUS	2019/2020	62	207369	85	1306	15
DENMARK	2019/2020	4785	193005	305	1632	228
ESTONIA	2019/2020	150	135371	343	127711	38
FINLAND	2019/2020	1320	170227	480	1178	239
FRANCE	2019/2020	12196	5512558	926	3012	68
GERMANY	2019/2020	1530	101043	207	671	2
GREECE	2019/2020	108	1449303	105	2596	151
ICELAND	2019/2020	168	99381	86	825	150
IRELAND	2019/2020	2377	101841	156	863	22
ITALY	2019/2020	60	25253	67	1168	19
LATVIA	2019/2020	851	25814	83	981	361
LITHUANIA	2020	103	6159	103	6159	
MALTA	2019/2020	762	34218	45	238	1
NETHERLANDS	2019/2020	1246	89618	80	405	110

Country	Years submitted	Fishing Effort Records	Fishing Effort DaS	Monitoring Effort Records	Monitored Effort DaS	ByCatch Records
NORWAY	2006-2020	240	1005552	525	25350	415
POLAND	2019/2020	1651	107437	82	209	2
PORTUGAL	2019/2020	91	76115	76	1461	8
PORTUGAL	2019/2020	379	398446	180	3689	50
SLOVENIA	2019/2020	383	10671	15	30	3
SPAIN	2019/2020	6937	1554066	406	2124	21
SWEDEN	2019/2020	4147	115947	114	147	13
UNITED KINGDOM	2019/2020	3982	738280	368	2093	44

References

ACCOBAMS, 2021. Estimates of abundance and distribution of cetaceans, marine mega-fauna and marine litter in the Mediterranean Sea from 2018-2019 surveys. By Panigada S., Boisseau O., Canadas A., Lambert C., Laran S., McLanaghan R., Moscrop A. Ed. ACCOBAMS - ACCOBAMS Survey Initiative Project, Monaco, 177 pp.

ACCOBAMS/ASCOBANS. 2021. Recommendations from the 1st Meeting of the Joint Bycatch Working Group of ACCOBAMS and ASCOBANS (February 2021). https://www.ascobans.org/sites/default/files/document/accobams-ascobans_jbwg1_recommendations.pdf

Bærum, K.M., Anker-Nilssen, T., Christensen-Dalsgaard, S., Fangel, K., Williams, T., and Vølstad, J.H. 2019. Spatial and temporal variations in seabird bycatch: Incidental bycatch in the Norwegian coastal gillnet-fishery. PLoS ONE,14:e0212786.

Bjørge, A., M. Skern-Mauritzen and M. C. Rossman (2013). "Estimated bycatch of harbour porpoise (Phocoena phocoena) in two coastal gillnet fisheries in Norway, 2006–2008. Mitigation and implications for conservation." Biological Conservation 161: 164-173

Carpentieri, P., Nastasi, A., Sessa, M. & Srour, A., eds. 2021. Incidental catch of vulnerable species in Mediterranean and Black Sea fisheries – A review. Studies and Reviews No. 101 (General Fisheries Commission for the Mediterranean). Rome, FAO. https://doi.org/10.4060/cb5405en

Clopper, C.J., and Pearson E.S. 1934. The use of confidence or fiducial limits illustrated in the case of the binomial. Biometrika 26 : 404-413.

Cosgrove R, Gosch M, Reid D, Sheridan M, Chopin N, Jessopp M, Cronin M (2016) Seal bycatch in gillnet and entangling net fisheries in Irish waters. Fisheries Research 183: 192–199

Ermolin, I., and Svolkinas, L. 2018. Assessment of the sturgeon catches and seal bycatches in an IUU fishery in the Caspian Sea. Marine Policy, 87 (September 2017), 284–290. https://doi.org/10.1016/j.marpol.2017.09.022.

European Commission. 2012. Action Plan for reducing incidental catches of seabirds in fishing gear, Brussels, 16pp.

Evans, P.G.H., Carrington, C.A., and Waggitt, J.J. (2021) Risk Mapping of Bycatch of Protected Species in Fishing Activities. Sea Watch Foundation & Bangor University, UK. European Commission Contract No. 09029901/2021/844548/ENV.D.3. 212 pages.

FAO. 2019. Monitoring the incidental catch of vulnerable species in Mediterranean and Black Sea fisheries: Methodology for data collection. FAO Fisheries and Aquaculture Technical Paper No. 640. Rome. FAO.

Galatius A., Brackmann J., Brasseur S., Diederichs B., Jeß A., Klöpper S., Körber P., Schop J., Siebert U., Teilmann J., Thøstesen B. and Schmidt B. (2020) Trilateral surveys of Harbour Seals in the Wadden Sea and Helgoland in 2020. Common Wadden Sea Secretariat, Wilhelmshaven, Germany.

Gilman E, Chaloupka M, Swimmer Y, Piovano S (2016) A cross-taxa assessment of pelagic longline by-catch mitigation measures: conflicts and mutual benefits to elasmobranchs. Fish & Fisheries 17: 748-784

Gilman E, Chaloupka M, Bach P, Fennell H, Hall M, Musyl M, Piovano S, Poisson F, Song L (2020) Effect of pelagic longline bait type on species selectivity: a global synthesis of evidence. Rev Fish Biol Fisheries 30: 535-551.

Greenstreet, S. P. R., Rossberg, A. G., Fox, C. J., Le Quesne, W. J. F., Blasdale, T., Boulcott, P., Mitchell, I., Millar, C., and Moffat, C. F. (2012). Demersal fish biodiversity: species-level indicators and trends-based targets for the Marine Strategy Framework Directive. ICES Journal of Marine Science, 69: 1789–1801.

Haelters. J. F. Kerckhof. K. Moreau. B. Rumes. Team SeaLife. T. Jauniaux & P. Cornillie. 2020. Strandingen en waarnemingen van zeezoogdieren en opmerkelijke andere soorten in België in 2019 [Strandings and sightings of marine mammals and remarkable other species in Belgium in 2019]. Koninklijk Belgisch Instituut voor Natuurwetenschappen (KBIN). Brussel. 34 pp.

ICES, 2013. Report of the Workshop to Review and Advise on Seabird Bycatch (WKBYCS). ICES CM 2013/ACOM:77. 79 pp. ICES CM 2013/ACOM:77

ICES. 2017. Report of the Workshop to compile and refine catch and landings of elasmobranchs (WKSHARK3), 20-24 February 2017, Nantes, France . ICES CM 2017/ACOM:38. 119 pp.

ICES. 2018. Report from the Working Group on Bycatch of Protected Species (WGBYC), 1–4 May 2018, Reykjavik, Iceland. ICES CM 2018/ACOM:25. 128 pp

ICES. 2019. Joint WGBYC-WGCATCH Workshop on sampling of bycatch and PET species (WKPETSAMP), 24–26 April 2018, SLU Aqua, Lysekil, Sweden, ICES CM 2018/EOSG:35. 76 pp. https://doi.org/10.17895/ices.pub.8183

ICES. 2019. Working Group on Bycatch of Protected Species (WGBYC). ICES Scientific Reports. 1:51. 163 pp. http://doi.org/10.17895/ices.pub.5563

ICES. 2020. Working Group on Bycatch of Protected Species (WGBYC). ICES Scientific Reports. 2:81. 209 pp. http://doi.org/10.17895/ices.pub.7471

ICES. 2020b. Workshop on incorporating discards into the assessments and advice of elasmobranch stocks (WKSHARK5, outputs from 2019 meeting). ICES Scientific Reports. 2:87. 94 pp. http://doi.org/10.17895/ices.pub.7494

ICES, 2021. Working Group on Marine Mammal Ecology (WGMME). ICES Scientific Reports. 3:19. 155 pp. https://doi.org/10.17895/ices.pub.8141

ICES. 2021a. Workshop on Fish of Conservation and Bycatch Relevance (WKCOFIBYC). ICES Scientific Reports. 3:57. 125 pp. https://doi.org/10.17895/ices.pub.8194

ICES. 2021b. Workshop on the Inclusion of Discard Survival in Stock Assessments (WKSURVIVE). ICES Scientific Reports. 3:41. 59 pp. https://doi.org/10.17895/ices.pub.8053

Kerametsidis, G. 2020. Interactions between small-scale fisheries and marine mammals in the Eastern Mediterranean Sea: case studies from the North-Western Levantine and the South Adriatic Sea. MSc thesis, Uppsala University, Sweden. 63 pp

Lopes, K., Passos, L., Rodrigues, J.G., et al. 2016. Sea Turtle, Shark, and Dolphin Bycatch Rates by Artisanal and Semi-Industrial Fishers in Maio Island, Cape Verde. Chelonian Conservation and Biology, 15(2): 279–288. doi: 10.2744/CB-1213.1

Marçalo, A., Carvalho, F., Frade, M., Pires, A., Alexandre, S., Bentes, L., Soares, C., Zabel, F., Rangel, M. Oliveira, F., Monteiro, P., Ressurreição, A., Erzini, K., Gonçalves, J.M.S. (2021). Redução de capturas acidentais de espécies marinhas protegidas em pescarias costeiras algarvias: inovação de procedimentos e técnicas de mitigação. Relatório técnico iNOVPESCA, Programa MAR2020, MAR-16-01-03-FMP-0020, Universidade do Algarve, CCMAR, Faro 62p + Anexos.

Mugerza, E., Zarauz, L., Andonegi, E., Mendes, H., Moreno, A., Armstrong, M., and Börjesson, P. 2017. "Strengthening Regional Cooperation of Fisheries Data Collection" WP3 – Regional sampling programmes for fisheries and ecosystem impact data not currently collected: A regional sampling plan for data collection of small-scale fisheries and recreational fisheries. fishPi project (MARE/2014/19).

Musyl M, Gilman E (2019) Meta-analysis of post-release fishing mortality in apex predatory pelagic sharks and white marlin. Fish & Fisheries 20: 466-500

Nilssen, K.T., and Bjørge, A. (2019) Status for kystsel - anbefaling av jaktkvoter 2020. Møte i Sjøpattedyrutvalget, Tromsø, 24–25 October 2020. 14 pp. (In Norwegian).

North Atlantic Marine Mammal Commission and the Norwegian Institute of Marine Research. 2019. Report of Joint IMR/NAMMCO International Workshop on the Status of Harbour Porpoises in the North Atlantic. Tromsø, Norway. ASCOBANS/AC25/Inf.4.3a Available at https://www.ascobans.org/sites/default/files/document/ascobans_ac25_inf.4.3a_joint-imr-nammco-ws-harbour-porpoise.pdf

OSPAR. 2017. Harbour Porpoise Bycatch. In: OSPAR Intermediate Assessment 2017. https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/biodiversity-status/marine-mammals/harbour-porpoise-bycatch/

SCOS (2020) Scientific Advice on Matters Related to the Management of Seal Populations. 223pp. http://www.smru.st-andrews.ac.uk/files/2021/06/SCOS-2020.pdf

Touloupaki, E., Doumpas, N., Bouziotis, D., Rae, V., Moutopoulos, D. K., & Giovos, I. 2020. Sea turtles and sharks bycatch in Greece: Fishers' and stakeholders' knowledge. Journal of the Black Sea/Mediterranean Environment, 26(1).

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Annex 2: Next meeting´s Draft Resolution

a) Review and summarize information submitted through the annual data call and other means, and data assembled by other ICES WGs to describe and evaluate the quality of current monitoring efforts for the collection of protected species bycatch;

b) Collate and review information from WGFTB national reports, other ICES WGs and recent published documents relating to implementation of protected species bycatch mitigation measures and summarize recent and ongoing bycatch mitigation trials;

c) Collate and use available data on protected species bycatch rates to direct and underpin assessments on the range of (minimum/maximum) impacts of bycatch on affected populations, and where possible, to identify likely conservation level threats.

d) Review ongoing monitoring of different taxonomic groups in relation to spatial bycatch risk and fishing effort, to inform coordinated sampling plans;

e) Coordinate with other ICES WGs to ensure complete compilation of data on protected species bycatch from multiple sources and to develop and improve on methods for bycatch monitoring, research and assessment;

f) Continue, in cooperation with the ICES Data Centre to develop, improve, populate and maintain the WGBYC database on bycatch monitoring and fishing effort in ICES and Mediterranean waters through a formal data call (Intersessional).

Annex 3: Recommendations

Recommendation	Recipient	Has this recommendation been communicated to the recipient?
WGCATCH and RCGs to review and contribute to improving the risk-based approach for informing coordinated sampling plans developed by WGBYC in 2020 and expanded at WGBYC 2021.	WGCATCH, RCGs	Yes
WGMME and WGBYC to discuss intersessionally the possibility of developing a shared data call and database for the annual acquisition and storage of international strandings data from national databases.	WGMME	No
WGMME and WGBYC to work towards an agreed reporting approach for strandings related bycatch data to avoid duplication between WG reports	WGMME	No

Annex 4: NEAFC Special Request for advice to ICES

NEAFC needs information regarding bird bycatch in the NEAFC regulatory area in order to address the calls and commitments set out on bird bycatch under the UNGA fisheries resolutions. According to anecdotal information bird bycatch is considered low in the fisheries conducted in the NEAFC regulatory area.

NEAFC requests ICES to compile and aggregate available data on bird bycatch in the NEAFC regulatory area,

i.e. spatially and temporally distributed, as well as per gear.

ICES is requested to advise upon what is necessary in order to provide recurrent advice on bird bycatch as well.

ICES may provide advice on other aspects of the request it deems necessary.

(ICES comments to the request)

This request would contain the following steps:

ICES interpret the request to contain 1 point:

a) Compile and aggregate available data on bird bycatch, spatially and temporally by fishery in general

ICES would need access to detailed data not currently provided which do imply a long timeline to respond to the request. ICES would need:

1. Data on total fishing effort from VMS and logbook data for all gears
2. Data on bycatch incidents would need to be by haul (i.e. higher detail than the current supplied data);

Data for point 1) can be delivered through a new ICES data call, data for point 2) will depend on available observers/self-sampled data; ICES can set up a data call for this. The current data available, (i.e. aggregating data over several hauls) would most likely not be sufficient to provide a robust advice.

NEAFC need to specify the temporal coverage of the request (i.e. number of years/the period). ICES refers to the Bycatch roadmap (link) in terms of process.

Annex 5: Reviewers' reports

Sheryl Hamilton, University of Tasmania, Australia

Review WGBYC 2021 report (ToR a, b, c, d and f)

General comments:

- The report provides a useful and important summary and assessment of bycatch. In summary, I conclude that the WG has answered the ToRs relevant to providing advice and the main conclusions are in accordance with the WG report.
- There are numerous acronyms used throughout the document and, often, these are not written in full when first referred to, e.g. VMS, AIS, PTM. It would be handy to have a summary list of acronyms and what they mean somewhere in the document.
- I have not undertaken word/text editing of the report. I feel that it is much easier to read than last year's report but would still benefit from a good general edit.
- Please ensure all species have the scientific name plus common name for first time they are mentioned.
- It appears that electronic monitoring is a much stronger feature both in the reporting and in some of the research summarised. In Australia, EM is also being utilised in a much greater capacity to improve monitoring of fisheries. It is important that EM programs are correctly implemented and assessed, including calibration with previous data methods (onboard observer data) and adequate assessment of the EM footage.

ToR a, Review and summarise data submitted

section 3.3.

A sentence at the start to list the MS that have not submitted data would be helpful.

It's a shame there is not the detail to be able to provide separate information on cetacean bycatch according to ADD functionality and/or presence/absence- there is variable evidence that ADD are effective in reducing cetacean interactions and mortality.

In the western Mediterranean data reported was highlighted for this ecoregion; fewer fishing days at sea were reported when compared to monitored days at sea for the longline métier. For the Adriatic Sea no fishing days at sea were reported for the longline metier, despite the reporting of monitored days at sea. Have these discrepancies been resolved?

The inclusion of logbook data in data submitted to WGBYC has resulted in very high observed effort days for a number of fisheries in the Baltic Seas ecoregion (Table 3.2a and 3.2b) and in some cases these logbook data were reported with no associated value for observed days at sea. I'm not sure I understand this. The logbook data showed very high OBSERVED effort days but, in some cases, this is not reflected in the reported "observed days at sea". Is this discrepancy clearly shown in the reporting tables?

Section 3.4.

It would be good to include literature citations where relevant.

Isn't there a publication to cite when referring to "Moreover, it's argued to investigate the limitation of the haul duration under a threshold (5 hours) as a mitigation strategy, especially in winter"?

Another study conducted by Observatoire Pelagis aimed at having a better understanding of the factors influencing common dolphin bycatch in Bay of Biscay nets. Can the wording be clearer that this work is on gillnets (assuming it is given the reference to gillnets in final sentence). Or is it all net types?

In France 31 common dolphins were observed bycaught in midwater pair trawlers operating in the Bay of Biscay. Is it possible to comment on the effectiveness (or lack of effectiveness?) of DDD-03H on trawlers to mitigate small cetacean bycatch since all trawlers had these devices deployed?

Section 3.8. Conclusions.

It is an important point that WGBYC continues to have insufficient data to provide bycatch rates according to pinger functionality and/or presence/absence in relevant métiers.

For many areas and métiers, there is insufficient monitored effort to enable any assessment of the over-all impact of fisheries on most protected species. This is a concerning and critical point. What can be done to improve this?

Table 3.1. It would be good to have this table include all relevant countries, including those that did not provide data.

Table 3.2a. Some of the monitoring coverage is very low. Where % coverage is very high, I assume it is due to Electronic Monitoring, although this is only useful if EM is well scrutinised.

ToR b, Implementation of protected species bycatch mitigation measures

In the summary for Canada it should be specified that it is a Northern right whale what WGBYC is referring to.

Section 4.3. Conclusions.

I agree that collecting knowledge on mitigation projects through the National report of WGFTFB is very useful and a great addition.

Thus, there might be studies conducted with other institutes who are conducting relevant bycatch mitigation studies but which are not reported to WGFTFB. WGBYC could add; Hamilton, S. & Baker, G.B. 2019. Technical mitigation to reduce marine mammal bycatch and entanglement in commercial fishing gear: lessons learnt and future directions. Reviews in Fish Biology and Fisheries, 29: 223–247.

ToR c. Evaluate the range of (minimum/maximum) impacts of bycatch on protected species populations

A note and comment on 'cryptic' mortality could be added to all sections here (i.e. turtles, marine mammals). E.g. “Note that a level of cryptic (undetected, unaccounted) bycatch mortality is also likely to occur for many fishing gear types”

ToR d. Review ongoing monitoring of different taxonomic groups in relation to spatial bycatch risk and fishing effort

Section 6.5. Conclusions

I think the two, combined approaches are useful and good to determine metier-area combinations that stand out as suitable candidate areas for increased monitoring effort with respect to PETs bycatch quantification.

Agree that Table 6.1 should be expanded to include all fishPi metiers regardless of whether monitoring occurred in a particular year or not, to provide a more comprehensive view of monitoring coverage.

Table 6.1 could be based on both mean of multiple years fishing and monitoring effort as well as presenting individual years.

ToR f. NEAFC special request on bird bycatch

Agree that because of all the data gaps in the data, it does not make sense to indicate the extent of the reported but incomplete monitoring.

Marian Paiu, Mare nostrum, Romania
Review WGBYC 2021 report (ToR a, b, c, d and f)

ToR c. Evaluate the range of (minimum/maximum) impacts of bycatch on protected species populations

WGBYC could use the CeNoBs project deliverable 2.3 to provide information on Black Sea area https://cenobs.eu/content/deliverables Also I was attaching a document that will be presented to the ACCOBAMS Scientific Committee this month from which you could draw information. And also Popov et al., 2020 Pingers as Cetacean Bycatch Mitigation Measure in Bulgarian Turbot Fishery.

ToR a, Review and summarise data submitted

Implementing Regulation (EU) 2020/967 mandates that ADDs be functional during the whole duration of the fishing operation, not only at the moment when nets are set. However, it is not clear why it should be used during all the fishing operation since most of them are triggered by water contact.

As additional information, in 2019 and 2020 under the CeNoBS project a bycatch pilort study was performed in Black Sea, covering Turkey, Bulgaria, Romania and Ukraine with questionaires and Bulgaria and Romania with observers on board. https://cenobs.eu/sites/default/files/Deliverable_2.3_Detailed_Report_of_the_pilot(s)_on_bycatch_monitoring.pdf Also in Bulgaria there was a paralele study including testing of pingers.

As additional information related to "other monitoring programs", the CeNoBS project under DG Environment MSFD call. In 2014 Birkun and collegues were assessing the bycatch in Black Sea.

Conclusions section

It is said that bycatch of marine mammals was observed in all but two ecoregions. Can it be mentioned which two ecoregions? if Black Sea is one is due to not contacting the right stakeholder most probably since CeNoBS was rolling a pilot study on bycatch during 2019-2020.

One of the conclusions notes "The use of strandings data highlighted lethal interactions between 11 species and fishing gears (9 cetacean species and 2 seal species) recorded by 10 countries. In certain areas when corrected by physical parameters such as drift conditions, strandings can provide bycatch estimates. However, in all cases, these data constitute an overview of an often scarcely observed process that should be encouraged." Including other sources of information would be most expected since at national level are missing.

ToR b, Implementation of protected species bycatch mitigation measures

It is said that in 2020 nine national reports were received. Something should be done with the rate of response. And Black Sea should be covered also.

As additional information in 2019-2021 in Bulgaria there were tested two types of pingers: future ocean pinger and PAL.

Nuno Oliveira

Summary

WGBYC2021 is a great piece of work. Overall the report is very concise and informative. A very good state of the art was developed for all PETS groups, and is worth no noted an increase in effort to delivery deeper analysis and insights for other than mammal species, namely seabirds and marine turtles. Regarding mitigation measures implementation, also a great improvement was done when compared to WGBYC2020, at least regarding to marine mammals and fish species. More information on mitigation measures for other PETS might be available and is worth to include in a future report, namely for seabirds but also for marine turtles. Risk-based approaches are valuable tools to identify bycatch hotspots and then priority areas for intervention. However, major concerns are related with the source of fisheries spatial data. VMS and AIS are mandatory in EU waters only for >15m vessels, although small-scale fleets contribute for an important amount of PETS bycatch.

Update on mitigation work by French industry (Thomas Rimaud (Producer Organization Les Pêcheurs de Bretagne) and Aurélien HENNEVEUX (Producer Organization Pêcheurs d'Aquitaine) France).

Only a small comment/question on this presentation and non-ToR related plenary discussion, what "tagged carcasses stranding rate of 53%; 12%; 45% and 15%" means/was estimated? Perhaps as the ratio between number of tagged carcacasses founded ashore and total number of tagged carcasses, or as the ratio between the number of tagged carcasses found ashore and the total number of carcasses found?

ToR A: Review and summarize data submitted through the annual data call and other means, and other data assembled by ICES WGs to collate pro-tected species bycatch rates and mortality esti-mates in EU waters (ToR A)

Like in the past year, WGBYC did a great job summarizing the information delivered by MS. But some attention must be paid to those MS who keep non-delivering data on bycatch rates, namely for those regions where data is absent at all. Missing information is present for black sea, oceanic northeast atlantic, Faroes, Greenland Sea, Barents Sea and Artic Ocean.

At the section 3.3, on the text for Bay of Biscay, please refer to this region as "The Bay of Biscay and the Iberian Coast". Remove "27." from the ICES code areas to keep coherence along the text. Number of observed days are given as decimals, is this right?

At the same section, for Baltic Sea a high number of birds are reported to be caught in traps, this is quite interesting and should be somehow highlighted. Generally traps are assumed to be "seabird friendly".

The second paragraph of the text for Norwegian sea is hard to understand. Please explain better the major concern about logbook data or the recording of fishing effort by a vessel-crew-observer. Are not all logbooks filled by vessel-crew-observers?

At the section 3.5, OBSCAMe in France are recording birds as well, or this REM program is (or planning to be) including other PET species (e.g. seabirds)?

Azti institute is carrying out the MITICET project. They refer to Electronic Monitoring System. I'm wondering if this is different of REM? If not, will enhance coherence by refer as REM. It might be also tracking system to record spatial and/or catch data from fishing operation, please clarify. Also this project aims to cover a 2% of the total number of trips in each stratum, as referred to be the minimum level recommended by FAO for on-board sampling of vulnerable species. However, ACAP (ACAP 2019. Data collection guidelines for observer programmes to improve knowledge of fishery impacts on ACAP-listed species) refer the level of observer coverage should ideally be 20% of the fishing effort, and at 5% bycatch estimates will remain highly imprecise for low occurrence species and would be inadequate to document the frequency of particular species' interactions with fishing gear. Although also seabird related, either European Commission recommend a minimum 10% observer coverage in the short term to accurately estimate bycatch (European Commission, 2012).

In the UK an EM system have been deployed on inshore netters. It is not clear if this EM system is the self-reporting app, or another method to validate skipper self-reporting. In case a kind of camera/cctv, please refer as REM to enhance coherence.

In the paragraph related with Aegean and the Ionian Sea, the Layman's Report LIFE07 NAT/GR/000285 is given as a reference, perhaps a full reference or a link for this publication is desirable.

Regarding the table 3.1, could the list include all 27 countries issued by data call rather than only the 22 which provided data in this last call?

Table 3.3a might be sorted by Métier3 followed by AreaCode to ease reading and searching!

Table 3.4a refers to 2020, is this right or should it be 2019? The same for table 3.4b, which is referred to 2021.

ToR B: Mitigation

A great improvement was done when compared to WGBYC2020, at least regarding to marine mammals and fish species. More information on mitigation measures for other PETS might be available and is worth to include in a future report, namely for seabirds but also for marine turtles. There is some overlap between sections 4.1 and 4.2. Some of the studies stated first are still running and others stated in the section 4.2 already presented some results. Perhaps all studies not finished by the end of 2020 should be included in this section? It is worth to review in order to avoid duplication and misunderstanding.

Portugal ran the project "MedAves Pesca" (led by SPEA) from 2018-2020 where about 2 mitigations measures were tested in order to reduce seabird bycatch. A scary bird device was used in small longliners and a medium size gill netter. Also LED lights were tested in small size GNS. Scary bird showed promissory results while LED lights were inconclusive. Technical factsheets were produced and made available at https://www.medavespesca.pt/solucoes.html (only PT though). Also a full report (PT) is available at https://www.medavespesca.pt/uploads/7/0/6/1/70619115/relatorio_medaves_final.pdf.

Perhaps add to table 4.1 this one (https://www.cambridge.org/core/journals/bird-conservation-international/article/abs/contribution-to-reducing-bycatch-in-a-high-priority-area-for-seabird-conservation-in-portugal/5966ED13D8D87669845413B94ED31190).

An example of ongoing project worth to add to section 4.2 is the Life project PanPuffinus. This project started in 2020 to 2025 and aims to test mitigation measures to reduce seabird bycatch in Malta, Greece, France, Spain and Portugal, mainly targeting Balearic and Yelkouan shearwaters. More information at https://birdlifemalta.org/conservation/current-projects/life-panpuffinus/.

ToR C:

In Fig. 6.2 is metier LTL well coded for the Bay of Biscay and the Iberian Coast? According to the table 6.2 perhaps should be LLS, which may make more sense.

In the table 6.2, Is this extrapolated mortality given for a certain year, or for the entire 4-years period?

In the section 1.2, it is stated that there is a recent abundance estimate (uncorrected for availability bias) for the Mediterranean Sea of 310-360,000 loggerhead turtles (ACCOBAMS 2021). Is this figure correct? It looks a huge CV.

In the section 1.4, there are missing dates for the WKMOMA workshop to address a special request from OSPAR took.

ToR D:

Risk-based approaches are valuable tools to identify bycatch hotspots and then priority areas for intervention. The 2 presented approaches are good examples of such analysis. However, in both cases an important assumption that might be highlighted is that AIS or VMS data is roughly only available for >15m vessels. Also, it would be desirable to explore the accuracy of VMS/AIS data to identify fishing grounds. One limitation with this kind of systems is the possibility to be turned off by the crew members, even if awarded on their obligation. A simple exercise to assess this source of bias might include the visual analysis of a random number of complete trips to identify possible gaps in the daily tracks.

Regarding table 6.2, I wouldn't say a gannet has a medium risk to be caught in a pot or trap, and a Shag to be of high risk, not when compared with other metiérs.

In the paragraph "Fishing effort measures by metier" of the "points to note" in section 6.4, a first point which might be noted is that both studies are not including small-scale vessels in their analysis, which comprehends an important part of EU fishing fleet with a high risk of bycatch, at least in certain ICES divisions. Small-scale vessels operate very close to the shore where high concentrations of seabirds and also marine mammals occur.

Also, as far as I am aware, there is an exception in the EU regulation for 12-15m vessels, allowing fishermen not using electronic devices (VMS, AIS or electronic logbook), and catch and then fishing effort may be recorded in paper forms.

In the "Protected, endangered and threatened species considered:" after crossing the list of seabirds under analysis with the list presented at the table 3.2a, other species might also worth to be included: velvet scoter, common merganser, mallard, yellow-legged gull and great crested grebe.

At the section 6.5, it would be highly recommended to expand this very informative analysis to small-scale fisheries, perhaps using other sources of fishing effort data (landings or logbooks) or as soon as the EU regulation, to all vessels (independently of their size) use an electronic system to record and report fishing effort, be in place.

ToR F:

NEAFC special request is a good example where risk-based approaches might be very useful as a first step to identify areas where bycatch might occur.