WORKING GROUP ON BYCATCH OF PROTECTED SPECIES (WGBYC)

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Contents

i Executive summary

WGBYC planned to address seven Terms of Reference, one of which was a special request from the European Commission on emergency bycatch mitigation measures for common dolphin in the Bay of Biscay and harbour porpoise in the Baltic Sea (ToR G). ToR G demanded a great deal of resources from WGBYC and, coupled with the COVID–19 disruption where WGBYC work had to be carried out remotely, this meant it was not possible to complete all tasks. The 2020 report is structured in the same order as the ToRs. Note that ToR E was not addressed while ToR G is reported in WKEMBYC (2020).

All data submissions were requested via a formal WGBYC/ICES data call (Annex 6: below). The data call requested data on fishing effort, monitoring effort and PETS (protected, endangered, and threatened species of marine mammals, seabirds, reptiles, and fish) bycatch incidents in 2018. 19 of the 24 countries that contacted (18 ICES countries and 6 Mediterranean non-ICES countries) responded. WGBYC did not accept data brought to the meeting, but where problems were found during assessments with country submissions, updated versions were accepted.

The quality and scope of Member States (MS) reports on the implementation of Regulation 812/2004 (cetacean bycatch) during 2018 remain varied (ToR A). Most countries have relied on monitoring through their DCF sampling programmes rather than implementing dedicated observer programmes. This means that *métiers* that pose the greatest risk of cetacean bycatch are generally under-sampled and bycatch is underestimated. Regulation 812/2004 was repealed and replaced in June 2019 by the Technical Conservation Measures Regulation (Regulation (EU) 2019/1241) and PETS bycatch monitoring is further implemented through the EU-MAP (Regulation (EU) 2017/1004).

For 2018, data received through the WGBYC data call amounted to 82 cetaceans (5 species); 175 seals (4 species), 696 birds (at least 22 species); 37 644 elasmobranchs (at least 49 species); 2061 teleost fish (9 species) and 134 turtles (at least 2 species). Equivalent data from non-EU countries was also received from the USA and Iceland. Bycatch of marine mammals was observed in all ecoregions and several gears including gillnets, traps, longlines, and trawls. Seabirds were bycaught in most ecoregions, mainly in nets and longlines. In 2018, bycaught marine turtles were recorded mostly in set nets and trawls in the Mediterranean and in longlines in the Azores. High bycatch rates were observed for some elasmobranch species which are of conservation concern, particularly in trawl gears in the Celtic Sea, the Greater North Sea and Western Mediterranean, and nets in the Celtic Sea. In the US Northwest Atlantic, the gear of most concern are set nets for marine mammals and sea turtles. The gears of most concern in Iceland are set nets (birds and marine mammals) and longlines (birds). Eight countries also contributed numbers of bycaught stranded cetaceans. Bycatch was the predominant cause of death of common dolphins stranded in the Bay of Biscay and Channel.

Member states compliance with the ‘pinger’ requirements of Regulation 812/2004 is difficult to gauge from the submitted reports due to reporting inconsistencies and incomplete information (ToR B). Only the United Kingdom appears to comply fully, reporting that all relevant vessels are equipped with “DDD” pingers used under a derogation and there is active enforcement in place. But in general, there has been little progress in the mitigation of cetacean bycatch and the effectiveness of pingers appears to vary among fishing *métiers* and geographical areas. WGBYC continues to have insufficient data to examine bycatch rates according to pinger use within their database.

Under ToR C, different bycatch unit of effort metrics were examined. Bycatch rates calculated by km/hr (rather than per haul, for example) provide the most insightful outputs and may alter our

interpretation of broad-scale patterns of bycatch and consequently where mitigation attempts might be best targeted. Further analysis is required to test the suitability of different effort metrics to complex statistical analysis, and their effects on assessments of total bycatch mortality. When fitting uncertainty around bycatch rate estimates, the Poisson or the negative binomial distributions tended to fit the tested datasets better than the binomial distribution that tended to be used in the past.

An assessment of bycatch for common dolphins was evaluated in the Celtic Seas Ecoregion and the Bay of Biscay and Iberian coast Ecoregion (ToR C/ToR G). In the Celtic Seas, the mean annual bycatch in 2016–2018 across all *métiers* ranged from 278–1345 dolphins, with bottom otter trawls (OTB) and gillnets (GNS) targeting demersal fish accounting for the largest bycatch. In the Bay of Biscay and Iberian Peninsula, the mean annual bycatch for 2016–2018 across all *métiers* ranged from 1998–6599 dolphins, with trammel nets (GTR) for demersal fish accounting for the largest bycatch. The mortality inferred from French common dolphin strandings in 2017 and 2018 in the Bay of Biscay and the Western Channel was estimated to be between 5800–17 900 and 3400–10 500 individuals, respectively. The bycatch estimates from strandings and the at-sea monitoring data collectively suggest that common dolphin bycatch likely exceeds the upper limits of "sustainable" anthropogenic removals, defined using a Potential Biological Removal threshold (proposed by WGMME (ICES 2020)) of 4927 common dolphins per year.

For the Baltic harbour porpoise (ToR C/ToR G), examination of bycatch rates of harbour porpoise generated from the WGBYC database (2005–2018) in all regions was carried out to identify high-risk *métiers*, given the lack of data for the Baltic proper. In the North Sea and Celtic Sea the highest bycatch rates occurred in gillnet or trammel nets. In the Bay of Biscay, the highest bycatch rate occurred in pelagic trawls but it is likely that gillnets would pose the greatest threat in terms of total harbour porpoise mortality due to the fleets' size.

Observed effort was too low to obtain robust bycatch estimates for seabirds for most areas (ToR C). For robust 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. Longer time-series of data would also allow more robust estimates for seabirds (and other taxa) and the ability to generate stratified bycatch estimates at finer temporal resolutions is important. This cannot be achieved currently with WGBYC data

This year the WGBYC data call requested raised monitoring data, primarily for elasmobranchs (ToR C). Bottom trawls had the most bycaught elasmobranch species and bycatch rates were highest, in general, in the Greater North Sea, Western Mediterranean Sea, and Barents Sea ecoregions. *Dipturus batis* and *Squalus acanthias* were, among the species of high conservation concern, the most captured species. WGBYC needs to continue coordination with other expert groups to better understand the raising factors used to ensure correct interpretation of elasmobranch bycatch data.

To better understand the distribution of monitoring and fishing effort, WGBYC mapped the 2018 data received through the data call. Additionally, monitoring effort was summarised by *métiers* against a "PETS bycatch risk index" (obtained from the fishPi project) (ToR C). A clear inverse relationship was demonstrated between the bycatch risk index and amount of monitoring effort. Considering that Member States are obliged to monitor protected species bycatch, the Regional Coordination Groups (RCGs) will need to consider increasing monitoring effort to static gears which have high bycatch risk.

WGBYC conducted a comparative analysis of the 2018 and 2017 fishing effort data contained within the WGBYC database with equivalent data from the ICES Regional Database (RDB). This work highlighted discrepancies with the quantity of fishing effort data submitted to each. In general, there was a lot of variability when comparing fishing effort in the two databases between countries, but more consistency between years for each country and database. Some of these inconsistencies might be explained by gear type definitions for the different submissions and/or national effort recording systems prior to submission. When the new Regional Database Estimations System (RDBES) becomes operational (2022), WGBYC will carry out complete comparisons of fishing effort, monitoring effort, and bycatch before any decisions on full transition to RDBES as a sole data source. Until then, WGBYC will continue to issue a formal data call to obtain fishing effort, monitoring effort, and bycatch data to form the basis of its bycatch assessments. WGBYC expressed concern that moving to the RDBES as their data source would mean that bycatch data from General Fisheries Commission for the Mediterranean (GFCM) areas would be lost since many Mediterranean countries are not ICES members; ICES needs to work with the GFCM to assist with this.

WGBYC has collaborated with the ICES Working Group on Commercial Catches (WGCATCH) on multiple tasks this year, including creation of species sampling lists to support at-sea PETS bycatch data-collection, collation of information on the sampling methods and the stages in the fishing process that are monitored for PETS, and participated in the WGCATCH PETS subgroup. Additionally, WGBYC reviewed case study proposals as part of RCG PETs subgroup work to develop regionally coordinated sampling plans. The group continues to work with other expert groups that also have an interest in bycatch (e.g. the ICES Working Group on Marine Mammal Ecology–WGMME) and encourages participants to share information on relevant initiatives, such as the Baltic Marine Environment Protection Commission (HELCOM) Roadmap on Fisheries Data. Importantly, WGBYC contributed to early drafts of the Roadmap for ICES bycatch advice on protected, endangered and threatened species which has now been published.

ii Expert group information

Expert group name	Working Group on Bycatch of Protected Species (WGBYC)
Expert group cycle	Annual
Year cycle started	2019
Reporting year in cycle	1/1
Chairs	Sara Königson, Sweden
	Kelly Macleod, United Kingdom
Meeting venue and dates	10–13 March 2020, Den Helder, The Netherlands (27 participants)

1 ToR A

Review and summarize annual national reports submitted to the European Commission under Regulation 812/2004 and other published documents and collated bycatch rates and estimates in EU waters

1.1 EU legislation concerning the bycatch of protected, endangered, and threatened species (PETS)

The work of WGBYC is primarily driven by the requirements of Council Regulation (EC) No. 812/2004 of 26 April 2004 laying down measures concerning incidental catches of cetaceans in fisheries (hereafter referred to as Reg.812/2004). The Regulation has two components: Articles 1–3 concerning the use of Acoustic Deterrent Devices (ADDs or 'pingers') on vessels of 12 m or over in métiers identified in Annex I; and Articles 4 and 5 concerning monitoring of 'incidental catches of cetaceans using observers on board the vessels flying their flag and with an overall length of 15 m or over, for the fisheries and under the conditions defined in Annex III'. Member States (MS) are obliged to establish Pilot or Scientific Studies on smaller vessels operating in the same broad métiers. MS are also required to report annually on their monitoring effort, fishing effort, number of incidental catches of cetaceans, and the use of pingers to the European Commission (EC).

The annual review of these reports is central to the work of WGBYC. WGBYC has repeatedly highlighted the shortcomings of this Regulation (primarily, it does not necessarily target all métiers with the highest bycatch rates) and also the lack of compliance from MS with regards to pinger implementation and reporting.

Data collected under Regulation 812/2004 are submitted to WGBYC through their annual data call, but also through Reg.812/2004 reports. These data are most commonly linked to at-sea observations carried out for fisheries monitoring following the EU Data Collection Framework Regulation 2017/1004 (DCF)[1]. The DCF aims to "*establish rules on the collection, management and use of biological, environmental, technical and socio-economic data concerning the fisheries sector*" and contribute "*towards reaching the objectives of the common fisheries policy, which include the protection of the marine environment, the sustainable management of all commercially exploited species, and in particular the achievement of good environmental status in the marine environment*" under the Marine Strategy Framework Directive (MSFD). In Article 4, it states that it "*shall establish a multiannual Union programme for the collection and management of data*". Article 4 is realised through Implementing Decisions (e.g. (EU) 2016/1251 of 12 July 2016). The implementing decision states that data collected should include '*incidental bycatch of all birds, mammals and reptiles and fish protected under Union legislation and international agreements, including the species listed in Table 1D, and if the species is absent in the catch during scientific observer trips on fishing vessels or by the fishers themselves through logbooks*'. Table 1D lists '*Species to be monitored under protection programmes in the Union or under international obligations*'. 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 observers not dedicated to monitoring protected species bycatch events may lead to downward bias in the number of recorded events (see: ICES 2015).

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

The draft implementing 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 (Technical Conservation Measures Regulation) came into force in June 2019, repealing Regulation 812/2004. The main elements of the Regulation are:

1. Measures to monitor, manage and mitigate bycatches of sensitive species (including but not limited to cetaceans, birds, and turtles) are subject to regionalised management where Member States should prepare Joint Recommendations to the European Commission who will, subject to scientific and technical validation, propose the measures for adoption into EU law. Member States are required to take the necessary steps to collect data on the relevant species.
2. The objectives of the new Regulation include that incidental catches of sensitive marine species are minimised, and where possible eliminated, such that they do not represent a threat to the conservation status of these species; to minimise negative environmental impacts of fishing on marine habitats and to put in place management measures for the purposes of complying with the Habitats, Birds, Water Framework and Marine Strategy Framework Directives. The new technical measures should ensure that bycatches of marine mammals, marine reptiles, seabirds, and other non-commercially exploited species do not exceed levels in Union legislation and international agreements.
3. Provisions existing in Regulation 812/2004 concerning vessel sizes, areas and fishing gears where pingers are required or where monitoring of bycatches is mandatory are retained. The technical specification of the pingers to be used has not been carried over.
4. The European Commission is to prepare triennial reports (the first of which is due in 2020) for presentation to Parliament and Council.

The measures contained in the draft implementing regulation were presented to the Committee in October 2019 for further discussion and review. The main elements under consideration can be summarised as follows:

i. Description of the same pinger features as in Regulation 812/2004, in terms of technicalities,
ii. Also in line with repealed Regulation 812/2004, to allow Member States to use alternate devices, of acoustic deterrent devices not in conformity with the technical specifications laid down in the proposed Regulation, provided there is evidence that such devices are at least as effective.
iii. Specific provision that makes mandatory that the acoustic deterrent devices need to be functional during the whole duration of the fishing operation, not only at the moment when nets are set.

In discussion, it was brought forward that the existing minimum vessel length overall where use of pingers is obligatory (12 m) and where monitoring of bycatches is required (15 m) are inappropriate as many bycatches are made from smaller vessels. However, it is acknowledged that the requirements for monitoring sensitive species bycatch are now incorporated into the EU-MAP, where there are no vessel size restrictions.

There are many monitoring obligations and measures required 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'). Article 12 states '*Member States shall establish a system to monitor the incidental capture and killing of the animal species listed in Annex IV (a). In the light of the information gathered, Member States shall take further research or conservation measures as required to ensure that incidental capture and killing does not have a significant negative*

[2]https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A31992L0043

impact on the species concerned.' 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 —The mortality rate per species from incidental bycatch is below levels which threaten the species, such that its long-term viability is ensured*. 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.

1.2 Monitoring under (EC) Regulation 812/2004–Overview

The WG was provided with MS annual reports to the European Commission on at-sea observations carried out under Reg. 812/2004 in 2017. Six of the 23 EU MS were not affected by any part of Reg. 812/2004 (hereafter in this section termed "the Regulation") in 2018 (Bulgaria, Croatia, Cyprus, Greece, Malta, Romania) because their vessels do not fish in areas covered by the Regulation (Table 1). Two MS that are affected by the Regulation, but which did not submit reports to the EC, were Lithuania and Spain (Table 1). Reports were received from the remaining 15 of the 17 MS affected by Articles 4–5 of the Regulation. The reports from Belgium, Denmark, Estonia, France, Finland, Germany, Italy, Ireland, Latvia, Poland, Portugal, Slovenia, Sweden and the UK were obtained via the EC. The report from The Netherlands was submitted directly to WGBYC. Section 1.3 summarises text extracted directly from individual MS reports.

The quality and scope of the information provided in the annual reports continues to be variable. Consistent with the annual content of WGBYC reports from previous years, the Regulation reports have been reviewed for:

1. Implementation of mandatory monitoring of cetacean bycatch, and information on voluntary mitigation and observation schemes (see ToR B for mitigation);
2. Information on cetacean bycatch (including records of individual bycatch events and bycatch estimates, and magnitude of observer coverage provided by MS);
3. Information on bycatch of non-cetacean taxa;
4. Other relevant issues emanating from the annual reports.

1.3 Monitoring reported under (EC) Regulation 812/2004 by Member States and to the ICES WGBYC data call (including non-cetacean bycatch events when provided)

In **Belgium**, no specific observer scheme was in place in 2018 to monitor bycatch of marine mammals. Fishing trips were only observed onboard vessels with towed gear to fulfil other monitoring requirements. No bycatch of marine mammals was observed during these fishing operations. Due to the small number of vessels affected by the Regulation, Belgium states that commercial fishing practices in the country have a limited impact on the marine mammal populations.

Denmark reported that in 2018, no specific monitoring programs for incidental catch of marine mammals took place in the Danish pelagic trawl fishery. The reason for not continuing previous monitoring programmes from 2006–2008 was that the observer schemes, with a coverage of up to 7%, had no records of incidental bycatch of cetaceans. A much higher coverage would be

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

needed to detect any bycaught cetaceans and other marine mammals in the Danish pelagic trawl fishery but this was also considered to be a very expensive task compared to the likely outcome. Also, no dedicated monitoring according to the Regulation No. 812/2004 took place in the Danish gillnet fishery. Instead, observer data on incidental catches of marine mammal in gillnets was collected under the national Data Collection Regulation scheme (DCR). As the DCR program's main purpose is to monitor discards of fish, the observer coverage of gillnet vessels was in general very low, except in Subarea 27.4. Gillnetters usually have a low discard and therefore observer hours to monitor these fisheries have not been prioritised. However, video monitoring onboard gillnet vessels was continued in 2018 by DTU Aqua (Technical University of Denmark) on board 8 vessels, all less than 15 meters of length. The data from 2018 had not yet been analysed at the time of writing the 2018 report and DTU Aqua are working on a consolidated analysis of all REM data from 2010–2019.

Finland reported that during the last ten years, no harbour porpoises were observed by authorities as bycatch or otherwise. As a result, no observer programme has been in place. Furthermore, it is stated that the Finnish National Fisheries Act obliges all vessels, regardless of size to report in their logbooks cetacean bycatch. Authorities have not received any reports of bycaught harbour porpoises or other cetaceans in commercial fisheries in Finland. It is also reported that private citizens are encouraged to report sightings of cetaceans and that, annually, 3–12 unconfirmed harbour porpoise sightings have been reported.

In **France**, the programme Obsmer manages all the observations at sea required by various fishery regulations. The sampling carried out during 2018 covered 867 fishing trips equivalent to 1991 days at sea. For towed gears in subareas 7 and 8 and in the Mediterranean, the sampling covered 206 fishing trips (115 in the Mediterranean and 91 in subareas 7 and 8), representing 254 days at sea. For passive gear in ICES subarea 8, the sampling covered 274 fishing trips, representing 321 days at sea. In addition, for set nets, there were 176 fishing trips, representing 180 days at sea, in the areas covered by pingers (subareas 4 and 7). Incidental catches of cetaceans across all the samples taken at sea during 2018 total 22 individuals: 20 common dolphins *(Delphinus delphis)* and 2 harbour porpoises *(Phocoena phocoena).*

Germany monitored bycatch under the DCF observer programme for the 2018 reporting period. Fishing effort was only recorded for vessels >8 m (Baltic Sea) and >10 m in overall length (North Sea and North Atlantic), since data on the fishing gear and mesh sizes used are unavailable for smaller vessels. The sampling intensity required under the Regulation 812/2004 was not possible in some fleet segments for technical reasons or owing to a lack of capacity in the sampling programme tailored to the requirements of the EU fisheries data collection programme. Sampling effort in pelagic trawls in subareas 6, 7 and 8 was 22 out of a total fishing effort of 237 days (9.3%). Effort sampled in bottom-set gillnet or entangling nets using mesh sizes ≥80 mm in ICES divisions 3b,c,d was 8 days out of a total fishing effort of 7573 days (0.1%). There was no sampling in static nets ≥80 mm in divisions 6a, 7a,b, 8a,b,c and 9a (total fishing effort 189 days) and pelagic trawls in divisions 3 a, b, c, d, 4, 9 (total fishing effort of 1067 days). No bycatches of marine mammals were observed during sampling.

Greece does not submit a Reg. 812/2004 annual report to the EC, due to no fishing activity of Greek vessels under the conditions defined in the Annexes of the Regulation. However, since 2017, Greece has been collecting data on the effects of fisheries on the Incidental Bycatch of Protected, Endangered and Threatened species (PETS) under the premises of the Commission Implementing Decision (EU) 2016/1251 within the Data Collection Framework. A preliminary list of PETS was established based on the results of the pilot study for monitoring of PET species carried out by FRI (Fisheries Research Institute, Kavala) in 2017 that covered the main métiers of the Greek fleet (GTR, GNS, OTB, PS, FPO, PS, SB, LLS, LLD related métiers); the list includes 33 birds, 7 mammals, 3 turtles, 29 elasmobranches fish, 1 agnathan fish, 14 bony fish, 3 bivalves, 2 gastropods and 1 coral.

In accordance with the recommendation 5 of the RCG Med & BS (2017), during 2018 Greece recorded and reported to the ICES WGBYC data call the incidental bycatch of PET species by onboard observers (DCF monitoring) of FRI and HCMR (Hellenic Centre for Marine Research, Athens & Heraklio) from bottom trawl fishery (OTB) in the north eastern Mediterranean (areas GSA 20, 22 and 23). In the eastern Ionian Sea (GSA 20), bycatches of 7 PET species were recorded, including 5 elasmobranch and 2 bony fish. In the Aegean Sea (GSA 22), bycatches of 8 PET species were recorded, including 6 elasmobranchs, 1 bony fish and one loggerhead turtle (*Caretta caretta*). *Squalus acanthias* was the most abundant PET species in both GSA 20 and 22. In the waters around Crete Island (GSA 23), among OTB bycatches only one specimen of *Oxynotuscentrina* was recorded as bycatch. No bycatch of birds and mammals was reported from Greek bottom trawl fisheries in all 3 GSA.

Ireland reported a total of 25 trips comprising 63 days at sea and 45 hauls observed in the pelagic trawl fishery in 2018 as part of the Data Collection Framework (DCF) monitoring and surveys. No intensive monitoring of the Irish set net fisheries was reported in 2018, and no Regulation 812/2004 specific observations of Irish pelagic vessels targeting albacore tuna took place in 2018. A total of 1227 and 800 fishing days at sea were reported for the set gillnet and midwater pair trawlers targeting large pelagic fish respectively. The tuna fishery was recorded as taking place further south than usual, (primarily in areas 8c and d) and as a result no Irish vessels used Irish ports as a base; therefore, there were no opportunities to place observers onboard. No seal or cetacean bycatch was observed in the pelagic fishery in 2018. However, during DCF monitoring of demersal otter trawlers, one harbour porpoise and one harbour seal were reported caught in separate incidents during this time period.

The inshore tangle-net fishery switched to a self-reporting system in 2018; 89 trips (equating to 89 days at sea) with no cetacean bycatch reported. Additional data for 2018, unavailable at the time of reporting, but included in the WGBYC data call, increases this effort to 122 days at sea, with 43 grey seals reported bycaught. All fishing occurred in ICES Division 7j.

Monitoring during the observer programme in accordance with the EC regulation 812/2004 resulted in only a single incidence of cetacean bycatch for 2018, a single harbour porpoise caught during a demersal bottom otter trawl in ICES Division 7j. Based on this result, it has not been possible to estimate raised bycatch rates for any of the most frequently caught cetacean species for Irish waters. Ireland will therefore continue to implement pilot monitoring schemes.

In **Italy**, 438 days were monitored on board 15 pelagic pair trawlers between GSA 16 (1 vessel) and GSA 17 (14 vessels) in 2018, which represent approximately 29.4% coverage of the national midwater trawl fleet. Two bottlenose dolphins (*Tursiops truncatus*) were accidentally caught in GSA 17 (northern Adriatic Sea). Observers from the monitoring programme were also trained to collect bycatch data of other PETS under the Habitats Directive (i.e. loggerhead turtles) and species of conservation concern (e.g. sharks, pelagic rays and skates). Twenty-nine loggerhead turtles (*Caretta caretta*) and a large number of sharks and rays were taken as bycatch in GSA 17. Only one starry ray (*Raja asterias*) was unintentionally caught in GSA 16.

Latvia: The Latvian national monitoring programme of incidental catches of cetaceans in 2018 covered observations of 508 trips in pelagic trawl fisheries. The observations were carried out by 5 observers on 13 different vessels. No incidental bycatch of cetaceans was observed in 2018. Reported observer coverage of the pelagic trawl fishery (12–18 m vessels) towing time was 8.6% or 9% of hauls in area 27.3.d (Subdivision 8.1–Gulf of Riga). For the vessels 24–40 m in Division 27.3.d (subdivisions 25, 26 and 28.2) the corresponding towing time and haul coverage was 8.6% in both cases. The covered days at sea for vessels 12–18 m and 24–40 m length was 7.5% and 8.9%, respectively. The lack of observed bycatch over the full decadal time period indicates that cetacean monitoring under Reg. 812/2004 has no practical significance in Latvian fisheries. Traditionally, the Latvian pelagic trawl fishery targets sprat and herring, and 90–93% of effort is allocated to subdivision 28.2 and 28.1. Based on an annual coverage of 8–10% of the pelagic fishery in the Baltic since 2006 by Latvia, and the lack of reports from fishers of cetacean bycatch, Latvia reiterates its previous statement that continuation of a cetacean bycatch program is an unnecessary expenditure of financial and human resources.

In the **Netherlands**, EU Council Regulation 812/2004 requires observer coverage in ICES areas 6, 7 and 8 in pelagic trawling fisheries for the period of 1 December to 31 March (fleet segment NLD003) and outside this area in all areas year round (fleet segment NLD004).The Netherlands reported for 2018 that, during 11 fishing trips, 63 days and 170 hauls were observed in fleet segment NLD003, and 121 days and 304 hauls were observed in fleet segment NLD004. With a total number of fleet days of 456 in fleet segment NLD003 and 922 in fleet segment NLD004, the coverage was 13.8% and 13.1%, respectively. Thus, the target of the Pilot Monitoring Scheme (PMS) of 10% for NLD003 and 5% for NLD004 has been fulfilled. In addition to these trips, one observer trip was carried out on board a foreign flagged trawler which makes the total number of monitored trips by the Netherlands twelve. The observer effort onboard the foreign trawler consisted of 12 days (46 hauls), covering approximately 6.5% of the total Dutch monitoring effort. The data collected during the trip on the foreign flagged vessel will be made available to the ICES database on incidental bycatch. The observed bycatch rate of 0.00 dolphins per day in the pelagic fishery in 2018 is in line with the findings in 2006 - 2017 when the observed bycatch rate was 0.00-0.01 dolphins per day.

In addition to cetaceans, the report includes information on incidental bycatches of megafauna species listed in Table 1D of EU Decision 2016/1251. 21 blue fin tuna (*Thunnus thynnus*) were caught in thirteen incidents by the NLD003 and NLD004 fleet segments in 2018; 6 grey seals (*Halichoerus grypus*) were caught in five incidents; 50 porbeagles (*Lamna nasus*) were caught in 28 incidents; three basking sharks (*Cetorhinus maximus*) were caught in one incident, one thresher shark (*Alopias sp.*), one blue shark (*Prionace glauca*) and one sunfish (*Mola mola*; this species not listed in table 1D) were caught in three separate incidents. For ICES subdivision 4b, the bycatch rate for grey seal is 0.71 animals/day, based on 4 incidents, 5 specimens and 7 observer days by 139 fleet days. Likewise, the bycatch rate of porbeagle shark in subdivision 7h is 3.09 animals/day, based on 15 incidents, 34 specimens and 11 observer days by 65 fleet days.

In **Poland**, the Cetacean Bycatch Monitoring Programme continued in 2018 as part of the National Fishery Data Collection Programme. Observers were tasked with monitoring commercial catch and bycatch of marine mammals, seabirds, and protected species of fish, such as twait shad (*Alosa fallax*) or Atlantic sturgeon (*Acipenser oxyrhynchus*). Observers carried out trips on board 18 vessels based out of 5 ports, and recorded 65 days at sea, including 60 days on vessels using pelagic trawls (OTM), and 5 days on vessels using bottom otter trawls. No observations were carried out on board fishing vessels using bottom-set gillnets (GNS). No incidences of bycatch of marine mammals, birds, or protected species of fish such as twait shad or Atlantic sturgeon were observed.

In **Portugal,** for 2018, monitoring of bycatch of cetaceans and other protected species in the mainland were provided by IPMA at-sea observations carried out under the National Biological Sampling Program (PNAB/EU-DCF) and dedicated observer effort from "ProgramaOperacional" MAR2020 projects (iNOVPESCA-University of Algarve, Sardinha2020-IPMA and PescApanha-IPMA). As in previous years, following the requirements of Reg. 812/2004, Portugal is required to monitor fleet segments >= 15 m for GNS and GTR only in Subarea 9a. The monitoring programme was maintained with its common limitations as sampling intensity required by the Regulation is frequently not achieved for practical and logistic reasons. A total of 45 trips (11 trips EU-DCF + 3 trips iNOVPESCA + 31 trips PescApanha) and 77 hauls were observed in set-nets (GNS and GTR) included in the polyvalent/multi gear fishery (vessels ≥15 m) operating in the Portuguese waters of ICES Division 9.a. This observation effort translated into coverage of 0.28% of the fishing effort of boats operating off ports in mainland Portugal. The effort on other métiers such as demersal trawls (OTB) and purse seine (PS) for division 9a were also presented. For this period, onboard EU-DCF observers recorded the bycatch of one bottlenose dolphin, *Tursiops truncatus*, in set nets. During the same period, project iNOVPESCA observers registered the mortality of one yellow-legged gull *Laru smichahellis,* also in set nets.

In **Slovenia**, vessels fishing under Reg. 812/2004 were monitored by the Fisheries Research Institute of Slovenia during the course of its regular monitoring activities (monitoring of catches and discards) under the DCF. In addition, the Slovenian non-governmental organisation Morigenos, has an independent long-term monitoring and conservation programme of observing bottlenose dolphins (*Tursiops truncatus*). No deaths of cetaceans due to fishing were reported in 2018.

Spain did not submit the Reg. 812/2004 annual report to the EC for 2018 data collection in 2019. Data on total effort, monitoring effort and bycatch events in 2018 for the Spanish fishing fleets operating in ICES major fishing area 27, NAFO area 21, and the Mediterranean Sea, were provided through the WGBYC data call. There is no dedicated national observer programme for protected species bycatch. Monitoring is carried out annually under the DCF observer programme, and protected species are recorded by the IEO and AZTI. Spain reported most of the bycatch incidents from the Mediterranean (GFCM areas 1 to 7) and from bottom trawls. Events in the Mediterranean included the bycatch of one Risso's dolphin (*Grampus griseus)*, and one Andouin's gull (*Larus audouinii)*, in bottom trawls (GFCM area 1) and two loggerhead turtles (*Caretta caretta)*, bycaught in drifting longlines targeting large pelagic fish (GFCM area 6). Spain also reported >7000 elasmobranch individuals from 9 species bycaught in the Mediterranean mostly from bottom trawls. The data reported from ICES subarea 27 include 153 elasmobranchs of 6 species and 42 shads of two species with most of the bycatches coming from bottom trawls in divisions 8c, 9a, 6b1 and 12b. In addition, Spain reported three Greenland sharks *Somniosus microcephalus,* bycaught in the NAFO area.

Sweden reported in their Reg. 812/2004 report monitoring effort under the EU Data Collection Framework, where on-board observation was carried out in bottom otter trawl fisheries and pot fisheries. In addition, in 2017, Sweden started a pilot project monitoring bycatch of marine mammals and birds in gillnet and trammel net fisheries targeting cod and lumpfish in the south of Sweden with dedicated onboard observers. The project continued in 2018. This survey was part of a pilot project with the aim of collecting information on bycatch in fisheries for DCMAP. In the report, Sweden has included data from this survey along with monitored effort which is part of the standard EU Data Collection Framework. In 2018, a total of 32 trips (equivalent to 32 DaS) were carried out with onboard observers. However, when summarizing the total number of trips/DaS per métier, it adds up to 43 observed trips. This is due to the fact that data are presented per métier and since fishers can fish with two different gears on the same trip, the number of observed trips/observed DaS per métier can exceed the total number of observed trips/DaS. The dedicated observer scheme along the Swedish coast gave valuable information regarding bycatches of harbour porpoises in gillnet fisheries; two harbour porpoises have been reported bycaught. No harbour porpoises were reported bycaught in bottom otter trawls or pot fisheries reported through the EU Data Collection Framework.

For the **United Kingdom**, in 2018, 172 dedicated protected species bycatch monitoring days were conducted during 150 trips on board static net vessels and 129 dedicated bycatch monitoring days during 36 trips on pelagic trawlers. A further 25 dedicated bycatch monitoring days were achieved in longline fisheries and 13 dedicated days in ring net fisheries. Over 100 days of non-dedicated sampling in static net fisheries was also conducted under other English, Welsh and Northern Irish fishery monitoring programmes, and roughly 600 days of non-dedicated sampling was undertaken under those same programmes mainly in a variety of demersal trawl fisheries. Observations of cetacean bycatch from all sampling (dedicated and non-dedicated) included two harbour porpoises and two common dolphins, all reported during dedicated monitoring in static net gears (large mesh tangle nets and hake gillnets). Both common dolphins and one porpoise were caught in the Celtic Sea (ICES Division 7g), and the other porpoise was reported from the southern North Sea (Division 4c).

Other protected species recorded during dedicated bycatch sampling included 10 (grey) seals (4 in static nets in Subarea 7 and 6 in the central North Sea sandeel midwater trawl fishery), and 32 seabirds (8 guillemots, 2 gannets, 18 fulmars, 3 cormorants and 1 black-backed gull). Rarer and/or protected fish species recorded included small-eyed ray (511), common skate (50), blue shark (14), undulate ray (55), tope (21), porbeagle shark (11), long-snouted seahorse (3), and shads (27).

1.4 Observed PETS specimens, bycatch rates, and mortality estimates–total and observed effort obtained from the ICES WGBYC data call (includes non-cetacean species)

Prior to the WGBYC 2020 meeting, a WGBYC/ICES data call (Annex 6: below) requesting 2018 bycatch data from dedicated (i.e. Reg. 812/2004) and non-dedicated (i.e. DCF) monitoring programmes was issued. The data call was issued to EU Member States and ICES Member countries with coastal areas in the European Atlantic (e.g. Iceland). This section summarises data obtained through the data call and extracted from the WGBYC database for 2018.

The total number of specimens or number of incidents of marine mammal, seabird, marine turtle and elasmobranch bycatch, total fishing effort and observed effort aggregated by gear type (métier level 3), ecoregion (Figure 1) and ICES Division extracted from the WGBYC database for 2018 are summarised in Table 2. The data provided from different MS used raising methods divided in three different categories as specified in the data call (Annex 6: below). We acknowledge that the terminology "raised" can cause confusion for fisheries scientists. In this context "raised" is referring to raised number of specimens to the observed trip level, admitting that when observers are onboard fishing vessels all fishing procedures might not be monitored or only a subsample has been collected. We do not ask for any data to be raised or extrapolated to total fishing effort to obtain total bycatch estimates[4].

Data under method A was unraised and can be obtained from a sub-sample, thus not providing an estimation of the bycatch to the trip level and most likely leading to an underestimation of bycatch rates. Data obtained from category level B was unraised due to 100% coverage of the monitored trips, and category C was raised to the trip level. Therefore, categories B and C are considered essentially the same as they are raised to trip level. However, no MS provided data on marine mammals, birds and turtles under Category C. Consequently, marine mammal, birds and turtle bycatch information provided to WGBYC from the 2018 data call fall into Categories A and B only. For elasmobranchs and fish, bycatch rates were calculated separately for data available for method A, and then combined if available for B and C. Furthermore, there were two entries from the Adriatic, one for bottom trawls and one for nets, which fall under category D in Table 2 that refer to an unknown category of raising and bycatch rates were not provided. Additionally, there were cases where the number of incidents is higher than the number of specimens, or there are incidents with no specimens reported. When it occurred, it was discovered that the MS had in some cases reported numbers of hauls with bycatch as "number of incidents".

Data were aggregated by ecoregion and ICES Division for consistency across taxa and to improve the accessibility or transferability of these data to other ICES Working Groups (WGs). Except for Italy, no extrapolated bycatch estimates were provided. In this section, WGBYC has not computed total bycatch estimates due to uncertainty associated with incomplete spatial/temporal

[4] Paragraph edited based on reviewers comments.

dedicated monitoring coverage and completeness of total fishing effort data as reported to WGBYC (ICES 2014).

For 2018, the WGBYC database yielded a total of 175 seals (four species) and 82 cetaceans (from five species: 22 common dolphins; 53 harbour porpoises, one Risso´s dolphin, four bottlenose dolphins and two white-beaked dolphins) were observed bycaught in 2018. A total of 696 seabird specimens and associated bycatch rates are reported for at least 22 bird species; 37 644 elasmobranch specimens and associated bycatch rates are reported for 49 elasmobranch species; a total of 2460 bony fish specimens and associated bycatch rates are reported for 9 bony fish species; and a total of 134 marine turtles and associated bycatch rates were reported for at least two marine turtle species.

Bycatch rates were calculated by dividing the total number of observed bycaught specimens from categories B and C for a given species, when available, by the total number of observed days in each fishery stratum; and separately for specimens assigned to category A (Table 2). This method was also used to summarize seabird, elasmobranch bony fish and marine turtle bycatches given the increased reporting frequency for those taxa in 2018.

Bycatch estimates were provided by one country (Italy) for some elasmobranch and turtle species in some parts of Mediterranean waters for 2018. For other areas, a high bycatch rate for non-marine mammal species consisted primarily of a range of elasmobranch species taken mostly in bottom-trawl fisheries in the Greater North Sea (e.g. *Dipturus batis, Amblyraja radiata, Raja montegui, Raja clavate, Raja undulata*), Celtic Seas (*Dipturusbatis*) and Western Mediterranean (*Etmopterus spinax, Raja undulata*) and nets in the Greater North Sea *(Squalus acanthias, Raja microocellata*) (Table 2).

There are insufficient data to provide cetacean bycatch rates according to pinger functionality and/or presence/absence. As a result, all observed bycaught specimens were combined to provide uncorrected (i.e. functioning or presence/absence of pingers) bycatch rates for each stratum. Table 3 provides a compilation of bycatch of marine mammals for the EU MS only, using data from both the WGBYC data call and Reg. 812/2004 reports. A mismatch was found between by-catch numbers provided in the Reg. 812/2004 reports and the data provided through the data call. The data call resulted in higher numbers of marine mammals in most of the regions for observation days at sea, number of incidents and number of specimens. A compilation of all 2018 monitored strata without bycatch reported through the WGBYC data call are summarized in Table 4.

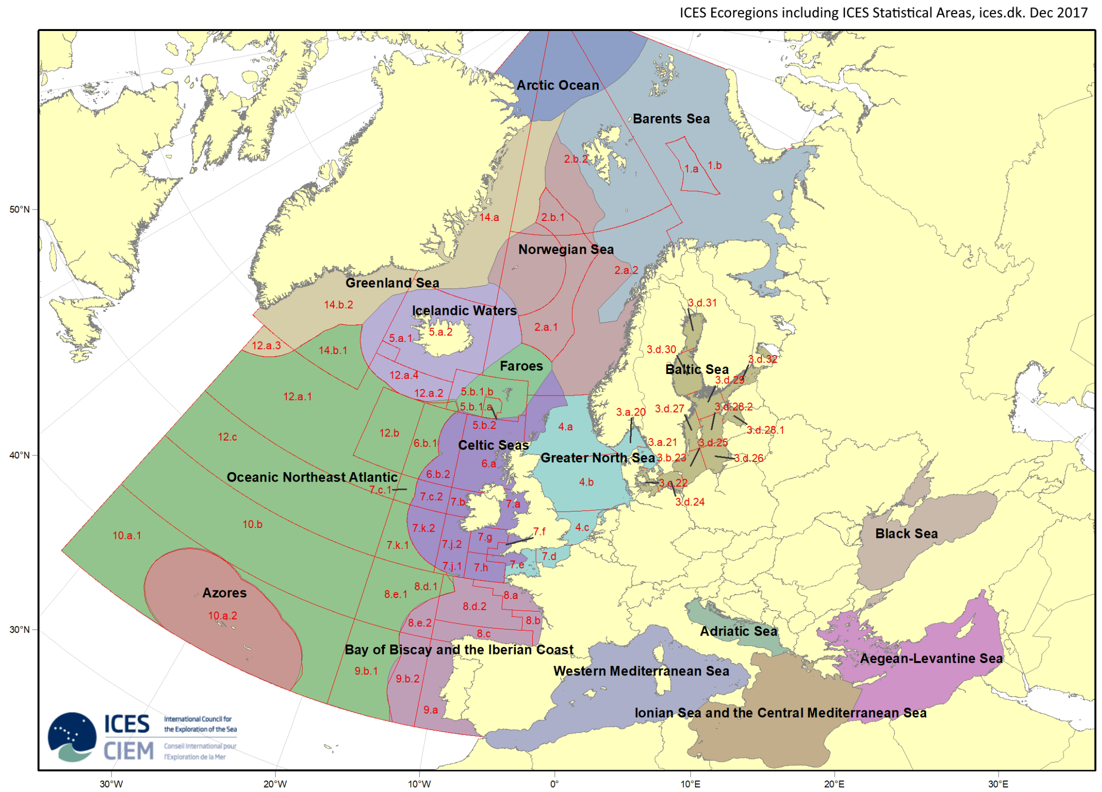

Figure 1. Map of ICES Ecoregions including ICES Statistical Areas.

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

1.5.1 EU Member States

Denmark has been carrying out a pilot study for bycatch of marine mammals and birds (outside DCF) using CCTV cameras on a number of smaller vessels.

During a pilot coastal fish survey (2016–2018) covering different areas along the **Estonian** coast, information on marine mammals and birds is also recorded.

A pilot study concerning bycatch data of seabirds was planned during 2018 in **Finland**. The data will be collected in 2018–2019 and analysed and reported in the annual report 2019.

An additional experiment funded by **France** FilierePeche and operated by the fisher's organisation Pêcheurs de Bretagne was undertaken, aimed at evaluating the efficiency of pinger DDD03H/STM on midwater pair trawlers in the Bay of Biscay between February and April 2018. Sixty-eight fishing operations of a pair of midwater trawlers were observed by a dedicated observer in charge of recording cetacean bycatch, and the protocol was deployed on two other pairs and 150 fishing operations; bycatch was reported by the fishers themselves. A total of 61 common dolphins were observed bycaught during this trial (7 observed by dedicated observers and 54 declared by volunteer fishers).

A pilot study in trawl fisheries ("bottom contacting fishing gears") has been underway in **Germany** (2018–2019) with observers trained to focus on elasmobranchs at species level but also other sensitive species such as marine mammals. It is ensured that bycatch of non-commercial and sensitive species is recorded during observer trips.

Portugal has been conducting a project since 2017 (outside DCF) to evaluate level of interactions and bycatch of cetaceans, marine birds and marine turtles in the southern coast (Algarve) with dedicated observers on several bottom set-net and purse seine vessels. The main objective of this project (project Mar2020-iNOVPESCA) is to account for high-risk areas for bycatch and promote mitigation measures. Incidental captures were not observed in 2018.

In **Spain**, some pilot projects targeting marine turtles are underway. INTEGRATED LIFE+ INTEMARES includes several research and conservation projects focusing on the mitigation of sea turtle bycatch in Spanish waters in collaboration with fishing fleets and recovery centres. Also, MEDTOP–Turtle oceanographers (USFWS, NOAA, STM, SOCIB and University of Exeter) is a programme that integrates data from sea turtle satellite transmitters in the SOCIB Integrated Ocean Observation System to produce tools for the management of the risks of bycatch and entanglement in ghost gear and marine litter. With estimates of over 20 000 ghost fishing artefacts drifting around the Alboran Sea, Algerian basin and Sicily Channel (a critical habitat for juvenile and sub-adult loggerhead turtles), entanglement in ropes and ghost gear is currently considered the number one threat to turtles of the NW Atlantic DPS during their early life stage in the Western Mediterranean.

Turtle bycatch assessment and monitoring in the longlining fisheries targeting swordfish (LLSWO) and albacore tuna (LLALB) started in the 1980's by the Spanish IEO tuna fisheries programme. Since 1986 fishers have collaborated actively with IEO and other research institutions and NGOs (Greenpeace, Alnitak, OCEANA, Fundación CRAM, SUBMON, ANSE, etc.).

Sweden carried out a pilot observer study for assessing bird and marine mammal bycatch (mainly harbour porpoises), partly self-sampling and in the future to use CCTV cameras. The pilot project occurring in 2018 primarily targeted fisheries carried out in shallower water depths and in bycatch risk areas and métiers. Results will be compared to vessels carrying observers. The present scheme for sampling passive gears will be redesigned in the future to consider high-risk areas and seasons for bycatches of birds and harbour porpoises.

1.5.2 Non-EU Member States

WGBYC is working towards incorporating monitoring effort, fishing effort and bycatch data from non-EU countries that have fishing fleets in the North Atlantic.

Monitoring in **Icelandic** waters during 2018 included 102 trips/days on lumpsucker gillnet vessels, 127 days on cod gillnet vessels, 51 trips/357 days on demersal trawl vessels, and 143 trips/192 days on long line vessels fishing within the Icelandic EEZ.

Observed marine mammal bycatch in the lumpsucker fishery was 32 harbour porpoises, 61 harbour seals, 21 grey seals, 14 harp seals, and two ringed seals. Observed seabird bycatch in the lumpsucker fishery was 112 eider ducks, 53 black guillemots, 143 common guillemots, 31 cormorants/shags, two long tailed ducks, two Atlantic puffins, one razorbill and one northern gannet. Observed marine mammal bycatch in the cod fishery was 32 harbour porpoises, two white-beaked dolphins and one harp seal. Observed seabird bycatch in the cod fishery was two northern fulmars, two Brünnich's guillemots, and 18 common guillemots. No marine mammals or seabirds were observed in the bottom trawl fishery, but four Atlantic halibut and one porbeagle were reported by observers. Observed seabird bycatch in the longline fishery was 70 northern fulmars and one northern gannet.

Raised estimates are available for the lumpsucker fishery based on observations from 2014–2018. These estimates are per year and are stratified by management area. Estimated marine mammal bycatch in the lumpsucker fishery was 3223 (1225–5221) animals, thereof 1389 (903–1875) harbour seals, 989 (405–1573) grey seals, 528 (296–760) harbour porpoises, 240 (82–398) harp seals, 49 (1–98) ringed seals, and 28 (10–46) bearded seals. Estimated seabird bycatch in the lumpsucker fishery was 8339 (4837-11841) birds, thereof 3508 (2140–4876) eider ducks, 1653 (926–2546) black guillemots, 2001 (680–3322) common guillemots, 929 (316–1542) cormorants/shags, 63 (11–115) long tailed ducks, 50 Atlantic puffins (11–90), and less than 50 razorbills, black-legged kittiwakes, gannets, and red-throated divers.

WGBYC made contact with the NAMMCO Scientific Secretariat for an overview of bycatch work being undertaken by its North Atlantic member countries. An email correspondence with NAMMCO country representatives resulted in an exchange with the **Faroe Islands representative,** who commented that dedicated monitoring of marine mammal bycatch is very limited. There was an independent observer programme running in 2018 until May 2019, with two observers inspecting mainly the pelagic fishery for mackerel, herring and blue whiting. No bycatch was recorded. The pelagic fisheries of the Faroese fleet have the highest bycatch potential, because gillnets are excluded in waters less than 380 meters deep.

All vessels over 15 BRT use electronic logbooks, where it is mandatory to register bycatch. There have been records of up to ca. five bycatch incidents annually, mainly by the pelagic fleet and mostly solitary long-finned pilot whales or minke whales. The logbooks, although not validated, may give an indication of the bycatch potential of different gears, and suggests, for example, that bycatch seems not to be frequent in the demersal trawl fishery, which has the main fishing effort on the Faroe Plateau.

US Northwest Atlantic 2018 bycatch estimates (mortality and serious injuries for small cetaceans and pinnipeds) (Table 5) have not yet undergone review by the US Atlantic Scientific Review Group and subsequent public comment period. As a result, small cetacean and pinniped bycatch estimates reported for 2018 should be treated as preliminary. Final 2018 estimates are expected to be published in the 2020 US Atlantic and Gulf of Mexico Marine Mammal Stock Assessment Report later in 2020. Earlier US Marine Mammal Stock Assessment Reports can also be found online[5]. Reported sea turtle bycatch estimates from gillnet fisheries were extracted from the referenced literature.

In summary, during 2018, fisheries observers monitored gillnet and bottom-trawl fisheries in both the New England and mid-Atlantic regions of the US Northwest Atlantic. Observer coverage in gillnet fisheries was 8% and 9%, respectively for each area. Harbour porpoise, common dolphin, grey seal, harbour seal, and harp seal, were observed as bycatch in New England gillnet fisheries. Common dolphin, coastal/estuarine bottlenose dolphin and harbour seal were observed as bycatch in mid-Atlantic gillnet fisheries. Total 2018 bycatch estimates and relative standard error (CV) attributed to gillnet fisheries for these species ranged from 8 (CV=0.91) common dolphins to 1113 (CV=0.32) grey seals (Table 5) (Orphanides, 2020 [in review]).

Sea turtle bycatch reported for US Northwest Atlantic remains unchanged from what was reported in WGBYC (2018). For convenience, the information is repeated in this report. Murray (2018) reported average sea turtle bycatch in gillnet fisheries, 2012–2016, for the Georges Bank to mid-Atlantic where overall coverage was 10%. During this period, the total estimated bycatch and relative standard error (CV) for loggerhead sea turtles was 705 (CV=0.29), followed by Kemp's ridley (*Lepidochelys kempii*) 145 (CV=0.43) and leatherback (*Dermochelys coriacea*) sea turtles 27 (CV=0.71) (Table 5).

Observer coverage in 2018 New England and mid-Atlantic bottom-trawl fisheries targeting fish species only was 15% and 11%, respectively. Only common dolphin and grey seal were observed

[5] https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-region

as bycatch in New England bottom-trawl fisheries. In the mid-Atlantic region, common dolphin, offshore bottlenose dolphin, harbour seal and grey seal were observed as bycatch in bottom-trawl fisheries. Total 2018 bycatch estimates and relative standard error (CV) attributed to bottom-trawl fisheries for these species ranged from 6 (CV=0.91) harbour seals to 205 (CV=0.21) common dolphins (Lyssikatos, 2020 [in review]) (Table 5).

Under the US Marine Turtle Conservation act and the Loggerhead and leatherback Turtle Recovery Plans, the US coordinates conservation actions on nesting sites, sea turtle recovery centres and monitoring of index beaches with bycatch assessment, management and monitoring of its fishing fleet. Strict regulations are imposed on fisheries as shrimp bottom trawling that requires measures as the use of Turtle Excluder Devices (TED), or operational changes in the longlining fleet (circle hooks, bait, soak time, depth, etc.). Furthermore, the observer coverage of main risk fleets is of 100%.

1.6 Auxiliary data (strandings, entanglement, and interviews) indicative of the impact of bycatch

1.6.1 Strandings networks to inform on marine mammal bycatch

In many European countries, the deployment of observers on fishing vessels remains challenging, and the observation effort is often below the requirements of the Reg. 812/2004. The use of other datasets to improve knowledge on the interactions between protected species and fisheries is encouraged by many organisations. Many countries provided data on strandings, from which bycatch can be identified as a cause of death. Harbour porpoises are the most commonly recorded stranded species along the coasts of the North Sea. Common dolphins are mostly recorded along the coasts of the Channel, Celtic Sea, Bay of Biscay and Iberian Peninsula, and the diversity of cetaceans in these coasts with evidence of having been bycaught is higher (Table 6).

Along the coasts of **Belgium**, the stranding network is organised and centralised by the Royal Belgian Institute of Natural Sciences (RBINS). RBINS maintains, in cooperation with the University of Liège, a single database which can partly be consulted online. 89 strandings of harbour porpoises were recorded in 2018 along Belgian coasts, and 10% of examined carcasses presented evidence of death in fishing gears.

The stranding network in **Denmark** is run by the Danish Nature Agency in collaboration with the Fisheries and Maritime Museum and the Zoological Museum, Natural History Museum of Denmark. Post-mortems on stranded marine mammals are conducted by the National Veterinary Institute. Twenty-five harbour porpoises were recorded stranded dead along the coasts of Denmark in 2018. Examinations were performed on two individuals, and one on them presented evidence of bycatch. The proportion of bycaught porpoises determined from stranding events in Denmark must be considered carefully according to the very low number of necropsies performed.

The **French** stranding network is co-ordinated by the Joint Service Unit *ObservatoirePelagis*, UMS 3462 University of La Rochelle/CNRS, dedicated to monitoring marine mammal and seabird populations and funded by the Ministry in charge of the environment and the French Agency for Biodiversity. It consists of around 400 trained volunteers distributed along the French coast who collect data according to a standardized observation and dissection protocol. More than a thousand small cetaceans were detected along the French coasts in 2018 (mostly common dolphins in the Bay of Biscay), and 270 seals. Along the French coasts the use of a drift prediction model allowed an estimate of the proportion of dead cetaceans at sea that sink or that would never get stranded according to the dominating winds and tides (Peltier et al., 2016). The strandings recovered are probably a fraction of dead cetaceans at sea. The total number of harbour porpoise dead at sea was therefore estimated at 910 individuals [570; 1800] in the Bay of Biscay and the Channel. The same modelling suggested that 5400 common dolphins [3400; 10 500] died in fishing gears in the Bay of Biscay and in the Western Channel in 2018. Along the French coasts of the Bay of Biscay, 37% of examined striped dolphins presented evidence of bycatch, whereas only 14% of them were recorded with evidence of bycatch along the French coasts of the Western Mediterranean Sea. The small number of examined stranded bottlenose dolphins and Risso's dolphins must be interpreted carefully but suggested a non-negligible e threat from bycatch on these species. Twenty-one percent of examined grey seals presented evidence of bycatch, most of them were juveniles.

In **Finland** there is no formalised stranding network operating but strandings are usually reported directly by private citizens to authorities. Also, in commercial fisheries, fishers usually report incidental bycatches of PETS directly in their logbooks. Although in 2018 no cetacean bycatch was reported to authorities, one harbour porpoise (*Phocoena phocoena*) bycaught in gill nets was reported to the Turku University of Applied Sciences. The animal was captured and released alive by the fishers.

In **Germany**, National Park Rangers control the coastline regularly throughout the year, ensuring a constant observation effort. Marine mammal carcasses that can be retrieved are collected and submitted for investigations at the University of Veterinary Medicine in Hannover and are usually kept in a deep-freeze storage until necropsies can be carried out by official veterinarians. The advanced decomposed status of strandings recovered along the Eastern coasts of North Sea (according to dominating winds) reduced the possible necropsies and examinations, and therefore the determination of cause of death. For the year 2018, 116 strandings of harbour porpoises were recorded. Only one out of 25 porpoises examined presented evidence of bycatch.

In **The Netherlands,** the strandings network consists of a consortium of a large number of organisations 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). Post-mortem research is carried out on a selection of the stranded cases (approximately 10–20% of all stranded individuals) since 2008 at the Faculty of Veterinary Medicine of Utrecht University. A total of 476 harbour porpoise carcasses were detected along the Dutch coasts in 2018 which is the highest number registered along the coasts of the North Sea (Table 6). According to the decomposition status of carcasses, necropsies were performed on 12% of them. The proportion of porpoises with bycatch evidence related to the number of examinations reached a maximum of 12% in the North Sea in the Netherlands.

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 sub-coordinated by the Portuguese Wildlife Society have been in place since 2000 in the Western North-Central coast and operated from 2010 to 2017 in the Southern region (no stranding team exists in the Western Central-south region). In areas where no stranding teams operate, basic data (biometrics, species identification) are registered only by maritime authorities and Nature Protected Areas staff. In 2018, a total of 285 cetaceans stranded dead on the Portuguese mainland coast. The work of local stranding networks in some areas allows the analysis of carcasses to assess mortality caused by fisheries interactions. For instance, in the North-Central western coast, of all animals stranded (n=150), in about 20% of the cases mortality was attributed to incidental capture in set nets (GNS/GTR). This was particularly evident for two species (*Delphinus delphis*; n=23, and *Phocoena phocoena*, n= 6).

In **Spain**, the NGO CEMMA started the Galician Stranding Network in the early 1990s, and since then, it is the body responsible for carrying out strandings assistance work. Since 1999, there was an improvement in assistance, with the involvement of the Ministry of Environment-Xunta de Galicia that began to direct the work, granted administrative authorizations, and provided financial financing. The Galician Stranding Network operates along the 1190 km of the coast of Galicia. Seven species of cetaceans and 244 carcasses were recorded in 2018 along the coasts of Galicia. The proportion of bycaught individuals among examined carcasses differs greatly among species: 37% for common dolphins (n=32), 25% for bottlenose dolphins (n=12), 17% for harbour porpoises (n=6), 8% for striped dolphins (n=13) and 100% for pygmy sperm whale, but referring to a single animal.

The collaborative Cetacean Strandings Investigation Programme in **United Kingdom** is a consortium of partner organisations (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. The most commonly stranded cetacean species are harbour porpoise and common dolphin, accounting for 503 and 186 individuals respectively in 2018. The proportion of bycaught porpoises ranged from 0 to 40% of examined carcasses according to the area considered, and between 24% and 33% for common dolphins. Other species, including minke whale and humpback whale are also recorded stranded with entanglement in gear as a cause of death.

In **Sweden**, reports of observations of both live and dead harbour porpoises are collected through a web-based system by the Swedish Museum of Natural History (SMNH), funded by the Swedish Agency for Marine and Water Management (SwAM). A limited number of the carcasses are collected for necropsy and sampling (since 2016, up to approximately 20 per year) by SMNH in collaboration with the National Veterinary Institute, funded by SwAM. Neimane et al. (2020) compiled data from necropsies of 89 stranded and 11 bycaught (handed over by fishers) harbour porpoises, collected from 2006 to 2019. In addition, during this period, a total of 460 encountered dead harbour porpoises were reported by the public. This can be regarded as a minimum number of strandings as Sweden has a long coastline with archipelagos, and the reporting system is voluntary and opportunistic. Of all reported dead animals, 27% were from the summer management range of the North Sea population (as defined by Sveegaard et al., 2015), 69% from the summer management range of the Belt Sea population (as defined by Sveegaard et al., 2015), 3% from the area west of this in the southern Baltic Sea, and none within the summer management area of the Baltic Proper population (as defined by Carlén et al., 2018). The collected carcasses were examined for health status, reproductive status, cause of death etc. Bycatch and likely bycatch were the most common causes of death (36%) for the collected stranded animals for which cause of death could be determined (n=61).

In Poland, during years 1998 – 2019, as many as 112 stranded harbour porpoises have been found along the Polish coast. For years 1998–2016, the mean number of stranded animals found varied around 3–4 individuals per year. However, during years 2017–2019, numbers of stranded animals observed at the Polish coast have significantly increased (in 2017, 11 stranded animals were found; in 2018, 15 animals; and in 2019, 13 animals respectively)[6]. Due to high decomposition state of most of the harbour porpoise carcasses, it is difficult to determine the cause of death in most of the cases. Since the beginning of 2010, a network of volunteers so called WWF "Blue Patrol" has been established. Their main goal is to collect data on observations of dead or alive sea mammals along the Polish coast, in cooperation with the Hel Marine Station Institute of

[6]On basis of data from WWF database, and data provided by the Hel Marine Station IOUG in Hel – data presented during ASCOBANS AC meeting in Stralsund in 2019.

Oceanography, University of Gdansk, and to report them to the WWF database. Their work allows more representative data to be gathered. In 2018, the highest number of stranded harbour porpoises was found onshore since 1998, namely 15 individuals, including one harbour porpoise reported by fishers to be bycaught in gillnets (carcass was provided to the Hel Marine Station Institute of Oceanography, University of Gdansk, for necropsy), and at least one which had wounds on a carcass indicating likely human induced mortality (bycatch).

1.6.2 Strandings networks to inform on turtle bycatch

Stranding networks and recovery centres play a fundamental role in conservation of sea turtles:

a) providing information on causes of stranding/death;
b) providing a platform for collaborating with fisheries and increasing survival rate of turtles caught accidentally;
c) providing an opportunity for conducting research for the development of technological measures to mitigate the risk of bycatch.

France: Two stranding networks are collecting observations in France (mainland) and territorial seas: the RTMAE "RéseauTortues Marines Atlantique Est" (coordinated by CESTM Aquarium La Rochelle) which monitors the coastal French OSPAR areas 7d, 7c, 7h, 8a, 8b and the RTMMF (coordinated by the Société Herpétologique de France) which operates in the continental French Mediterranean, and in Corsica. Recovery centres work together with the stranding networks when turtles need medium or long-term veterinarian care and surgery (CESTM in La Rochelle, CESTMed in Le Grau du Roi and CRFS in Antibes). These recovery centres also maintain tight relationships with fishers who may also actively participate in research and designing experimentation procedures, and mitigation measures. The bycatch data do not to date include effort of fishery operations, however valuable information about species, seasons, métiers, fishing techniques, circumstances and geo-localisation of bycatch, mortality and other impact which are shared by fishers on a voluntary basis, at each capture event or through interviews and informal discussions. Since 2020, rapid assessments are currently ongoing using the FAO methodology on the request of the national Office Français pour la Biodiversité, in charge of the monitoring programme of MSFD.

Impact data including mortality are also collected by stranding networks and rescue centres through necropsies of dead individual, and veterinary examination of alive turtles.

All data are shared with the national Ministry in charge of ecology and the French Ministry in charge of fisheries, in particular in the frame of the Marine Environment Action Plan and the Marine Strategy Framework Directive (see below auxiliary data).

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 sub-coordinated by the Portuguese Wildlife Society have been in place since 2000 in the Western North-Central coast and operated from 2010 to 2017 in the Southern region (no stranding team exists in the Western Central-south region). In areas where no stranding teams operate, basic data (biometric, species identification) is registered only by maritime authorities and Nature Protected Areas staff. The work of local stranding networks in some areas allows the analysis of carcasses to access mortality caused by fisheries interactions.

In **Spain** Sea turtle data presented by Spain under 812/2004 does not allow for a proper assessment of the bycatch risk by the Spanish fleet. This is clearly highlighted by the information of specific sea turtle/bycatch projects or by the Spanish stranding network.

Stranding network and sea turtle recovery centres of the North Atlantic Coast (3), the Gulf of Cadiz (2) and the Mediterranean (8). Most of these recovery centres were set up in the early 1990s and have progressively developed a stranding network that covers most of the Spanish coast year-round. Collaboration with fishes and relevant authorities ensures close to 100% coverage of strandings and the recovery of turtles brought in by fishers.

Since 1995, hundreds of marine turtles are recovered stranded dead or brought in by fishers or boaters, mainly in the Mediterranean and the Canary Islands. The network is composed of 15 sea turtle recovery centres located on the North Atlantic Coast (3), in the Canary Islands (2), Gulf of Cadiz (2), and the Mediterranean (8). Most of these recovery centres were set up in the early 1990's and have progressively developed a stranding network that covers most of the Spanish coast year-round. Collaboration with fishers and relevant authorities ensures close to 100% coverage of strandings, and the recovery of turtles brought in by fishers.

In **Italy,** stranding network started in the 1980s within the framework of several research and conservation projects (Argano 1992; Vallini 2000; Affronte and Scaravelli 2001; Russo et al., 2003; Casale et al. 2010). Approximately 30 sea turtles rescue facilities operate along the Italian coast (Ullmann and Stachowitsch 2015). The activity of these centres is not limited only on the rehabilitation of rescued sea turtles. They also collaborate and provide additional data for research including EU projects i.e. TARTALIFE (Lucchetti et al., 2019) and raise public awareness.

Malta has its coastline covered by the Malta Nature Trust NGO that collaborates with the Ministry for the Environment. The MNT collaborates also with fisheries to rescue turtles caught accidentally mainly in longlines, anchored FADs, and gillnets.

1.7 Conclusions

- The quality and scope of the information provided by the Regulation 812/2004 reports for 2018 continues to be variable.
- In most of the Mediterranean MS, with the exception of Italy, monitoring is not required because they do not fish in affected areas, thus Regulation 812/2004 reports usually repeat the information provided in previous years stating that there is no monitoring required. However, pilot projects carried out by some MS (e.g. Greece) provided evidence of PETS bycatch in demersal and pelagic fisheries.
- Nine countries rely on the DCF sampling programme to monitor marine mammal and other protected species bycatch. Nine MS have been running pilot projects or dedicated programmes to monitor bycatch of PETS and associated bycatch estimates.
- Relying only on observations carried out under the DCF may lead to an underestimation of bycatch events as some bycatches may be missed by the observers who focus mostly on other tasks (e.g. fish sampling). This is a concern to WGBYC in existing data but particularly moving forward to data collection driven by the EU-MAP and to some extent the Technical Conservation Measures Regulation, with the repeal of Reg. 812/2004.
- WGBYC continues to have insufficient data to provide bycatch rates according to pinger functionality and/or presence/absence in relevant métiers.
- Italy provided extrapolated bycatch estimates through the data call for some species of cetaceans, birds, fish, marine turtles and seals Table 2. UK provided extrapolated estimates through the Reg. 812/2004 report only, as the method of calculation differs from the method used in the data call. Similarly, regarding the methodology on calculating bycatch estimates, Iceland provided extrapolated data for some species of marine mammals, marine birds and fish, made available at the WGBYC meeting only.US provided bycatch estimates for Northwest Atlantic Ecoregion for marine mammals and turtles.
- The records of bycaught specimens and monitored days within the data obtained through the data call were higher than those reported in the Regulation 812/2004 reports.

- Monitoring coverage per métier and vessel size was highly variable within each Ecoregion and ICES Division, with some countries relying on only monitoring vessel sizes and gear types that were mandatory in Reg. 812/2004 (>15 m for set-nets and pelagic trawls).
- The available data provide an indication of bycatch rates for various taxa by gear and Ecoregion. Bycatch of marine mammals was observed in all Ecoregions and for several gears such as set-nets, traps, longlines and trawl gears (pelagic and bottom trawl). Seabirds are also bycaught in most Ecoregions, and—depending on species specific feeding behaviour—are mainly taken in nets and longlines. In 2018, marine turtles have been recorded mostly in set nets and trawl gears (both pelagic and bottom) in the Mediterranean and also in longlines in the Azores.
- High bycatch rates were observed for some elasmobranch species which are of conservation concern, particularly in trawl gears in the Celtic Sea, the Greater North Sea and Western Mediterranean, and nets in the Celtic Sea (Table 2).
- In 2018, bycatch monitoring data were available for Iceland and USA: from the USA, bycatch estimates were provided for several marine mammal and marine turtle species; from Iceland, bycatches were reported for seabirds, seals, fish and cetaceans. In the US, the gear of most concern are set nets for marine mammals and sea turtles. The gears of most concern in Iceland are set nets (bycatch of birds and cetaceans) and longlines (bycatch of birds).
- For 2018, eight countries contributed with cetacean stranding information (Belgium, Denmark, France, Germany, Ireland, Netherlands, Poland, Portugal, Spain, Sweden and UK). In the Greater North Sea, The Netherlands had very large numbers of stranded harbour porpoises in 2018 (n=476). France had very large numbers of stranded cetaceans in the Bay of Biscay in 2018 (n=807), 80% of which were common dolphins, most showing evidence of having been bycaught.
- Strandings schemes provide useful supplementary evidence of bycatch. However, the level of investigation of post-mortem examination to determine cause of death varies between countries making it difficult to compare proportions of animals whose death is attributed to bycatch.
- Monitored effort with no bycatch events and associated fishing effort represented 0.8% and 2% respectively of monitoring effort and fishing effort with bycatch events reported through the data call. MS should report all monitoring effort in all métiers regardless of whether there is a bycatch or not, so there is no risk of inflating bycatch rates.

Information provided through the Member States' Reg. 812/2004 reports and other additional and relevant sources of information is limited. This, in part, was due to requirements under Reg. 812/2004, which led to focussed monitoring of only a few métiers within specific areas (static nets and pelagic trawls), specific vessel segments (predominantly above 15 m) and targeting bycatch of cetaceans. For many areas and métiers, there is insufficient monitored effort to enable any assessment of the overall impact of fisheries on cetaceans or other protected species. Greater monitoring effort is needed in metiers that make up a large portion of the MS fishing effort and have high risk of bycatch, independent of vessel size. On small vessels, alternatives to observers must be found where a lack of space to take observers onboard can be a barrier to monitoring. MS that hold polyvalent fleets, where set nets are used, should find a strategy to improve monitoring of fishing effort.

Table 1. Summary table of coastal EU Member States (MS) regarding the status of Reg. 812/2004 report submissions to the European Commission (Green = Yes for report with data on observer effort (either days at sea or other measurement, e.g. effort per haul or set); Pale grey = Yes for report with no data on observer effort (either days at sea or other measurement); Darker grey = As for pale grey but report only received in 2019; Orange = no report submitted; Empty (white cells) = Not required to report * No Reg.812/2004 report but reports on cetacean bycatch observations made under DCF sent to the Commission. Some of this information was made available at the meeting; **** Report made available at the meeting. ***** Data made available through the data call[7].**

Coastal Member State of the EU	Monitoring (Art. 4-5)	Report reg 812 & effort data provided												
	Fishing in areas affected	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Estonia EE	Yes													
Finland FI	Yes													
Latvia LV	Yes													
Lithuania LT	Yes													
Poland PL	Yes													
Italy IT	Yes													
Slovania SI	Yes													
Portugal PT	Yes											****		
Spain ES	Yes											****	****	****
Germany DE	Yes									***				
France FR	Yes								****					
Ireland IE	Yes													
Netherlands NL	Yes											****		****
United Kingdom UK	Yes													
Belgium BE	Yes													
Denmark DK	Yes													
Sweden SE	Yes								****	****		****	****	
Bulgaria BG (MS since 2007)	No													
Croatia HR (MS since 2013)	No													
Cyprus CY	No													
Greece GR	No													
Malta MT	No													
Romania RO (Ms since 2007)	No													

[7] The table format was edited based on reviewers' comments.

Table 2. Total number of bycatch specimens or number of incidents reported and bycatch rates derived from the ICES WGBYC data call for 2018 data. Bycatch numbers and rates are grouped by ecoregion, taxa, métier, and species. Rates are presented raised to trip level were provided (Categories B and C; also when unraised (Category A) (refer to section 1.4 for raising description)). Marine mammals, birds, and turtles have only been reported in category A and B. * likely data reported incorrectly since number of incidents > number of specimens. DaS = Days at Sea.

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Adriatic Sea	17	Bottom trawls	Elasmo-branch	*Aetomylaeus bovinus*	272	76635	1		1			1		0.004
Adriatic Sea	17	Bottom trawls	Elasmo-branch	*Tetronarce nobiliana*	272	76635	1		1			1		0.004
Adriatic Sea	17	Bottom trawls	Elasmo-branch	*Myliobatis aquila*	272	76635	8		51			51		0.188
Adriatic Sea	17	Bottom trawls	Elasmo-branch	*Dasyatis pastinaca*	272	76635	2		4			4		0.015
Adriatic Sea	17	Bottom trawls	Elasmo-branch	*Pteroplatytrygon violacea*	272	76635	7		12			12		0.044
Adriatic Sea	17	Bottom trawls	Elasmo-branch	*Squalus acanthias*	272	76635	16		44			44		0.162
Adriatic Sea	17	Bottom trawls	Elasmo-branch	*Mustelus mustelus*	272	76635	30		111			111		0.408
Adriatic Sea	17	Bottom trawls	Marine bird	*Phalacrocorax aristotelis*	272	76635	2	2				2	0.007	
Adriatic Sea	17	Bottom trawls	Marine Mammal	*Pagophilus groenlandicus*[8]	272	76635	2				2	2		

[8] Likely that the species has been misidentified.

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Adriatic Sea	17	Bottom trawls	Marine turtle	*Caretta caretta*	272	76635	9		23			23		0.085
Adriatic Sea	17	Nets	Elasmobranch	*Dasyatis pastinaca*	46	4508	1				3	3		
Adriatic Sea	17	Nets	Teleost fish	*Alosa fallax*	46	4508	1	1				1	0.022	
Adriatic Sea	17	Pelagic trawls	Elasmobranch	*Mylio batisaquila*	386	11242	53		134			134		0.347
Adriatic Sea	17	Pelagic trawls	Elasmobranch	*Prionage glauca*	386	11242	3		3			3		0.008
Adriatic Sea	17	Pelagic trawls	Elasmobranch	*Aetomylaeus bovinus*	386	11242	17		29			29		0.075
Adriatic Sea	17	Pelagic trawls	Elasmobranch	*Mustelus punctulatus*	386	11242	43		120			120		0.311
Adriatic Sea	17	Pelagic trawls	Elasmobranch	*Dasyatis pastinaca*	386	11242	1		1			1		0.003
Adriatic Sea	17	Pelagic trawls	Elasmobranch	*Alopias vulpinus*	386	11242	1		1			1		0.003
Adriatic Sea	17	Pelagic trawls	Elasmobranch	*Scyliorhinus canicula*	386	11242	4		4			4		0.010
Adriatic Sea	17	Pelagic trawls	Elasmobranch	*Scyliorhinus stellaris*	386	11242	3		3			3		0.008

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Adriatic Sea	17	Pelagic trawls	Elasmo-branch	*Pteroplatytrygon violacea*	386	11242	70		109			109		0.282
Adriatic Sea	17	Pelagic trawls	Elasmo-branch	*Squalus acanthias*	386	11242	31		39			39		0.101
Adriatic Sea	17	Pelagic trawls	Elasmo-branch	*Raja clavata*	386	11242	3		4			4		0.010
Adriatic Sea	17	Pelagic trawls	Elasmo-branch	*Mustelus mustelus*	386	11242	43		61			61		0.158
Adriatic Sea	17	Pelagic trawls	Marine Mammal	*Tursiops truncatus*	386	11242	2		2			2		0.005
Adriatic Sea	17	Pelagic trawls	Marine tur-tle	*Caretta caretta*	386	11242	24		29			29		0.075
Adriatic Sea	17	Pelagic trawls	Teleost fish	*Alosa fallax*	386	11242	90		190			190		0.492
Adriatic Sea	18	Bottom trawls	Elasmo-branch	*Prionage glauca*	392	60436	1		1			1		0.003
Adriatic Sea	18	Bottom trawls	Elasmo-branch	*Hexanchus griseus*	392	60436	1		1			1		0.003
Adriatic Sea	18	Bottom trawls	Elasmo-branch	*Myliobatis aquila*	392	60436	7		8			8		0.020
Adriatic Sea	18	Bottom trawls	Elasmo-branch	*Dasyatis pastinaca*	392	60436	16		69			69		0.176

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Adriatic Sea	18	Bottom trawls	Elasmo-branch	*Pteroplatytrygon violacea*	392	60436	7		7			7		0.018
Adriatic Sea	18	Bottom trawls	Elasmo-branch	*Squalus acanthias*	392	60436	3		3			3		0.008
Adriatic Sea	18	Bottom trawls	Marine tur-tle	*Caretta caretta*	392	60436	33		54			54		0.138
Aegean-Levantine Sea	22	Bottom trawls	Elasmo-branch	*Oxynotus centrina*	198	38161	9			14		14		0.071
Aegean-Levantine Sea	22	Bottom trawls	Elasmo-branch	*Mustelus punctulatus*	198	38161	2			2		2		0.010
Aegean-Levantine Sea	22	Bottom trawls	Elasmo-branch	*Hexanchus griseus*	198	38161	4			4		4		0.020
Aegean-Levantine Sea	22	Bottom trawls	Elasmo-branch	*Centrophorus granulosus*	198	38161	2			14		14		0.071
Aegean-Levantine Sea	22	Bottom trawls	Elasmo-branch	*Squalus acanthias*	198	38161	25			237		237		1.197
Aegean-Levantine Sea	22	Bottom trawls	Elasmo-branch	*Mustelus mustelus*	198	38161	26			46		46		0.232
Aegean-Levantine Sea	22	Bottom trawls	Marine tur-tle	*Caretta caretta*	198	38161	1		1			1		0.005
Aegean-Levantine Sea	22	Bottom trawls	Teleost fish	*Alosa fallax*	198	38161	9			25		25		0.126

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Aegean-Levantine Sea	23	Bottom trawls	Elasmo-branch	*Oxynotus centrina*	9	1514	1			1		1		0.111
Aegean-Levantine Sea	25	Longlines	Elasmo-branch	*Pteroplatytrygon violacea*	52	30025	6	27				27	0.519	
Aegean-Levantine Sea	25	Nets	Marine tur-tle	*Cheloniidae*	503	61933	1	1				1	0.002	
Azores	27.10.a.2	Longlines	Elasmo-branch	*Deania calcea*	363	6981	12			70		70		0.193
Azores	27.10.a.2	Longlines	Elasmo-branch	*Selachii*	363	6981	1	1				1	0.003	
Azores	27.10.a.2	Longlines	Elasmo-branch	*Isurus oxyrinchus*	363	6981	21	38				38	0.105	
Azores	27.10.a.2	Longlines	Elasmo-branch	*Alopias superciliosus*	363	6981	2	3				3	0.008	
Azores	27.10.a.2	Longlines	Elasmo-branch	*Hexanchus griseus*	363	6981	1			1		1		0.003
Azores	27.10.a.2	Longlines	Elasmo-branch	*Dipturus batis*	363	6981	6			13		13		0.036
Azores	27.10.a.2	Longlines	Elasmo-branch	*Alopias vulpinus*	363	6981	5	7				7	0.019	
Azores	27.10.a.2	Longlines	Elasmo-branch	*Dalatias licha*	363	6981	16			44		44		0.121

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Azores	27.10.a.2	Longlines	Elasmo-branch	*Centrophorus granulosus*	363	6981	4			7		7		0.019
Azores	27.10.a.2	Longlines	Elasmo-branch	*Pteroplatytrygon violacea*	363	6981	3	3				3	0.008	
Azores	27.10.a.2	Longlines	Elasmo-branch	*Raja clavata*	363	6981	23	50	247	35		332		0.777
Azores	27.10.a.2	Longlines	Elasmo-branch	*Etmopterus pusillus*	363	6981	1			18		18		0.050
Azores	27.10.a.2	Longlines	Elasmo-branch	*Galeorhinus galeus*	363	6981	17		116	5		121		0.333
Azores	27.10.a.2	Longlines	Elasmo-branch	*Etmopterus spinax*	363	6981	17			69		69		0.190
Azores	27.10.a.2	Longlines	Marine tur-tle	*Dermochelys coriacea*	363	6981	2	2				2	0.006	
Azores	27.10.a.2	Longlines	Marine tur-tle	*Caretta caretta*	363	6981	1	1				1	0.003	
Azores	27.10.a.2	Nets	Elasmo-branch	*Galeorhinusgaleus*	2	3210	1		14			14		7.000
Azores	27.10.a.2	Rods and lines	Elasmo-branch	*Hexanchus griseus*	614	22320	1			1		1		0.002
Azores	27.10.a.2	Rods and lines	Elasmo-branch	*Dipturus batis*	614	22320	1			2		2		0.003

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Azores	27.10.a.2	Rods and lines	Elasmo-branch	*Raja clavata*	614	22320	4		28	2		30		0.049
Azores	27.10.a.2	Rods and lines	Elasmo-branch	*Galeorhinus galeus*	614	22320	2		4			4		0.007
Baltic Sea	27.3.b.23	Nets	Elasmo-branch	*Raja clavata*	13	4976.5	1			1		1		0.077
Baltic Sea	27.3.b.23	Nets	Marine bird	*Uria aalge*	13	4976.5	1		1			1		0.077
Baltic Sea	27.3.b.23	Nets	Marine bird	*Phalacrocorax carbo*	13	4976.5	3		4			4		0.308
Baltic Sea	27.3.b.23	Nets	Marine bird	*Somateria mollissima*	13	4976.5	1		1			1		0.077
Baltic Sea	27.3.b.23	Nets	Marine Mammal	*Phocoena phocoena*	13	4976.5	2		2			2		0.154
Baltic Sea	27.3.d.25	Bottom trawls	Teleost fish	*Alosa fallax*	69.214	6984	3	4				4	0.058	
Baltic Sea	27.3.d.25	Longlines	Marine bird	*Uria aalge*	7	2178.2667	4	4				4	0.571	
Baltic Sea	27.3.d.25	Traps	Teleost fish	*Coregonus lavaretus*	3	2656.5	1		49			49		16.333
Baltic Sea	27.3.d.27	Traps	Marine bird	*Phalacrocorax carbo*	3	3938.0786	1		1			1		0.333
Baltic Sea	27.3.d.28	Nets	Marine bird	*Uria aalge*	10	423.5	1		1			1		0.100
Baltic Sea	27.3.d.28	Nets	Marine bird	*Phalacrocorax carbo*	10	423.5	4		6			6		0.600
Baltic Sea	27.3.d.28	Nets	Marine bird	*Aythya marila*	10	423.5	1		1			1		0.100

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Baltic Sea	27.3.d.28	Nets	Marine bird	*Aythya fuligula*	10	423.5	2		2			2		0.200
Baltic Sea	27.3.d.28.1	Pelagic trawls	Teleost fish	*Coregonus lavaretus*	356	6331	51	391				391	1.098	
Baltic Sea	27.3.d.28.1	Traps	Marine Mammal	*Halichoerus grypus*	22	5086	1	1				1	0.045	
Baltic Sea	27.3.d.28.1	Traps	Marine Mammal	*Pusa hispida*	22	5086	1	1				1	0.045	
Baltic Sea	27.3.d.28.1	Traps	Teleost fish	*Coregonus lavaretus*	22	5086	2	5				5	0.227	
Baltic Sea	27.3.d.29	Nets	Marine bird	*Mergus*	77	12058.167	5		13			13		0.169
Baltic Sea	27.3.d.29	Nets	Marine bird	*Aves*	77	12058.167	1		1			1		0.013
Baltic Sea	27.3.d.29	Nets	Marine bird	*Phalacrocorax carbo*	77	12058.167	2		3			3		0.039
Baltic Sea	27.3.d.29	Nets	Marine bird	*Bucephala clangula*	77	12058.167	1		1			1		0.013
Baltic Sea	27.3.d.29	Nets	Marine bird	*Podicepscristatus*	77	12058.167	1		1			1		0.013
Baltic Sea	27.3.d.29	Nets	Marine bird	*Aythya fuligula*	77	12058.167	5		13			13		0.169
Baltic Sea	27.3.d.29	Nets	Marine bird	*Melanitta fusca*	77	12058.167	1		3			3		0.039
Baltic Sea	27.3.d.30	Nets	Marine bird	*Phalacrocorax carbo*	44	26485.75	4		9			9		0.205
Baltic Sea	27.3.d.30	Nets	Marine bird	*Somateria mollissima*	44	26485.75	2		5			5		0.114

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Baltic Sea	27.3.d.30	Nets	Marine bird	*Mergus merganser*	44	26485.75	3		5			5		0.114
Baltic Sea	27.3.d.30	Nets	Marine bird	*Podiceps cristatus*	44	26485.75	1		1			1		0.023
Baltic Sea	27.3.d.30	Nets	Marine Mammal	*Halichoerus grypus*	44	26485.75	1		1			1		0.023
Baltic Sea	27.3.d.30	Traps	Marine Mammal	*Halichoerus grypus*	93	10972.25	1		1			1		0.011
Baltic Sea	27.3.d.31	Nets	Marine bird	*Mergus*	7	16123.833	1		1			1		0.143
Baltic Sea	27.3.d.31	Nets	Marine bird	*Phalacrocorax carbo*	7	16123.833	2		3			3		0.429
Baltic Sea	27.3.d.31	Nets	Marine bird	*Mergus merganser*	7	16123.833	1		1			1		0.143
Baltic Sea	27.3.d.31	Nets	Marine bird	*Anas platyrhynchos*	7	16123.833	1		4			4		0.571
Baltic Sea	27.3.d.31	Traps	Marine bird	*Mergus*	41	16757.167	1		5			5		0.122
Baltic Sea	27.3.d.31	Traps	Marine bird	*Phalacrocorax carbo*	41	16757.167	1		1			1		0.024
Baltic Sea	27.3.d.31	Traps	Marine bird	*Anas platyrhynchos*	41	16757.167	1		1			1		0.024
Baltic Sea	27.3.d.31	Traps	Marine Mammal	*Halichoerus grypus*	41	16757.167	1		1			1		0.024
Baltic Sea	27.3.d.32	Nets	Marine bird	*Melanittanigra*	58	6705	1		1			1		0.017
Baltic Sea	27.3.d.32	Nets	Marine bird	*Phalacrocorax carbo*	58	6705	5		13			13		0.224
Baltic Sea	27.3.d.32	Nets	Marine bird	*Somateria mollissima*	58	6705	1		2			2		0.034

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Baltic Sea	27.3.d.32	Nets	Marine bird	*Bucephala clangula*	58	6705	2		2			2		0.034
Baltic Sea	27.3.d.32	Nets	Marine bird	*Podicepscristatus*	58	6705	2		2			2		0.034
Baltic Sea	27.3.d.32	Traps	Marine bird	*Phalacrocorax carbo*	72	6911	4	1	17			18		0.236
Baltic Sea	27.3.d.32	Traps	Marine bird	*Anas platyrhynchos*	72	6911	2		20			20		0.278
Baltic Sea	27.3.d.32	Traps	Marine Mammal	*Halichoerus grypus*	72	6911	4	1	4			5		0.056
Barents Sea	27.1.b	Bottom trawls	Elasmo-branch	*Amblyraja radiata*	30	633.35667	64			634		634		21.133
Barents Sea	27.2.b.2	Bottom trawls	Elasmo-branch	*Amblyraja radiata*	6	228	11			172		172		28.667
Bay of Biscay and the Iberian Coast	27.8.a	Bottom trawls	Elasmo-branch	*Dipturus batis*	581.484	22051	6	10				10	0.017	
Bay of Biscay and the Iberian Coast	27.8.a	Bottom trawls	Elasmo-branch	*Raja microocellata*	581.484	22051	4	6				6	0.010	
Bay of Biscay and the Iberian Coast	27.8.a	Bottom trawls	Elasmo-branch	*Squalus acanthias*	581.484	22051	2	4				4	0.007	
Bay of Biscay and the Iberian Coast	27.8.a	Bottom trawls	Elasmo-branch	*Leucoraja circularis*	581.484	22051	6	11				11	0.019	
Bay of Biscay and the Iberian Coast	27.8.a	Bottom trawls	Elasmo-branch	*Raja undulata*	581.484	22051	23	37				37	0.064	

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Bay of Biscay and the Iberian Coast	27.8.a	Bottom trawls	Teleost fish	*Alosa*	581.484	22051	1	1				1	0.002	
Bay of Biscay and the Iberian Coast	27.8.a	Bottom trawls	Teleost fish	*Alosa alosa*	581.484	22051	2	2				2	0.003	
Bay of Biscay and the Iberian Coast	27.8.a	Bottom trawls	Teleost fish	*Alosa fallax*	581.484	22051	8	13				13	0.022	
Bay of Biscay and the Iberian Coast	27.8.a	Nets	Elasmo-branch	*Hexanchus griseus*	145.867	10421.115	1	1				1	0.007	
Bay of Biscay and the Iberian Coast	27.8.a	Nets	Elasmo-branch	*Raja microocellata*	145.867	10421.115	2	2				2	0.014	
Bay of Biscay and the Iberian Coast	27.8.a	Nets	Elasmo-branch	*Squalus acanthias*	145.867	10421.115	3	3				3	0.021	
Bay of Biscay and the Iberian Coast	27.8.a	Nets	Elasmo-branch	*Leucoraja circularis*	145.867	10421.115	16	175				175	1.200	
Bay of Biscay and the Iberian Coast	27.8.a	Nets	Elasmo-branch	*Raja undulata*	145.867	10421.115	21	64				64	0.439	
Bay of Biscay and the Iberian Coast	27.8.a	Nets	Marine bird	*Morus bassanus*	145.867	10421.115	2	2				2	0.014	
Bay of Biscay and the Iberian Coast	27.8.a	Nets	Marine Mammal	*Delphinus delphis*	145.867	10421.115	1	1				1	0.007	
Bay of Biscay and the Iberian Coast	27.8.a	Nets	Marine Mammal	*Halichoerus grypus*	145.867	10421.115	2	2				2	0.014	

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Bay of Biscay and the Iberian Coast	27.8.a	Nets	Teleost fish	*Alosa alosa*	145.867	10421.115	10	49				49	0.336	
Bay of Biscay and the Iberian Coast	27.8.a	Nets	Teleost fish	*Hippocampus hippocampus*	145.867	10421.115	1	1				1	0.007	
Bay of Biscay and the Iberian Coast	27.8.a	Nets	Teleost fish	*Alosa fallax*	145.867	10421.115	8	10				10	0.069	
Bay of Biscay and the Iberian Coast	27.8.a	Pelagic trawls	Marine bird	*Morus bassanus*	50.344	1562.0579	1	1				1	0.020	
Bay of Biscay and the Iberian Coast	27.8.a	Pelagic trawls	Marine Mammal	*Delphinus delphis*	50.344	1562.0579	1	1				1	0.020	
Bay of Biscay and the Iberian Coast	27.8.a	Pelagic trawls	Teleost fish	*Alosa alosa*	50.344	1562.0579	2	4				4	0.079	
Bay of Biscay and the Iberian Coast	27.8.a	Seines	Teleost fish	*Alosa alosa*	17.444	702.94417	5	6				6	0.344	
Bay of Biscay and the Iberian Coast	27.8.a	Seines	Teleost fish	*Alosa fallax*	17.444	702.94417	2	2				2	0.115	
Bay of Biscay and the Iberian Coast	27.8.b	Bottom trawls	Elasmo-branch	*Raja microocellata*	41.881	10759.01	2	5				5	0.119	
Bay of Biscay and the Iberian Coast	27.8.b	Bottom trawls	Elasmo-branch	*Raja undulata*	41.881	10759.01	5	11				11	0.263	
Bay of Biscay and the Iberian Coast	27.8.b	Bottom trawls	Teleost fish	*Alosa fallax*	41.881	10759.01	2	5				5	0.119	

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Bay of Biscay and the Iberian Coast	27.8.b	Longlines	Elasmo-branch	*Raja undulata*	11.633	2813.7472	2	3				3	0.258	
Bay of Biscay and the Iberian Coast	27.8.b	Longlines	Teleost fish	*Petromyzon marinus*	11.633	2813.7472	2	2				2	0.172	
Bay of Biscay and the Iberian Coast	27.8.b	Nets	Elasmo-branch	*Hexanchus griseus*	172.344	7279.9816	1	1				1	0.006	
Bay of Biscay and the Iberian Coast	27.8.b	Nets	Elasmo-branch	*Raja microocellata*	172.344	7279.9816	23	131				131	0.760	
Bay of Biscay and the Iberian Coast	27.8.b	Nets	Elasmo-branch	*Squalus acanthias*	172.344	7279.9816	1	1				1	0.006	
Bay of Biscay and the Iberian Coast	27.8.b	Nets	Elasmo-branch	*Raja undulata*	172.344	7279.9816	74	240				240	1.393	
Bay of Biscay and the Iberian Coast	27.8.b	Nets	Marine bird	*Uria aalge*	172.344	7279.9816	12	37				37	0.215	
Bay of Biscay and the Iberian Coast	27.8.b	Nets	Marine bird	*Morus bassanus*	172.344	7279.9816	3	3				3	0.017	
Bay of Biscay and the Iberian Coast	27.8.b	Nets	Marine Mammal	*Phocoena phocoena*	172.344	7279.9816	1	1				1	0.006	
Bay of Biscay and the Iberian Coast	27.8.b	Nets	Marine Mammal	*Delphinus delphis*	172.344	7279.9816	5	7				7	0.041	
Bay of Biscay and the Iberian Coast	27.8.b	Nets	Teleost fish	*Alosa alosa*	172.344	7279.9816	21	36				36	0.209	

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Bay of Biscay and the Iberian Coast	27.8.b	Nets	Teleost fish	*Acipenser sturio*	172.344	7279.9816	4	6				6	0.035	
Bay of Biscay and the Iberian Coast	27.8.b	Nets	Teleost fish	*Petromyzon marinus*	172.344	7279.9816	1	1				1	0.006	
Bay of Biscay and the Iberian Coast	27.8.b	Nets	Teleost fish	*Hippocampus hippocampus*	172.344	7279.9816	1	1				1	0.006	
Bay of Biscay and the Iberian Coast	27.8.b	Nets	Teleost fish	*Alosa fallax*	172.344	7279.9816	45	325				325	1.886	
Bay of Biscay and the Iberian Coast	27.8.b	Pelagic trawls	Teleost fish	*Alosa fallax*	11	762.69176	4	53				53	4.818	
Bay of Biscay and the Iberian Coast	27.8.b	Seines	Elasmo-branch	*Hexanchus griseus*	7.701	282.81083	1	1				1	0.130	
Bay of Biscay and the Iberian Coast	27.8.c	Bottom trawls	Elasmo-branch	*Raja undulata*	94	11049.86	22			7*		7		0.074
Bay of Biscay and the Iberian Coast	27.8.c	Bottom trawls	Teleost fish	*Alosa alosa*	94	11049.86	5			6*		6		0.064
Bay of Biscay and the Iberian Coast	27.8.c	Bottom trawls	Teleost fish	*Alosa fallax*	94	11049.86	34			4*		4		0.043
Bay of Biscay and the Iberian Coast	27.8.c	Nets	Teleost fish	*Alosa fallax*	29	33177.279	10			3*		3		0.103
Bay of Biscay and the Iberian Coast	27.8.c	Pelagic trawls	Marine Mammal	*Delphinus delphis*	10.528	187.83875	1	1				1	0.095	

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Bay of Biscay and the Iberian Coast	27.8.d	Nets	Elasmo-branch	*Cetorhinus maximus*	9.907	294.37416	1	1				1	0.101	
Bay of Biscay and the Iberian Coast	27.8.d	Nets	Elasmo-branch	*Dipturusbatis*	9.907	294.37416	1	1				1	0.101	
Bay of Biscay and the Iberian Coast	27.8.d	Nets	Elasmo-branch	*Leucoraja circularis*	9.907	294.37416	13	143				143	14.435	
Bay of Biscay and the Iberian Coast	27.9.a	Bottom trawls	Elasmo-branch	*Raja undulata*	149	50861.487	98			15*		15		0.101
Bay of Biscay and the Iberian Coast	27.9.a	Bottom trawls	Teleost fish	*Alosa fallax*	149	50861.487	93	1		23*		24		0.154
Bay of Biscay and the Iberian Coast	27.9.a	Nets	Marine Mammal	*Tursiops truncatus*	21	109869.46	1		1			1		0.048
Bay of Biscay and the Iberian Coast	27.9.a	Nets	Teleost fish	*Alosa*	21	109869.46	1		3			3		0.143
Bay of Biscay and the Iberian Coast	27.9.a	Nets	Teleost fish	*Alosa fallax*	21	109869.46	4			4		4		0.190
Bay of Biscay and the Iberian Coast	27.9.a	Seines	Marine bird	*Larus michahellis*	68	13674	1	1				1	0.015	
Bay of Biscay and the Iberian Coast	27.9.a	Surrounding nets	Teleost fish	*Alosa fallax*	28	17597.488	9			2*		2		0.071
Celtic Seas	27.6.a	Bottom trawls	Elasmo-branch	*Hexanchus griseus*	259.158	23117.753	7	9				9	0.035	

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Celtic Seas	27.6.a	Bottom trawls	Elasmo-branch	*Dipturus batis*	259.158	23117.753	11	69				69	0.266	
Celtic Seas	27.6.a	Bottom trawls	Elasmo-branch	*Dalatiaslicha*	259.158	23117.753	5	5				5	0.019	
Celtic Seas	27.6.a	Bottom trawls	Elasmo-branch	*Chlamydoselachus anguineus*	259.158	23117.753	1	1				1	0.004	
Celtic Seas	27.6.a	Bottom trawls	Elasmo-branch	*Dipturus oxyrinchus*	259.158	23117.753	18	121				121	0.467	
Celtic Seas	27.6.a	Bottom trawls	Elasmo-branch	*Squalus acanthias*	259.158	23117.753	13	47		55		102		0.212
Celtic Seas	27.6.a	Bottom trawls	Elasmo-branch	*Raja clavata*	259.158	23117.753	47		357			357		1.378
Celtic Seas	27.6.a	Bottom trawls	Marine Mammal	*Phoca vitulina*	259.158	23117.753	1		1			1		0.004
Celtic Seas	27.6.a	Bottom trawls	Teleost fish	*Hippoglossus hippoglossus*	259.158	23117.753	6		8			8		0.031
Celtic Seas	27.6.a	Bottom trawls	Teleost fish	*Alosa fallax*	259.158	23117.753	1		1			1		0.004
Celtic Seas	27.6.a	Longlines	Elasmo-branch	*Squalus acanthias*	49	2805.1727	1	2				2	0.041	
Celtic Seas	27.6.a	Longlines	Marine bird	*Morus bassanus*	49	2805.1727	4	5				5	0.102	
Celtic Seas	27.6.a	Pelagic trawls	Elasmo-branch	*Lamna nasus*	124	2300.5363	8	8				8	0.065	

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Celtic Seas	27.6.a	Pelagic trawls	Elasmo-branch	*Squalus acanthias*	124	2300.5363	3	3				3	0.024	
Celtic Seas	27.6.a	Pelagic trawls	Marine Mammal	*Halichoerus grypus*	124	2300.5363	1	1				1	0.008	
Celtic Seas	27.6.b	Bottom trawls	Elasmo-branch	*Raja clavata*	15	2010.4635	17		77			77		5.133
Celtic Seas	27.6.b	Bottom trawls	Teleost fish	*Hippoglossus hippoglossus*	15	2010.4635	1		1			1		0.067
Celtic Seas	27.7.a	Bottom trawls	Elasmo-branch	*Squalus acanthias*	339.430	15029.092	55			619		619		1.824
Celtic Seas	27.7.a	Bottom trawls	Elasmo-branch	*Raja clavata*	339.430	15029.092	11		33			33		0.097
Celtic Seas	27.7.a	Nets	Elasmo-branch	*Raja microocellata*	5	353.19671	1		1			1		0.200
Celtic Seas	27.7.a	Nets	Elasmo-branch	*Squalus acanthias*	5	353.19671	2		7			7		1.400
Celtic Seas	27.7.b	Bottom trawls	Elasmo-branch	*Dipturus batis*	33.833	3093.7054	1	1				1	0.030	
Celtic Seas	27.7.b	Bottom trawls	Elasmo-branch	*Raja clavata*	33.833	3093.7054	7		66			66		1.951
Celtic Seas	27.7.b	Pelagic trawls	Marine bird	*Morus bassanus*	12	457.87347	1		1			1		0.083
Celtic Seas	27.7.c	Bottom trawls	Elasmo-branch	*Dipturus batis*	18.119	3669.6468	4	5				5	0.276	

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Celtic Seas	27.7.c	Pelagic trawls	Elasmo-branch	*Centrophorus granulosus*	12	382.27693	4	4				4	0.333	
Celtic Seas	27.7.f	Bottom trawls	Elasmo-branch	*Tetronarce nobiliana*	120.871	11138.257	1	1				1	0.008	
Celtic Seas	27.7.f	Bottom trawls	Elasmo-branch	*Dipturus batis*	120.871	11138.257	2			211.5		211.5		1.750
Celtic Seas	27.7.f	Bottom trawls	Elasmo-branch	*Squalus acanthias*	120.871	11138.257	2	2				2	0.017	
Celtic Seas	27.7.f	Bottom trawls	Marine Mammal	*Delphinus delphis*	120.871	11138.257	1	1				1	0.008	
Celtic Seas	27.7.f	Nets	Elasmo-branch	*Prionage glauca*	66	2695.0822	2		2			2		0.030
Celtic Seas	27.7.f	Nets	Elasmo-branch	*Raja microocellata*	66	2695.0822	7		12			12		0.182
Celtic Seas	27.7.f	Nets	Elasmo-branch	*Squalus acanthias*	66	2695.0822	9		17			17		0.258
Celtic Seas	27.7.f	Nets	Elasmo-branch	*Galeorhinusgaleus*	66	2695.0822	13		40			40		0.606
Celtic Seas	27.7.f	Nets	Elasmo-branch	*Raja undulata*	66	2695.0822	1		1			1		0.015
Celtic Seas	27.7.f	Nets	Marine bird	*Uria aalge*	66	2695.0822	4		5			5		0.076
Celtic Seas	27.7.f	Nets	Marine bird	*Phalacrocorax carbo*	66	2695.0822	2		2			2		0.030

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Celtic Seas	27.7.f	Nets	Marine Mammal	*Halichoerus grypus*	66	2695.0822	1		1			1		0.015
Celtic Seas	27.7.f	Nets	Teleost fish	*Alosa*	66	2695.0822	1		1			1		0.015
Celtic Seas	27.7.f	Surrounding nets	Marine bird	*Larus argentatus*	13	103.5	3		3			3		0.231
Celtic Seas	27.7.g	Bottom trawls	Elasmo-branch	*Tetronarce nobiliana*	477.182	24146.819	3	3				3	0.006	
Celtic Seas	27.7.g	Bottom trawls	Elasmo-branch	*Dipturus batis*	477.182	24146.819	91	466	22	1066		1554		2.281
Celtic Seas	27.7.g	Bottom trawls	Elasmo-branch	*Dipturus intermedius*	477.182	24146.819	1		1			1		0.002
Celtic Seas	27.7.g	Bottom trawls	Elasmo-branch	*Squalus acanthias*	477.182	24146.819	22	84				84	0.176	
Celtic Seas	27.7.g	Bottom trawls	Elasmo-branch	*Raja clavata*	477.182	24146.819	37		47			47		0.098
Celtic Seas	27.7.g	Bottom trawls	Marine bird	*Morus bassanus*	477.182	24146.819	1		1			1		0.002
Celtic Seas	27.7.g	Bottom trawls	Marine Mammal	*Delphinus delphis*	477.182	24146.819	5	5				5	0.010	
Celtic Seas	27.7.g	Bottom trawls	Teleost fish	*Alosa fallax*	477.182	24146.819	3	1	2			3		0.004
Celtic Seas	27.7.g	Nets	Elasmo-branch	*Lamna nasus*	63	2302.4727	9		9			9		0.143

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Celtic Seas	27.7.g	Nets	Elasmo-branch	*Prionage glauca*	63	2302.4727	13		15			15		0.238
Celtic Seas	27.7.g	Nets	Elasmo-branch	*Dipturus batis*	63	2302.4727	18	4	47			51		0.746
Celtic Seas	27.7.g	Nets	Elasmo-branch	*Squalus acanthias*	63	2302.4727	62	343	80			423		1.270
Celtic Seas	27.7.g	Nets	Elasmo-branch	*Galeorhinusgaleus*	63	2302.4727	15	8	21			29		0.333
Celtic Seas	27.7.g	Nets	Marine bird	*Uria aalge*	63	2302.4727	2		12			12		0.190
Celtic Seas	27.7.g	Nets	Marine Mammal	*Phocoena phocoena*	63	2302.4727	1		1			1		0.016
Celtic Seas	27.7.g	Nets	Marine Mammal	*Delphinus delphis*	63	2302.4727	2		2			2		0.032
Celtic Seas	27.7.g	Pelagic trawls	Elasmo-branch	*Lamna nasus*	9	185.86577	1	1				1	0.111	
Celtic Seas	27.7.h	Bottom trawls	Elasmo-branch	*Tetronarce nobiliana*	860.618	11591.212	8	8				8	0.009	
Celtic Seas	27.7.h	Bottom trawls	Elasmo-branch	*Hexanchus griseus*	860.618	11591.212	1	1				1	0.001	
Celtic Seas	27.7.h	Bottom trawls	Elasmo-branch	*Dipturus batis*	860.618	11591.212	127	544				544	0.632	

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Celtic Seas	27.7.h	Bottom trawls	Elasmo-branch	*Dalatias licha*	860.618	11591.212	2	2				2	0.002	
Celtic Seas	27.7.h	Bottom trawls	Elasmo-branch	*Raja microocellata*	860.618	11591.212	1	1				1	0.001	
Celtic Seas	27.7.h	Bottom trawls	Elasmo-branch	*Squalus acanthias*	860.618	11591.212	12	25				25	0.029	
Celtic Seas	27.7.h	Bottom trawls	Elasmo-branch	*Leucoraja circularis*	860.618	11591.212	5	35				35	0.041	
Celtic Seas	27.7.h	Bottom trawls	Elasmo-branch	*Raja undulata*	860.618	11591.212	2	2				2	0.002	
Celtic Seas	27.7.h	Bottom trawls	Marine Mammal	*Phocoena phocoena*	860.618	11591.212	1	1				1	0.001	
Celtic Seas	27.7.h	Nets	Elasmo-branch	*Lamna nasus*	29.583	1168.5103	2		3			3		0.101
Celtic Seas	27.7.h	Nets	Elasmo-branch	*Dipturus batis*	29.583	1168.5103	2	1	1			2		0.034
Celtic Seas	27.7.h	Nets	Elasmo-branch	*Raja microocellata*	29.583	1168.5103	1	1				1	0.034	
Celtic Seas	27.7.h	Nets	Elasmo-branch	*Squalus acanthias*	29.583	1168.5103	23	180				180	6.085	
Celtic Seas	27.7.h	Nets	Elasmo-branch	*Galeorhinus galeus*	29.583	1168.5103	7	18	2			20		0.068

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Celtic Seas	27.7.h	Nets	Elasmo-branch	*Raja undulata*	29.583	1168.5103	5	7				7	0.237	
Celtic Seas	27.7.h	Nets	Marine Mammal	*Halichoerus grypus*	29.583	1168.5103	1	1				1	0.034	
Celtic Seas	27.7.h	Pelagic trawls	Elasmo-branch	*Lamna nasus*	11	252.41395	21	34				34	3.091	
Celtic Seas	27.7.h	Pelagic trawls	Elasmo-branch	*Cetorhinus maximus*	11	252.41395	1	3				3	0.273	
Celtic Seas	27.7.j	Bottom trawls	Elasmo-branch	*Dipturus nidarosiensis*	312.843	11512.017	1	1				1	0.003	
Celtic Seas	27.7.j	Bottom trawls	Elasmo-branch	*Hexanchus griseus*	312.843	11512.017	9	22				22	0.070	
Celtic Seas	27.7.j	Bottom trawls	Elasmo-branch	*Dipturus batis*	312.843	11512.017	199	53		130		183		0.416
Celtic Seas	27.7.j	Bottom trawls	Elasmo-branch	*Dalatias licha*	312.843	11512.017	9	14				14	0.045	
Celtic Seas	27.7.j	Bottom trawls	Elasmo-branch	*Dipturus oxyrinchus*	312.843	11512.017	8	11				11	0.035	
Celtic Seas	27.7.j	Bottom trawls	Elasmo-branch	*Squalus acanthias*	312.843	11512.017	7	14				14	0.045	
Celtic Seas	27.7.j	Bottom trawls	Elasmo-branch	*Raja clavata*	312.843	11512.017	2		25			25		0.080

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Celtic Seas	27.7.j	Bottom trawls	Elasmo-branch	*Leucoraja circularis*	312.843	11512.017	1	1				1	0.003	
Celtic Seas	27.7.j	Bottom trawls	Marine Mammal	*Phocoena phocoena*	312.843	11512.017	1		1			1		0.003
Celtic Seas	27.7.j	Bottom trawls	Marine Mammal	*Delphinus delphis*	312.843	11512.017	1	1				1	0.003	
Celtic Seas	27.7.j	Bottom trawls	Teleost fish	*Alosa fallax*	312.843	11512.017	1		1			1		0.003
Celtic Seas	27.7.j	Nets	Elasmo-branch	*Squalus acanthias*	175	3200.8046	1		1			1		0.006
Celtic Seas	27.7.j	Nets	Elasmo-branch	*Raja clavata*	175	3200.8046	54		84			84		0.480
Celtic Seas	27.7.j	Nets	Marine Mammal	*Halichoerus grypus*	175	3200.8046	37		43			43		0.246
Celtic Seas	27.7.j	Nets	Teleost fish	*Alosa alosa*	175	3200.8046	3	4				4	0.023	
Celtic Seas	27.7.j	Pelagic trawls	Elasmo-branch	*Lamna nasus*	14	474.80297	2	4				4	0.286	
Celtic Seas	27.7.k	Bottom trawls	Elasmo-branch	*Hexanchus griseus*	26.326	3799.9565	1	1				1	0.038	
Celtic Seas	27.7.k	Bottom trawls	Elasmo-branch	*Dipturus batis*	26.326	3799.9565	15	1		8		9		0.304
Celtic Seas	27.7.k	Bottom trawls	Elasmo-branch	*Dalatias licha*	26.326	3799.9565	1	1				1	0.038	

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Celtic Seas	27.7.k	Pelagic trawls	Elasmo-branch	*Centrophorus squamosus*	9	163.05969	1	1				1	0.111	
Faroes	27.5.b	Bottom trawls	Elasmo-branch	*Dalatias licha*	5.835	178.61036	1	2				2	0.343	
Greater North Sea	27.3.a.20	Bottom trawls	Elasmo-branch	*Dipturus batis*	161	29631.353	4	3		1		4		0.006
Greater North Sea	27.3.a.20	Bottom trawls	Elasmo-branch	*Dipturus linteus*	161	29631.353	6	5		5		10		0.031
Greater North Sea	27.3.a.20	Bottom trawls	Elasmo-branch	*Raja clavata*	161	29631.353	18	9		35		44		0.217
Greater North Sea	27.3.a.20	Bottom trawls	Elasmo-branch	*Amblyraja radiata*	161	29631.353	67	183		894		1077		5.553
Greater North Sea	27.3.a.20	Bottom trawls	Teleost fish	*Hippoglossus hippoglossus*	161	29631.353	2			5		5		0.031
Greater North Sea	27.3.a.20	Bottom trawls	Teleost fish	*Alosa fallax*	161	29631.353	1	1				1	0.006	
Greater North Sea	27.3.a.20	Nets	Marine bird	*Melanitta nigra*	10	7634.5833	1	1				1	0.100	
Greater North Sea	27.3.a.20	Nets	Marine bird	*Phalacrocorax carbo*	10	7634.5833	1	1				1	0.100	
Greater North Sea	27.3.a.20	Seines	Elasmo-branch	*Amblyraja radiata*	17	2051.2222	8	39				39	2.294	
Greater North Sea	27.3.a.21	Bottom trawls	Elasmo-branch	*Raja clavata*	85	14172.333	7	6		24		30		0.282

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Greater North Sea	27.3.a.21	Bottom trawls	Elasmo-branch	*Amblyraja radiata*	85	14172.333	10	15		7		22		0.082
Greater North Sea	27.4.a	Bottom trawls	Elasmo-branch	*Dipturus batis*	347.955	41430.559	18	34		8		42		0.023
Greater North Sea	27.4.a	Bottom trawls	Elasmo-branch	*Dipturus oxyrinchus*	347.955	41430.559	3	4				4	0.011	
Greater North Sea	27.4.a	Bottom trawls	Elasmo-branch	*Dipturus linteus*	347.955	41430.559	5	13				13	0.037	
Greater North Sea	27.4.a	Bottom trawls	Elasmo-branch	*Squalus acanthias*	347.955	41430.559	3	3				3	0.009	
Greater North Sea	27.4.a	Bottom trawls	Elasmo-branch	*Raja clavata*	347.955	41430.559	1	1				1	0.003	
Greater North Sea	27.4.a	Bottom trawls	Elasmo-branch	*Leucoraja circularis*	347.955	41430.559	1	1				1	0.003	
Greater North Sea	27.4.a	Bottom trawls	Elasmo-branch	*Amblyraja radiata*	347.955	41430.559	85	2446		12		2458		0.034
Greater North Sea	27.4.a	Bottom trawls	Teleost fish	*Hippoglossus hippoglossus*	347.955	41430.559	10			28		28		0.080
Greater North Sea	27.4.a	Longlines	Elasmo-branch	*Squalus acanthias*	58	4955.8077	1	1				1	0.017	
Greater North Sea	27.4.a	Longlines	Marine bird	*Fulmarus glacialis*	58	4955.8077	5		18			18		0.310
Greater North Sea	27.4.a	Longlines	Marine bird	*Morus bassanus*	58	4955.8077	1		2			2		0.034

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Greater North Sea	27.4.a	Pelagic trawls	Elasmo-branch	*Squalus acanthias*	68	2022.079	13	13				13	0.191	
Greater North Sea	27.4.a	Seines	Elasmo-branch	*Amblyraja radiata*	7	3999.2174	3	7				7	1.000	
Greater North Sea	27.4.b	Bottom trawls	Elasmo-branch	*Rajella lintea*	160.167	88836.646	1			1		1		0.006
Greater North Sea	27.4.b	Bottom trawls	Elasmo-branch	*Dipturus batis*	160.167	88836.646	2			2		2		0.012
Greater North Sea	27.4.b	Bottom trawls	Elasmo-branch	*Raja montagui*	160.167	88836.646	122			1803		1803		11.255
Greater North Sea	27.4.b	Bottom trawls	Elasmo-branch	*Raja clavata*	160.167	88836.646	28			336.1		336.1		2.099
Greater North Sea	27.4.b	Bottom trawls	Elasmo-branch	*Amblyraja radiata*	160.167	88836.646	41	227		2663		2890		16.626
Greater North Sea	27.4.b	Bottom trawls	Elasmo-branch	*Mustelus asterias*	160.167	88836.646	1			14		14		0.087
Greater North Sea	27.4.b	Bottom trawls	Teleost fish	*Hippoglossus hippoglossus*	160.167	88836.646	17			31		31		0.194
Greater North Sea	27.4.b	Bottom trawls	Teleost fish	*Lampetra fluviatilis*	160.167	88836.646	3			13		13		0.081
Greater North Sea	27.4.b	Bottom trawls	Teleost fish	*Alosa fallax*	160.167	88836.646	4	1	2	1		4		0.019
Greater North Sea	27.4.b	Nets	Elasmo-branch	*Amblyraja radiata*	9	12317.236	1	1				1	0.111	

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Greater North Sea	27.4.b	Pelagic trawls	Elasmo-branch	*Lamna nasus*	30.833	666.48315	1	1				1	0.032	
Greater North Sea	27.4.b	Pelagic trawls	Marine Mammal	*Halichoerus grypus*	30.833	666.48315	9	5	6			11		0.195
Greater North Sea	27.4.c	Bottom trawls	Elasmo-branch	*Dipturus batis*	85.846	36941.096	2			2		2		0.023
Greater North Sea	27.4.c	Bottom trawls	Elasmo-branch	*Raja montagui*	85.846	36941.096	197			3574		3574		41.636
Greater North Sea	27.4.c	Bottom trawls	Elasmo-branch	*Raja clavata*	85.846	36941.096	230			3816		3816		44.450
Greater North Sea	27.4.c	Bottom trawls	Elasmo-branch	*Mustelus mustelus*	85.846	36941.096	12			277		277.2		3.230
Greater North Sea	27.4.c	Bottom trawls	Elasmo-branch	*Mustelus asterias*	85.846	36941.096	11			158		157.5		1.835
Greater North Sea	27.4.c	Bottom trawls	Elasmo-branch	*Galeorhinus galeus*	85.846	36941.096	2			2		2		0.023
Greater North Sea	27.4.c	Bottom trawls	Teleost fish	*Hippocampus hippocampus*	85.846	36941.096	1			12		11.5		0.134
Greater North Sea	27.4.c	Longlines	Elasmo-branch	*Squalus acanthias*	2	259.31736	1		1			1		0.500
Greater North Sea	27.4.c	Nets	Elasmo-branch	*Mustelus mustelus*	18	3682.7819	3			3		3		0.167

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Greater North Sea	27.4.c	Nets	Marine Mammal	*Phocoena phocoena*	18	3682.7819	1		1			1		0.056
Greater North Sea	27.4.c	Rods and lines	Marine bird	*Morus bassanus*	3	86.25	1	1				1	0.333	
Greater North Sea	27.7.d	Bottom trawls	Elasmo-branch	*Dipturus batis*	217.468	28150.301	2			15		14.75		0.068
Greater North Sea	27.7.d	Bottom trawls	Elasmo-branch	*Squalus acanthias*	217.468	28150.301	1	2				2	0.009	
Greater North Sea	27.7.d	Bottom trawls	Elasmo-branch	*Galeorhinus galeus*	217.468	28150.301	1		1			1		0.005
Greater North Sea	27.7.d	Bottom trawls	Elasmo-branch	*Raja undulata*	217.468	28150.301	111	302		69		370.9		0.317
Greater North Sea	27.7.d	Bottom trawls	Teleost fish	*Alosa alosa*	217.468	28150.301	1	1				1	0.005	
Greater North Sea	27.7.d	Bottom trawls	Teleost fish	*Alosa fallax*	217.468	28150.301	2	6				6	0.028	
Greater North Sea	27.7.d	Nets	Elasmo-branch	*Dasyatis pastinaca*	131	11816.962	1		1			1		0.008
Greater North Sea	27.7.d	Nets	Elasmo-branch	*Raja microocellata*	131	11816.962	13		30			30		0.229
Greater North Sea	27.7.d	Nets	Elasmo-branch	*Raja undulata*	131	11816.962	78	69	129			198		0.985
Greater North Sea	27.7.d	Nets	Marine bird	*Uria aalge*	131	11816.962	1		1			1		0.008

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Greater North Sea	27.7.d	Nets	Teleost fish	*Alosa*	131	11816.962	5		6			6		0.046
Greater North Sea	27.7.d	Nets	Teleost fish	*Alosa alosa*	131	11816.962	3	4				4	0.031	
Greater North Sea	27.7.d	Nets	Teleost fish	*Acipenser sturio*	131	11816.962	1	1				1	0.008	
Greater North Sea	27.7.d	Nets	Teleost fish	*Hippocampus guttulatus*	131	11816.962	3		3			3		0.023
Greater North Sea	27.7.d	Pelagic trawls	Elasmo-branch	*Lamna nasus*	55.815	1006.7213	2	2				2	0.036	
Greater North Sea	27.7.d	Pelagic trawls	Elasmo-branch	*Mustelus mustelus*	55.815	1006.7213	3	3				3	0.054	
Greater North Sea	27.7.d	Pelagic trawls	Elasmo-branch	*Mustelus asterias*	55.815	1006.7213	17	17				17	0.305	
Greater North Sea	27.7.d	Pelagic trawls	Elasmo-branch	*Raja undulata*	55.815	1006.7213	7	24				24	0.430	
Greater North Sea	27.7.d	Pelagic trawls	Teleost fish	*Alosa alosa*	55.815	1006.7213	3	5				5	0.090	
Greater North Sea	27.7.d	Pelagic trawls	Teleost fish	*Alosa fallax*	55.815	1006.7213	1	5				5	0.090	
Greater North Sea	27.7.d	Seines	Elasmo-branch	*Raja undulata*	9.779	3365.5056	2	2				2	0.205	
Greater North Sea	27.7.e	Bottom trawls	Elasmo-branch	*Tetronarce nobiliana*	439.135	31665.05	4	2	2			4		0.005
Greater North Sea	27.7.e	Bottom trawls	Elasmo-branch	*Prionage glauca*	439.135	31665.05	2	2				2	0.005	

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Greater North Sea	27.7.e	Bottom trawls	Elasmo-branch	*Dipturusbatis*	439.135	31665.05	66	451	1			452		0.002
Greater North Sea	27.7.e	Bottom trawls	Elasmo-branch	*Torpedo marmorata*	439.135	31665.05	16	25				25	0.057	
Greater North Sea	27.7.e	Bottom trawls	Elasmo-branch	*Raja microocellata*	439.135	31665.05	1	2				2	0.005	
Greater North Sea	27.7.e	Bottom trawls	Elasmo-branch	*Squalus acanthias*	439.135	31665.05	16	26	11			37		0.025
Greater North Sea	27.7.e	Bottom trawls	Elasmo-branch	*Galeorhinus galeus*	439.135	31665.05	4	4	4			8		0.009
Greater North Sea	27.7.e	Bottom trawls	Elasmo-branch	*Raja undulata*	439.135	31665.05	167	857	67			924		0.153
Greater North Sea	27.7.e	Bottom trawls	Marine Mammal	*Delphinus delphis*	439.135	31665.05	2	3				3	0.007	
Greater North Sea	27.7.e	Bottom trawls	Marine Mammal	*Halichoerus grypus*	439.135	31665.05	1	1				1	0.002	
Greater North Sea	27.7.e	Bottom trawls	Teleost fish	*Alosa fallax*	439.135	31665.05	6	10	23			33		0.052
Greater North Sea	27.7.e	Dredges	Elasmo-branch	*Raja undulata*	16	10038.482	1	1				1	0.063	
Greater North Sea	27.7.e	Nets	Elasmo-branch	*Lamna nasus*	164.524	11442.159	4		4			4		0.024

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Greater North Sea	27.7.e	Nets	Elasmo-branch	*Prionage glauca*	164.524	11442.159	1		1			1		0.006
Greater North Sea	27.7.e	Nets	Elasmo-branch	*Dipturus batis*	164.524	11442.159	15	8	11			19		0.067
Greater North Sea	27.7.e	Nets	Elasmo-branch	*Raja microocellata*	164.524	11442.159	8	3	468			471		2.845
Greater North Sea	27.7.e	Nets	Elasmo-branch	*Squalus acanthias*	164.524	11442.159	33	490	268			758		1.629
Greater North Sea	27.7.e	Nets	Elasmo-branch	*Galeorhinusgaleus*	164.524	11442.159	17	6	14			20		0.085
Greater North Sea	27.7.e	Nets	Elasmo-branch	*Raja undulata*	164.524	11442.159	29	117	6			123		0.036
Greater North Sea	27.7.e	Nets	Marine bird	*Uria aalge*	164.524	11442.159	2	1	2			3		0.012
Greater North Sea	27.7.e	Nets	Marine bird	*Phalacrocorax carbo*	164.524	11442.159	2	3	1			4		0.006
Greater North Sea	27.7.e	Nets	Marine Mammal	*Halichoerus grypus*	164.524	11442.159	3	2	1			3		0.006
Greater North Sea	27.7.e	Nets	Teleost fish	*Alosa alosa*	164.524	11442.159	3		20			20		0.122
Greater North Sea	27.7.e	Nets	Teleost fish	*Alosa fallax*	164.524	11442.159	1	1				1	0.006	
Greater North Sea	27.7.e	Pelagic trawls	Elasmo-branch	*Alopias vulpinus*	12	713.29374	1	1				1	0.083	

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Greater North Sea	27.7.e	Rods and lines	Elasmo-branch	*Prionage glauca*	39	5656.5275	1		4			4		0.103
Greenland Sea	27.14.b.2	Bottom trawls	Elasmo-branch	*Rajella lintea*	71	387	1			3		3		0.042
Greenland Sea	27.14.b.2	Bottom trawls	Elasmo-branch	*Dipturus batis*	71	387	13			14		14		0.197
Greenland Sea	27.14.b.2	Bottom trawls	Elasmo-branch	*Centrophorus squamosus*	71	387	1			1		1		0.014
Greenland Sea	27.14.b.2	Bottom trawls	Elasmo-branch	*Centroscymnus coelolepis*	71	387	8			8		8		0.113
Greenland Sea	27.14.b.2	Bottom trawls	Elasmo-branch	*Amblyraja radiata*	71	387	38			128		128		1.803
Greenland Sea	27.14.b.2	Bottom trawls	Teleost fish	*Hippoglossus hippoglossus*	71	387	33			68		68		0.958
Iceland Sea	27.5.a.2	Bottom trawls	Elasmo-branch	*Lamna nasus*	357	11308	1		1			1		0.003
Iceland Sea	27.5.a.2	Bottom trawls	Teleost fish	*Hippoglossus hippoglossus*	357	11308	4		4			4		0.011
Iceland Sea	27.5.a.2	Longlines	Marine bird	*Fulmarus glacialis*	94	13149	5		70			70		0.745
Iceland Sea	27.5.a.2	Longlines	Marine bird	*Morus bassanus*	94	13149	1		1			1		0.011
Iceland Sea	27.5.a.2	Nets	Marine bird	*Uria aalge*	229	7634	14		161			161		0.703
Iceland Sea	27.5.a.2	Nets	Marine bird	*Fratercula arctica*	229	7634	2		2			2		0.009

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Iceland Sea	27.5.a.2	Nets	Marine bird	*Cepphus grylle*	229	7634	24		53			53		0.231
Iceland Sea	27.5.a.2	Nets	Marine bird	*Uria lomvia*	229	7634	3		3			3		0.013
Iceland Sea	27.5.a.2	Nets	Marine bird	*Somateria mollissima*	229	7634	25		112			112		0.489
Iceland Sea	27.5.a.2	Nets	Marine bird	*Phalacrocoracidae*	229	7634	15		31			31		0.135
Iceland Sea	27.5.a.2	Nets	Marine bird	*Fulmarus glacialis*	229	7634	2		2			2		0.009
Iceland Sea	27.5.a.2	Nets	Marine bird	*Morus bassanus*	229	7634	1		1			1		0.004
Iceland Sea	27.5.a.2	Nets	Marine bird	*Clangula hyemalis*	229	7634	2		2			2		0.009
Iceland Sea	27.5.a.2	Nets	Marine bird	*Alca torda*	229	7634	1		1			1		0.004
Iceland Sea	27.5.a.2	Nets	Marine Mammal	*Phocoena*	229	7634	36		46			46		0.201
Iceland Sea	27.5.a.2	Nets	Marine Mammal	*Phoca vitulina*	229	7634	27		61			61		0.266
Iceland Sea	27.5.a.2	Nets	Marine Mammal	*Halichoerus grypus*	229	7634	10		21			21		0.092
Iceland Sea	27.5.a.2	Nets	Marine Mammal	*Pagophilus groenlandicus*	229	7634	8		15			15		0.066
Iceland Sea	27.5.a.2	Nets	Marine Mammal	*Pusa hispida*	229	7634	2		2			2		0.009

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Iceland Sea	27.5.a.2	Nets	Marine Mammal	*Lagenorhynchus albirostris*	229	7634	2		2			2		0.009
Ionian Sea and the Central	16	Bottom trawls	Elasmo-branch	*Leucoraja melitensis*	1000	55516	3		23			23		0.023
Ionian Sea and the Central	16	Bottom trawls	Elasmo-branch	*Heptranchias perlo*	1000	55516	2		3			3		0.003
Ionian Sea and the Central	16	Bottom trawls	Elasmo-branch	*Rostroraja alba*	1000	55516	2		2			2		0.002
Ionian Sea and the Central	16	Bottom trawls	Marine Mammal	*Tursiops truncatus*	1000	55516	1		1			1		0.001
Ionian Sea and the Central	16	Bottom trawls	Marine tur-tle	*Caretta caretta*	1000	55516	7		7			7		0.007
Ionian Sea and the Central	16	Pelagic trawls	Elasmo-branch	*Raja asterias*	30	3469	1		1			1		0.033
Ionian Sea and the Central	19	Bottom trawls	Elasmo-branch	*Hexanchus*	225	34139	1		2			2		0.009
Ionian Sea and the Central	19	Bottom trawls	Elasmo-branch	*Squalus blainville*	225	34139	2		12			12		0.053
Ionian Sea and the Central	19	Bottom trawls	Elasmo-branch	*Hexanchus griseus*	225	34139	4		4			4		0.018
Ionian Sea and the Central	19	Bottom trawls	Elasmo-branch	*Myliobatis aquila*	225	34139	2		2			2		0.009

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Ionian Sea and the Central	19	Bottom trawls	Elasmo-branch	*Dasyatis pastinaca*	225	34139	3		5			5		0.022
Ionian Sea and the Central	19	Bottom trawls	Elasmo-branch	*Dalatias licha*	225	34139	4		5			5		0.022
Ionian Sea and the Central	19	Bottom trawls	Elasmo-branch	*Pteroplatytrygon violacea*	225	34139	1		1			1		0.004
Ionian Sea and the Central	19	Bottom trawls	Elasmo-branch	*Mustelus mustelus*	225	34139	3		14			14		0.062
Ionian Sea and the Central	19	Bottom trawls	Elasmo-branch	*Mustelus asterias*	225	34139	1		1			1		0.004
Ionian Sea and the Central	19	Bottom trawls	Marine tur-tle	*Caretta caretta*	225	34139	1		1			1		0.004
Ionian Sea and the Central	20	Bottom trawls	Elasmo-branch	*Mustelus punctulatus*	53	5695	2			2		2		0.038
Ionian Sea and the Central	20	Bottom trawls	Elasmo-branch	*Squalus acanthias*	53	5695	2			56		56		1.057
Ionian Sea and the Central	20	Bottom trawls	Elasmo-branch	*Mustelus mustelus*	53	5695	6			7		7		0.132
Ionian Sea and the Central	20	Bottom trawls	Elasmo-branch	*Gymnura altavela*	53	5695	2			2		2		0.038
Ionian Sea and the Central	20	Bottom trawls	Elasmo-branch	*Mustelus asterias*	53	5695	1			2		2		0.038

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Ionian Sea and the Central	20	Bottom trawls	Teleost fish	*Alosa fallax*	53	5695	2			43		43		0.811
North West Atlantic	21.3.L	Bottom trawls	Elasmo-branch	*Somniosus microcephalus*	93	538	2	2				2	0.022	
North West Atlantic	21.3.L	Bottom trawls	Elasmo-branch	*Centroscymnuscoelolepis*	93	538	1	1				1	0.011	
North West Atlantic	21.3.L	Bottom trawls	Teleost fish	*Hippoglossus hippoglossus*	93	538	27	0				0	0.000 *	
North West Atlantic	21.3.M	Bottom trawls	Elasmo-branch	*Somniosus microcephalus*	76	729	1	1				1	0.013	
North West Atlantic	21.3.M	Bottom trawls	Teleost fish	*Hippoglossus hippoglossus*	76	729	18	0				0	0.000 *	
North West Atlantic	21.3.N	Bottom trawls	Elasmo-branch	*Lamna nasus*	97	969	2	0				0	0.000 *	
North West Atlantic	21.3.N	Bottom trawls	Teleost fish	*Hippoglossus hippoglossus*	97	969	105	0				0	0.000 *	
North West Atlantic	21.3.O	Bottom trawls	Elasmo-branch	*Lamna nasus*	59	625	13	0				0	0.000 *	
North West Atlantic	21.3.O	Bottom trawls	Teleost fish	*Hippoglossus hippoglossus*	59	625	96	0				0	0.000 *	
Norwegian Sea	27.2.a.2	Bottom trawls	Elasmo-branch	*Dipturus batis*	76	223	9			14		14		0.184

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Norwegian Sea	27.2.a.2	Bottom trawls	Elasmo-branch	*Raja clavata*	76	223	3			14		14		0.184
Norwegian Sea	27.2.a.2	Bottom trawls	Elasmo-branch	*Amblyraja radiata*	76	223	39			140		140		1.842
Norwegian Sea	27.2.a.2	Bottom trawls	Teleost fish	*Hippoglossus hippoglossus*	76	223	85			419		419		5.513
Oceanic Northeast Atlantic	27.12.b	Bottom trawls	Elasmo-branch	*Deania calcea*	53	147	16	1				1	0.019	
Oceanic Northeast Atlantic	27.12.b	Bottom trawls	Elasmo-branch	*Etmopterus princeps*	53	147	47	0				0	0.000 *	
Oceanic Northeast Atlantic	27.12.b	Bottom trawls	Elasmo-branch	*Centrophorus squamosus*	53	147	5	5				5	0.094	
Oceanic Northeast Atlantic	27.12.b	Bottom trawls	Elasmo-branch	*Centroscymnus coelolepis*	53	147	58	1				1	0.019	
Oceanic Northeast Atlantic	27.6.b.1	Bottom trawls	Elasmo-branch	*Deania calcea*	31	60	6	0				0	0.000 *	
Oceanic Northeast Atlantic	27.6.b.1	Bottom trawls	Elasmo-branch	*Etmopterus princeps*	31	60	30	0				0	0.000 *	
Oceanic Northeast Atlantic	27.6.b.1	Bottom trawls	Elasmo-branch	*Centroscymnus coelolepis*	31	60	40	1				1	0.032	
Western Mediterranean Sea	1	Bottom trawls	Elasmo-branch	*Dalatias licha*	131	21633	4			23		23		0.176

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Western Mediterranean Sea	1	Bottom trawls	Elasmo-branch	*Centrophorus granulosus*	131	21633	4			4		4		0.031
Western Mediterranean Sea	1	Bottom trawls	Elasmo-branch	*Raja clavata*	131	21633	21			67		67		0.511
Western Mediterranean Sea	1	Bottom trawls	Elasmo-branch	*Etmopterus spinax*	131	21633	42			2194		2194		16.748
Western Mediterranean Sea	1	Longlines	Elasmo-branch	*Isurus oxyrinchus*	459	5590	1	1				1	0.002	
Western Mediterranean Sea	1	Longlines	Marine bird	*Larus audouinii*	459	5590	1	1				1	0.002	
Western Mediterranean Sea	1	Longlines	Marine Mammal	*Grampus griseus*	459	5590	1	1				1	0.002	
Western Mediterranean Sea	2	Bottom trawls	Elasmo-branch	*Dalatias licha*	59	887	13			30		30		0.508
Western Mediterranean Sea	2	Bottom trawls	Elasmo-branch	*Centrophorus granulosus*	59	887	3			4		4		0.068
Western Mediterranean Sea	2	Bottom trawls	Elasmo-branch	*Etmopterus spinax*	59	887	171			2756		2756		46.712
Western Mediterranean Sea	5	Bottom trawls	Elasmo-branch	*Raja clavata*	26	7984.5763	15			485		485		18.654
Western Mediterranean Sea	5	Bottom trawls	Elasmo-branch	*Etmopterusspinax*	26	7984.5763	2			42		42		1.615

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Western Mediterranean Sea	6	Bottom trawls	Elasmo-branch	*Hexanchus griseus*	212	74820	1			1		1		0.005
Western Mediterranean Sea	6	Bottom trawls	Elasmo-branch	*Dalatias licha*	212	74820	6			64		64		0.302
Western Mediterranean Sea	6	Bottom trawls	Elasmo-branch	*Centrophorus granulosus*	212	74820	3			15		15		0.071
Western Mediterranean Sea	6	Bottom trawls	Elasmo-branch	*Raja clavata*	212	74820	15			117		117		0.552
Western Mediterranean Sea	6	Bottom trawls	Elasmo-branch	*Heptranchias perlo*	212	74820	1			1		1		0.005
Western Mediterranean Sea	6	Bottom trawls	Elasmo-branch	*Gymnura altavela*	212	74820	1			1		1		0.005
Western Mediterranean Sea	6	Bottom trawls	Elasmo-branch	*Etmopterus spinax*	212	74820	48			994		994		4.689
Western Mediterranean Sea	6	Bottom trawls	Marine tur-tle	*Caretta caretta*	212	74820	2		2			2		0.009
Western Mediterranean Sea	7	Bottom trawls	Elasmo-branch	*Squalus acanthias*	140.250	6705.7371	8	13		4		17		0.029
Western Mediterranean Sea	7	Bottom trawls	Elasmo-branch	*Raja clavata*	140.250	6705.7371	3			31		31		0.221
Western Mediterranean Sea	7	Bottom trawls	Elasmo-branch	*Raja undulata*	140.250	6705.7371	1	1				1	0.007	

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Western Mediterranean Sea	7	Bottom trawls	Elasmo-branch	*Etmopterus spinax*	140.250	6705.7371	11			429		429		3.059
Western Mediterranean Sea	7	Bottom trawls	Teleost fish	*Alosa fallax*	140.250	6705.7371	8	101				101	0.720	
Western Mediterranean Sea	9	Bottom trawls	Elasmo-branch	*Squalus blainville*	1373	44322	45		447			447		0.326
Western Mediterranean Sea	9	Bottom trawls	Elasmo-branch	*Oxynotus centrina*	1373	44322	28		32			32		0.023
Western Mediterranean Sea	9	Bottom trawls	Elasmo-branch	*Mustelus punctulatus*	1373	44322	1		1			1		0.001
Western Mediterranean Sea	9	Bottom trawls	Elasmo-branch	*Hexanchus griseus*	1373	44322	34		36			36		0.026
Western Mediterranean Sea	9	Bottom trawls	Elasmo-branch	*Dasyatis pastinaca*	1373	44322	16		17			17		0.012
Western Mediterranean Sea	9	Bottom trawls	Elasmo-branch	*Scyliorhinus stellaris*	1373	44322	4		4			4		0.003
Western Mediterranean Sea	9	Bottom trawls	Elasmo-branch	*Centrophorus granulosus*	1373	44322	3		3			3		0.002
Western Mediterranean Sea	9	Bottom trawls	Elasmo-branch	*Squalus acanthias*	1373	44322	7		20			20		0.015
Western Mediterranean Sea	9	Bottom trawls	Elasmo-branch	*Mustelus mustelus*	1373	44322	5		31			31		0.023

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Western Mediterranean Sea	9	Bottom trawls	Marine turtle	*Caretta caretta*	1373	44322	5		5			5		0.004
Western Mediterranean Sea	10	Bottom trawls	Elasmobranch	*Centrophorus granulosus*	67	33690	2		3			3		0.045
Western Mediterranean Sea	11.2	Bottom trawls	Elasmobranch	*Aetomylaeus bovinus*	1245	21239	2		3			3		0.002
Western Mediterranean Sea	11.2	Bottom trawls	Elasmobranch	*Squalus blainville*	1245	21239	24		34			34		0.027
Western Mediterranean Sea	11.2	Bottom trawls	Elasmobranch	*Oxynotus centrina*	1245	21239	5		6			6		0.005
Western Mediterranean Sea	11.2	Bottom trawls	Elasmobranch	*Mustelus punctulatus*	1245	21239	1		1			1		0.001
Western Mediterranean Sea	11.2	Bottom trawls	Elasmobranch	*Hexanchus griseus*	1245	21239	9		9			9		0.007
Western Mediterranean Sea	11.2	Bottom trawls	Elasmobranch	*Myliobatis aquila*	1245	21239	4		5			5		0.004
Western Mediterranean Sea	11.2	Bottom trawls	Elasmobranch	*Dasyatis pastinaca*	1245	21239	19		105			105		0.084
Western Mediterranean Sea	11.2	Bottom trawls	Elasmobranch	*Centrophorus granulosus*	1245	21239	5		5			5		0.004
Western Mediterranean Sea	11.2	Bottom trawls	Elasmobranch	*Pteroplatytrygon violacea*	1245	21239	2		3			3		0.002

Ecoregion	ICES Area	Métier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	No of Specimens A	No of Specimens B	No of Specimens C	No of Specimens D	Total No Specimens	Bycatch Rate (Specimens A/DaS)	Bycatch Rate (Specimens B+C/DaS)
Western Mediterranean Sea	11.2	Bottom trawls	Elasmo-branch	*Heptranchias perlo*	1245	21239	1		1			1		0.001
Western Mediterranean Sea	11.2	Bottom trawls	Elasmo-branch	*Mustelus mustelus*	1245	21239	25		88			88		0.071
Western Mediterranean Sea	11.2	Bottom trawls	Marine tur-tle	*Caretta caretta*	1245	21239	8		8			8		0.006

Table 3. Marine mammal bycatch reported in the Regulation 812/2004 reports compared with data submitted to the WGBYC database for data collection during 2018. * not an EU Member State, no 812/2004 report submitted but data added to the database.

			Reported			***Database***		
Species	**ICES Division**	**Level 3 Métier**	**Observed days at sea**	**Total number Incidents**	**Total number specimens**	**Observed days at sea**	**Total number of incidents**	**Total number of specimens**
Phocoena phocoena	27.7.h	Bottom trawls		1	1	861	1	1
	27.7.j	Bottom trawls		1	1	313	1	1
	27.3.b.23	Nets	32	2	2	13	2	2
	27.4.c	Nets	1	1	1	18	1	1
	27.5.a.2*	Nets				229	36	46
	27.7.g	Nets	18	1	1	63	1	1
	27.8.b	Nets	37	1	1	172	1	1
Subtotal			***88***	***7***	***7***	***1669***	***43***	***53***
Delphinus delphis	27.7.e	Bottom trawls		2	3	439	2	3
	27.7.f	Bottom trawls		1	1	121	1	1
	27.7.g	Bottom trawls		5	5	477	5	5
	27.7.j	Bottom trawls		1	1	313	1	1
	27.8.a	Nets	138	1	1	146	1	1
	27.8.b	Nets	156	5	7	172	5	7
	27.7.g	Nets	18	2	2	63	2	2

Species	ICES Division	Level 3 Métier	*Reported* Observed days at sea	Total number Incidents	Total number specimens	*Database* Observed days at sea	Total number of incidents	Total number of specimens
	27.8.a	Pelagic trawls	3	1	1	50	1	1
	27.8.c	Pelagic trawls	9	1	1	11	1	1
Subtotal			***324***	***19***	***22***	***1792***	***19***	***22***
Grampus griseus	1	Longlines				459	1	1
Subtotal			***0***	***0***	***0***	***459***	***1***	***1***
Tursiops truncatus	16	Bottom trawls				1000	1	1
	17	Pelagic trawls	418	2	2	386	2	2
	27.9.a	Nets	18	1	1	21	1	1
Subtotal			***436***	***3***	***3***	***1407***	***4***	***4***
Lagenorhynchus albirostris	27.5.a.2*	Nets				229	2	2
Subtotal			***0***	***0***	***0***	***229***	***2***	***2***
Halichoerus grypus	27.7.e	Bottom trawls				439	1	1
	27.3.d.30	Nets				44	1	1
	27.8.a	Nets	138			146	2	2
	27.7.f	Nets	66	2	2	66	1	1
	27.7.h	Nets	11			30	1	1

Species	ICES Division	Level 3 Métier	*Reported*			*Database*		
			Observed days at sea	**Total number Incidents**	**Total number specimens**	**Observed days at sea**	**Total number of incidents**	**Total number of specimens**
	27.7.j	Nets	127	37	43	175	37	43
	27.7.e	Nets	113	2	2	165	3	3
	27.5.a.2*	Nets				229	10	21
	27.6.a	Pelagic trawls	73	1	1	124	1	1
	27.4.b	Pelagic trawls	30	9	11	31	9	11
	27.3.d.28.1	Traps				22	2	2
	27.3.d.30	Traps				93	1	1
	27.3.d.31	Traps				41	1	1
	27.3.d.32	Traps				72	4	5
Subtotal			***558***	***51***	***59***	***1677***	***74***	***94***
Phoca vitulina	27.6.a	Bottom trawls	1		1	259	1	1
	27.5.a.2*	Nets	229		61	229	27	61
Subtotal			***230***	***0***	***62***	***488***	***28***	***62***
Phoca hispida	27.5.a.2*	Nets				229	2	2
	27.3.d.28.1	Traps				22	2	2
Subtotal			***0***	***0***	***0***	***251***	***4***	***4***

			Reported			Database		
Species	**ICES Division**	**Level 3 Métier**	**Observed days at sea**	**Total number Incidents**	**Total number specimens**	**Observed days at sea**	**Total number of incidents**	**Total number of specimens**
Pagophilus groenlandicus	17	Bottom trawls				272	2	2
	27.5.a.2*	Nets				229	8	15
Subtotal						***501***	***10***	***17***
TOTAL			***1636***	***80***	***153***	***8473***	***185***	***259***

Table 4. Monitored effort (Days at Sea) reported by ICES division and métier (level 3) with no PETS bycatch observed for 2018.

ICES_division	MétierL3	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)
7	Pelagic trawls	18	213
7	Longlines	16	2303
9	Longlines	2	
25	Bottom trawls	17	276
21.1.C	Bottom trawls	17	82
21.6.G	Pelagic trawls	8	24
27.1	Bottom trawls	49	470
27.1.a	Bottom trawls	10	1258
27.1.a	Pelagic trawls	87	
27.1.b	Pelagic trawls	1	6
27.14.b.1	Pelagic trawls	32	15
27.14.b.2	Pelagic trawls	7	7
27.2.a	Pelagic trawls	81	541
27.2.a	Bottom trawls	17	545
27.2.a.1	Pelagic trawls	43	106
27.2.a.2	Pelagic trawls	1	79

ICES_division	MétierL3	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)
27.2.b	Pelagic trawls	1	13
27.2.b	Bottom trawls	26	1326
27.3.a.20	Traps	8	11347
27.3.a.21	Traps	1	3626
27.3.c.22	Bottom trawls	22	4844
27.3.c.22	Seines	2	229
27.3.c.22	Nets	21	12496
27.3.d.24	Bottom trawls	25	3648
27.3.d.24	Traps	2	6081
27.3.d.24	Nets	9	16705
27.3.d.24	Pelagic trawls	23	1445
27.3.d.25	Pelagic trawls	26	4299
27.3.d.25	Nets	2	13461
27.3.d.26	Pelagic trawls	31	5540
27.3.d.26	Bottom trawls	62	4343
27.3.d.26	Traps	5	3997

ICES_division	MétierL3	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)
27.3.d.26	Nets	9	11553
27.3.d.27	Nets	8	2831
27.3.d.28.1	Nets	2	6160
27.3.d.28.2	Nets	4	3665
27.3.d.28.2	Pelagic trawls	280	4909
27.3.d.29	Pelagic trawls	16	2488
27.3.d.29	Traps	33	3546
27.3.d.29	Bottom trawls	7	12
27.3.d.30	Pelagic trawls	17	2763
27.3.d.30	Bottom trawls	41	64
27.3.d.31	Bottom trawls	13	781
27.3.d.32	Pelagic trawls	14	1951
27.3.d.32	Bottom trawls	5	
27.4.b	Dredges	1	5639
27.4.c	Seines	4	969
27.4.c	Traps	3	5733

ICES_division	MétierL3	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)
27.5.b	Pelagic trawls	1	106
27.6.a	Dredges	4	4555
27.6.b	Pelagic trawls	1	150
27.7.a	Pelagic trawls	2	738
27.7.a	Dredges	25	12327
27.7.b	Nets	3	665
27.7.d	Other gear	2	2526
27.7.e	Surrounding nets	2	793
27.7.e	Traps	7	28391
27.7.e	Other gear	2	4094
27.7.e	Longlines	2	1803
27.7.g	Seines	6	993
27.7.g	Dredges	7	697
27.7.j	Seines	2	760
27.8	Pelagic trawls	1	
27.8.a	Traps	9	8139

ICES_division	MétierL3	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)
27.8.a	Surrounding nets	10	513
27.8.a	Rods and lines	4	412
27.8.a	Other gear	10	3186
27.8.a	Longlines	35	9906
27.8.b	Surrounding nets	10	2135
27.8.b	Rods and lines	1	177
27.8.b	Other gear	3	1210
27.8.b	Traps	2	603
27.8.c	Rods and lines	1	5938
27.8.d	Bottom trawls	58	702
27.8.d	Rods and lines	10	9
27.8.d	Pelagic trawls	84	1777
27.9.a	Longlines	26	12765
Total		1459	258458

Table 5. Summary of fished and observed effort in the US Northwest Atlantic Ecoregion and observed number of PET specimens bycaught. Bycatch estimates for the métier (Level 3) and their source are also given.

Year	Area	Gear Type (Métier level 3)	Species	Total Observer Effort	Total Fishing Effort	Total No. Specimens	Bycatch Estimate (CV)	Source
2018	New England	Sink Gillnets	*Phocoena phocoena*	966 (metric tons)	12731 (metric tons)	9	92 (0.52)	Orphanides 2020 (*in review*)
2018	New England	Sink Gillnets	*Delphinus delphis*	966 (metric tons)	12731 (metric tons)	10	93 (0.45)	Orphanides 2020 (*in review*)
2018	New England	Sink Gillnets	*Halichoerus grypus*	966 (metric tons)	12731 (metric tons)	103	1113 (0.32)	Orphanides 2020 (*in review*)
2018	New England	Sink Gillnets	*Phoca vitulina*	966 (metric tons)	12731 (metric tons)	22	188 (0.36)	Orphanides 2020 (*in review*)
2018	New England	Sink Gillnets	*Pagophilus groenlandicus*	966 (metric tons)	12731 (metric tons)	2	14 (0.80)	Orphanides 2020 (*in review*)
2018	Mid-Atlantic	Sink Gillnets	*Delphinus delphis*	621 (metric tons)	6932 (metric tons)	1	8 (0.91)	Orphanides 2020 (*in review*)
2018	Mid-Atlantic	Sink Gillnets	*Phoca vitulina*	621 (metric tons)	6932 (metric tons)	3	26 (0.52)	Orphanides 2020 (*in review*)
2014-2018	Mid-Atlantic	Sink Gillnets	*Tursiops truncatus (coastal & estuarine ecotypes)*	605 (trips)	27875 (trips)	5	16.33 (0.23) – 28.21 (0.15)	Lyssikatos 2020 (*in review*)

Year	Area	Gear Type (Métier level 3)	Species	Total Observer Effort	Total Fishing Effort	Total No. Specimens	Bycatch Estimate (CV)	Source
2018	New England	Bottom Trawls	*Delphinus delphis*	613 (trips)	5048 (trips)	4	28 (0.54)	Lyssikatos et al. 2020 (*in review*)
2018	New England	Bottom Trawls	*Halichoerus grypus*	613 (trips)	5048 (trips)	5	32 (0.42)	Lyssikatos et al. 2020 (*in review*)
2018	Mid-Atlantic	Bottom Trawls	*Delphinus delphis*	1053 (trips)	8727 (trips)	35	205 (0.21)	Lyssikatos et al. 2020 (*in review*)
2018	Mid-Atlantic	Bottom Trawls	*Halichoerus grypus*	1053 (trips)	8727 (trips)	7	56 (0.58)	Lyssikatos et al. 2020 (*in review*)
2018	Mid-Atlantic	Bottom Trawls	*Phoca vitulina*	1053 (trips)	8727 (trips)	1	6 (0.94)	Lyssikatos et al. 2020 (*in review*)
2018	Mid-Atlantic	Bottom Trawls	*Tursiops truncatus (offshore ecotype)*	1053 (trips)	8727 (trips)	1	6 (0.91)	Lyssikatos et al. 2020 (*in review*)
2012-2016	Georges Bank to Mid-Atlantic	Sink Gillnets	*Caretta caretta*	4902 (trips)	51533 (trips)	27	705 (0.29)	Murray 2018
2012-2016	Georges Bank to Mid-Atlantic	Sink Gillnets	*Lepidochelys kempii*	4902 (trips)	51533 (trips)	7	145 (0.43)	Murray 2018
2012-2016	Georges Bank to Mid-Atlantic	Sink Gillnets	*Dermochelys coriacea*	4902 (trips)	51533 (trips)	2	27 (0.71)	Murray 2018

Table 6. 2018 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). Note: NS = North Sea, W = Western coasts, BB = Bay of Biscay, Med=Mediterranean Sea.

Species	Country	No. of Strandings	No. examinations on fresh or slightly decomposed carcasses	Bycatch evidence / examinations (%)
Phocoena phocoena	Belgium	89	30	3/30 (10%)
	Denmark	25	2	1/2 (50%)
	France (BB)	71	38	18/38 (47%)
	France (Channel)	182	73	26/73 (36%)
	Germany	116	25	1/25 (4%)
	The Netherlands	476	57	7/57 (12%)
	Portugal	33	27	6/27 (22%)
	Spain / Galicia	16	6	1/6 (17%)
	Poland	15	1	1/15 (7%)
	United Kingdom (NS)	155	15	0/15 (0%)
	United Kingdom (Channel)	28	5	2/5 (40%)
	United Kingdom (W)	320	49	0/49 (3%)
Delphinus delphis	France (BB)	646	345	194/345 (61%)
	France (Channel)	66	27	14/27 (52%)
	Portugal	138	87	23/87 (28%)
	Spain / Galicia	173	88	32/88 (37%)
	United Kingdom (Channel)	13	3	1/3 (33%)

Species	Country	No. of Strandings	No. examinations on fresh or slightly decomposed carcasses	Bycatch evidence / examinations (%)
	United Kingdom (W)	173	41	10/41 (24%)
Stenella coeruleoalba	France (BB)	36	19	7/19 (37%)
	France (MED)	76	42	6/42 (14%)
	Spain / Galicia	21	13	1/13 (8%)
	Portugal	16	7	0/16 (0%)
Tursiops truncatus	France (BB, Channel)	31	5	4/5 (80%)
	France (MED)	12	6	2/6 (33%)
	Spain / Galicia	24	12	3/12 (25%)
	Portugal	7	3	0/3 (0%)
Globicaphala melas	France (BB, Channel)	14	5	0/5 (0%)
	France (MED)	1	0	0/0 (0%)
	Spain / Galicia	5	3	0/3 (0%)
Grampus griseus	France (BB, Channel)	9	2	1/2 (50%)
	France (MED)	3	2	0/2 (0%)
Balaenoptera physalus	Spain / Galicia	4	1	0/1 (0%)
Kogia breviceps	Spain / Galicia	1	1	1/1 (100%)
Halichoerus grypus	France (BB, Channel)	164	86	18/86 (21%)
Phoca vitulina	France (BB, Channel)	106	43	6/43 (14%)

2 ToR B

Collate and review information from national (Regulation 812/2004) reports and elsewhere in the North Atlantic relating to the implementation of bycatch mitigation measures and ongoing bycatch mitigation trials and compile recent results on protected species bycatch mitigation

2.1 Mitigation compliance carried out under (EC) Regulation 812/2004–Mandatory and voluntary mitigation measures

Relevant text extracted from Member States (EC) Reg. 812/2004 reports pertaining to mitigation compliance is summarised below by MS. Article 2 of Reg. 812/2004 requires certain métiers (identified in Annex I) to use pingers to mitigate against cetacean bycatch. However, other mitigation methods such as alternative fishing gear or modified gear can also be reported by MS. Also included are summaries from relevant literature.

2.1.1 Member States

In **Belgium**, the use of acoustic deterrents, so-called pingers, has not yet been generalised in set net fisheries. It should be noted that the number of vessels of the national fleet using this fishing method is limited (currently only two vessels). Furthermore, these vessels do not meet the basic conditions, namely the length of the ship, to have this obligation imposed. As in recent years, there was no scientific monitoring of the use of pingers on vessels in 2018.

In **Denmark**, 21 vessels were obliged to use pingers in 2018. Four of these vessels (5% of the total number of vessels) were engaged in fishing activities in ICES areas IIId24 and IIIc22 in fleet segments FPN, GN, GNS, and GTR, and 17 (57% of the total number of vessels) were engaged in fishing activities in ICES areas 3a and 4 in fleet segments FPN, GN, GNS, and GTR with mesh sizes above 220 mm.

The pinger type "AQUAmark100" has previously been used in the Danish gillnet fisheries, where the use of pingers is mandatory. However, this pinger model is no longer available in Denmark, so other types are now being used. The Danish Fisher's Association report that a 10 kHz pinger is now the most widely used pinger in Danish commercial fisheries because batteries can easily be changed. The 10 kHz pinger does, however, not have the same effectiveness as the AquaMark 100, so the distance between these is mandated to be 200 m. The latest derogation applies not only to the AQUAmark100, but to also other acoustic deterrent devices, which scientifically are proven to be as effective.

Monitoring of pingers is a mandatory part of the general inspection of gillnet vessels in Denmark. When a gear inspection is conducted, the fisheries inspector registers whether there is a requirement for use of pingers on the gear. If there is a requirement, the activity and distance between pingers is checked. In 2018, the Danish fisheries inspection did not conduct any inspections on vessels with an overall length of 12 meters or above, due to a large organisational change and transfer of responsibility to another ministry (formerly the Ministry of Food and Agriculture, now the Ministry of Foreign Affairs). Similarly, no inspections were carried out for foreign vessels in 2018. It is expected that the Danish Fisheries Agency will conduct inspections again in 2019.

Denmark is continuing trials of both pingers and lights as a means to mitigate bycatch of harbour porpoises and seabirds, as well as conducting research on the behaviour of porpoises around pingers. Denmark is also continuing the development and testing of fishing gear as alternatives to gillnets primarily for catching cod and flatfish. This includes both small-scale Danish seines and baited pots.

In the coastal area of **Finland**, fishing effort with gillnets has reduced substantially (between 30–40%) and has moved to the inner archipelago during the last ten years. This reduces any potential interaction between harbour porpoise and gillnet fisheries. The SAMBAH project (Carlén et al. 2018) provided additional information on harbour porpoises in Finnish waters. The probability to detect harbour porpoise in the Finnish gillnet fishery area is low.

In **France**, a total of 9 netters (GNS-GTR) fishing in area VII were equipped with STM DDD03L pingers in 2018 in accordance with Reg. 812/2004. No infringements were found in 2018 during the checks conducted in the areas and on the vessels covered by Regulation (EC) No 812/2004.The decree of 15 April 2014 permits the use of STM DDD03L acoustic deterrent devices by French fishing vessels.

Between February and April 2018, an experiment was conducted on French midwater pair trawlers operating in the Bay of Biscay, to test the efficiency of pinger DDD03H/STM. This project, called PIC, was carried out by the fishing organisation Les pêcheurs de Bretagne together with Ifremer and the Pelagis Observatory (Joint Services Unit 3462 CNRS National Centre for Scientific Research - University of La Rochelle), with financial support from France FilièrePêche. Three pairs were involved and deployed pingers alternatively on 38.5% of hauls. One observer on board ensured the correct deployment of pingers and recorded bycaught cetaceans when it occurred. 68 fishing operations of a pair of midwater trawlers were observed by a dedicated observer in charge of recording cetacean bycatch, and the same protocol was deployed on two other pairs and 150 fishing operations; bycatch was reported by the fishers themselves. A total of 61 common dolphins were observed bycaught during this experiment (55 without pingers and 6 with pingers). The reduction of bycatch related to pingers, modelled for the fleet, was 65%.

In 2018, **Germany** had fisheries operating in some areas listed in Annex I to Reg. 812/2004 where the use of pingers is mandatory. Fishing vessels use analogue and digital pingers commercially available. No data are available on the number of vessels equipped with pingers. Compliance monitoring was done by competent authorities using Pinger Detector Amplifiers (Etec PD1102) when nets were in place. Due to masking of pinger signals by the inspection vessel noise, the relevant equipment is difficult to use. The relevant provision (Article 2(2) of Regulation (EC) No 812/2004) merely requires pingers to be operational when setting the gear. Thus, no penalties can be imposed for any infringements found using the current procedure. The legal framework for the detection and prosecution of infringements needs to be further improved. In 2018, federal fishing protection vessels inspected a total of three fishing vessels obliged to use pingers. No violations were found.

In a systematic study, the acoustic reflectivity of a variety of objects in different shapes, sizes and bulk characteristics (e.g. Young's Modulus, density) were simulated and experimentally verified in a water tank. First simulation results indicated that commercially available acrylic glass spheres of less than 10 mm diameter exhibited promising characteristics with up to -42dB target strength at 130 kHz (the peak frequency used by harbour porpoise). Echograms taken with the sonar of FRV "Clupea" revealed that the net with spheres was highly visible at 120 kHz compared to a standard gillnet.

In order to test the efficacy, a set of modified nets were tested against a set of standard gillnets in the Turkish Black Sea turbot fishery with a total of 10 hauls conducted. The analysis is in progress, but it seems advisable to carry out further trials and conduct a behavioural experiment where porpoises are observed around standard and modified gear. At the moment, the pearl net is tested in the Swedish lumpsucker fishery with F-PODs attached to both ends of the string in order to examine the porpoise echolocation behaviour around the nets.

In **Ireland**, the number of Irish vessels currently using pingers is unknown. Extensive research on the practicalities and spacing of gillnet pingers has previously been carried out by BIM (Board Iascaigh Mhara, Ireland's seafood development agency) in Ireland and has been reported in previous reports under Reg. 812/2004 and at WGBYC. BIM have also been heavily involved in the development and testing of pelagic trawl pingers as reported previously. Sea Fisheries Protection Authority (SFPA) officers continue to monitor and test pingers as part of their routine inspection regime. Based on pinger spacing research carried out by Ireland and Denmark, a temporary derogation under Article 3(2) of Reg. 812/2004 allowed for an increase in maximum spacing between pingers to 500 m for digital devices from 13 June 2007 for a period of two years. This derogation has not been renewed.

Poland reports that in 2018, WWF Poland Foundation, as part of the project "Protection of marine mammals and birds and their habitats" purchased 300 pingers (so-called BANANA pingers made by Fishtek Marine) to be used by fishing vessels under 12 m. In 2018, 160 pingers were provided fishers on 18 coastal vessels located west of Kołobrzeg to avoid bycatches of porpoises.

The use of pingers by vessels equal to or over 12 m and holding a permit to use bottom-set gillnets, was controlled by the Regional Sea Fisheries Inspectorate in Szczecin (new structure of fisheries inspectorates has been implemented since 2018), as well as by foreign control services, during fishing in the ICES subarea 24, where, pursuant to Annex I to the Reg. 812/2004, the use of pinger is mandatory. During the controls, inspectors checked if pingers were on board of the vessel. Inspectors were also equipped with special tester for pingers AQUAmark 100, in order to test if pingers are operational when underwater. However, in inspectors' opinion, controlling pingers during fishing operations, using tester for pingers, was difficult and not very effective.

It needs to be stressed that due to the reduced number of commercial trips of fishing vessels equal to or over 12 m of length and fishing by means of GNS gear, in 2018, when compared to 2017, the level of fishing effort, to which the obligation of using pingers applies, was significantly reduced. In 2018, only 4 Polish fishing vessels, falling under Reg. 812/2004, conducted fishing operations in the ICES subdivision 24.

In **Portugal**, Articles 2 and 3 of the Reg. 812/2004 concerning the use of acoustic deterrent devices are not mandatory for the correspondent ICES 9a area. However, some information is gathered based on voluntary opportunistic deployments 2011–2012. Field tests performed until 2015 were conducted within the scope of the projects SafeSeaEEAGrants (2008–2010) and Life + MarPro (2011–2017). These trials were conducted with FUMUNDA 10 kHz and 70 kHz pingers. For the North western coast, during 2011–2012, field assays were performed with 7 boats using trammel nets. The test was based on comparing bycatch rates between pingered and non pingered nets (controls). Pingers of 10 and 70 kHz frequencies were mixed (toggled) along the pingered net. Results indicated that 10 common dolphins and 1 bottlenose dolphin were captured in control nets and 2 common dolphins in nets using pingers[9].

At the Southern Portuguese coast, during 2014–2015, field assays were performed by one fishing boat using gill nets. The objective of the study was to compare bycatch rates between pingered

[9] Paragraphs updated based on reviewers' comments.

and non pingered nets (controls). In 2014 and 2015 FUMUNDA 10 kHz were used and 2 bottlenose dolphins were observed bycaught in pingered nets, non in control nets. In 2015, the trials switched to the use FUMUNDA 70 kHz pingers, but fast habituation of the bottlenoses of the pingered nets increased the depredation rate, which contributed to fish and gear damage and the dissatisfaction of fishers o proceed whereby trial only lasted one month[10].

In 2018, one field assay (comprising 31 fishing surveys performed between May and October 2018) using "Banana pingers" (FiSHTEK MARINE) was performed with one polyvalent vessel <10 m operating with set nets (GNS) off the port of Quarteira in the southern Portuguese Coast (Algarve) and conducted by IPMA. The fishers´ local association approached IPMA´s southern branch (Portuguese Institute of the Sea and Atmosphere – Centre of Olhão) to propose a mitigation trial. This was a result of several generalised complains from fishers in the area operating with set nets (GNS and GTR), who experienced frequent interactions with cetaceans, mostly bottlenose dolphins, that cause economic loss through occasional relevant catch and net damage. The fisher´s association paid for the acoustic alarms and selected the fishing vessel to voluntarily participate in the study. Within the trial no incidental captures of cetaceans were observed in control or pingered nets. However, habituation of bottlenoses to the pingers apparently occurred (within a few months) as a "dinner bell effect", which indicates that the pinger model used may not be the most indicated to decrease interactions between bottlenose dolphins and GNS fisheries in this area. A paper is being prepared for submission in a peer review journal with this work´s results. Mitigation trials within one project from CCMAR/University of Algarve (Mar 2020-iNOVPESCA) using DDD´s and DiD´s (Dolphin deterrent devices, STM Industrial Electronics, Italy) are taking place since 2019 and results are to be discussed in next year´s report.

The **Netherlands** report indicates that according to Reg. 812/2004, the Dutch fishery does not include fleet segments in which pingers are mandatory. The use of pingers is obligatory in ICES subarea 4 for vessels larger than 12 m for the period 1 August until 31 October, using nets that do not exceed 400 m length (the regulation intends to cover set nets fishery at wrecks, where relatively short net lengths are being used). Most of the Dutch set gillnet fleet fishing in this period for sole use much longer nets. Thereby, no acoustic deterrents are in use by Dutch gillnet fishers.

In **Sweden** there are uncertainties regarding if pingers have been implemented on boats and in fisheries were pingers are mandatory. In 2007, fishers conducting fisheries in areas where pingers were mandatory were given pingers. Pingers have a lifetime of two years why one must assume that pingers provided to fishers in 2007 are not functioning. There is limited enforcement to control of use of pingers and no equipment to be able to see if the pingers are functioning. However, there has been an increased use of pingers in southern Swedish waters and along the west coast. In 2018, 13 fishers voluntary used pingers (Banana Fish tech and Future Oceans) in the lumpfish and cod fisheries in subdivision 21 and 23. Pingers are lent to the fishers from year to year. Seven fishers were using pingers in the lumpfish fishery and three fishers were using pingers in the cod gillnet fishery. Fishers reported their fishing effort and use of pingers to the Swedish University of Agriculture Science.

The seal fisheries conflict in the Baltic Sea is severe. There are studies showing that the pingers work as a dinner bell effect to seals increasing the damage to the catch and fishing gear. Therefore, pingers audible to seals are not seen as a potential mitigation method among fishers and fishers are reluctant to use them. In 2015 a project started with the aim to develop a pinger not audible to seals. In 2017 a pinger which seals cannot hear has been tried out in the field to study the behaviour of harbour porpoise around the pingers. Results show that harbour porpoise clicks (i.e. harbour porpoise presence) in the vicinity of the new developed seal safe pinger decrease.

[10] Paragraphs updated based on reviewers' comments.

The study will be published in 2020. The seal safe pingers are tried out in commercial fisheries in 2020.

In the area where pingers have been used in the commercial lumpfish fisheries in southern Sweden a study looking at the distribution of harbour porpoises in relation to a commercial fishery with pingers is currently taking place. Preliminary results show that harbour porpoise detections in the area are low when fisheries with pingers are carried out. However, when fishery stops the harbour porpoise detections increase and are at the same levels as areas where no fishing with pingers has been carried out. The study will be finalised in 2020.

There is also an implementation project implementing cod pots as an alternative to gillnet fisheries for cod. In 2018 there are two fishers are using cod pots as an alternative to gillnets. Development of alternative gears to gillnet fisheries targeting species such as cod is ongoing.

UK vessels that are required to use pingers in the relevant fisheries have all been made aware of the requirements of Reg. 812/2004, and for several years have been using appropriate devices and have been subject to at-sea inspections by national regulatory agencies. Enforcement Officers have been provided with appropriate training on how to assess pinger attachment and functioning. The Marine Management Organisation (MMO) has provided full guidance on the implementation of the Regulation and the use of pingers[11].

Many of the UK vessels affected are using a device that does not meet the acoustic criteria specified in Annex II of the 812/2004 Regulation. The UK ran a series of trials of the DDD-03 pinger, which was initially tested for efficacy between 2008 and 2011 and extended with EMFF funding during 2010–2011. Following this work the device (DDD-03L - manufactured by STM products in Italy) was authorised for use by the UK Government's Department for the Environment and Rural Affairs (Defra) under the derogation contained in Article 3(2) of the Regulation. In June 2014 and again in 2016, the Commission was notified that the authorisation was to be extended for a further two years, in accordance with Article 3(2) of the Regulation.

Of the 26 vessels over 12 m in length that were reported to have used nets in 2018, 22 fished in Divisions 7defghj and thus required the use of pingers. Three vessels fished in subarea 4 and are assumed to have been required to use pingers (as all reported using meshes >220 mm). One of these vessels fished in both Subareas 4 and 7, while two of the 26 over 12 m vessels did not fish in any areas requiring the use of pingers under Reg. 812/2004.Overall, we conclude that during 2018, 24 over 12 m UK registered vessels fished in areas and with gears that require the use of pingers. In 2018, there were no records of vessels over 12 m using encircling gillnets.

Based on observations, UK registered >12 m vessels operating from ports in the southwest of England appear to be using DDD-03 pingers routinely. Marine Scotland on board inspections noted the use of the same devices in Division 4a. Historical observer data and anecdotal accounts indicate that other pinger models (meeting the type 1 or type 2 specifications of Reg. 812/2004) may also be in use by some of the larger UK registered vessels that land into Spain or overland their catch to the continent from the UK.

During 2018, eight trips where pingers were used (as per Reg. 812/2004) were monitored, amounting to 77 observed hauls. Porpoise bycatch rates overall remain substantially (83%) lower when pingers are used according to the UK Government guidelines compared with when pingers are not being used, and there is no evidence of any change in pinger efficacy over time. The guidelines on pinger use which were produced in 2012 and agreed with industry, state that DDD pingers should be placed no more than 4 km apart, either to the buoy ropes at each end of a net

[11] https://www.gov.uk/guidance/reduce-dolphin-and-porpoise-by-catch-comply-with-regulations

fleet, or if net fleets more than 4 km are used, pingers should be attached to the float line and/or buoy ropes so that no part of the net fleet is more than 2 km from an active pinger.

Royal Navy and other relevant national marine enforcement officers have been checking for compliance with Reg. 812/2004 whilst carrying out at-sea inspections; this is a task, which is included as a regular inspection requirement in the relevant fishing areas. Inspections of >12 m gillnetting vessels are carried out according to a risk-based enforcement approach. In English and Welsh waters, 10 inspections of >12 m static net vessels were carried out at sea and in port in the relevant areas during 2018. Inspections took place in ICES Subareas 4 and 7, and included 6 UK, 2 German and 2 Norwegian vessels. One infringement was detected on a UK vessel, which had no pingers on board and was given an official written warning. At-sea inspections (in line with the risk-based enforcement model) are the primary monitoring tool for the Regulation, but vessels are also checked in port for pinger presence by Marine Management Organisation (MMO) coastal officers.

In Scottish waters, Marine Scotland's Marine Protection Vessels (MPVs) completed 7 at-sea inspections on gillnetters in ICES Division 4a (Northern North Sea) during 2018. No infringements were detected during this boarding. Pingers were noted to be in use during the inspections and one specifically noted the pinger to be of the STM DDD03 type. Marine Scotland received no intelligence regarding lack of pinger use during 2018. There were no reports of any cetaceans being caught during the inspections, which included a period aboard the fishing vessels while the net was being hauled.

The main concentration of netting effort in Scottish waters continues to be along the continental shelf edge west of the Shetland Islands, with some netting effort taking place up to the 6 NM limit around Shetland. Compliance operational priorities during 2018 did not focus on this sector and Marine Scotland will also continue to base the majority of their at-sea inspection activities on a risk assessed basis. However, previous reports from observer trips in this area indicate that a variety of pinger types are used by the vessels involved.

2.2 Mitigation trials outside the EU

No mitigation trials outside the EU were reported to the meeting.

2.3 Protected species bycatch mitigation studies from recent literature (2019–2020)

The articles highlighted below were selected based on knowledge of peer-reviewed papers published over the last year. This was supplemented by Google Scholar and Web of Science searches using a filter for publication years (2019 and 2020), and the keywords "bycatch", "mitigation" and "reduction". If the papers in question reviewed or tested factors affecting bycatch, bycatch mitigation devices or alternative fishing gears aimed to reduce the bycatch of marine mammals, seabirds, reptiles and other PET species, they were included in this review.

2.3.1 Marine mammals

Bielli et al. (2020) report on a study where light emitting diodes (LEDs)—a visual cue—on the float lines of paired gillnets (control versus illuminated net) during 864 fishing sets on small-scale vessels departing from three Peruvian ports between 2015 and 2018 have been deployed. Bycatch probability per set for sea turtles, cetaceans and seabirds as well as catch per unit effort (CPUE) of target species were analysed for illuminated and control nets using a generalised linear mixed-effects model (GLMM). For illuminated nets, 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 Bycatch per Unit Effort (BPUEs) decreased by 84.0% in the presence of LEDs. Target species CPUE was not negatively affected by the presence of LEDs. This study highlights the efficacy of net illumination as a multi-taxa BRT for small-scale gillnet fisheries in Peru. Given the success shown here of net illumination in mitigating small cetacean bycatch, the authors encourage additional trials in other gillnet fisheries and with bycatch of other marine mammal species, including pinnipeds.

Clay et al. (2019) investigated the effect of pingers on the behaviour of Burmeister's porpoise *Phocoena spinipinnis* in the vicinity of the Peruvian small-scale driftnet fleet. Over a 4-year period (2009–2012), 116 control (without pingers) and 94 experimental (with pingers) fishing sets were observed, and porpoise acoustic activity around nets was recorded using passive acoustic loggers (C-PODs). Authors modelled variation in detection rates as a function of pinger use and habitat covariates, and found that in regions of preferred habitat associated with cooler (17–18°C), shallow waters (within the 100 m isobath), the use of pingers led to an 86% reduction in porpoise activity around nets. The DukaneNetmark™ 1000 pingers have been used. The results suggest that pingers are likely to be particularly effective at deterring Burmeister's porpoises from fishing nets and given the vast capacity of this and other fleets in the region, may substantially reduce mortality. This study also emphasises the potential of passive acoustic monitoring to determine the effectiveness of bycatch mitigation measures, both for species for which visual observations are scarce, and in regions where gathering statistically meaningful bycatch rates is logistically challenging.

Hamilton & Baker (2019) provide a comprehensive assessment and synopsis of gear modifications and technical devices to reduce marine mammal bycatch in commercial trawl, purse seine, longline, gillnet and pot/trap fisheries based on a literature review. The authors have used a range of sources, not limited to peer-reviewed journals. Based on their review they conclude that successfully implemented mitigation measures include acoustic deterrent devices (pingers) which reduced the bycatch of some small cetacean species in gillnets, appropriately designed exclusion devices which reduced pinniped bycatch in some trawl fisheries, and various pot/trap guard designs that reduced marine mammal entrapment. The authors also conclude that substantial development and research of mitigation options is required to address the bycatch of a range of species in many fisheries. According to the authors, no reliably effective technical solutions to reduce small cetacean bycatch in trawl nets are available, although loud pingers have shown potential. The authors conclude there are currently no technical options that effectively reduce marine mammal interactions in longline fisheries, although development of catch and hook protection devices is promising. Solutions are also needed for species, particularly pinnipeds and small cetaceans, that are not deterred by pingers and continue to be caught in static gillnets. Large whale entanglements in static gear, particularly buoy lines for pots/traps, needs urgent attention although there is encouraging research on rope-less pot/trap systems and identification of rope colours that are more detectable to whale species. It is emphasised that future mitigation development and deployment requires rigorous scientific testing to determine if significant bycatch reduction has actually been achieved, as well as consideration of potentially conflicting mitigation outcomes if multiple species are impacted by a fishery.

Iriarte et al. (2019**)** reported on the implementation of exclusion devices to mitigate pinniped (*Arctocephalus australis, Otaria flavescens*) incidental mortalities during bottom-trawling in the Falkland Islands (Southwest Atlantic). Until 2015, interactions of these species with the Patagonian bottom trawl squid fishery were uncommon. During the second fishing season 2017, a dramatic increase in seal interactions was observed, with a corresponding increase in incidental mortalities. Various mitigation measures were applied, of which seal exclusion devices (SEDs) fitted inside a net extension inserted between the trawl net and cod-end being the most efficient.

The SEDs became mandatory in the fishery in September 2017. Since then, the number of seal mortalities remains negligible. SED efficiency is monitored by 100% observer coverage.

Jounela et al. (2019) investigated the impact of gillnet fishing restrictions on juvenile bycatch mortality of the endangered Saimaa ringed seal (*Pusahis pidasaimensis*) by analyses of mortality and birth lair data from 1991–2013. To reduce the risk of bycatches during juvenile dispersal in spring, an annual gillnet ban from 15 April to 30 June was introduced in 1982, gradually increasing from 18% spatial coverage of the birth sites in 1991, to 90% in 2013. In addition, the most harmful gear types are forbidden year-round. Overall, the gillnet ban is estimated to have led to a 20% increase in population size (60 individuals in relation to an average estimated stock size of 355 in 2013). However, the critical period for juvenile survival in relation to fishing gears was estimated to be 15 months, resulting in a slight increase in seal mortality immediately after the end of the gillnet ban period, as well as a second peak later in the season. During 2000–2005, the annual average juvenile bycatch was estimated at 13.3 individuals, decreasing to an estimated annual average of 6.3 in 2009–2013. The authors suggest that the seasonal gillnet ban should be extended at least until the end of July to reduce the bycatch mortality peak in summer. Further, as estimated bycatch numbers exceed observed numbers, the results indicate that the control of fishing regulations still requires education and patrolling.

Tulloch et al. (2019) used an economic tool, return-on-investment, to identify cost-effective measures to reduce cetacean bycatch in the trawl, net, and line fisheries of Australia. Their method can be used to delineate strategies to reduce bycatch threats to mobile marine species across diverse fisheries at relevant spatial scales to improve conservation outcomes. The authors examined three management actions: spatial closures, acoustic deterrents, and gear modifications and compared an approach for which the primary goal was to reduce the cost of bycatch reduction to fisheries with an approach that aims solely to protect whale and dolphin species. Based on cost-effectiveness and at a fine spatial resolution, the management strategies across Australia have been identified that most effectively reduced dolphin and whale bycatch. Although trawl-net modifications were the cheapest strategy overall, there were many locations where spatial closures were the most cost-effective solution, despite their high costs to fisheries, due to their effectiveness in reducing all fisheries interactions.

Zaharieva et al. (2019) did an experiment to determine whether acoustic deterrent devices (pingers) reduce cetacean bycatch in the turbot gillnets and catch rates of the target fish in the Bulgarian Black Sea territorial waters. During the study period 2017–2019, 12.4 km of turbot gillnets were included in the experiment. They were equipped with 10 kHz Porpoise Pingers manufactured by Future Oceans. Observations were carried out on a regular basis on active (with pingers) and on control nets (without pingers). The results showed that the pingers used were very effective in reducing cetacean bycatch in turbot gillnets without affecting the target catch.

2.3.2 Turtles

Báez et al. (2019) presents an analysis of the Spanish Mediterranean tuna fleet programme data to look at how operational changes and new strategies of the longlining fleet have affected bycatch of sea turtles in the Western Mediterranean. In the early 2000s, an estimated minimum of 60 000 loggerhead sea turtles were caught as bycatch in Mediterranean longline fisheries, including all countries operating in the area. Since 2000, the Spanish traditional home-based surface longline fishery targeting swordfish has been gradually modified or replaced by other métiers, and on most vessels, it has been replaced by a new deeper semi-pelagic longline targeting the same species, which has led to a dramatic decrease in sea turtle mortality. The main result of this study is that loggerhead turtle post-release mortality due to the bycatch by the Spanish surface fleets using different longline métiers has significantly decreased during the last 8 years of the study period. The study estimates an average post-release mortality around 1800 loggerheads sea turtles per year. The observed decrease in turtle mortality was an indirect effect of the introduction of changes in technology and fishing strategies in the fleets in the attempt to improve their economic objectives.

Kakai (2019) assessed the effectiveness of LED lights for the reduction of sea turtle bycatch in an artisanal bottom-set gillnet fishery at three sites on the north coast of Kenya. A total of 10 boats with pairs of control and illuminated nets were deployed during the study, with 56 turtles caught in control nets, while 30 were caught in illuminated nets. The mean catch per unit effort (CPUE) of target species was similar for both control and illuminated nets. In contrast, the mean CPUE of sea turtles was reduced by 64.3% in illuminated nets. This statistically significant decrease ($p<0.04$) in sea turtle catch rate suggests that net illumination could be an effective conservation tool. The issues associated with implementing the use of LED lights included increased net handling times, equipment costs, and limited awareness among fishers regarding the effectiveness of this technology.

2.3.3 Seabirds

Goad et al. (2019) trialled Hookpod-minis in the New Zealand surface longline fishery in 2016–2017 during short-term experimental (20 longline sets) and longer-term operational (110 longline sets) trials. Two sets of experimental trials were conducted. The first compared snoods fitted with Hookpod-minis with a tori line to unweighted snoods with a tori line. The second compared snoods fitted with Hookpod-minis as a stand-alone mitigation measure to weighted snoods in combination with a tori line. All gear, across both trials, was set at night. Operational trials compared snoods fitted with Hookpod-minis and tori lines to standard mitigation requirements for unweighted gear and tori lines, with all gear set at night. Both sets of trials demonstrated that Hookpod-minis fit easily into fishing operations, do not reduce target species catch rate, and may reduce seabird bycatch to low levels. The findings suggest that Hookpod-minis as a stand-alone mitigation measure are as effective, or more effective, than current bycatch mitigation measures including the combination of line weighting and tori lines.

Jiménez et al. (2019) assessed the effect of two seabird mitigation measures for pelagic longline fisheries which are already known as being effective on 13 threatened, protected and/or bycaught species, including elasmobranchs, teleosts, sea turtles and fur seals. Analyses were from two experimental studies in Uruguay assessing the effect of a bird scaring line (BSL) and branch lines with weights close to the hooks (weighted branch lines) on these taxa. One hundred longline sets with randomised use of a BSL were deployed. In turn, 224 paired longline sections, with control branch lines versus weighted branch lines, were deployed. BSL use did not increase the capture of any of the species addressed. No detectable differences in capture rate were recorded in the branch line weighting study. However, the effect of branch line weighting in the capture of Porbeagle shark (*Lamna nasus*) remains unclear and requires further research. The study suggests that effective measures to reduce seabird bycatch in pelagic longline have no negative connotations for other vulnerable species.

Paterson et al. (2019) recorded seabird bycatch and other interactions in the Namibian demersal longline fishery. Interaction rates were estimated for seasonal and spatial strata and scaled up to fishing effort data. Bycatch rates were 0.77 (95% CI 0.24–1.39) and 0.37 (95% CI 0.11–0.72) birds per 1000 hooks in winter and summer, respectively. Scaling up to 2010, the most recent year for which complete data are available, suggests 20 567 (95% CI 6328–37 935) birds were killed in this fishery that year. The study compared bycatch rates to those from experimental fishing sets using mitigation measures (one or two bird-scaring lines and the replacement of standard concrete weights with 5 kg steel weights). All mitigation measures significantly reduced the bycatch rate. The study confirms that the Namibian longline fishery has some of the highest known impacts on seabirds globally but implementing simple measures could rapidly reduce those impacts.

Santos et al. (2019) trialled Lumo Leads, an alternative weight system designed to slide in the event of a line break, and therefore prevent accidents, in pelagic longline fisheries off southern Brazil. Four fishing trips were conducted and 26 377 hooks sampled to compare sink rates, seabird bycatch rates and catch rates of target species between three treatments: (1) 60 g Lumo Lead attached at 1.0 m from the hook; (2) 60 g Lumo Lead at 3.5 m; and (3) 60 g leaded swivels at 3.5 m from the hook. A Lumo Lead placed at 1.0 m from the hook resulted in a faster sink rate and caught fewer seabirds (0.11 birds per unit of effort [BPUE]) when compared with a Lumo Lead (0.33 BPUE) or weighted swivel (0.85 BPUE) placed at 3.5 m. The bycatch with Lumo Lead placed at 1.0 m from the hook was 90% lower than the bycatch of Lumo Lead or weighted swivel placed at 3.5 m combined. There was no difference in the catch rates of target species between the three treatments. These findings support a growing body of evidence that placing weights close to the hook reduces seabird bycatch without affecting the catchability of the target species. The high seabird bycatch rates recorded despite night setting and recommended line weighting regimes reinforces the need for simultaneous deployment of a tori line with these other two mitigation measures to reduce seabird bycatch to negligible levels in the southwest Atlantic.

2.3.4 Elasmobranchs

Broadhurst et al. (2020) described the mortality of elasmobranchs (and other taxa) getting by-caught in gillnets set around beaches off eastern Australia to protect bathers from sharks. Their results showed that obligate ram ventilating elasmobranchs (e.g. great hammerhead, *Sphyrna mokarran*, and common blacktip shark, *Carcharhinus limbatus*) had greater mortality than species with spiracles, such as rays. They also assessed the effect of soak time on mortality and found that a soak time of 72–96 hours was optimal to target sharks but minimise the mortality of rays.

Driggers et al. (2019) reported results from a follow-up study aiming to test earlier results that several shark species may have a preference for Atlantic mackerel (*Scomber scombrus*) over northern shortfin squid (*Illex illecebrosus*). They found no differential preference for bait type for four out of five shark species but catch rates for Atlantic sharpnose sharks (*Rhizoprionodon terraenovae*) were significantly higher on mackerel-baited hooks. They suggested that the use of squid bait can reduce the catch of at least one shark species while not reducing catch of target species, but also highlighted that since some other protected species show higher bycatch rates on squid-baited hooks, a multi-taxa holistic assessment is necessary before adopting any bycatch reduction measure.

2.4 Additional information regarding mitigation projects on turtle bycatch

The text in this section includes additional information on projects mitigating bycatch of turtles and are not included in the literature search above.

Bycatch mitigation measures currently in use include capacity development of fishers mainly on bycatch handling and release; the recovery and reintroduction of turtles brought in by fishers (Portugal, France, Spain, Italy, Malta); and the rescue of turtles caught in poundnets (Ceuta, Spain). In all these countries, research on factors affecting the bycatch risk and fishing trials have been conducted since the early 90's. A general summary of these factors is given here.

Sea temperature can affect bycatch risk through a) stunning and/or causing reduced capacity to avoid active nets such as trawls (France (Med), and bottom trawling (Spain and Tunisia in winter months), or b) increased activity in warm waters from May to September increasing bycatch rate (gillnets, poundnets and longlines) (Domenec et al., 2015, Cardona et al., 2019). Using lights for fishing has also been shown to increase risk of bycatch (Wang et al., 2013); Longline hooks with lights or soaked in the photic zone attract turtles and increase bycatch rates. Lighting of gillnets has been shown to reduce bycatch in some fisheries, but experiments in the Mediterranean (Balearic lobster fishery and French artisanal gillnets) have not been conclusive (Virgili et al., 2017).

Deep setting of gear generally reduces bycatch risk to turtles, but bycatch in deep gear usually results in a higher death rate by drowning. Bycatch in surface longlines soaking close to the surface often has turtles alive when hauling in, so adequate handling and release can reduce the death rate. Research on Decompression Sickness of turtles caught in bottom trawls and gillnets has highlighted the need for a review of the handling and release procedures of turtles diagnosed with "comatosis" (Parraga et al., 2014).

In all gear, but mainly in trawling, set duration greatly affects the chances of survival of bycaught turtles. However, if combined with the effect of depth, turtle handling requires verifying "decompression sickness" before release of turtle (FAO Sea Turtle Bycatch Guidelines 2009).

Bycatch mitigation trials have shown that bycatch rate and severity of hooking significantly increased with the use of squid bait (Echwikhi et al., 2011). Modern artificial baits can also have a negative effect with deeper hooking due to elasticity of bait (Baez et al., 2014, Piovano et al., 2016). Circle hooks do also have an effect on bycatch rates and have reduced bycatch rates without negatively affecting tuna fisheries. However, swordfish catch is reduced with circle hooks as opposed to "J" hooks (Swimmer et al., 2017).

In many sea turtle bycatch situations, the animals are still alive when the gear is hauled. Adequate handling and release of turtles can greatly increase chances of survival (Oros et al., 2016). Hauling onboard of the animal, safe placing on deck, hook removal, gear disentangling, or comatose treatment require proper gear and training of fishers and in some cases the support of sea turtle recovery centres (Baez et al., 2019. The design and use of guidelines (sheets and video), as well as the integration in bycatch research programmes of the veterinarian perspective since 2005 has highlighted the relevance of adequate protocols and capacity development of fishers and fishery biologists.

Bycatch mitigation projects intensified in 2002, focusing on; a) Circle hooks, Hook sizes, Depth, Bait trials in Spanish Mediterranean LLSWO – EC Pilot project by IEO and CARBOPESCA (2005), b) Bait trials in Spanish Mediterranean LLSWO by Alnitak and NOAA NMFS (2005), c) Circle hooks and Depth trials in Spanish Mediterranean LLALB by Alnitak, CEPESCA and NOAA NMFS (2006 – 2008), d) Project on veterinarian approach to turtle handling and release, stress and survival of hooked turtles and electronic monitoring systems in Mediterranean LLALB and LLSWO by Alnitak, CEPESCA, SGP, NOAA NMFS, CRAM and SUBMON, e) Testing of Circle hooks, Hook sizes, Depth, Bait trials in Spanish Mediterranean LLSWO – EC Pilot project by AZTI (2007), f) Turtle stress studies related to bycatch in longlining.

Since 2008 bycatch in LLSWO was reduced by over 95% after the Spanish Mediterranean longlining fleet switched to deep setting and artificial bait.

Several projects have focused on bycatch mitigation measures, electronic monitoring, sea turtle handling and release, survival, etc. conducted in collaboration with fisheries by AZTI, IEO, University of Barcelona, University of Valencia, CSIC, SEC, Chelonia, Xaloc, Oceanografic Valencia, etc. Although most projects have focused on bycatch in longlining, some have also focused on a) trawling and testing Turtle Excluder Devices (CRAM and Chelonia in the Mediterranean bottom trawling fishery), b) tuna poundnet of Ceuta (A. de los Rios), and c) lobster gillnets in the Balearic Islands (University of Barcelona 2003, Alnita–USFWS–CEPESCA–ACCOBAMS/GFCM 2016).

In the Spanish long-distance fleet, we can also highlight projects on bycatch mitigation measures, ghost fishing and electronic monitoring in the tuna longlining and purse seining fisheries (IEO, AZTI, Alnitak–USFWS–NOAA, ISSF, OPAGAC, and WWF).

Since 2013, Alnitak and SOCIB have worked on developing bycatch risk zoning maps by integrating loggerhead turtle satellite tracking data in the SOCIB Integrated Ocean Observing System.

In Italy, between 2006 and 2017, a national observer programme was conducted on board mid-water pair trawlers under Regulation (EC) no. 812/2004. This was an ad hoc monitoring programme in which observers were trained to collect not only data on cetacean bycatch, but also additional data on bycatch of other protected species under the Habitats Directive, i.e. loggerhead turtle (Fortuna et al., 2010). Since 2018, this programme has been implemented in the Data Collection Framework, DCF (Pulcinella et al., 2019). In addition, over the last decades, a number of studies have been conducted to test different mitigation measures (Sala et al., 2011; Lucchetti et al., 2016a) and assess the interaction of sea turtles with different fishing gears (Casale 2008; Lucchetti and Sala 2010; Wallace et al., 2013; Casale et al., 2018) including bottom trawl (Vallini et al., 2003; Casale 2004, 2011; Sala et al., 2011; Lucchetti et al., 2016b, 2017a,b, 2019; Vasapollo et al., 2019), beam ("rapido") trawl (Lucchetti et al., 2018), set nets (Casale 2011; Lucchetti et al., 2017a,b; Virgili et al., 2018) and longline (Casale 2007, 2011) in the framework of several national and EU projects (TARTALIFE, TARTA-TUR, TARTANET, DELTA).

In **France**, data on sea turtle bycatch are collected by the onboard observing programme OBSMER, according to EU regulations. Furthermore, NGOs stranding networks are operating since the 1990s, covering all French mainland coasts (see ToR A).

2.5 Conclusions

As in earlier years, Member States' reports on Reg. 812/2004 are inconsistent and do not always follow the agreed format for reporting, making it difficult to get an overview of how many vessels in each MS are required to use pingers, of the level of compliance, and of the level of enforcement. Of all the submitted Reg. 812/2004 reports, it appears that only in the UK is pinger use fully implemented and there is active enforcement.

- Although some development and testing of mitigation measures are taking place, it is clear from the above that further development of mitigation measures as well as trials to test their effectiveness are needed to reduce the bycatch of protected species in many fisheries. In particular, research is needed to understand the aetiology of bycatch to guide this development.
- More research is also needed on e.g. why pingers are effective in some fisheries and not in others, on the possible effects of habituation and habitat exclusion in relation to pinger deployment, and on why LED lights can reduce bycatch for some seabird species but increase bycatch of other species.
- The information on ongoing development and testing of mitigation measures comes to the WGBYC through various avenues. Some information is available in the Reg. 812/2004 national reports; other information comes via the members of the working group and in particular those members participating in answering the relevant ToRs. This means that the information is to some extent random and certainly incomplete. To improve on this situation and ensure that the WGBYC is provided with a comprehensive overview of ongoing development and testing of mitigation measures, it is proposed to introduce national reports on ongoing projects similar to what is happening in e.g. WGFTFB.
- WGBYC has, as in previous years, provided a short summary of protected species bycatch mitigation studies from recent literature. However, this can be a very time-consuming task, and WGBYC considers that with easy internet access to search engines like e.g. Google Scholar, Web of Science etc., the WGBYC should instead list up to date references and focus more on reported ongoing mitigation projects.

3 ToR C

Evaluate the range of (minimum/maximum) impacts of bycatch on protected species populations where possible to assess likely conservation level threats and prioritize areas where additional monitoring/mitigation is needed

3.1 Does the choice of fishing effort metric for calculating bycatch rates alter our interpretation of bycatch occurrence?

In recent years, there have been increasing calls from a variety of organisations (e.g. ASCOBANS, HELCOM etc.) for improved fishing effort data recording in relation to all gears, but particularly static nets. The rationale behind this is the generally accepted notion that routinely collected effort metrics such as Days at Sea may not be particularly suitable for describing patterns of bycatch rates because a Day at Sea is primarily a reflection of a fishing vessel's overall activity and is not necessarily an accurate guide to the relative fishing effort of different net types that can vary widely in terms of net length and soak times. The production of bycatch mortality estimates is also generally undertaken using Days at Sea (e.g. the WGBYC Bycatch Risk Approach) and in some cases haul (e.g. UK annual marine mammal estimates), but the number of hauls by métier for the wider fleet typically is not available and so is estimated based on observer métier level data.

Some basic exploratory analysis of the factors that influence bycatch rates (based on almost 14 000 static net hauls monitored under the UK Bycatch Monitoring Programme since 1996) was conducted in 2015 and presented at an ASCOBANS workshop (Kingston, 2015). Part of the analysis presented compared harbour porpoise bycatch rates calculated from the same data but using two different effort metrics, haul and kilometre per hour (km/hr). Of note was how this simple change in calculation method altered the overall picture of bycatch rates across the depth range of the fisheries studied (Figure 2 and Figure 3).

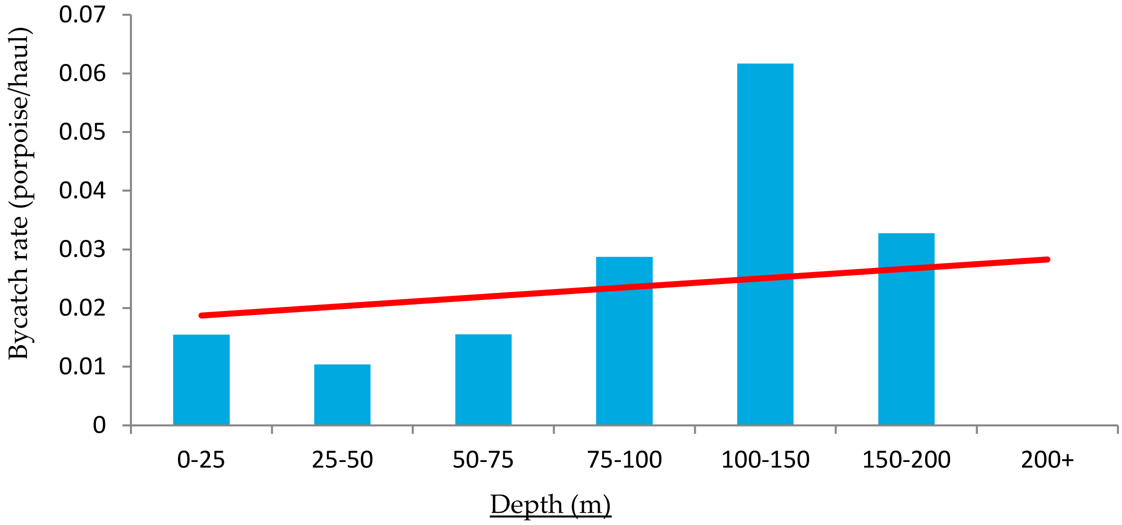

Figure 2. Porpoise bycatch rate in static net fisheries (porpoises/haul) by depth. The red line represents the trend in rate with depth (m).

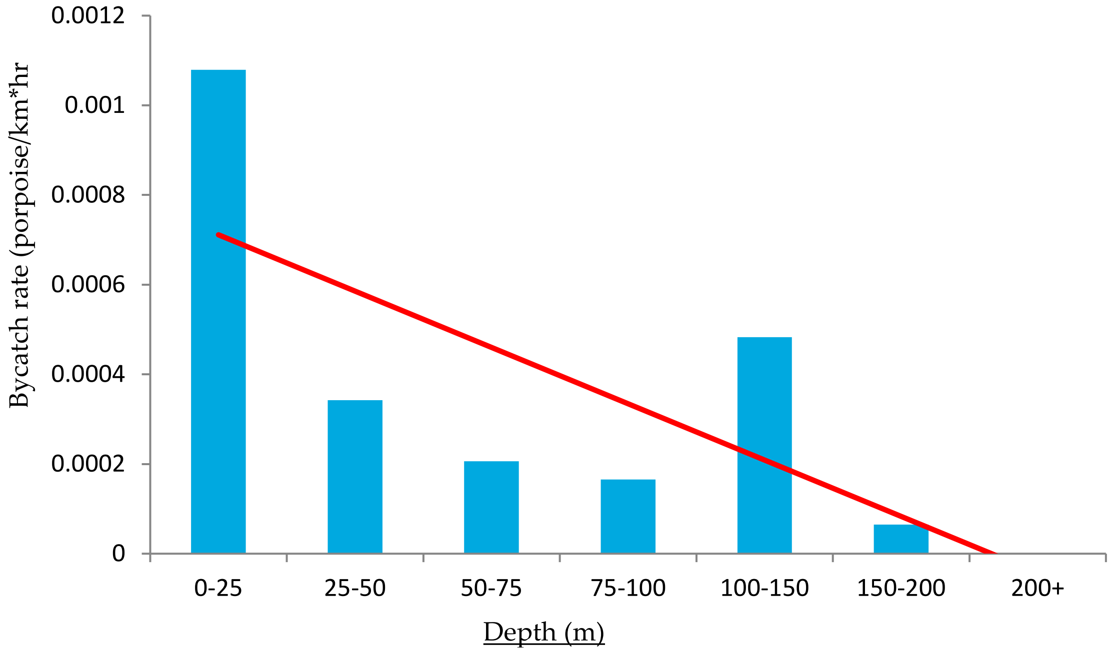

Figure 3. Porpoise bycatch rates in static net fisheries (porpoise/Km*Hr) by depth. The red line represents the trend in rate with depth.

The general trend of bycatch rates associated with different depth ranges (Figure 2 and Figure 3) essentially reverses from gradually increasing rates with depth when calculated by haul, to generally decreasing rates with depth when calculated by km/hr. A fairly obvious explanation for this is that inshore fisheries tend to operate in shallower water closer to shore, by smaller vessels which often have shorter net fleet lengths, and several inshore fisheries in the UK with generally short soak times (red mullet, sole, bass etc.) are not normally prosecuted by larger offshore vessels. Consequently, bycatch rates calculated by haul in inshore fisheries are relatively underestimated compared to offshore fisheries which generally use longer net fleets and are often associated with longer soak times, particularly in large mesh tangle and trammel net fisheries.

This preliminary finding prompted some discussion in WGBYC about whether the choice of effort metric may be important in terms of our overall understanding of general patterns of bycatch. This could be informative in determining where bycatch mitigation efforts might be best targeted, and to assess if the choice of metric significantly influences mortality estimates within existing métier stratification approaches. Consequently, during the 2020 WGBYC meeting it was decided to begin conducting some further exploratory analysis to start trying to answer some of these questions. An updated data file was prepared (also using data from the UK Bycatch Monitoring Programme) containing additional recent data (circa 20 000 net hauls in total) which was anonymised and so essentially provides a test (but real) dataset to gauge how the choice of fishing effort metric may alter our perception of bycatch rates.

For this analysis, we selected several different variables: depth, métier (level 4) and ICES rectangle, and have plotted bycatch rates calculated by four different commonly used fishing effort metrics: trip, haul, days at sea and km/hr. We calculated rates for three separate taxonomic groups of marine mammals: harbour porpoise (*P.phocoena*), dolphins (multiple species but predominantly *D. delphis*), and seals (predominantly *H. grypus*) (Figure 4 through Figure 6).

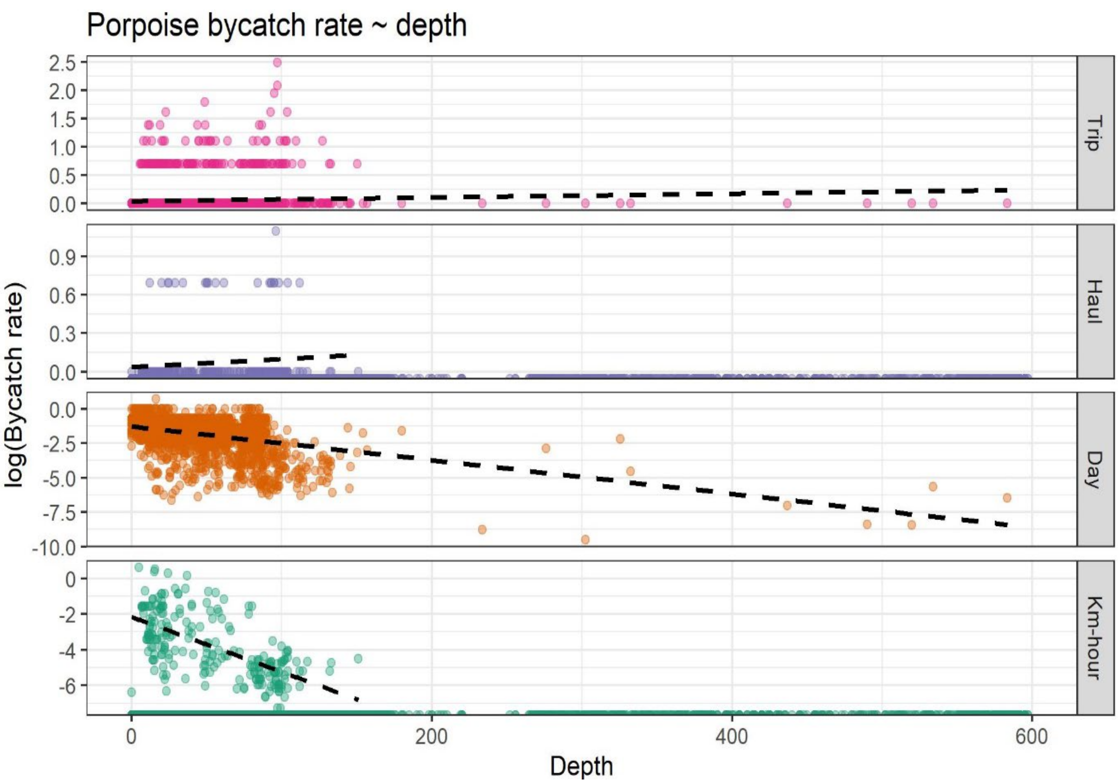

Figure 4. Porpoise bycatch rates in static net fisheries by depth for each effort metric.

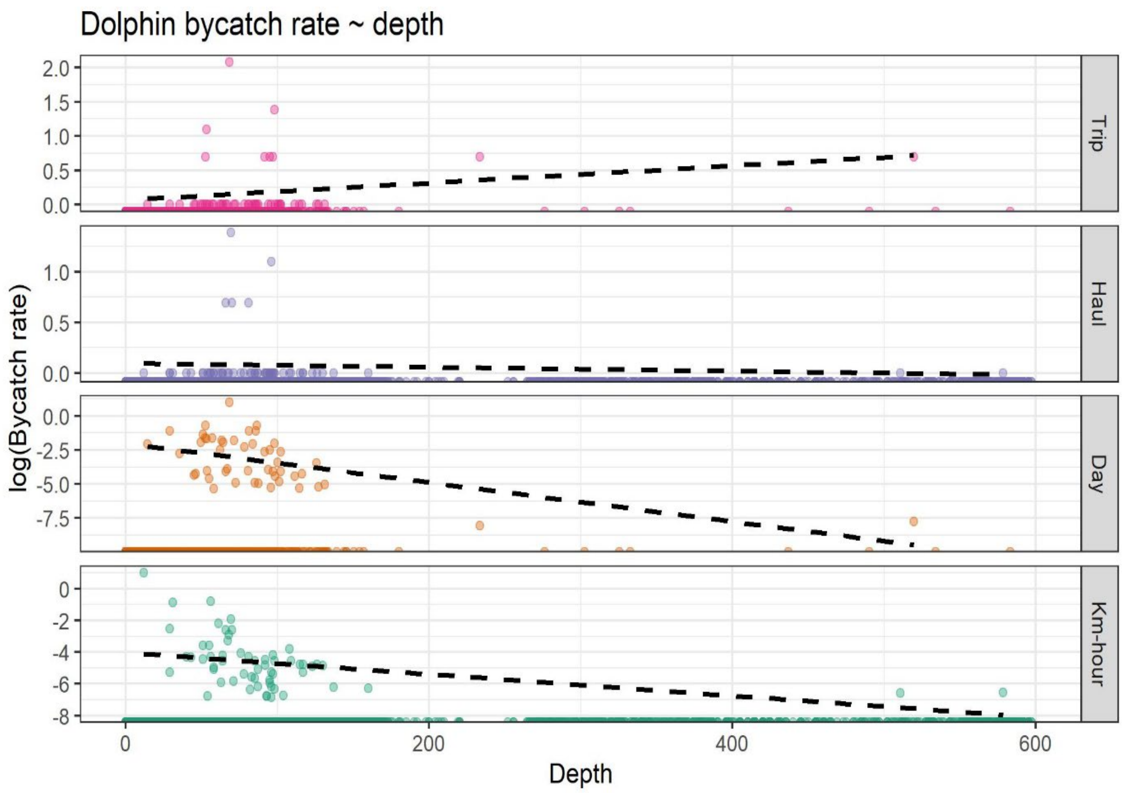

Figure 5. Dolphin bycatch rates in static net fisheries by depth for each effort metric.

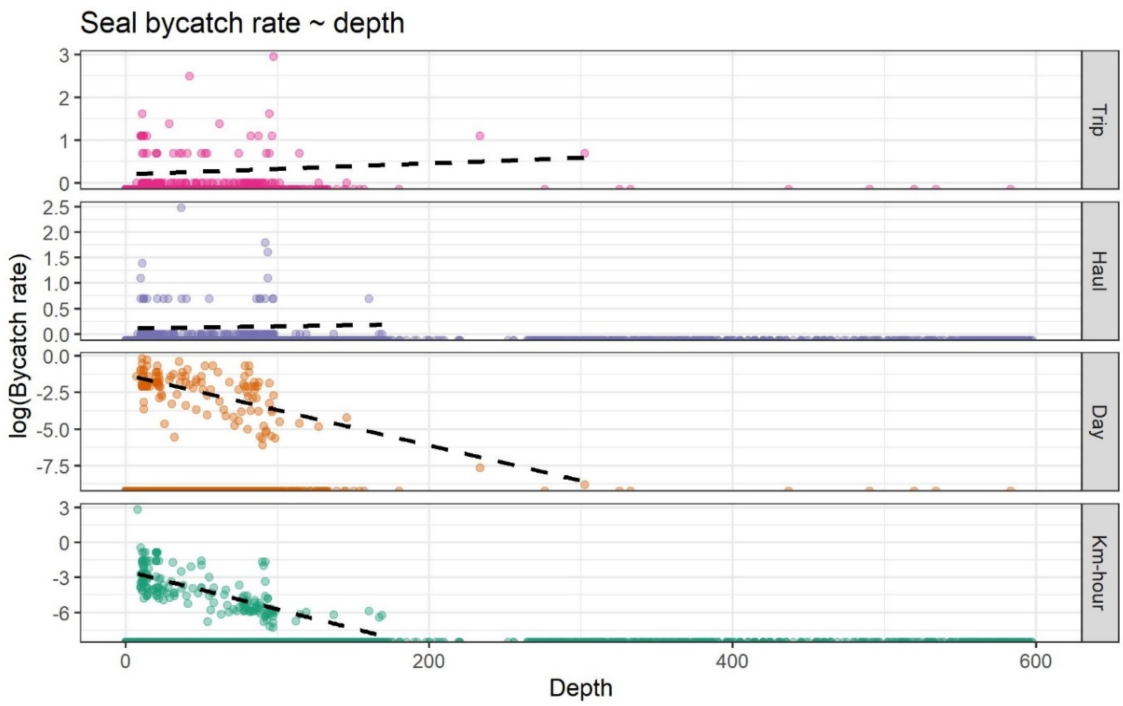

Figure 6. Seal bycatch rates in static net fisheries by depth for each effort metric.

The trends in rates by depth for each taxonomic group are similar within but differ between metrics. Generally, rates increase gradually with depth when calculated by trip and haul but decrease when calculated by day at sea and km/hr. The explanation for this general pattern again seems likely to be connected to a combination of differences between net fleet lengths and soak durations between inshore and offshore fisheries as previously described. Furthermore, the opposing trends seen between trip and day at sea in this later analysis might be explained by the fact that in offshore fisheries a significant part of many trips involves steaming, net deployment and net guarding operations. This means that bycatch rates calculated by day at sea may be relatively underestimated in offshore fisheries because hauling operations do not necessarily occur every day that a vessel is at sea, but those days are still counted in monitored trip durations (and in official logbook records). Conversely, small boat fishing effort is mainly conducted on a day to day basis (i.e. vessels leave and return to port each day) and observers generally only join boats if they know some hauling operations will occur so every monitored day at sea is associated with some net hauling operations. Similarly, fishing effort statistics for small boats are typically based on sales notes which are related to landing events and so probably do not include days at sea where only net deployments were carried out.

Figure 7 show box plots of bycatch rates for the three taxonomic groups calculated by métier level 4. Similar patterns are evident between taxa with day and km/hr providing the most insightful analyses. In most cases, rates calculated by trip and haul are not sufficient to distinguish differences in bycatch rates between métiers at métier level 4, whereas rates calculated by day at sea and km/hr show more between métier variation. Analysis at métier level 5 was discussed, and was considered unlikely to add to the picture because the majority of net fisheries in the UK target species that would fall under the demersal fish (DEF) métier classification. Additionally, at métier level 4, GTR and GNS both encompass a wide range of specific fisheries that may have quite different bycatch rates. To explore this, we also undertook bycatch rate calculations by target species but the resulting outputs were difficult to interpret so are not presented here. Consequently, we propose for further analyses to include a basic mesh size category system, loosely analogous to métier level 6, to explore how more detailed métier based rate calculations are influenced by choice of fishing effort metric.

Figure 8 through Figure 10 show bycatch rates calculated by ICES Rectangle for each of the four metrics. Although the overall spatial trend for each metric is essentially the same (because rates can only be calculated in rectangles with at least one observed bycatch), there is some indication of a slight smoothing of bycatch rates when calculated by km/hr compared to the other three metrics. The data analysed here have been collected since the mid-1990s so represent bycatch rates over what would typically be classed as the medium-long term. Clearly there may be several explanations at play, and further analysis is required but if this initial smoothing effect is correct it may have implications for our understanding and defining of the spatial distribution of “high-risk” areas and the notion of specific and enduring small-scale bycatch hotspots and so deserves further attention

Analysing bycatch rates of protected species is statistically challenging due to zero-inflation and variability in small datasets. We acknowledge that each of the covariates chosen in this analysis were presented independent of any additional predictors of bycatch and may only explain a small percentage of the variability in bycatch rates. Nonetheless, it is clear, that some effort metrics provide a clearer insight into covariate effects than others. Given the known correlation between net length, soak time, and bycatch rates in marine mammals it is unsurprising that the most detailed effort metric of km/hr provides the clearest picture of depth and métier effects on bycatch rates. Interestingly, bycatch per day at sea appears to provide the closest approximation of these trends, whereas bycatch per trip and per haul show less clear trends in depth and métier effects. Future efforts to statistically model covariate effects using each effort metric would provide valuable insights into which metrics allow for the most statistically robust analysis of bycatch rates and will improve our overall understanding of patterns of protected species bycatch.

It was not possible in the time available and with current data to assess how or if the choice of metric might influence overall total mortality estimates, and estimates are also likely to be influenced by whatever stratification approach is used. Fishing effort data are a fundamental component of mortality estimates but are currently not widely available in km/hr which appears from this initial analysis to be the most informative metric. However, this metric has been included in the RDBES database structure as an optional field, and this can be altered easily to a mandatory field if this level of effort data recording became a requirement of routine data collection procedures in static net fisheries. For future ICES WGBYC it would be of interest to further evaluate the variation in metric (i.e. the variation of net length and soak time per haul or day at sea) for specific fisheries or areas. This is needed for estimating total bycatch mortality if available effort is limited to for example trips or DaS.

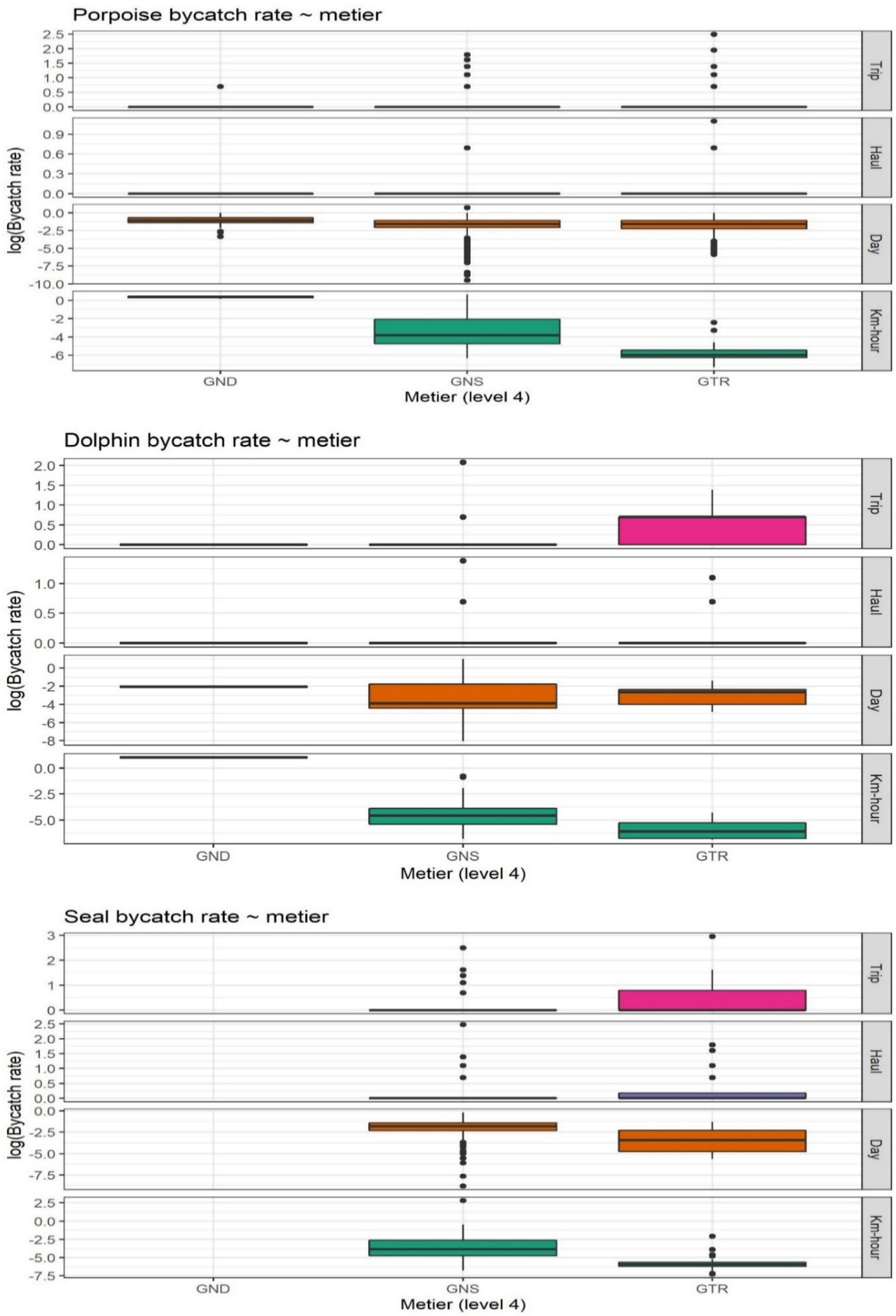

Figure 7. Bycatch rates calculated using four metrics by metier level 4 for harbour porpoise (top), dolphins (middle) and seals (bottom).

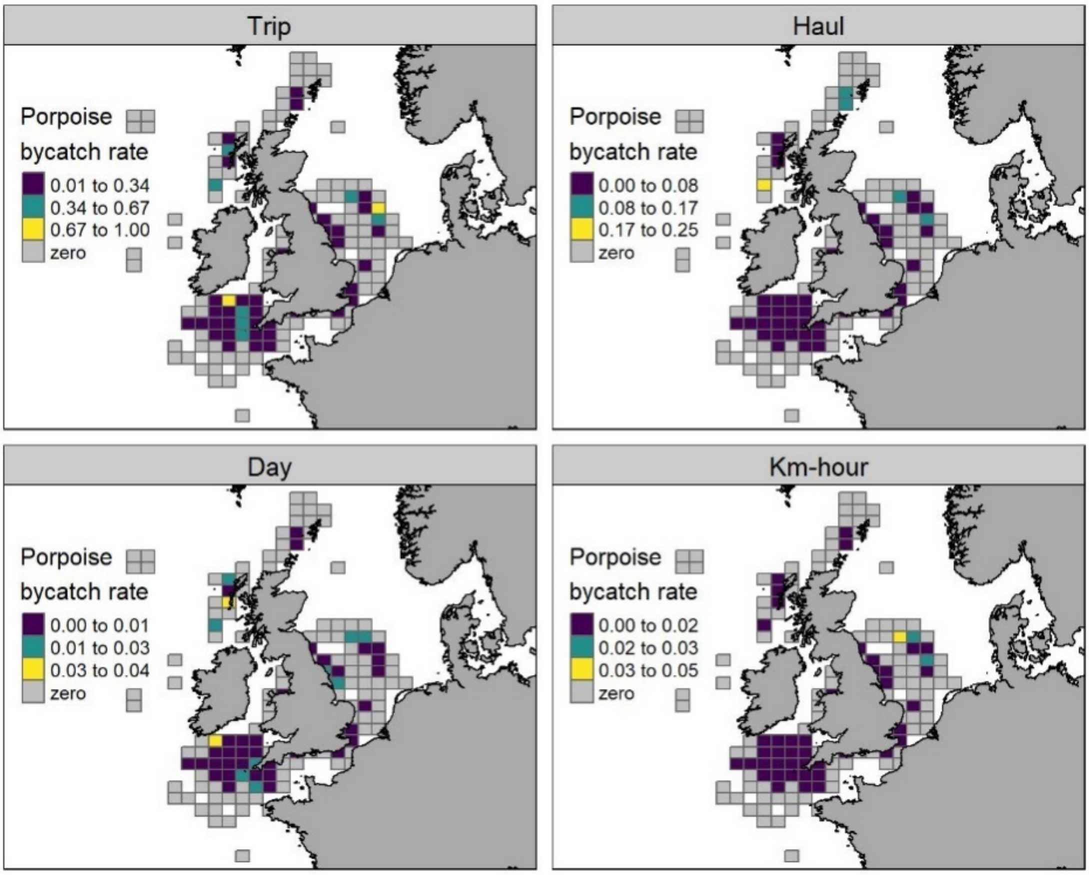

Figure 8. Observed porpoise bycatch rates by ICES Rectangle.

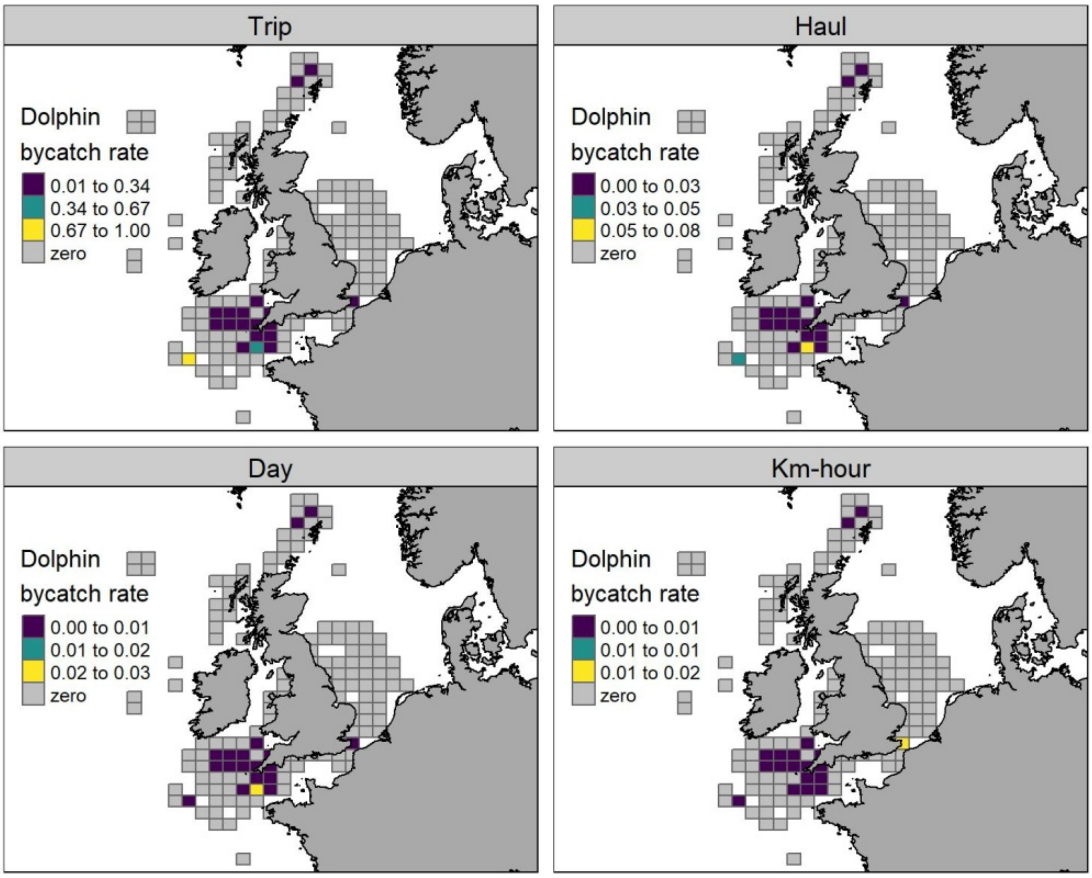

Figure 9. Observed dolphin bycatch rates by ICES Rectangle.

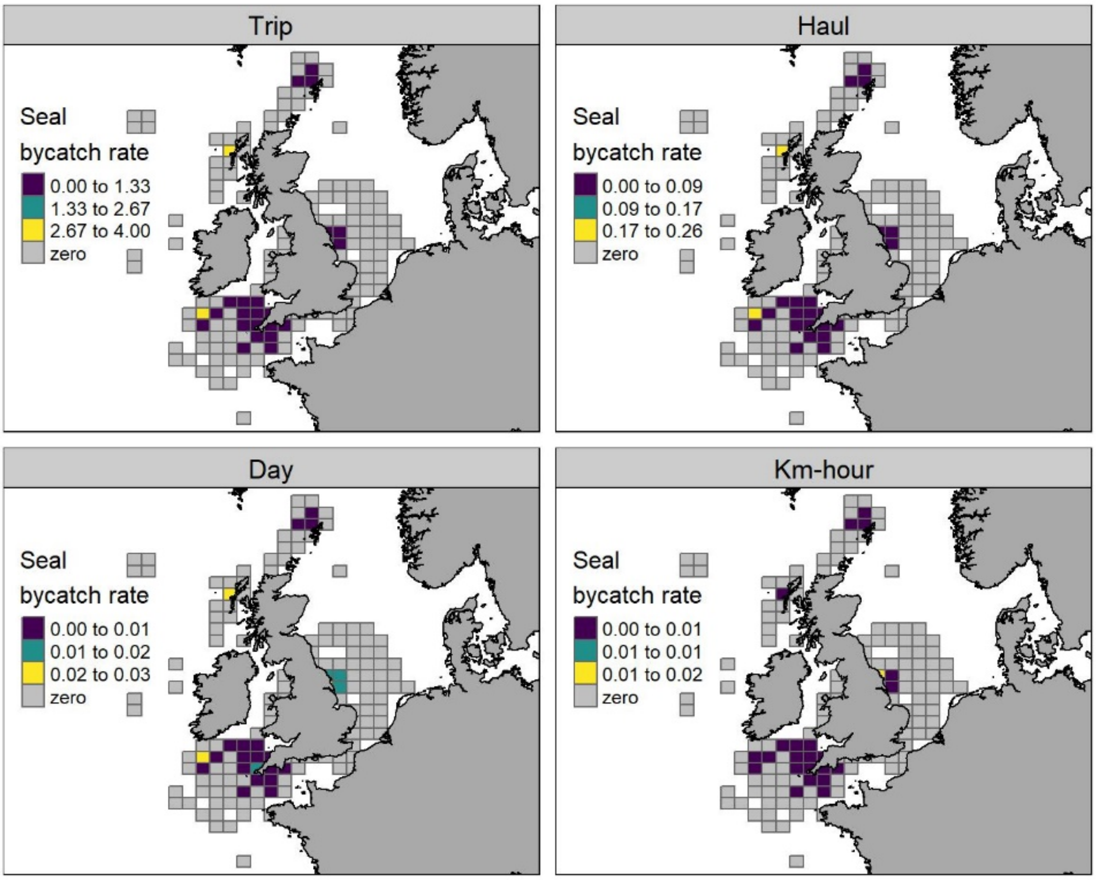

Figure 10. Observed seal bycatch rates by ICES Rectangle.

3.2 Approach to estimating minimum and maximum bycatch rates

As the exact frequency distribution of the bycatch is not available from the data in the WGBYC database, the question arose what would be the best method to estimate error around the produced bycatch rates used by the working group. In the past, when estimating harbour porpoise bycatch rates and associated confidence intervals, a binomial error distribution was most commonly assumed, but concerns were raised within the group as to whether that distribution was appropriate for all groups of species and gear types. Therefore, a modelling exercise was conducted on a subset of data provided by the Netherlands (cetaceans in pelagic trawl), UK (cetaceans and seals in gillnets, cetaceans in pelagic trawls), Denmark and Sweden (cetaceans in gillnets), and Norway (cetaceans and seabirds in gillnets). The objectives were to test several common model families to estimate bycatch error ranges to determine which one was most appropriate with the datasets provided. The model families that fit the data best would then be used in the future to estimate error around the bycatch estimates produced by the working group.

3.2.1 Methods

Several different probability distributions were tested on the sample datasets, and fit metrics such as AIC used to compare the different distributions. A binomial distribution along with two other commonly used distributions, the Poisson, and the negative binomial, were tested. Additionally, a more complex model was used - a two-step gamma-hurdle model; in this model, it first estimates bycatch probability (i.e. the probability of a non-zero bycatch event) with a binomial generalised linear model with logit-link function while the bycatch intensity (number of animals) is then estimated with a gamma-generalised linear model with log-link function (see Christensen-Dalsgaard et al., 2019 and Hilborn & Mangel, 1997). The datasets that were used for this exercise were as follows:

- Harbour porpoise bycatch from the Danish gillnet fleet, from electronic monitoring of 25 918 gillnet hauls.
- Dolphin bycatch from the Dutch pelagic trawler fleet, from 5966 trawl hauls observed by observers.
- Harbour porpoise bycatch from the Swedish gillnet fleet, from 457 observed hauls using electronic monitoring.
- Porpoise, dolphin and seal bycatch from the UK gillnet fleet, from 17342 observed hauls by observers.
- Porpoise (327 self-sampled trips) and sea bird (267 trips including trips with scientific observers and self-sampled trips) bycatch from Norwegian gillnet reference fleet.
- For each distribution/model method, the mean bycatch rate and 95% confidence intervals were calculated. The Akaike Information Criterion (AIC) was also estimated for all four methods for comparison.

3.2.2 Results

The result of this exercise showed that either Poisson or the negative binomial distributions fitted better to the given data than the binomial distribution that had been used in the past. This is not surprising, as the binomial distribution is best used to estimate whether or not there was a bycatch, but not the severity of it. In some cases, as in the freezer trawl fisheries example, three methods (binomial, negative binomial and Poisson distribution) perform similarly due to the nature of the data, as very few animals were bycaught and no instances of more than 1 dolphin per haul were observed. The two-step gamma hurdle model was a good fit in most cases, but due to the nature of the WGBYC dataset (frequency of bycatch in each bycatch event unknown), it is not going to be possible to use this method. Data calls in the future should consider asking for each bycatch event separately so the error can be estimated directly to avoid the need to assume a certain error distribution around the bycatch rates.

Danish gillnet example. Hypothetical effort of 300 000 unit effort used for raising. Total observed marine mammal bycatch/unit effort=0.0145. Results are shown in Table 7 and Table 8. Using a binomial distribution likely underestimates porpoise bycatch a bit, the other methods are largely similar.

Table 7. Bycatch rates in the Danish gillnet example given the three different methods.

Method	95% CI (Lower)	Mean	95% CI (Upper)	AIC score
Gamma-Hurdle model	0.0117	0.0145	0.0178	1895
Binomial	0.0105	0.0118	0.0132	3327
Negative binomial	0.0126	0.0143	0.0161	3667
Poisson	0.0129	0.0143	0.0157	4107

Table 8. Bycatch rates in the Danish gillnet example raised using the hypothetical number of unit effort (300 000 unit efforts).

Method	95% CI (Lower)	Mean	95% CI (Upper)
Gamma-Hurdle model	3843	4353	4876
Binomial	3222	3543	3859
Negative binomial	3871	4289	4703
Poisson	3941	4290	4639

Dutch pelagic freezer trawler example. Hypothetical effort of 300 000 unit effort used for raising. Total observed marine mammal bycatch/unit effort=0.00067. Results are shown in Table 9 and

Table 10. As there were no instances where there was more than one dolphin caught in a unit effort, the distribution used does not matter as it results in the same numbers.

Table 9. Bycatch rates in the Dutch freezer trawl example given the three different methods.

Method	95% CI (Lower)	Mean	95% CI (Upper)	AIC score
Gamma-Hurdle model	Not possible due to few observations	Not possible due to few observations	Not possible due to few observations	
Binomial	0.00021	0.00067	0.00156	69
Negative binomial	0.00021	0.00067	0.00156	71
Poisson	0.00021	0.00067	0.00156	69

Table 10. Bycatch rates in the Dutch freezer trawl example raised using the hypothetical number of unit effort (300 000 unit efforts).

Method	95% CI (Lower)	Mean	95% CI (Upper)
Gamma-Hurdle model	Not possible due to few observations	Not possible due to few observations	Not possible due to few observations
Binomial	85	201	318
Negative binomial	85	201	318
Poisson	85	201	318

Swedish gillnet example. Hypothetical effort of 30 000 unit efforts used for raising. Total observed marine mammal bycatch/unit efforts=0.0722. Results are shown in Table 11 and**Error! Reference source not found.**. Due to the small sample size, the binomial grossly overestimates the bycatch while both the negative binomial and Poisson are close to the average rate.

Table 11. Bycatch rates in the Swedish gillnet example given the three different methods.

Method	95% CI (Lower)	Mean	95% CI (Upper)	AIC score
Gamma-Hurdle model	0.13076	0.22917	0.38088	85
Binomial	0.11193	0.16667	0.23312	132
Negative binomial	0.04375	0.06734	0.10133	231
Poisson	0.04788	0.06734	0.09068	255

Table 12. Bycatch rates in the Swedish gillnet example raised using the hypothetical number of unit efforts (30 000 unit efforts).

Method	95% CI (Lower)	Mean	95% CI (Upper)
Gamma-Hurdle model	4890	6912	9051
Binomial	3571	4992	6522
Negative binomial	1568	2024	2516
Poisson	1562	2019	2494

UK gillnet example. Hypothetical effort of 300 000 unit efforts used for raising. Total observed marine mammal bycatch/unit effort=0.0225. Results are show in Table 13 and Table 14. The binomial is again underestimating and fits the data poorly. Using the joint method (gamma hurdle) leads to a wider error range. Negative binomial and Poisson are very similar, as would be expected. Although the fit is not good, the over-all estimates are similar.

Table 13. Bycatch rates in the UK gillnet example given the three different methods.

Method	95% CI (Lower)	Mean	95% CI (Upper)	AIC score
Gamma-Hurdle model	0.01878	0.02254	0.02700	1810
Binomial	0.01674	0.01868	0.02077	3223

Method	95% CI (Lower)	Mean	95% CI (Upper)	AIC score
Negative binomial	0.01962	0.02204	0.02472	3571
Poisson	0.01998	0.02204	0.02425	3885

Table 14. Bycatch rates in the UK gillnet example raised using hypothetical number of unit efforts (300 000 unit effort).

Method	95% CI (Lower)	Mean	95% CI (Upper)
Gamma-Hurdle model	5634	6762	8100
Binomial	5021	5604	6230
Negative binomial	6006	6616	7221
Poisson	6098	6615	7130

Norwegian gillnet example. Hypothetical effort of 3000 trips used for raising. Total observed marine mammal bycatch/number of trips=0.1896. Results are shown in Table 15 and Table 16. The binomial is again underestimating. Using the joint method (gamma hurdle) leads to a wider error range, but a more accurate mean. Negative binomial and Poisson are very similar, as would be expected.

Table 15. Bycatch rates in the Norwegian gillnet example given the three different methods.

Method	95% CI (Lower)	Mean	95% CI (Upper)	AIC score
Gamma-Hurdle model	0.1242	0.1896	0.2819	168
Binomial	0.1032	0.1376	0.1777	264
Negative binomial	0.1212	0.1594	0.2053	340
Poisson	0.1276	0.1594	0.1941	359

Table 16. Bycatch rates in the Norwegian gillnet example raised using the hypothetical number of trips (3000 trips).

Method	95% CI (Lower)	Mean	95% CI (Upper)
Gamma-Hurdle model	441	565	698
Binomial	315	408	491
Negative binomial	369	476	574
Poisson	402	479	559

Norwegian lumpsucker gillnet example. Hypothetical effort of 3000 trips used for raising. Total observed bird bycatch/number of trips=0.902. Results are shown in Table 17 and Table 18. The binomial is underestimating again. Using the joint method (gamma hurdle) leads to a wider error range, but a more accurate mean. Negative binomial and Poisson are very similar, as would be expected, but lead to a lower estimate than the gamma-hurdle method.

Table 17. Bycatch rates in the Norwegian lumpsucker gillnet example given the three different methods.

Method	95% CI (Lower)	Mean	95% CI (Upper)	AIC score
Gamma-Hurdle model	0.6416	0.901515	1.2606	359
Binomial	0.3435	0.4015	0.4614	357
Negative binomial	0.4211	0.4741	0.5289	683
Poisson	0.4419	0.4741	0.5052	839

Table 18. Bycatch rates in the Norwegian lumpsucker gillnet example raised using the hypothetical number of trips (3000 trips).

Method	95% CI (Lower)	Mean	95% CI (Upper)
Gamma-Hurdle model	2246	2737	3278
Binomial	1052	1201	1337
Negative binomial	1281	1425	1551
Poisson	1338	1423	1502

3.3 Estimates of métier specific minimum and maximum bycatch rates: common dolphin and harbour porpoise

Under Tor G reported in WKEMBYC (ICES, 2020) an assessment of bycatch for common dolphins was evaluated in two ICES defined ecoregions: Celtic Seas (divisions 6.a, 6.b.2, 7.c.2, f, g, h, 7.j.2, 7.j.1 and 7.k.2, 7 e and 7d[12]) and Bay of Biscay (divisions 8abde) and Iberian coast (8c and9a). The evaluation was based on two data sources: the WGBYC database and the results of modelling stranded dolphins. The ToR G subgroup further evaluated the bycatch risk posed to the Baltic harbour porpoise of different métiers (WKEMBYC 2020). No additional marine mammal bycatch assessments have been conducted under ToR C and the main outputs of those under ToR G are summarised here.

Using the WGBYC database, to get recent bycatch rates the monitored effort Days at Sea (DaS) and the number of common dolphins (specimens) bycaught was summarised for métier Level 4 (Gear) and métier Level 5 (target assemblage) for the years 2016 to 2018. To estimate the 95% confidence intervals around the error rates in the areas of interest, the Poisson distribution was assumed, and the confidence intervals estimated with bootstrapping given the mean and sample size. The bycatch rates were raised to fleet level using the average annual fishing effort within the métier (ML5) from the RDB.

In the Celtic Seas ecoregion, highest numbers of dolphins caught were estimated to be in bottom otter trawl (OTB) and gillnet (GNS) fisheries targeting demersal fish, capturing 276 dolphins (95% CI 151–427) and 192 dolphins (95% 85 – 299 CI) respectively. The total amount of annual bycatch in recent years (2016–2018) across all métiers amounted to 720 dolphins (95% CI 278–1345).

[12] 7e and 7d are not within the ICES Celtic Seas analysis but they were important areas to be considered in the context of this task.

In the Bay of Biscay and Iberian Peninsula ecoregion, the highest numbers of dolphins caught annually were estimated to be in the trammel net fisheries for demersal fish (GTR_DEF) amounting to 2061 dolphins (95% CI 1202–3092). The mean annual bycatch in recent years (2016–2018) across all métiers amounted to 3973 dolphins (95% CI 1998–6599). In 2017 and 2018, the mortality inferred from French strandings in the Bay of Biscay and the Western Channel were respectively estimated at 9300 (5800–17 900) and 5400 (3400–10 500) common dolphins.

Estimating the annual bycatch of the Baltic Proper harbour porpoise is not possible. Bycatch events are extremely rare due to the low abundance of the Baltic harbour porpoise. The WGBYC database from 2006 until 2018 in the ICES subdivision 24 to 32, holds 7258 monitored DaS across métiers and only one recorded bycaught harbour porpoise in a bottom trawl.

To evaluate métiers that pose a high bycatch risk, the WGBYC database from 2005 until 2018 for other areas then the Baltic was separated into time periods and areas that related to the spatial distribution of harbour porpoises in the areas. Analyses of WGBYC monitoring data since 2005, confirmed that the highest bycatch rates for harbour porpoise occurred in gillnet or trammel net fisheries (GNS or GTR) in the North and Celtic Sea. In the Bay of Biscay, on the other hand, the highest bycatch rate occurred in the pelagic trawl fisheries. However, it is reasonable, given the much greater size (in terms of numbers of vessels) of the gillnet fleet compared to pelagic trawls in this area that gillnets would pose the greatest threat. The group concluded that gillnet and trammel nets therefore pose the greatest threat to the harbour porpoise in the Baltic.

In the Baltic Sea (ICES Areas 24–32), fishing effort is dominated by gillnets accounting for up to 75% of fishing effort (in DaS) from the ICES RDB in 2017. Gillnet fishing effort is mainly concentrated in the southern Baltic, and around the German and Polish coasts. The cod ban introduced in August 2019 has significantly reduced the amount of gillnet effort in the southern Baltic. In the Baltic overall, gillnet fishing effort has decreased by 44% over the past 10 years.

3.4 Estimates of métier specific minimum and maximum bycatch rates: seabirds

A number of bird species groups are known to be susceptible to bycatch in various types of fishing gear. Among these are: ducks, grebes, phalaropes, skuas, auks, gulls, terns, divers, storm petrels, petrels/fulmar, shearwaters, sulids and cormorants. Fishing gears known to catch birds include static and drift nets, hooks and lines/longlines, seines/surrounding nets, midwater and demersal trawls, traps, fyke nets and dredges, based on information collated by JWGBIRD (ICES 2018). Many of those species are classed as endangered either regionally or globally (ICES WGBYC 2019). Bycatch risk is generally considered to be closely linked to species specific foraging behaviour. For example, surface-feeding seabirds are more inclined to suffer from bycatch during line setting operations in longline fisheries when they are attracted by baited hooks or when gear is being deployed or hauled in other gear types; while diving species are generally more at risk of bycatch in bottom set gears such as static nets and traps when the gear is properly fishing.

The EU Plan of Action on Seabirds addresses the possible impacts of bycatch on protected species populations. Systematic collection and reporting of data on seabird bycatch is essential to tackling seabird bycatch (European Commission, 2012). WGBYC issued a data call in late 2019 requesting fishing effort, monitoring effort and bycatch records from MS national databases for 2018. In addition, monthly monitoring effort data were requested, including information on whether the data were raised or not. 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. Additionally, reported bycatch events available for analysis are often pooled (e.g. total X number of species A during a total of Y hours at sea for specific areas and métiers), which makes estimates of uncertainty highly difficult as the data available for analysis hides the variation. Thus, for the current report, calculating any confidence for the pooled bycatch rate is virtually impossible as we do not see the actual spread of the pooled data per focal scale for the reporting. To estimate this, we need data on a finer level giving multiple data points per level of focal scale (e.g. not pooled over long time periods or large areas).

In some species/areas, bird bycatch can be considered mainly seasonal. Especially where overwintering birds are aggregating in areas with intensive fisheries such as in shallow coastal waters or offshore banks in the Baltic Sea, the risk is highest (Sonntag et al., 2012). For this reason, observer data cannot simply be extrapolated from observer effort to total fishing effort but a monthly presentation would be needed. Monthly effort data are not available from all countries. Therefore, a quarterly presentation was chosen by the group.

In the data provided in the data call, 217 bycatch incidents with 696 birds of 22 species were reported. Table 19 provides a selection of species, areas and gears. Monitoring effort by at-sea observers, total effort and bycatch are presented by quarter. Observer coverage and mean bycatch rates were calculated. We are not able to produce any confidence intervals for bycatch rates within reasonable limits, as the data available for estimation mostly had only one or very few data points per species, métier and area (Table 19). Thus, the bycatch rates need to be considered as rough estimates which might not be representative across the whole spatio-temporal scale of fishing activities. The records presented in this table were chosen based upon the following criteria: (1) the observer coverage was above an arbitrarily set limit of 1% of the total fishing effort. This does not mean, however, that the group considered this a sufficient coverage; 2) only data were included which represented full coverage of observer trips; (3) data based on self-reporting instead of at sea observations were excluded; (4) data from surrounding nets in the Celtic Sea were excluded due to an observer coverage exceeding 100%. The resulting selection included 109 bycatch events with 399 bycaught individuals of 12 species. These bycatches occurred mainly in static nets whereas one bycatch event was in a pelagic trawl and another in a bottom trawl. Other gears for which bycatch of birds was reported (but not shown in this selection) were longlines, rods and lines, seines, surrounding nets, and traps.

In the Baltic Sea (27.3.d.23-32) most bycatches were reported in nets (n=55) and traps (n=10). Also bycatches in longlines were reported (n=4). Whereas in nets a broad range of species (6 species of diving ducks, com-mon guillemot, great cormorant, mergansers, horned grebe, and mallard) were bycaught, mallard, great cormorant and mergansers were reported from traps. In the Greater North Sea (27.3.a; 27.4 a,c; 27.7 d,e), the main gear producing bird bycatch was nets (n=7) with common guillemot, great cormorant and common scoter, followed by longlines (n=6) with northern fulmar and northern gannet. A northern gannet was re-ported bycaught in rods and lines. In the Celtic Sea (27.6a; 27.7.b-f-g), most bycatches were reported from nets (n=8), consisting of common guillemots and great cormorants. Northern gannets were bycaught in longlines as well as bottom and pelagic trawls, and three herring gulls were bycaught in surrounding nets. In the Bay of Biscay (27.8.a-b; 9a) most bycatches were reported in nets (n=17), consisting of common guillemots and northern gannets. A northern gannet was also bycaught in a pelagic trawl and a yellow-legged gull in a seine. In Icelandic waters (27.5.a.2), most bycatch was reported from nets (n=89) with 10 bird species affected. Northern fulmars and northern gannets were also bycaught in longlines (n=6). In the Western Mediterranean, a bycaught Audouin's gull was reported from a longline and in the Adriatic Sea, two shags were reported bycaught in bottom trawls.

Considering the uncertainties mentioned above and restricted to the combinations of gear type, ICES area and species selected here, it appears that highest bycatch rates occur on common guillemots in nets (Celtic Seas and Icelandic waters), great cormorants in nets (Baltic Sea), and common eiders in nets (Icelandic waters).

3.5 Estimates of métier specific minimum and maximum bycatch rates: elasmobranchs and bony fish

3.5.1 Elasmobranchs: summary of bycatch rates for 2018

Elasmobranchs are not protected under the Habitats Directive, but species are listed on the OSPAR List of Threatened and/or Declining Species and Habitats under OSPAR's Biological Diversity and Ecosystems Strategy and also through the Marine Strategy Framework Directive (MSFD). A number of elasmobranch species are also protected according to the Convention on Migratory Species (CMS). Some countries around Europe have national protection for some elasmobranchs, e.g. basking shark in UK, Norway, and Iceland etc. The main international protection they have is under the EU's Common Fisheries Policy (CFP) prohibited species list and the deep-water elasmobranch Total Allowable Catch (TAC) list. The deep-water species are also protected by North-East Atlantic Fisheries Commission (NEAFC). These prohibitions in EU and NEAFC essentially allow discarding of dead or alive bycatch.

The EU's MSFD requires that for commercial elasmobranch species the level of fishing mortality is quantified against the fishing mortality (F) consistent with maximum sustainable yield, and stock size is above a level termed MSY B trigger. For non-commercial elasmobranchs, MSFD requires that fishing mortality due to bycatch is below levels that affect the long-term sustainability of the species. Essentially this is similar to the F criterion for the commercial species.

There is no single definition of what constitutes endangered or threatened status of elasmobranchs in Europe. However, the EU red list (Nieto et al., 2015) is widely used. There are also global and regional red lists published by the International Union for the Conservation of Nature (IUCN).

This is the third time that elasmobranch bycatch data have been accessed formally by WGBYC through their annual data call. WGBYC has collated all bycatch data for protected elasmobranchs from 2018 to provide an overview of the degree of bycatch by gear and geographic region for various species, from records for the countries which submitted data.

This year, data from different countries were provided using three different raising methods which posed some difficulties when trying to obtain total bycatch values. Data under raising method A, was provided without an estimation of the bycatch to the trip level, so it was not useful to quantify the bycatch. These data were presented in Table 21 and should be interpreted cautiously as total interactions could be underestimated. However, with elasmobranchs which are rarely bycaught as for example Basking shark (*Cetorhinus maximus*) raising your bycatch values if the monitored coverage is low is not appropriate and reported unraised samples are preferred.

Data obtained under raising methods B and C gave us information of total number of bycaught individuals at trip level. In the case of raising method B, there was a 100% coverage of the trip and in raising method C, sample data was raised to the trip level. In both cases, bycatch values provided information of the incidents at trip level, so they were considered jointly in Table 20.

Raising methods B and C were valid to calculate ratios of bycatch per fishing days (due to 100% sampling coverage or data already raised to the trip level). The raising method A gave us information about the bycatch on the sample, without raising to a trip level. Therefore, it could only be used as qualitative information or minimum bycatch rate.

For more specific presentational purposes, WGBYC has focussed on species of high and medium conservation concern, using the EU red list of fishes (Nieto et al., 2015) as the basis for classification. Species classified as “endangered EN” or “critically endangered CR” were considered to be of high conservation concern. Those classified as “vulnerable VU” are classified as of medium concern; those classified as “near threatened NT”, or “data deficient DD” were considered for now to be of low conservation concern; whilst those classified as “least concern LC” are considered to be of no conservation concern. The least concern species are often characterised by large numbers of observations reflecting the relatively high abundance of those species in some areas. Further work on producing raised or extrapolated discard estimates for these species could be a useful exercise to help assess total mortality but this is beyond the scope of WGBYC at this time.

Bycatch rates, in terms of numbers of specimens per observed day at sea in a particular métier were calculated for all species of high and medium conservation concern and presented in Table 20.

The gear with most bycatch was bottom trawl and the ecoregions with higher bycatch rates were Greater North Sea, Western Mediterranean Sea and Barents Sea (few records). Species listed as Critically Endangered (CR), Endangered (EN) and Vulnerable (VU) were caught in Celtic Seas. *Dipyurus batis* and *Squalus acanthias* were, among the species of high conservation concern, the most captured species.

3.5.2 Fish: summary of bycatch rates for 2018

The analysed species on WGBYC and showed in Table 22 and Table 23, are 'Species to be monitored under protection programmes in the Union or under inter-national obligations' of the Commission Implementing Decision (EU) 2016/1251 adopting a mul-tiannual Union programme (EU-MAP) for the collection, management and use of data in the fisheries and aquaculture sectors for the period 2017–2019, those species are listed which are to be recorded by the member states as part of the data collection programme. As it has been done with the elasmobranches, the data have been separated depending on the raising method provided by different countries. Table 23 shows unraised data, which only should be considered as a qualitative information. Table 22 shows information of 100% sampling coverage and data raised to the trip level so, in both cases, total bycatch values could be estimated.

3.6 Review of turtle bycatch information at WGBYC

This review is based on data and information on marine turtle bycatch presented at WGBYC meetings since 2011. Most of this is from specific marine turtle bycatch projects conducted in the US, Canada, France, Portugal, Spain, Italy, and Greece, or from marine turtle working groups of OSPAR, ICCAT, and the North West Atlantic Loggerhead Turtle Recovery Plan. Part of the information on sea turtle bycatch in WGBYC also comes from a few of the sea turtle recovery centres and stranding networks that presented data and reports. The current system of data collection under 812/2004 does not allow for a proper assessment of sea turtle bycatch in EU waters. Sea turtle bycatch data available for WGBYC is in general very incomplete, except for a few cases of fisheries with high percentage observer coverage and/or fisheries subject to studies on bycatch. Bycatch can pass undetected or be difficult/impossible to assess in fisheries made up of large fleets of small vessels where data is often limited to interviews. This is the case for the artisanal polyvalent fleet of Portugal in ICES area 9a and also poundnets, setnets, and deep longlines throughout the Mediterranean where mortality rates are high due to drowning.

In contrast the semi-industrial and industrial surface longlining fisheries with observer programmes operating in the Mediterranean and ICES areas 10, 9a and b, and Canaries bycatch is conspicuous. The same goes for the Adriatic pelagic trawler fleet.

Finally, we must highlight that currently (and for several decades now) the main threat to loggerhead turtles in the Western Mediterranean and adjacent Atlantic areas comes from entanglement in ghost gear and illegal pelagic driftnets still widely in use along the North African coast. In addition, the bycatch of sea turtles in the EU's distant water fleets tuna longlining and purse seining fleet in the Atlantic, Indian, and Pacific oceans, which is considerable, is not addressed.

3.6.1 Species and populations affected

Despite intensive sea turtle population research and monitoring efforts over the last four decades, we do not currently have the knowledge for analysing the impact of bycatch at the population level. However, bycatch assessments from fisheries where we do have data does raise alarm. In 2014, in the Mediterranean Sea, more than 52 000 turtle bycatch events and 10 000 deaths occurred in Italian waters (Lucchetti et al., 2017). In Spain, between 1980 and 2008 bycatch in surface longlines has ranged between 2000 to over 30 000 logger-head turtles per year. Quevedo et al. (2013) estimate an annual death of 3421 to 4028 turtle deaths annually. This range is equivalent to 8.5–10.1% of the approximately 40 000 turtles inhabiting the fishing grounds used by Spanish longliners.

Here, we focus on the main species subject to bycatch in the ICES and Mediterranean areas.

3.6.1.1 Loggerhead turtle (*Caretta caretta*)

There are nine biologically described regional management units (RMUs; Wallace et al., 2010) that vary widely in population size, geographic range. Four are listed under the US Endangered Species Act as threatened (Northwest Atlantic Ocean, North East Atlantic Ocean, South West

Atlantic Ocean, Southwest Indian Ocean, Southeast Indo-Pacific Ocean, and South Atlantic Ocean DPSs) and five listed as endangered (Northeast Atlantic Ocean, Mediterranean Sea, North Pacific Ocean, South Pacific Ocean, and North Indian Ocean DPSs). Listed in the Habitat Directive (Annex IV and II), IUCN Red List (vulnerable), Bern Convention (Annex II), Bonn CMS (Annex I & II), CITES (Appendix I), OSPAR (Threatened), Barcelona Convention (Annex II).

According to the IUCN Red List Criteria, the loggerhead is considered globally as Vulnerable (Casale et al., 2015). Considering regional assessment, there are 10 subpopulations of loggerhead: North West Atlantic (Least Concern), North East Atlantic (Endangered), Mediterranean (Least Concern), South West Atlantic (Least Concern), North West Indian (Critically Endangered), North East Indian (Critically Endangered), South West Indian (Near Threatened), South East Indian (Near Threatened), North Pacific (Least Concern) and South Pacific (Critically Endangered).

3.6.1.2 Leatherback turtle (*Dermochelys coriacea*)

Leatherback turtles are listed as endangered throughout their range under the US Marine Turtle Conservation Act. Pacific populations are most at risk of extinction. The North West Atlantic Distinct Population Segment (DPS) is listed as threatened under the US Endangered Species Act.

3.6.1.3 Other species

Other species of marine turtle as the green turtle (*Chelonia mydas*) and the Kemp's ridley (*Lepidochelys kempii*) have been reported in bycatch data tables in WGBYC reports, for the Eastern Mediterranean and the Georges Bank respectively.

3.6.2 Fisheries and bycatch risk factors

In the ICES region: based on information presented to WGBYC since 2012, there is a bycatch risk to turtles primarily in areas 12, 10, 7k, 8e, 8c, 9b and 9a. Most common fishing operations with bycatch risk are longlining and pelagic trawling in the open sea. In coastal regions bycatch is also common in gillnets and other gear of the polyvalent artisanal fleet of Portugal and tuna poundnets of Ceuta, Barbate, and Tarifa (Cadiz, Spain) and Morocco. Pot ropes are also responsible for common leatherback entanglement in France (areas 8a, 8b). Both in Portugal and Spain several EC funded projects have addressed the risk of bycatch and the development of technological measures for its mitigation.

Throughout the Mediterranean: bycatch, mainly of loggerheads, occurs in the surface longlining fisheries, particularly for the albacore fishery and swordfish fishery when hooks are soaking close to the surface with artificial lighting or daylight. In the Adriatic, there is also a major problem in the pelagic trawling fleet that has been monitored in the last decade. Bycatch risk in bottom trawlers has been addressed in certain areas of Tunisia, Eastern Spain, France and Italy and TED trials have been conducted in Levante (Spain). Other fisheries are also of concern, but data is scarce and bycatch estimates often only based on interviews. This is the case of gillnet fisheries throughout the Mediterranean, and specially the lobster fishery around the Balearic Islands.

Along the north coast of Africa, bycatch in illegal pelagic drift nets and ghost gear is currently considered the number one risk for the loggerhead turtle in the Mediterranean and contiguous Atlantic waters.

EU long-distance fisheries have bycatch mainly of ridleys, leatherback and loggerhead turtles in all oceans. Bycatch events occur mainly in surface longlining, but also in trawling and the tropical tuna FAD purse seining operations. There are no reports on this in the WGBYC archive, but there are several projects that address this problem at present (e.g. OPAGAC–WWF Fishery Improvement Project and ABNJ/ISSF–IEO–AZTI Fish Aggregating Device research, or the “FAD Watch” project). Data on bycatch in these fisheries is available through the IEO tuna fisheries observer programmes. In the Spanish longlining fleet, a capacity development programme has been conducted since 2010 based on the success of bycatch management in the Spanish Mediterranean longlining fleet where the data set spans three decades on bycatch in the swordfish and albacore fisheries.

3.6.3 Sea turtle bycatch records from WGBYC data calls (2016–2018)

Prior to the WGBYC 2020 meeting, a WGBYC/ICES data call (Annex 6:) requesting 2018 bycatch data from dedicated (i.e. Reg. 812/2004) and non-dedicated (i.e. DCF) monitoring programmes was issued. The data call is issued to EU Member States and ICES Member countries with coastal areas in the European Atlantic (e.g. Iceland). This section summarises data obtained through the data call and extracted from the WGBYC database (section 8) for 2018.

The total number of specimens or number of incidents of marine mammal, seabird, marine turtles and elasmobranch bycatch, total fishing effort and observed effort aggregated by gear type (métier level 3), ecoregion and ICES Division extracted from the WGBYC database for 2018 are summarised in Table 2 and extracted by gear and ecoregion in Table 24 for 2016 through 2018. In 2018, a total of 134 marine turtles were reported bycaught and the associated bycatch rates calculated for 2 marine turtle species; *Caretta caretta* and *Dermochelys coricea*. In 2016 turtles were bycaught in pelagic and bottom trawls, nets and longlines, 12 *Caretta caretta* and one *Chelonia mydas* were caught. In 2017 only pelagic trawls and nets were monitored and four *Caretta caretta* were bycaught. In general, the volume of data received on marine turtle bycatch has improved from 2016–2018. In all years, the loggerhead turtle is the most commonly reported bycaught turtle to WGBYC. However, comparison of bycatch rates across years is not recommended given the changes to the data call and inconsistencies in response to the data call.

In order to assess conservation level threats, it's important to take into account the relevant legislation and agreements that guide conservation status assessments. These are presented in Annex 1: below.

3.7 Review of monitoring effort in the WGBYC database 2018

3.7.1 Methodology to derive the FishPi risk indexes

WKBYC (2013) developed an approach, combining species "abundance", bycatch rates (or risk), fishing effort and current 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 estimate the bycatch risk of different groups of species, based on the métier, fishing effort and abundance in different fishing regions. The bycatch risk was then combined with DCF sampling effort to provide an index of which areas and fishing gears require further sampling. To summarise the approach (from fishPi):

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 has to be 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. In order to check the relative distribution of monitoring effort in the DCF against the risk by the métier, the risk index by métier at different regions is then combined with the monitored effort in the DCF National programmes. In order to do this, the numbers by métier in both tables are expressed as percentages of the total in each area. The differences between these percentages are given in a sampling index: positive numbers indicate relative under-sampling; negative numbers indicate relative over-sampling.

The FishPi project applied the approach to the North Atlantic and North Sea regions.

3.7.2 Monitoring effort and fishing effort versus risk factors assigned to fisheries

Using data collected during 2018 and collated through the WGBYC data call, we compared the total reported fishing effort, and both dedicated and non-dedicated bycatch monitoring across ICES subareas and métiers (level 4) that have been assigned a risk score (see point 5 above) by the FishPi project. We differentiated be-tween dedicated and non-dedicated bycatch monitoring based on the type of programme reported in the data call. Programmes reported as “Reg812” or “Research programme” were included as dedicated monitoring effort, and all other programme types were considered “non-dedicated”. The total observer coverage for each métier and division was calculated as the sum of dedicated and non-dedicated monitoring effort as a percentage of total fishing effort. For any fisheries that exceeded 100% observer coverage, we assumed this was due to misreported effort data, and observer coverage was labelled NA. The results are presented in Table 25 and mapped in Figure 14.

3.7.3 Maps of observer coverage

To visually explore the distribution of fishing and monitoring effort across different fishing métiers, maps were generated of total fishing effort, monitoring effort, and observer coverage for each métier (level 3) for the year 2018, spatially aggregated by ICES divisions. These maps were based on 2018 data submitted through the WGBYC data call. Generating these maps highlighted some irregularities and inconsistencies in the re-porting of effort by Member States. The data included information on fishing effort, monitoring effort, fishing métier, and ICES division; however, the level of detail regarding ICES division was inconsistent. While 86% of entries included the ICES subarea, division, and subdivision in which fishing and monitoring effort took place, 14% of the data could not be matched to subdivisions as only the division (13%) or subarea (1%) had been reported. For these entries, effort was split evenly amongst nested divisions and/or subdivisions, for the purpose of mapping only. Fishing effort was likely underreported in certain fisheries as observer coverage occasionally exceeded 100% (e.g. pelagic trawls subareas 1 and 14; bottom trawls subarea 3), including two cases where observer effort was reported with zero fishing effort.

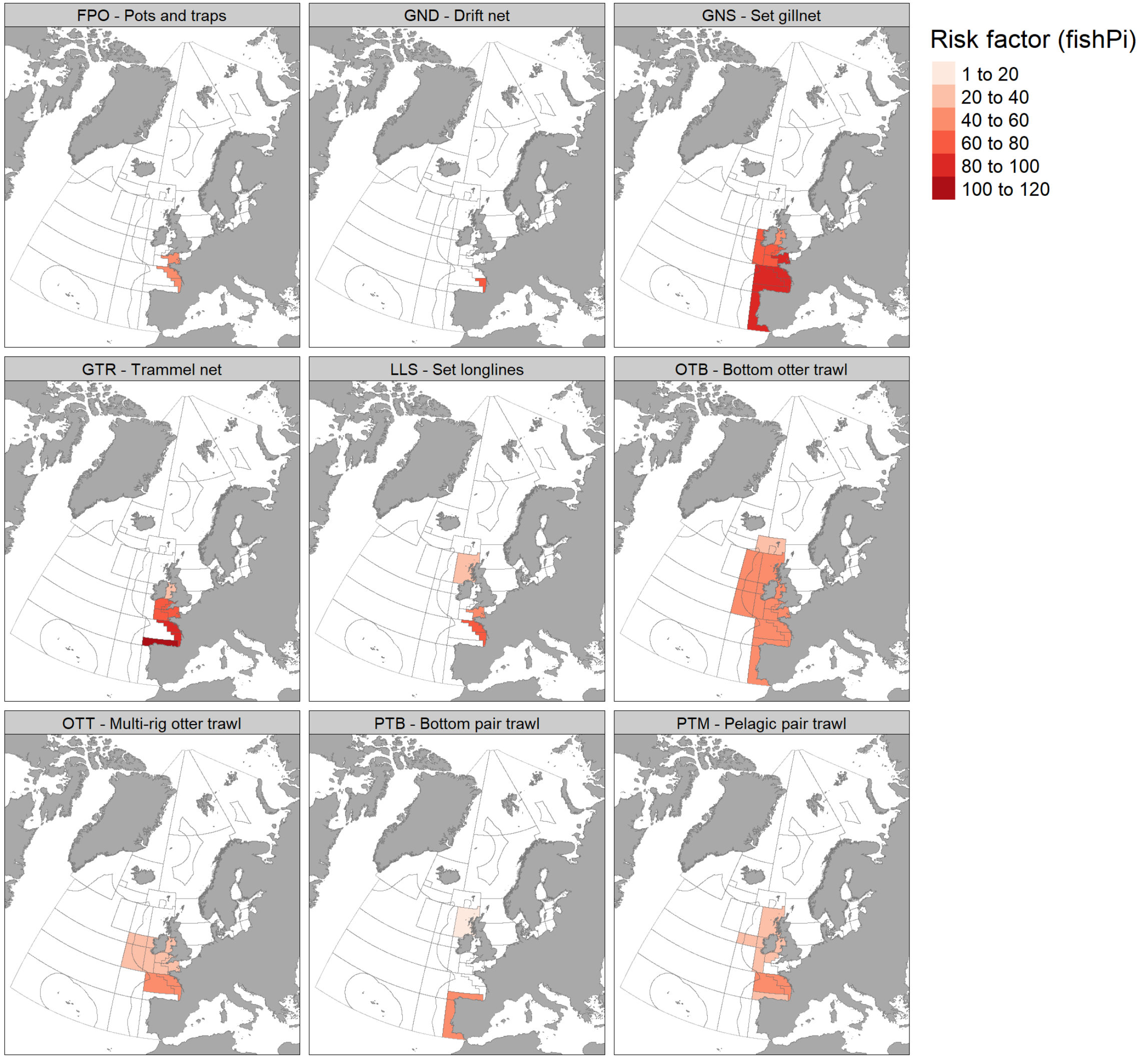

Figure 11. FishPi risk index score per métier (level 4) throughout assessed ICES areas.

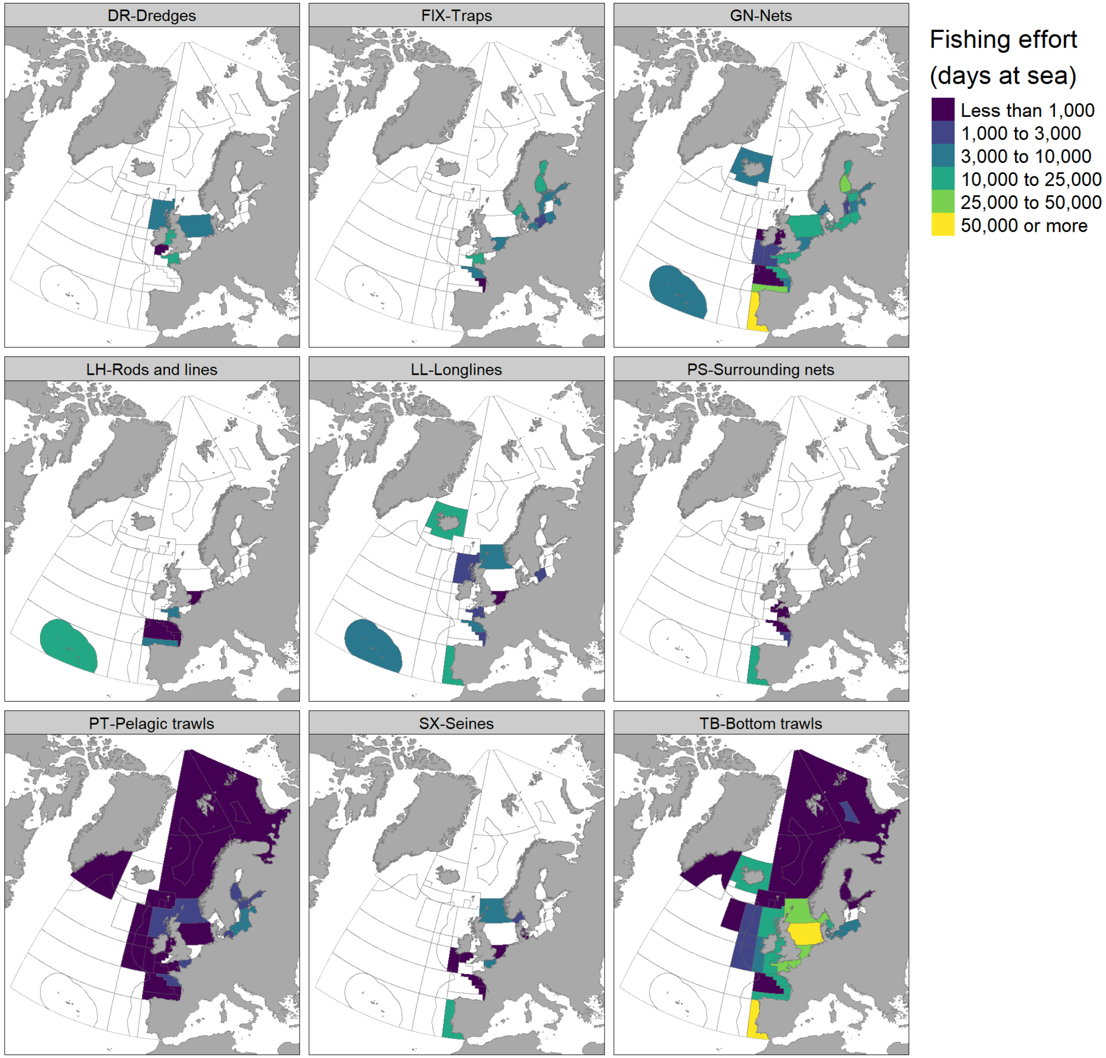

Figure 12. Distribution of fishing effort per métier (level 3) throughout ICES areas.

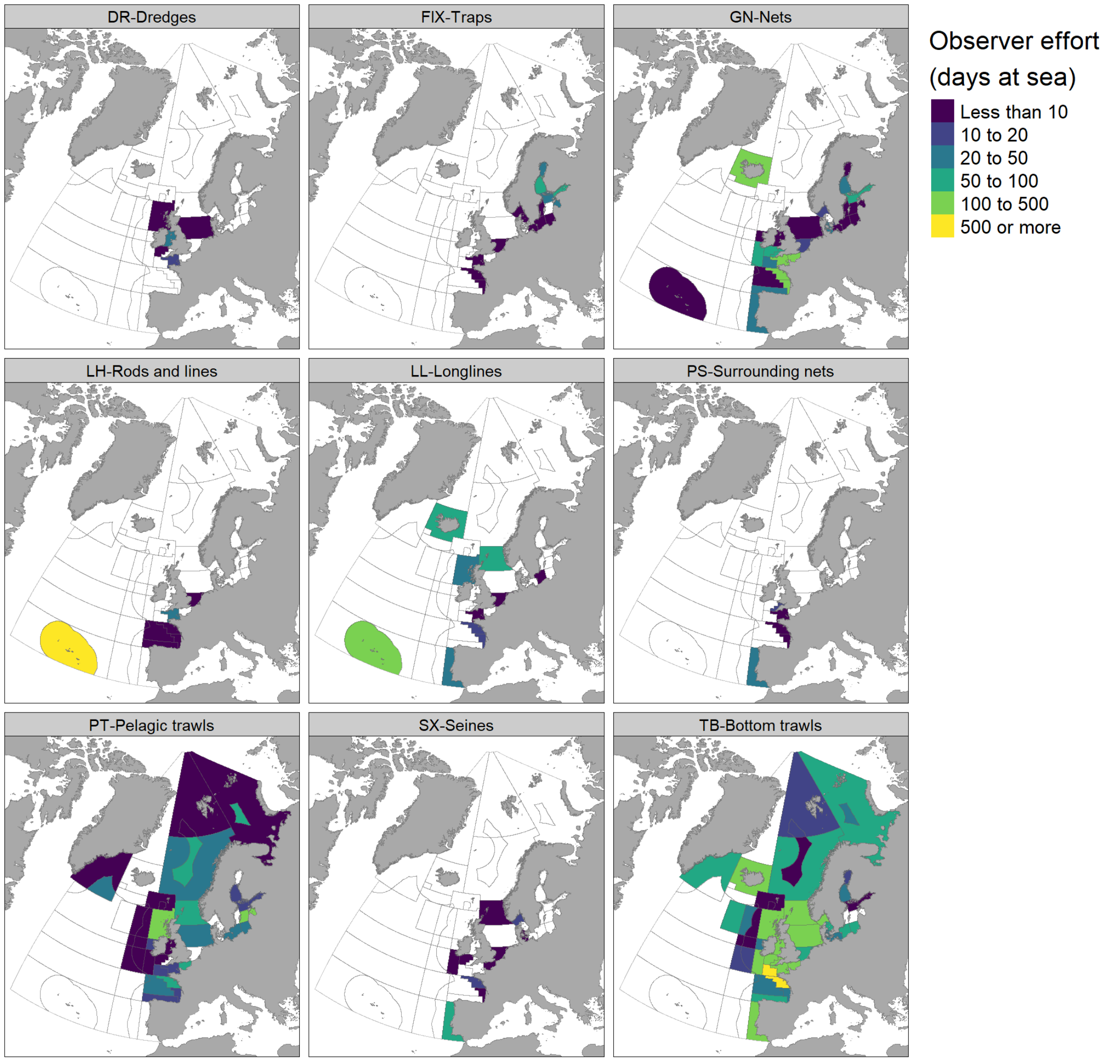

Figure 13. Distribution of bycatch monitoring effort per métier (level 3) throughout ICES areas.

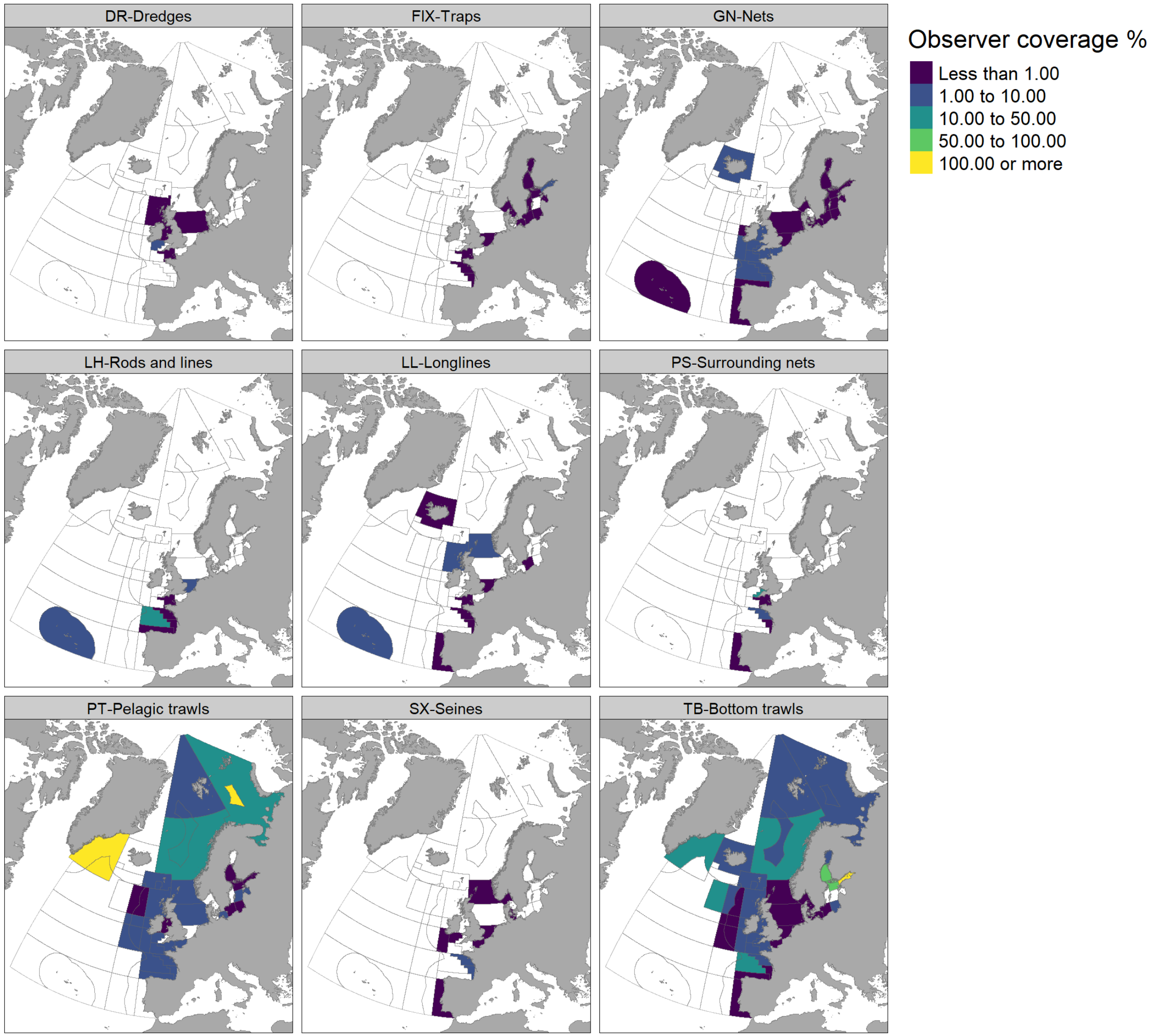

Figure 14. Observer coverage per métier (level 3) throughout the ICES areas.

3.7.4 Discussion

3.7.4.1 Monitoring effort and fishing effort versus risk factors assigned to fisheries

Purse seine fisheries in ICES division 7f received the lowest risk factor of 11, compared to the highest risk factor of 105 associated with trammel nets in division 8c. Observer coverage across all divisions and métiers ranged from 0% to 32%, with a median of 1.59%. Fisheries with the highest risk factors had very low levels of observer coverage (e.g. trammel nets in area 8c, risk factor=105, observer coverage=0.01%). In total, 250 days of dedicated bycatch monitoring effort was reported compared to 5143 days of non-dedicated monitoring. Most dedicated monitoring occurred in subarea 7, due primarily to the UK's dedicated protected species bycatch monitoring programme.

<u>Static net: gill nets (GNS)</u>

- Relatively high fishing effort, high bycatch risk (FishPi risk index 84), and low bycatch monitoring effort, particularly in areas 27.8.c (0.17% observer coverage) and 27.9.a (0.03%). It should be noted that some effort in 27.9.a likely belongs to a polyvalent fishery, in which case gillnet effort specifically may be over reported.
- Due to relatively high fishing effort (9087 DaS and 5081 DaS respectively) and low observer coverage (below 2%), for the ICES divisions 27.7.e and 27.8.a, combined with high bycatch risk (FishPi), there is a clear need for improved bycatch monitoring for these ICES divisions. However, considerable dedicated bycatch monitoring (73 days) has been carried out for GNS in area 27.7.e.
- Especially for areas 27.8.c, **27.9.a,** as well as 27.8.a and 27.7.e, bycatch monitoring for this set gillnets (GNS) should be improved, especially in regard to dedicated PETS monitoring.

<u>Static net: trammel nets (GTR)</u>

- GTR in area 27.8.c received the highest risk index of all fisheries yet was only subject to one day of non-dedicated monitoring effort. High fishing and low monitoring effort (including zero dedicated PETS monitoring) was also prevalent in divisions 27.8.a and 27.8.b.
- Observer coverage was higher in areas 27.7.f (5.21%), 27.7.g (17.77%), and 27.7.a (25.00%) although considerably less fishing effort (4–96 days) was carried out in these areas.
- Dedicated monitoring effort in high-risk GTR fisheries in areas 27.8.c, 27.8.a, 27.8.b, is lacking and effort should be increased.

<u>Hooks and lines: set longlines (LLS)</u>

- Highest risk indices for set longlines occurred in divisions 27.8.a and 27.8.b. In both these areas fishing effort was relatively high and observer coverage was below 0.5% in both cases, including zero dedicating monitoring effort.
- Dedicated monitoring of hooks and lines should be increased for high risk areas, where observer coverage is extremely low.

<u>Bottom otter trawls (OTB)</u>

- Only four days of dedicated PETS monitoring were carried out in OTB fisheries, with all of these occurring in area 27.6.a.
- Dedicated monitoring could be improved across all OTB fisheries, particularly in area 27.9.a where fishing effort was highest, and all areas with less than 1% observer coverage.

Twin otter trawls (OTT)

- Relatively high levels of observer coverage (up to 32.42%) were recorded in OTT fisheries, however, all of these were considered non-dedicated effort for PETS bycatch monitoring.
- Observer coverage was relatively high across most OTT fisheries, with the exception of those operating in areas 27.8.b (0.50%) and 27.7.b (1.18%). No dedicated bycatch monitoring has been carried out despite moderate risk index scores.

Bottom pair trawls (PTB)

- Risk index scores for PTB fisheries ranged from low (13) to moderate (52) however observer coverage was extremely low (< 0.5%), with zero dedicated PETS monitoring effort.
- Increased monitoring effort for PTB fisheries in areas 27.8.c and 27.9.a is recommended.

3.7.4.2 Maps of observer coverage

Despite the high-risk indices, static net fisheries had relatively low levels of observer coverage in the Bay of Biscay, with gillnet fisheries having slightly higher coverage than trammel nets. Active gears including pelagic and bottom trawls had the highest levels of observer coverage, albeit non-dedicated.

Maps of fishing effort and observer coverage suggest an underreporting of fishing effort in the WGBYC data call. In three areas, observer effort exceeded (impossibly) fishing effort (pelagic trawls in areas 27.1.a, 27.14.b.1; bottom trawls in subdivision 27.3.d.32), as observer effort was reported in excess of fishing effort, or no fishing effort was reported at all. Other fisheries are notable in their absence, for example zero reported effort from trap fisheries around Ireland and in west Scotland, and pelagic trawls around Iceland.

In order to identify gaps in observer coverage and effectively target future monitoring effort, it is critical that fishing effort be reported in full, alongside monitoring effort, including all fishing effort with and without bycatch of PETS.

3.8 Conclusions

- The choice of bycatch metric (e.g. km/hr; per haul etc.) appears to influence the patterns of bycatch rates with the variables considered (depth) but further analysis is needed to fully understand how these and other covariates interact.
- Bycatch rates in static nets calculated by km/hr provide the most insightful outputs and may alter our interpretation of broad scale patterns of bycatch and consequently where mitigation attempts might be best targeted.
- Further analysis is required to test the suitability of different effort metrics to complex statistical analysis, and their effects on assessments of total bycatch mortality.
- When fitting uncertainty around bycatch rate estimates, the Poisson or the negative binomial distributions tended to fit the tested datasets better than the binomial distribution that had been used in the past.
- Data calls in the future should consider asking for each bycatch event separately so the error can be estimated directly to avoid the need to assume a certain error distribution around the bycatch rates.
- An assessment of bycatch for common dolphins was evaluated in two ICES defined ecoregions: Celtic Seas and Bay of Biscay including Iberian coast. In the Celtic Seas ecoregion, highest numbers of dolphins caught were estimated to be in bottom otter trawl (OTB) and gillnet (GNS) fisheries targeting demersal fish. In the Celtic Sea, the annual bycatch in recent years (2016–2018) across all métiers amounted to 720 dolphins (95% CI 278–1345). In the Bay of Biscay and Iberian Peninsula ecoregion, the highest numbers of

dolphins caught annually were estimated to be in the trammel net fisheries for demersal fish. The mean annual bycatch in recent years (2016–2018) across all métiers amounted to 3973 dolphins (95% CI 1998–6599).

- The mortality inferred from French strandings, in 2017 and 2018, in the Bay of Biscay and the Western Channel were respectively estimated at 9300 (5800–17 900) and 5400 (3400–10 500) common dolphins.
- The bycatch estimates from strandings and the at-sea monitoring data collectively suggest that common dolphin bycatch likely exceeds the upper limits of anthropogenic takes, defined using a Potential Biological Removal threshold (proposed by WGMME (ICES 2020)) of 4927 common dolphins per year.
- For the Baltic harbour porpoise, examination of bycatch rates generated from the WGBYC database (2005–2018) in all regions was carried out given the lack of data for the Baltic proper. The highest bycatch rates for harbour porpoise occurred in gillnet or trammel net fisheries (GNS or GTR) in the North Sea and Celtic Sea. In the Bay of Biscay, on the other hand, the highest bycatch rate occurred in the pelagic trawl fisheries. However, it is reasonable, given the much greater size of the gillnet fleet (in terms of numbers of vessels) compared to pelagic trawl fleet in this area that gillnets would pose the greatest threat in terms of total harbour porpoise mortality.
- Observed effort was too low to obtain robust bycatch estimates for seabirds for most/all areas. For robust calculations including error estimates, the raw data of each bycatch event needs to be provided, including the number of zero-bycatch events.
- Longer time-series of data may allow for more robust estimates for seabirds (and other taxa), but inter-annual variation would be obscured and it may take a long time to detect any changes from mitigation measures applied or from changes in fishing practices.
- Given the strong seasonal influence on behaviour of seabirds, the ability to generate stratified total bycatch estimates at finer temporal resolutions is important. This cannot be achieved with WGBYC existing data.
- This year the WGBYC data call requested raised monitoring data, primarily for elasmobranchs and fish. WGBYC need to work further with other EGs to better understand the raising factors used so as to ensure correct interpretation. There was concern that raising some species incidents such as elasmobranchs caught very rarely, may give rise to an upward bias in the numbers of individuals caught.
- Data obtained under raising methods B and C provided information on the total number of bycaught individuals at trip level. The gear with the most bycatch of elasmobranch species was the bottom trawl and the ecoregions with higher bycatch rates were Greater North Sea, Western Mediterranean Sea and Barents Sea (few records). Most species listed as Critically Endangered (CR), Endangered (EN) and Vulnerable (VU) species were caught in Celtic Seas. *Dipyurus batis* and *Squalus acanthias* were, among the species of high conservation concern, the most captured species.
- The tabulation and mapping of WGBYC database 2018 fishing effort, monitoring effort and FishPi risk indices provided an overview of the state of monitoring in relation to risks for PETS bycatch by subdivision. There was clear relationship between risk index and monitoring effort. The majority of métiers with more than 5% observer coverage were mobile gears, including OTT and OTM fisheries, which generally had lower risk index scores, whereas GNS and GTR fisheries in the Bay of Biscay had the highest risk indices but relatively low levels of observer coverage.
- Active fisheries, including trawls, had a higher proportion of non-dedicated bycatch monitoring compared to static net fisheries, which were subject to more dedicated monitoring for bycatch of PETS. This may be a consequence of greater monitoring effort across active fisheries for the purposes of stock assessments, compared to static net fish-

eries, which are often considered a greater risk for PETS bycatch. Considering that member states are obliged to monitor protected species bycatch, the Regional Coordination Groups may consider refocussing relative observer effort from active to passive fisheries, mainly GNS and GTR. The on-board sampling protocols and data management procedures for DCF sampling are currently under revision in most member states.

- By summing risk across species groups, one loses important information on the vulnerability of particular species or species groups. It may also introduce a bias because the population sizes of different species can vary markedly with region, and thus influence the resultant summed bycatch risk value. Longlines, for example, are a much greater risk to seabirds (particularly northern fulmar and other petrels) than to cetaceans; pots & lines are a greater risk to baleen whales (e.g. minke whale, humpback whale) and to seals than to dolphins.
- Caution is needed in interpretation of the maps and summary table of bycatch risk indices, because of issues with the classification of monitoring data and species groups in the development of the bycatch risk indices. In the first place, it is not always known what "dedicated monitoring" refers to. In most dedicated observer programmes, the main target group is cetaceans and it is not always clear to what extent other groups are included. Secondly, as indicated above, there are issues with the WGBYC effort data. Third, the FishPi risk indexes are based on expert judgement. This is unavoidable as studies that have been carried out in the past are scattered and targeted on specific areas and taxonomic groups. This will leave many gaps but may also reveal detailed knowledge that can be used in more specified areas, métiers and species (groups).

Table 19. Selection of reported bycatch rate per quarter, area, species, and gear (criteria for selection explained in the text) for seabirds.

Ecoregion	ICES Division	Quarter	Métier (L3)	Species	Common Name	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	% Coverage	Incidents	Total No. Specimens	Bycatch Rate (Ind./DaS)
Baltic Sea	27.3.d.28	3	Nets	*Phalacrocorax carbo*	great cormorant	7	256	2.73	3	5	0.7143
Baltic Sea	27.3.d.28	3	Nets	*Aythya marila*	greater scaup	7	256	2.73	1	1	0.1429
Baltic Sea	27.3.d.28	3	Nets	*Aythya fuligula*	tufted duck	7	256	2.73	1	1	0.1429
Baltic Sea	27.3.d.28	4	Nets	*Uria aalge*	common guillemot	3	88	3.43	1	1	0.3333
Baltic Sea	27.3.d.28	4	Nets	*Phalacrocorax carbo*	great cormorant	3	88	3.43	1	1	0.3333
Baltic Sea	27.3.d.28	4	Nets	*Aythya fuligula*	tufted duck	3	88	3.43	1	1	0.3333
Celtic Seas	27.7.g	1	Nets	*Uria aalge*	common guillemot	8	405	1.98	2	12	1.5000
Celtic Seas	27.7.b	1	Pelagic trawls	*Morus bassanus*	northern gannet	8	390	2.05	1	1	0.1250
Celtic Seas	27.7.f	2	Nets	*Uria aalge*	common guillemot	22	957	2.30	3	4	0.1818
Celtic Seas	27.7.g	3	Bottom trawls	*Morus bassanus*	northern gannet	166	6061	2.73	1	1	0.0060
Celtic Seas	27.7.f	4	Nets	*Uria aalge*	common guillemot	16	520	3.08	1	1	0.0625
Celtic Seas	27.7.f	4	Nets	*Phalacrocorax carbo*	great cormorant	16	520	3.08	2	2	0.1250
Greater North Sea	27.7.d	1	Nets	*Uria aalge*	common guillemot	19	1864	1.02	1	1	0.0526

Ecoregion	ICES Division	Quarter	Métier (L3)	Species	Common Name	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	% Coverage	Incidents	Total No. Specimens	Bycatch Rate (Ind./DaS)
Greater North Sea	27.7.e	1	Nets	*Uria aalge*	common guillemot	33	1919	1.72	1	2	0.0606
Greater North Sea	27.7.e	4	Nets	*Phalacrocorax carbo*	great cormorant	34	2570	1.32	1	1	0.0296
Iceland Sea	27.5.a.2	1	Nets	*Cepphus grylle*	black guillemot	57	1917	2.97	1	1	0.0175
Iceland Sea	27.5.a.2	1	Nets	*Somateria mollissima*	common eider	57	1917	2.97	5	12	0.2105
Iceland Sea	27.5.a.2	1	Nets	*Clangula hyemalis*	long-tailed duck	57	1917	2.97	1	1	0.0175
Iceland Sea	27.5.a.2	2	Nets	*Uria aalge*	common guillemot	134	4071	3.29	12	156	1.1642
Iceland Sea	27.5.a.2	2	Nets	*Fratercula arctica*	Atlantic puffin	134	4071	3.29	2	2	0.0149
Iceland Sea	27.5.a.2	2	Nets	*Cepphus grylle*	black guillemot	134	4071	3.29	23	52	0.3881
Iceland Sea	27.5.a.2	2	Nets	*Uria lomvia*	Brünnich's guillemot	134	4071	3.29	3	3	0.0224
Iceland Sea	27.5.a.2	2	Nets	*Somateria mollissima*	common eider	134	4071	3.29	20	100	0.7463
Iceland Sea	27.5.a.2	2	Nets	Phalacrocoracidae	cormorants	134	4071	3.29	15	31	0.2313
Iceland Sea	27.5.a.2	2	Nets	*Fulmarus glacialis*	northern fulmar	134	4071	3.29	2	2	0.0149
Iceland Sea	27.5.a.2	2	Nets	*Morus bassanus*	northern gannet	134	4071	3.29	1	1	0.0075
Iceland Sea	27.5.a.2	2	Nets	*Clangula hyemalis*	long-tailed duck	134	4071	3.29	1	1	0.0075
Iceland Sea	27.5.a.2	2	Nets	*Alca torda*	razorbill	134	4071	3.29	1	1	0.0075
Iceland Sea	27.5.a.2	4	Nets	*Uria aalge*	common guillemot	30	660	4.55	1	1	0.0333

Table 20. Data under raising methods B and C. Bycatch of protected elasmobranchs of high and medium conservation concern expressed in numbers and rate (no. specimens) presented by Ecoregion, and ICES/GFCM area. Bycatch rate is number of specimens per day at sea observed[13].

Ecoregion	Area	Gear	Species	Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Total No. Speci-mens	Bycatch Rate	Inci-dents	Red List Cri-terion
Adriatic Sea	17	Bottom trawls	*Mustelus mustelus*	272	76635	111	0.4081	30	VU
Adriatic Sea	17	Pelagic trawls	*Myliobatis aquila*	386	11242	134	0.3472	53	VU
Adriatic Sea	17	Pelagic trawls	*Mustelu spunctulatus*	386	11242	120	0.3109	43	VU
Adriatic Sea	17	Bottom trawls	*Myliobatis aquila*	272	76635	51	0.1875	8	VU
Adriatic Sea	18	Bottom trawls	*Dasyatis pastinaca*	392	60436	69	0.1760	16	VU
Adriatic Sea	17	Bottom trawls	*Squalus acanthias*	272	76635	44	0.1618	16	EN
Adriatic Sea	17	Pelagic trawls	*Mustelus mustelus*	386	11242	61	0.1580	43	VU
Adriatic Sea	17	Pelagic trawls	*Squalus acanthias*	386	11242	39	0.1010	31	EN
Adriatic Sea	18	Bottom trawls	*Myliobatis aquila*	392	60436	8	0.0204	7	VU
Adriatic Sea	17	Bottom trawls	*Dasyatis pastinaca*	272	76635	4	0.0147	2	VU
Adriatic Sea	18	Bottom trawls	*Squalus acanthias*	392	60436	3	0.0077	3	EN
Adriatic Sea	17	Bottom trawls	*Aetomylaeus bovinus*	272	76635	1	0.0037	1	DD
Adriatic Sea	17	Pelagic trawls	*Dasyatis pastinaca*	386	11242	1	0.0026	1	VU
Adriatic Sea	17	Pelagic trawls	*Alopias vulpinus*	386	11242	1	0.0026	1	EN

[13] Table edited at ADGBYC in August 2020; ICES has focused on species of high and medium conservation concern, using the EU red list of fishes (Nieto et al., 2015) as the basis for classification. Species classified as "endangered" or "critically endangered" were considered to be of high conservation concern. Those classified as "vulnerable" are classified as of medium concern.

Ecoregion	Area	Gear	Species	Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Total No. Speci-mens	Bycatch Rate	Inci-dents	Red List Cri-terion
Adriatic Sea	18	Bottom trawls	*Prionace glauca*	392	60436	1	0.0026	1	NT
Aegean-Levantine Sea	22	Bottom trawls	*Squalus acanthias*	198	38161	237	1.1970	25	EN
Aegean-Levantine Sea	22	Bottom trawls	*Mustelus mustelus*	198	38161	46	0.2323	26	VU
Aegean-Levantine Sea	23	Bottom trawls	*Oxynotus centrina*	9	1514	1	0.1111	1	VU
Aegean-Levantine Sea	22	Bottom trawls	*Oxynotus centrina*	198	38161	14	0.0707	9	VU
Aegean-Levantine Sea	22	Bottom trawls	*Centrophorus granulosus*	198	38161	14	0.0707	2	CR
Aegean-Levantine Sea	22	Bottom trawls	*Mustelus punctulatus*	198	38161	2	0.0101	2	VU
Azores	27.10.a.2	Nets	*Galeorhinus galeus*	2	3210	14	7.0000	1	VU
Azores	27.10.a.2	Longlines	*Galeorhinus galeus*	363	6981	116	0.3196	16	VU
Azores	27.10.a.2	Longlines	*Deania calcea*	363	6981	70	0.1928	12	EN
Azores	27.10.a.2	Longlines	*Dalatias licha*	363	6981	44	0.1212	16	EN
Azores	27.10.a.2	Longlines	*Dipturus batis*	363	6981	13	0.0358	6	CR
Azores	27.10.a.2	Longlines	*Centrophorus granulosus*	363	6981	7	0.0193	4	CR
Azores	27.10.a.2	Longlines	*Galeorhinus galeus*	363	6981	5	0.0138	1	VU
Azores	27.10.a.2	Rods and lines	*Galeorhinus galeus*	614	22320	4	0.0065	2	VU
Azores	27.10.a.2	Rods and lines	*Dipturus batis*	614	22320	2	0.0033	1	CR
Celtic Seas	27.7.g	Bottom trawls	*Dipturus batis*	477	24147	1066	2.2350	8	CR
Celtic Seas	27.7.a	Bottom trawls	*Squalus acanthias*	339	15029	619	1.8236	55	EN

Ecoregion	Area	Gear	Species	Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Total No. Speci-mens	Bycatch Rate	Inci-dents	Red List Cri-terion
Celtic Seas	27.7.f	Bottom trawls	*Dipturus batis*	121	11138	212	1.7498	2	CR
Celtic Seas	27.7.a	Nets	*Squalus acanthias*	5	353	7	1.4000	2	EN
Celtic Seas	27.7.g	Nets	*Squalus acanthias*	63	2302	80	1.2698	30	EN
Celtic Seas	27.7.g	Nets	*Dipturus batis*	63	2302	47	0.7460	16	CR
Celtic Seas	27.7.f	Nets	*Galeorhinus galeus*	66	2695	40	0.6061	13	VU
Celtic Seas	27.7.j	Bottom trawls	*Dipturus batis*	313	11512	130	0.4155	169	CR
Celtic Seas	27.7.g	Nets	*Galeorhinus galeus*	63	2302	21	0.3333	11	VU
Celtic Seas	27.7.k	Bottom trawls	*Dipturus batis*	26	3800	8	0.3039	14	CR
Celtic Seas	27.7.f	Nets	*Squalus acanthias*	66	2695	17	0.2576	9	EN
Celtic Seas	27.6.a	Bottom trawls	*Squalus acanthias*	259	23118	55	0.2122	2	EN
Celtic Seas	27.7.g	Nets	*Lamna nasus*	63	2302	9	0.1429	9	CR
Celtic Seas	27.7.h	Nets	*Lamna nasus*	30	1169	3	0.1014	2	CR
Celtic Seas	27.7.h	Nets	*Galeorhinus galeus*	30	1169	2	0.0676	1	VU
Celtic Seas	27.7.g	Bottom trawls	*Dipturus batis*	477	24147	22	0.0461	6	CR
Celtic Seas	27.7.h	Nets	*Dipturus batis*	30	1169	1	0.0338	1	CR
Celtic Seas	27.7.j	Nets	*Squalus acanthias*	175	3201	1	0.0057	1	EN
Greater North Sea	27.4.c	Bottom trawls	*Mustelus mustelus*	86	36941	277	3.2296	12	VU
Greater North Sea	27.7.e	Nets	*Squalus acanthias*	165	11442	268	1.6289	20	EN

Ecoregion	**Area**	**Gear**	**Species**	**Observed Effort (Days at sea)**	**Fishing Effort (Days at sea)**	**Total No. Speci-mens**	**Bycatch Rate**	**Inci-dents**	**Red List Cri-terion**
Greater North Sea	27.4.c	Longlines	*Squalus acanthias*	2	259	1	0.5000	1	EN
Greater North Sea	27.4.c	Nets	*Mustelus mustelus*	18	3683	3	0.1667	3	VU
Greater North Sea	27.7.e	Nets	*Galeorhinus galeus*	165	11442	14	0.0851	13	VU
Greater North Sea	27.7.d	Bottom trawls	*Dipturus batis*	217	28150	15	0.0678	2	CR
Greater North Sea	27.7.e	Nets	*Dipturus batis*	165	11442	11	0.0669	10	CR
Greater North Sea	27.7.e	Bottom trawls	*Squalus acanthias*	439	31665	11	0.0250	4	EN
Greater North Sea	27.7.e	Nets	*Lamna nasus*	165	11442	4	0.0243	4	CR
Greater North Sea	27.4.c	Bottom trawls	*Dipturus batis*	86	36941	2	0.0233	2	CR
Greater North Sea	27.4.c	Bottom trawls	*Galeorhinu sgaleus*	86	36941	2	0.0233	2	VU
Greater North Sea	27.4.a	Bottom trawls	*Dipturus batis*	348	41431	8	0.0230	7	CR
Greater North Sea	27.4.b	Bottom trawls	*Dipturus batis*	160	88837	2	0.0125	2	CR
Greater North Sea	27.7.e	Bottom trawls	*GALEORHINUS GALEUS*	439	31665	4	0.0091	3	VU
Greater North Sea	27.7.d	Nets	*Dasyatis pastinaca*	131	11817	1	0.0076	1	VU
Greater North Sea	27.3.a.20	Bottom trawls	*Dipturus batis*	161	29631	1	0.0062	1	CR
Greater North Sea	27.7.d	Bottom trawls	*Galeorhinu sgaleus*	217	28150	1	0.0046	1	VU
Greater North Sea	27.7.e	Bottom trawls	*Dipturus batis*	439	31665	1	0.0023	1	CR
Greenland Sea	27.14.b.2	Bottom trawls	*Dipturus batis*	71	387	14	0.1972	13	CR
Greenland Sea	27.14.b.2	Bottom trawls	*Centroscymnus coelolepis*	71	387	8	0.1127	8	EN

Ecoregion	Area	Gear	Species	Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Total No. Speci-mens	Bycatch Rate	Inci-dents	Red List Cri-terion
Greenland Sea	27.14.b.2	Bottom trawls	*Centrophorus squamosus*	71	387	1	0.0141	1	EN
Iceland Sea	27.5.a.2	Bottom trawls	*Lamna nasus*	357	11308	1	0.0028	1	CR
Ionian Sea and the Central	20	Bottom trawls	*Squalus acanthias*	53	5695	56	1.0566	2	EN
Ionian Sea and the Central	20	Bottom trawls	*Mustelus mustelus*	53	5695	7	0.1321	6	VU
Ionian Sea and the Central	19	Bottom trawls	*Mustelus mustelus*	225	34139	14	0.0622	3	VU
Ionian Sea and the Central	20	Bottom trawls	*Mustelus punctulatus*	53	5695	2	0.0377	2	VU
Ionian Sea and the Central	20	Bottom trawls	*Gymnura altavela*	53	5695	2	0.0377	2	CR
Ionian Sea and the Central	16	Bottom trawls	*Leucoraja melitensis*	1000	55516	23	0.0230	3	CR
Ionian Sea and the Central	19	Bottom trawls	*Dasyatis pastinaca*	225	34139	5	0.0222	3	VU
Ionian Sea and the Central	19	Bottom trawls	*Dalatias licha*	225	34139	5	0.0222	4	EN
Ionian Sea and the Central	19	Bottom trawls	*Myliobatis aquila*	225	34139	2	0.0089	2	VU
Ionian Sea and the Central	16	Bottom trawls	*Rostroraja alba*	1000	55516	2	0.0020	2	CR
Norwegian Sea	27.2.a.2	Bottom trawls	*Dipturus batis*	76	223	14	0.1842	9	CR
Western Mediterranean Sea	2	Bottom trawls	*Dalatias licha*	59	887	30	0.5085	13	EN
Western Mediterranean Sea	6	Bottom trawls	*Dalatias licha*	212	74820	64	0.3019	6	EN
Western Mediterranean Sea	1	Bottom trawls	*Dalatias licha*	131	21633	23	0.1756	4	EN
Western Mediterranean Sea	11.2	Bottom trawls	*Dasyatis pastinaca*	1245	21239	105	0.0843	19	VU
Western Mediterranean Sea	6	Bottom trawls	*Centrophorus granulosus*	212	74820	15	0.0708	3	CR

Ecoregion	**Area**	**Gear**	**Species**	**Observed Effort (Days at sea)**	**Fishing Effort (Days at sea)**	**Total No. Speci-mens**	**Bycatch Rate**	**Inci-dents**	**Red List Cri-terion**
Western Mediterranean Sea	11.2	Bottom trawls	*Mustelus mustelus*	1245	21239	88	0.0707	25	VU
Western Mediterranean Sea	2	Bottom trawls	*Centrophorus granulosus*	59	887	4	0.0678	3	CR
Western Mediterranean Sea	10	Bottom trawls	*Centrophorus granulosus*	67	33690	3	0.0448	2	CR
Western Mediterranean Sea	1	Bottom trawls	*Centrophorus granulosus*	131	21633	4	0.0305	4	CR
Western Mediterranean Sea	7	Bottom trawls	*Squalus acanthias*	140	6706	4	0.0285	1	EN
Western Mediterranean Sea	9	Bottom trawls	*Oxynotus centrina*	1373	44322	32	0.0233	28	VU
Western Mediterranean Sea	9	Bottom trawls	*Mustelus mustelus*	1373	44322	31	0.0226	5	VU
Western Mediterranean Sea	9	Bottom trawls	*Squalus acanthias*	1373	44322	20	0.0146	7	EN
Western Mediterranean Sea	9	Bottom trawls	*Dasyatis pastinaca*	1373	44322	17	0.0124	16	VU
Western Mediterranean Sea	11.2	Bottom trawls	*Oxynotus centrina*	1245	21239	6	0.0048	5	VU
Western Mediterranean Sea	6	Bottom trawls	*Gymnura altavela*	212	74820	1	0.0047	1	CR
Western Mediterranean Sea	11.2	Bottom trawls	*Myliobatis aquila*	1245	21239	5	0.0040	4	VU
Western Mediterranean Sea	11.2	Bottom trawls	*Centrophorus granulosus*	1245	21239	5	0.0040	5	CR
Western Mediterranean Sea	9	Bottom trawls	*Centrophorus granulosus*	1373	44322	3	0.0022	3	CR
Western Mediterranean Sea	11.2	Bottom trawls	*Mustelus punctulatus*	1245	21239	1	0.0008	1	VU
Western Mediterranean Sea	9	Bottom trawls	*Mustelus punctulatus*	1373	44322	1	0.0007	1	VU

Table 21. Data under raising method A. Bycatch of protected elasmobranchs of high and medium conservation concern expressed in numbers and rate (no. specimens) presented by Ecoregion, and IC-ES/GFCM area[14].

Ecoregion	ICES_Area	Métier 3	Species	Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Total No. Speci-mens	Bycatch Rate	Inci-dents	Red List Crite-rion
Azores	27.10.a.2	Longlines	*Alopias vulpinus*	363	6981	7	0.0193	5	EN
Azores	27.10.a.2	Longlines	*Alopias superciliosus*	363	6981	3	0.0083	2	EN
Bay of Biscay and the Iberian Coast	27.8.d	Nets	*Leucoraja circularis*	10	294	143	14.4347	13	EN
Bay of Biscay and the Iberian Coast	27.8.a	Nets	*Leucoraja circularis*	146	10421	175	1.1997	16	EN
Bay of Biscay and the Iberian Coast	27.8.d	Nets	*Cetorhinus maximus*	10	294	1	0.1009	1	EN
Bay of Biscay and the Iberian Coast	27.8.d	Nets	*Dipturus batis*	10	294	1	0.1009	1	CR
Bay of Biscay and the Iberian Coast	27.8.a	Nets	*Squalus acanthias*	146	10421	3	0.0206	3	EN
Bay of Biscay and the Iberian Coast	27.8.a	Bottom trawls	*Leucoraja circularis*	581	22051	11	0.0189	6	EN
Bay of Biscay and the Iberian Coast	27.8.a	Bottom trawls	*Dipturus batis*	581	22051	10	0.0172	6	CR
Bay of Biscay and the Iberian Coast	27.8.a	Bottom trawls	*Squalus acanthias*	581	22051	4	0.0069	2	EN
Bay of Biscay and the Iberian Coast	27.8.b	Nets	*Squalus acanthias*	172	7280	1	0.0058	1	EN
Celtic Seas	27.7.h	Nets	*Squalus acanthias*	30	1169	180	6.0845	23	EN
Celtic Seas	27.7.g	Nets	*Squalus acanthias*	63	2302	343	5.4444	32	EN
Celtic Seas	27.7.h	Pelagic trawls	*Lamna nasus*	11	252	34	3.0909	21	CR

[14] Table edited at ADGBYC in August 2020; ICES has focused on species of high and medium conservation concern, using the EU red list of fishes (Nieto et al., 2015) as the basis for classification. Species classified as “endangered” or “critically endangered” were considered to be of high conservation concern. Those classified as “vulnerable” are classified as of medium concern.

Ecoregion	ICES_Area	Métier 3	Species	Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Total No. Speci-mens	Bycatch Rate	Inci-dents	Red List Crite-rion
Celtic Seas	27.7.g	Bottom trawls	*Dipturus batis*	477	24147	466	0.9766	77	CR
Celtic Seas	27.7.h	Bottom trawls	*Dipturus batis*	861	11591	544	0.6321	127	CR
Celtic Seas	27.7.h	Nets	*Galeorhinus galeus*	30	1169	18	0.6085	6	VU
Celtic Seas	27.7.c	Pelagic trawls	*Centrophorus granulosus*	12	382	4	0.3333	4	CR
Celtic Seas	27.7.j	Pelagic trawls	*Lamna nasus*	14	475	4	0.2857	2	CR
Celtic Seas	27.7.c	Bottom trawls	*Dipturus batis*	18	3670	5	0.2760	4	CR
Celtic Seas	27.7.h	Pelagic trawls	*Cetorhinus maximus*	11	252	3	0.2727	1	EN
Celtic Seas	27.6.a	Bottom trawls	*Dipturus batis*	259	23118	69	0.2662	11	CR
Celtic Seas	27.6.a	Bottom trawls	*Squalus acanthias*	259	23118	47	0.1814	11	EN
Celtic Seas	27.7.g	Bottom trawls	*Squalus acanthias*	477	24147	84	0.1760	22	EN
Celtic Seas	27.7.j	Bottom trawls	*Dipturus batis*	313	11512	53	0.1694	30	CR
Celtic Seas	27.7.g	Nets	*Galeorhinus galeus*	63	2302	8	0.1270	4	VU
Celtic Seas	27.7.g	Pelagic trawls	*Lamna nasus*	9	186	1	0.1111	1	CR
Celtic Seas	27.7.k	Pelagic trawls	*Centrophorus squamosus*	9	163	1	0.1111	1	EN
Celtic Seas	27.6.a	Pelagic trawls	*Lamna nasus*	124	2301	8	0.0645	8	CR
Celtic Seas	27.7.g	Nets	*Dipturus batis*	63	2302	4	0.0635	2	CR
Celtic Seas	27.7.j	Bottom trawls	*Dalatias licha*	313	11512	14	0.0448	9	EN

Ecoregion	ICES_Area	Métier 3	Species	Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Total No. Speci-mens	Bycatch Rate	Inci-dents	Red List Crite-rion
Celtic Seas	27.7.j	Bottom trawls	*Squalus acanthias*	313	11512	14	0.0448	7	EN
Celtic Seas	27.6.a	Longlines	*Squalus acanthias*	49	2805	2	0.0408	1	EN
Celtic Seas	27.7.h	Bottom trawls	*Leucoraja circularis*	861	11591	35	0.0407	5	EN
Celtic Seas	27.7.k	Bottom trawls	*Dipturus batis*	26	3800	1	0.0380	1	CR
Celtic Seas	27.7.k	Bottom trawls	*Dalatias licha*	26	3800	1	0.0380	1	EN
Celtic Seas	27.7.h	Nets	*Dipturus batis*	30	1169	1	0.0338	1	CR
Celtic Seas	27.7.b	Bottom trawls	*Dipturus batis*	34	3094	1	0.0296	1	CR
Celtic Seas	27.7.h	Bottom trawls	*Squalus acanthias*	861	11591	25	0.0290	12	EN
Celtic Seas	27.6.a	Pelagic trawls	*Squalus acanthias*	124	2301	3	0.0242	3	EN
Celtic Seas	27.6.a	Bottom trawls	*Dalatias licha*	259	23118	5	0.0193	5	EN
Celtic Seas	27.7.f	Bottom trawls	*Squalus acanthias*	121	11138	2	0.0165	2	EN
Celtic Seas	27.7.j	Bottom trawls	*Leucoraja circularis*	313	11512	1	0.0032	1	EN
Celtic Seas	27.7.h	Bottom trawls	*Dalatias licha*	861	11591	2	0.0023	2	EN
Faroes	27.5.b	Bottom trawls	*Dalatias licha*	6	179	2	0.3427	1	EN
Greater North Sea	27.7.e	Nets	*Squalus acanthias*	165	11442	490	2.9783	13	EN
Greater North Sea	27.7.e	Bottom trawls	*Dipturus batis*	439	31665	451	1.0270	65	CR
Greater North Sea	27.4.a	Pelagic trawls	*Squalus acanthias*	68	2022	13	0.1912	13	EN

Ecoregion	ICES_Area	Métier 3	Species	Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Total No. Speci-mens	Bycatch Rate	Inci-dents	Red List Crite-rion
Greater North Sea	27.4.a	Bottom trawls	*Dipturus batis*	348	41431	34	0.0977	11	CR
Greater North Sea	27.7.e	Pelagic trawls	*Alopias vulpinus*	12	713	1	0.0833	1	EN
Greater North Sea	27.7.e	Bottom trawls	*Squalus acanthias*	439	31665	26	0.0592	12	EN
Greater North Sea	27.7.d	Pelagic trawls	*Mustelus mustelus*	56	1007	3	0.0537	3	VU
Greater North Sea	27.7.e	Nets	*Dipturus batis*	165	11442	8	0.0486	5	CR
Greater North Sea	27.7.e	Nets	*Galeorhinus galeus*	165	11442	6	0.0365	4	VU
Greater North Sea	27.7.d	Pelagic trawls	*Lamna nasus*	56	1007	2	0.0358	2	CR
Greater North Sea	27.4.b	Pelagic trawls	*Lamna nasus*	31	666	1	0.0324	1	CR
Greater North Sea	27.3.a.20	Bottom trawls	*Dipturus linteus*	161	29631	5	0.0311	2	DD
Greater North Sea	27.3.a.20	Bottom trawls	*Dipturus batis*	161	29631	3	0.0186	3	CR
Greater North Sea	27.4.a	Longlines	*Squalus acanthias*	58	4956	1	0.0172	1	EN
Greater North Sea	27.7.d	Bottom trawls	*Squalus acanthias*	217	28150	2	0.0092	1	EN
Greater North Sea	27.7.e	Bottom trawls	*Galeorhinus galeus*	439	31665	4	0.0091	1	VU
Greater North Sea	27.4.a	Bottom trawls	*Squalus acanthias*	348	41431	3	0.0086	3	EN
Greater North Sea	27.4.a	Bottom trawls	*Leucoraja circularis*	348	41431	1	0.0029	1	EN
North West Atlantic	21.3.L	Bottom trawls	*Centroscymnus coelolepis*	93	538	1	0.0108	1	EN
North West Atlantic	21.3.N	Bottom trawls	*Lamna nasus*	97	969	0	0.0000	2	CR

Ecoregion	ICES_Area	Métier 3	Species	Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Total No. Speci-mens	Bycatch Rate	Inci-dents	Red List Crite-rion
North West Atlantic	21.3.O	Bottom trawls	*Lamna nasus*	59	625	0	0.0000	13	CR
Oceanic Northeast Atlantic	27.12.b	Bottom trawls	*Centrophorus squamosus*	53	147	5	0.0943	5	EN
Oceanic Northeast Atlantic	27.6.b.1	Bottom trawls	*Centroscymnus coelolepis*	31	60	1	0.0323	40	EN
Oceanic Northeast Atlantic	27.12.b	Bottom trawls	*Deania calcea*	53	147	1	0.0189	16	EN
Oceanic Northeast Atlantic	27.12.b	Bottom trawls	*Centroscymnus coelolepis*	53	147	1	0.0189	58	EN
Oceanic Northeast Atlantic	27.6.b.1	Bottom trawls	*Deania calcea*	31	60	0	0.0000	6	EN
Western Mediterranean Sea	7	Bottom trawls	*Squalus acanthias*	140	6706	13	0.0927	7	EN
Western Mediterranean Sea	7	Bottom trawls	*Raja undulata*	140	6706	1	0.0071	1	NT

Table 22. Data under raising methods B and C. Bycatch of protected fish of high and medium conservation concern expressed in numbers and rate (no. specimens) presented by Ecoregion, and ICES/GFCM area[15].

Ecoregion	Area	Gear	Species	Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Total No. Specimens	Bycatch Rate	Incidents	Red List Criterion
Baltic Sea	27.3.d.25	Traps	*Coregonus lavaretus*	3	2657	49	16.3333	1	VU
Celtic Seas	27.6.b	Bottom trawls	*Hippoglossus hippoglossus*	15	2010	1	0.0667	1	VU
Celtic Seas	27.6.a	Bottom trawls	*Hippoglossus hippoglossus*	259	23118	8	0.0309	6	VU
Greater North Sea	27.4.b	Bottom trawls	*Hippoglossus hippoglossus*	160	88837	31	0.1935	17	VU
Greater North Sea	27.4.a	Bottom trawls	*Hippoglossus hippoglossus*	348	41431	28	0.0805	10	VU
Greater North Sea	27.3.a.20	Bottom trawls	*Hippoglossus hippoglossus*	161	29631	4.778711485	0.0297	2	VU
Greenland Sea	27.14.b.2	Bottom trawls	*Hippoglossus hippoglossus*	71	387	68	0.9577	33	VU
Iceland Sea	27.5.a.2	Bottom trawls	*Hippoglossus hippoglossus*	357	11308	4	0.0112	4	VU
Norwegian Sea	27.2.a.2	Bottom trawls	*Hippoglossus hippoglossus*	76	223	419	5.5132	85	VU

[15] Table edited at ADGBYC in August 2020; ICES has focused on species of high and medium conservation concern, using the EU red list of fishes (Nieto et al., 2015) as the basis for classification. Species classified as "endangered" or "critically endangered" were considered to be of high conservation concern. Those classified as "vulnerable" are classified as of medium concern.

Table 23. Data under raising method A. Bycatch of protected fish of high and medium conservation concern expressed in numbers and rate (no. specimens) presented by Ecoregion, and ICES/GFCM area[16].

Ecoregion	Area	Gear	Species	Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Total No. Specimens	Bycatch Rate	Inci-dents	Red List Criterion
Baltic Sea	27.3.d.28.1	Pelagic trawls	*Coregonus lavaretus*	356	6331	391	1.0983	51	VU
Baltic Sea	27.3.d.28.1	Traps	*Coregonus lavaretus*	22	5086	5	0.2273	2	VU
Bay of Biscay and the Iberian Coast	27.8.b	Nets	*Acipenser sturio*	172	7280	6	0.0348	4	CR
Greater North Sea	27.7.d	Nets	*Acipenser sturio*	131	11817	1	0.0076	1	CR
North West Atlantic	21.3.L	Bottom trawls	*Hippoglossus hippoglossus*	93	538	0	0.0000	27	VU
North West Atlantic	21.3.M	Bottom trawls	*Hippoglossus hippoglossus*	76	729	0	0.0000	18	VU
North West Atlantic	21.3.N	Bottom trawls	*Hippoglossus hippoglossus*	97	969	0	0.0000	105	VU
North West Atlantic	21.3.O	Bottom trawls	*Hippoglossus hippoglossus*	59	625	0	0.0000	96	VU

[16] Table edited at ADGBYC in August 2020; ICES has focused on species of high and medium conservation concern, using the EU red list of fishes (Nieto et al., 2015) as the basis for classification. Species classified as "endangered" or "critically endangered" were considered to be of high conservation concern. Those classified as "vulnerable" are classified as of medium concern.

Table 24. Summary of turtle bycatch records in the WGBYC database 2016 -2018 by gear and ecoregion. No. Spec=number of specimens. Observed effort (Obs Eff) reported as DaS = Days at Sea; bycatch rate = number of specimens/number of days at sea observed. * In 2018, some turtle records were received having been raised (see ToR A Table 2).

	2018			2017			2016		
Species:MetierL3:Ecoregion	**Obs. Effort**	**No Spec.**	**Bycatch Rate***	**Obs. Effort**	**No Spec.**	**Bycatch Rate**	**Obs. Effort**	**No Spec**	**Bycatch Rate**
Total *Caretta caretta*	**5666**	**131**	**0.023**	**599**	**4**	**0.007**	**379**	**12**	**0.032**
Bottom trawls	**4917**	**101**	**0.021**				**25**	**1**	0.040
Adriatic Sea	664	77	0.116						
Aegean-Levantine Sea	198	1	0.005						
Ionian Sea and the Central	1225	8	0.007						
Western Mediterranean Sea	2830	15	0.005				25	1	0.040
Longlines	**363**	**1**	**0.003**				**10**	**1**	**0.100**
Azores	363	1	**0.003**						
Western Mediterranean Sea							10	1	0.100
Pelagic trawls	**386**	**29**	**0.075**	**173**	**3**	**0.017**	**342**	**4**	**0.012**
Adriatic Sea	386	29	0.075						
Western Mediterranean Sea				173	3	0.017	342	4	0.012
Nets				**426**	**1**	**0.002**	**2**	**6**	**3.000**
Western Mediterranean Sea				426	1	0.002	2	6	3.000
Total *Chelonia mydas*							2	1	0.500
Nets							**2**	**1**	**0.500**

	2018			2017			2016		
Species:MetierL3:Ecoregion	**Obs. Effort**	**No Spec.**	**Bycatch Rate***	**Obs. Effort**	**No Spec.**	**Bycatch Rate**	**Obs. Effort**	**No Spec**	**Bycatch Rate**
Western Mediterranean Sea							2	1	0.500
Total *Dermochelys coriacea*	**363**	**2**	**0.006**						
Longlines	**363**	**2**	**0.006**						
Azores	363	2	0.006						
Total *Cheloniidae*	**503**	**1**	**0.002**						
Nets	**503**	**1**	**0.002**						
Aegean-Levantine Sea	503	1	0.002						
Grand Total	**6532**	**134**	**0.021**	**599**	**4**	**0.007**	**381**	**13**	**0.034**

Table 25. Fishing and bycatch monitoring effort (2018) throughout fisheries assigned risk scores by FishPi project.

Métier (L4)	ICES Division	ICES Sub-area	Risk factor (fishPi)	Fishing effort (days at sea)	Dedicated bycatch monitoring (days at sea)	Non-dedicated bycatch monitoring (days at sea)	Total observer effort (days at sea)	Observer coverage (% days at sea)
GTR	27.8.c	8	105	16914	0	1	1	0.01
GNS	27.7.e	7	84	9087	73	48	121	1.33
GNS	27.8.a	8	84	5081	0	76	76	1.50
GNS	27.8.b	8	84	2111	0	85	85	4.04
GNS	27.8.c	8	84	16101	0	28	28	0.17
GNS	27.8.d	8	84	262	0	10	10	3.79
GNS	27.9.a	9	84	71536	3	18	21	0.03
GTR	27.8.a	8	84	5165	0	70	70	1.35
GTR	27.8.b	8	84	4643	0	86	86	1.86
GND	27.8.b	8	75	459	0	1	1	0.15
LLS	27.8.a	8	64	5531	0	18	18	0.32
LLS	27.8.b	8	64	2698	0	12	12	0.43
GNS	27.7.b	7	63	496	0	3	3	0.60
GNS	27.7.f	7	63	2539	52	9	61	2.40
GNS	27.7.g	7	63	2274	21	37	58	2.55

Métier (L4)	ICES Division	ICES Sub-area	Risk factor (fishPi)	Fishing effort (days at sea)	Dedicated bycatch monitoring (days at sea)	Non-dedicated bycatch monitoring (days at sea)	Total observer effort (days at sea)	Observer coverage (% days at sea)
GNS	27.7.h	7	63	530	0	16	16	3.00
GNS	27.7.j	7	63	3139	5	170	175	5.58
GTR	27.7.e	7	63	2037	8	35	43	2.12
GTR	27.7.f	7	63	96	2	3	5	5.21
GTR	27.7.g	7	63	28	5	0	5	17.77
GTR	27.7.h	7	63	639	0	14	14	2.14
OTB	27.6.a	6	56	17485	4	257	261	1.49
OTB	27.6.b	6	56	2033	0	46	46	2.26
OTB	27.7.a	7	56	12706	0	198	198	1.56
OTB	27.7.b	7	56	3090	0	33	33	1.06
OTB	27.7.c	7	56	3593	0	8	8	0.22
OTB	27.7.e	7	56	17305	0	305	305	1.76
OTB	27.7.f	7	56	2189	0	25	25	1.16
OTB	27.7.g	7	56	12034	0	253	253	2.10
OTB	27.7.h	7	56	4970	0	288	288	5.80

Métier (L4)	ICES Division	ICES Sub-area	Risk factor (fishPi)	Fishing effort (days at sea)	Dedicated bycatch monitoring (days at sea)	Non-dedicated bycatch monitoring (days at sea)	Total observer effort (days at sea)	Observer coverage (% days at sea)
OTB	27.7.j	7	56	10000	0	105	105	1.05
OTB	27.7.k	7	56	3742	0	21	21	0.56
OTB	27.8.a	8	56	8083	0	42	42	0.52
OTB	27.8.b	8	56	5842	0	25	25	0.42
OTB	27.8.c	8	56	6270	0	76	76	1.21
OTB	27.8.d	8	56	143	0	0	0	0.14
OTB	27.9.a	9	56	39094	0	147	147	0.38
OTT	27.8.a	8	52	13587	0	539	539	3.97
OTT	27.8.b	8	52	454	0	2	2	0.50
OTT	27.8.d	8	52	247	0	46	46	18.53
PTB	27.8.c	8	52	4537	0	18	18	0.40
PTB	27.9.a	9	52	963	0	2	2	0.21
FPO	27.7.e	7	48	20546	0	4	4	0.02
FPO	27.8.a	8	48	4021	0	7	7	0.17
FPO	27.8.b	8	48	269	0	1	1	0.21

Métier (L4)	ICES Division	ICES Sub-area	Risk factor (fishPi)	Fishing effort (days at sea)	Dedicated bycatch monitoring (days at sea)	Non-dedicated bycatch monitoring (days at sea)	Total observer effort (days at sea)	Observer coverage (% days at sea)
LLS	27.7.e	7	48	498	0	2	2	0.40
OTM	27.7.e	7	48	485	5	7	12	2.47
PTM	27.8.a	8	48	1419	0	49	49	3.42
PTM	27.8.b	8	48	632	0	11	11	1.74
PTM	27.8.d	8	48	1097	0	40	40	3.65
TBB	27.9.a	9	48	10804	0	0	0	0.00
PS	27.9.a	9	44	28358	33	63	96	0.34
GNS	27.7.a	7	42	341	3	1	4	1.17
LHM	27.7.e	7	40	1	0	39	39	NA
OTT	27.7.b	7	39	4	0	1	1	32.42
OTT	27.7.c	7	39	77	0	10	10	13.17
OTT	27.7.e	7	39	1368	0	16	16	1.18
OTT	27.7.f	7	39	76	0	8	8	10.58
OTT	27.7.g	7	39	1509	0	141	141	9.36
OTT	27.7.h	7	39	4080	0	525	525	12.86

Métier (L4)	ICES Division	ICES Sub-area	Risk factor (fishPi)	Fishing effort (days at sea)	Dedicated bycatch monitoring (days at sea)	Non-dedicated bycatch monitoring (days at sea)	Total observer effort (days at sea)	Observer coverage (% days at sea)
OTT	27.7.j	7	39	1425	0	208	208	14.57
OTT	27.7.k	7	39	58	0	5	5	9.25
DRB	27.7.a	7	36	12298	0	25	25	0.20
DRB	27.7.e	7	36	10038	0	16	16	0.16
TBB	27.7.e	7	36	12939	0	118	118	0.91
TBB	27.7.f	7	36	8862	0	87	87	0.99
TBB	27.7.g	7	36	10604	0	83	83	0.78
TBB	27.7.h	7	36	2541	0	47	47	1.86
PS	27.7.e	7	33	594	0	1	1	0.17
PS	27.8.a	8	33	257	0	5	5	1.95
PS	27.8.b	8	33	2109	0	5	5	0.24
LLS	27.6.a	6	32	1843	0	49	49	2.66
OTM	27.6.a	6	32	1224	22	85	107	8.74
OTM	27.6.b	6	32	72	0	1	1	1.39
OTM	27.7.a	7	32	386	0	87	87	22.57

Métier (L4)	ICES Division	ICES Sub-area	Risk factor (fishPi)	Fishing effort (days at sea)	Dedicated bycatch monitoring (days at sea)	Non-dedicated bycatch monitoring (days at sea)	Total observer effort (days at sea)	Observer coverage (% days at sea)
OTM	27.7.b	7	32	66	0	1	1	1.52
OTM	27.7.c	7	32	196	0	9	9	4.59
OTM	27.7.g	7	32	26	0	1	1	3.78
OTM	27.7.h	7	32	154	0	11	11	7.13
OTM	27.7.j	7	32	85	0	11	11	12.91
OTM	27.7.k	7	32	39	0	9	9	23.30
PTM	27.6.a	6	32	1076	0	18	18	1.67
PTM	27.7.a	7	32	352	0	6	6	1.70
PTM	27.7.b	7	32	392	0	11	11	2.81
PTM	27.7.c	7	32	186	0	3	3	1.61
PTM	27.7.g	7	32	159	0	8	8	5.02
PTM	27.7.j	7	32	390	0	3	3	0.77
PTM	27.8.c	8	32	188	0	11	11	5.61
LHM	27.8.b	8	30	108	0	0	0	0.23
OTB	27.5.b	5	28	179	0	6	6	3.27

Métier (L4)	ICES Division	ICES Sub-area	Risk factor (fishPi)	Fishing effort (days at sea)	Dedicated bycatch monitoring (days at sea)	Non-dedicated bycatch monitoring (days at sea)	Total observer effort (days at sea)	Observer coverage (% days at sea)
OTT	27.7.a	7	26	235	0	42	42	17.86
TBB	27.7.a	7	24	2082	0	8	8	0.40
TBB	27.8.b	8	24	3933	0	15	15	0.38
SDN	27.8.a	8	22	703	0	17	17	2.48
SDN	27.8.b	8	22	283	0	8	8	2.72
SSC	27.7.g	7	22	993	0	6	6	0.60
SSC	27.7.j	7	22	760	0	2	2	0.26
GTR	27.7.a	7	21	4	1	0	1	25.00
DRB	27.7.g	7	18	697	0	7	7	1.00
OTM	27.5.b	5	16	87	0	1	1	1.15
OTM	27.8.a	8	16	143	0	3	3	1.98
PTB	27.6.a	6	13	183	0	1	1	0.50
PS	27.7.f	7	11	100	13	0	13	13.00

4 ToR D

Continue to develop, improve and coordinate with other ICES WGs on methods for bycatch monitoring, research and assessment

4.1 Coordination with Working Group on Commercial Catches (WGCATCH): Sampling lists for marine mammals and birds to be used by onboard observers

In accordance with the EU Regulation 2017/1004 on the establishment of a Union framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the common fisheries policy (EU-MAP), at-sea observations should be carried out for the purposes of collecting data "bycatch of non-target species, in particular species protected under Union or international law". Inevitably, the focus and experience of observers has been towards fish bycatch rather than that of protected species such as birds, mammals or turtles, and ICES (2015) has expressed concern that this could lead to a downward bias in the number of recorded events.

Several ICES working groups have addressed how to collect these data and how to store the data into the ICES RDBES. One step in this progress, is to develop species sampling lists to be used by observers at-sea and to inform the vocabulary of the RDBES. Thereby, there will be information in the RDBES on which species have been observed and which have not been observed as bycatch. The species list might need to be adapted depending on the different defined processes on board such as pre-sorting, sorting and drop-outs. To initiate this work, WGBYC has developed comprehensive initial lists of species that may be sensitive to bycatch for fisheries observers, along with guidance as to where confusion may occur in species identification for personnel untrained in those taxa. As a start, WGBYC has prepared lists of marine mammals and birds for ten ICES ecoregions, and an assessment of their relative status (Table 26 and Table 27). Lists for mammals and birds for ecoregions in the Mediterranean and Black Seas, and for other protected species such as sea turtles and elasmobranchs, will need to be developed by WGBYC and other relevant expert groups and therefore WGBYC has recommended JGBIRD and WGMME to review the preliminary species lists. .

The ecoregions addressed here include: Barents Sea, Norwegian Sea, Faroes, Iceland Sea, Oceanic north-east Atlantic, Azores, Bay of Biscay and the Iberian Coast, Celtic Sea, Greater North Sea, and Baltic Sea. A total of 46 marine mammal species and 80 bird species were considered. Taxonomy follows Clements et al. (2019) for birds and the Society for Marine Mammalogy (2019) for marine mammals and are in accordance with the World Register of Marine Species[17]. For every species, a status assessment by ecoregion was made. Status was assessed in terms of the relative encounter rate between species at sea within that region. Four categories of status were used:

- VAG – Vagrant, defined as a very low probability of being encountered at sea;
- RAR – Rare, defined as a low probability of being encountered at sea;
- REG – Regular but uncommon, defined as likely to be encountered at sea in small numbers;
- COM – Common, defined as likely to be encountered at sea in relatively large numbers

[17]http://www.marinespecies.org/

Where possible, recent distribution maps of species densities derived from surveys, have been used. For three ecoregions (Greater North Sea, Celtic Seas, Bay of Biscay and Iberian Coast), these have utilised encounter rates and derived densities mapped as part of the UK Marine Ecosystem Research Programme. This project collated 2.68 million km of cetacean and bird survey effort over the period 1979–2018 (Waggitt et al., 2020), although for this particular purpose, emphasis was placed upon maps for the latest ten years. For the ecoregions Barents Sea, Norwegian Sea, Faroes, and Iceland Sea, marine mammal encounter rates and numbers were derived from maps produced following NASS, T-NASS and national (e.g. Norwegian) surveys (Lockyer & Pike, 2009; Desportes et al., 2019). In the Norwegian Sea and Barents Sea, marine bird species encounter rates and numbers were derived from density maps produced as part of the Norwegian SEAPOP Programme (SEAPOP, 2020), and in the Baltic, maps from surveys of water bird populations as part of the SOWBAS project (Skov et al., 2011), supplemented by recent data published by HELCOM (2018a, b). Additional information from the Barents Sea came from Mehlum (1989) and Gabrielsen et al. (2008), and from the Norwegian Sea from Nygard et al. (1988) and Fauchald et al. (2015).

For some ecoregions (Azores, Oceanic north-east Atlantic, Iceland Sea), dedicated at-sea seabird surveys have generally not been undertaken although pelagic birdwatching trips have taken place, as have surveys of marine mammals in inshore waters around the Azores. For those areas in particular, local experts were consulted on status assessments. Wherever possible, maps derived from tracking data (using satellite or GPS tags, geo-locators) were used to establish presence of marine mammal and bird species, particularly for areas poorly surveyed (e.g. Oceanic north-east Atlantic).

Some of the rarer species are not necessarily recorded from dedicated surveys because of too low sampling effort. Their presence/status was assessed from tracking data, when available, and by reference to standard texts on bird and mammal faunas (e.g. Snow & Perrins, 1998; Jefferson et al., 2015), updated where appropriate by internet searches and consultation with authors of regional species lists.

Table 26 lists bird species by ecoregion whilst Table 27 does the same for mammal species.

It should be noted that the status of some species can vary markedly with season. Some species (for example, Manx shearwater in the Celtic Sea; blue whale in the Barents Sea) may largely migrate out of an area in winter whereas others (for example, several duck species in the Baltic) may form large wintering populations. There can also be marked spatial variation in numbers within an ecoregion. Harbour porpoise at any time of year are more common in the western Baltic compared with the eastern Baltic, and killer whale in the northern North Sea compared with the southern North Sea; several species of birds (sea duck, divers, grebes, and some gull species) are much more likely to be encountered in inshore waters than further offshore. If required, these tables of species could be split into sub-regions and seasons.

The extent to which species may be confused with one another depends upon the level of experience of the observer. For those with little knowledge, species groups such as gulls amongst birds, and dolphins of the family *Delphinidae* amongst cetaceans, are likely to prove challenging to the observer. In Table 28 and 29 species that can be mistaken for each other have been grouped.

4.2 Coordination with Working Group on Commercial Catches (WGCATCH): onboard monitoring practices

Members were asked to fill in a template regarding monitoring practices used for different monitoring programmes, métiers and species sampled. The purpose was to get an overview of the different methods used taking into regards the different procedures that have been defined in a fishing operation (Table 30).

When monitoring bycatch of protected species, the fishing operation is divided into three procedures. These will match available fields in the RDBES database. The most important purpose for dividing visual observations into different stages/processes is to record an accurate measure/level of the visual coverage of each part of the fishing operation rather than describing the circumstances surrounding individual bycatch incidents. It is important to get information as to whether the whole or only parts of the full fishing operation have been monitored. The three procedures during the fishing operation that need to be covered are (1) the part of the fishing operation that happens outside of the vessel (checking for "slipping" and "drop-outs"), (2) the part where the catch comes on board (observation of "pre-sorting" operations, e.g., cod-end opening) and (3) the part where the catch is sorted (i.e., the "sorting" operations taking place, e.g., on a sorting table or conveyor belt).

Altogether seven members reported their onboard practices. In general, for all monitoring carried out for the purposes of monitoring bycatch of protected species the drop-out and slipping procedure was observed. In routine programmes such as DCF, monitoring "drop-outs" or "slipping" outside the vessel was not common. In routine monitoring programmes conducted in trawl fisheries (including OTT, OTB, OTM, PTM, PTB and PS) using a sample protocol collecting data on all species, monitoring is carried out both by using volume subsamples and by visual observations. The main sampling is carried out within the sorting and the pre-sorting procedure onboard. However, the drop-out or the slipping monitoring is rarely monitored. On the contrary, when protected species is noted down to be sampled in the routine monitoring programmes all procedures (sorting, pre-sorting, drop out and slipping) is visually monitored.

In routine monitoring programmes carried out in gillnet fisheries (including GNS and GTR) using a sample protocol for all species and fish, monitoring is carried out mainly visually. Sampling is always conducting during the pre-sorting procedure and only occasionally at the sorting procedure. Monitoring drop-outs and slipping is very seldom recorded. However, when marine mammals and birds were recorded in dedicated monitoring programmes all procedures were observed.

There are only few records concerning other passive gears such as longlines and pots. When monitored as part of routine monitoring programmes (e.g. DCF) visual and volume samples are sampled either in pre-sorting or in the sorting procedure. No monitoring is carried out under drop out or slipping except when monitoring is within a dedicated sampling programme.

4.3 Coordination with Working Group on Commercial Catches (WGCATCH): PETS subgroup 2019

In order to deal with the workload connected to the implementation of sampling of protected species under the DCF, the WGCATCH 2019 ToR "Review developments in sampling and estimation of incidental bycatch, including Protected, Endangered and Threatened Species (PETS) and rare fish species" was addressed in a subgroup which included members from WGCATCH and WGBYC. The full report of this joint WGCATCH-WGBYC subgroup can be found in the 2019 WGCATCH report.

The work agenda contained the following ToRs:

- Look over RDBES database set up (New database design, taking collection of incidental catches of protected species into account).
- To review gear specific definitions of sorting, hauling and slipping for the implementation in on board protocols and the inclusion in the RDBES documentation of the data model for guidance.
- Detailed instruction on how to sample protected species. Some work has been done by fishPi. Review the work that has already been done in FishPi and fill in the gaps.
- Include Specimen State with the following codes; dead/alive/wounded/unknown/damaged/looks-like-it-will-die, etc. Set up codes.
- Discuss the need and relevance of an historical data call on incidental bycatch.

Under ToR 1 of the WGCATCH subgroup, the data call template of WGBYC was compared with the current draft RDBES structure and format in the awareness that the WGBYC data call template is a result of historic events and requirements connected to the 812/2004 EU resolution while the current draft design of the RDBES is built around general catch sampling under the DCF. Several points were discussed and the inclusion of several new fields in the RDBES have been proposed. In addition, the subgroup discussed the need for more detailed fishing effort data for all vessel types, including very small vessels, which is needed for more robust assessments of the impact of incidental bycatch on PETS.

Under ToR 2 the level of gear specific definitions for the recording of PETS sampling was discussed. The main issue is that the instructions for observers during on board sampling should match the available fields in the database. However, the descriptions in the manual for the database should not be too detailed as it is impossible to describe every possible situation in each National fishery. It was agreed that the most important purpose of dividing visual observations into different stages/processes was to record an accurate measure/level of the visual coverage of each part of the fishing operation rather than to describe the circumstances of individual bycatch incidents. Essentially, the three processes for visual observation cover (1) the part of the fishing operation that happens outside of the vessel (checking for "slipping" and "drop-outs"), (2) the part where the catch comes on board (observation of "pre-sorting" operations, e.g., cod-end opening) and (3) the part where the catch is sorted (i.e., the "sorting" operations taking place, e.g., on a sorting table or conveyor belt).

Under ToR 3 of the subgroup the work that has already been carried out under fishPi was reviewed. The set of instructions in the FishPi2 report was found to represent a solid basis for developing adequate procedures for sampling PETS bycatch at a national level. The subgroup added a short list of additional points.

The group agreed that the codes list for specimen state (ToR 4 of the subgroup) should be as simple as possible, but capable of describing all specimen's states important for the proper assessment of the impact of bycatch. The following six codes were proposed:

- Dead – the specimen is definitely dead.
- Impaired – the specimen has some type of injury or lack of reflexes
- Alive - the specimen was released alive to the sea.
- Mixed - mixture of dead, impaired and/or healthy specimens in unknown proportion.
- Unknown – the observer was not able to note the state of specimen but was expected to (e.g. specimens dropped of gillnets to the sea, especially on video footage).
- Not determined - the observer did not try to determine the state of the specimen.
- Decomposed (dead before caught)

ToR 5 of the subgroup: since the RDBES is being developed to include bycatch of protected species it will be important that any historical data obtained is submitted in a form closely compatible with the new RDBES data so that the historical data can be seamlessly combined with future data. Therefore, there is a need for competence from both WGCATCH and WGBYC when developing the historical data call. The importance and the need of a historical data call was discussed in plenary, however there was no immediate consensus regarding how to proceed.

4.4 RCG PETS subgroup

The RCG intersessional subgroups (ISSG) on PETS was established by the Liaison Meeting (LM) in 2018 to streamline and facilitate the work on PETS data collection, monitoring and regional sampling programmes under the EU MAP. The ISSGs are intended to work throughout the year, self-organising their work and having a subgroup chair as point of contact with the RCGs chairs. It is the responsibility of the subgroup chair to define the ToRs and the work plans for the year ahead. The work done by the subgroup must be finalised one month before the RCGs annual meeting as it is indicated under the Rules and Procedures agreed by the RCGs. In the following paragraphs the work done by this subgroup in the last two years is mentioned.

Although there is a wish to monitor a broad range of PETS, covering several taxa, an overarching design that adequately covers all situations and taxa is not realistic within existing catch sampling programmes. One approach to help address some of these issues maybe to use data collected under the DCF or other sources to help identify “hot spots”, such as fishing grounds, PETS species and métiers with relatively high bycatch rates. Based on initial assessments of the data at fishing ground scale, relevant Member States or RCG’s could then carry out more focussed data collection to fully assess the scale and patterns of PETS bycatch in those specific high-risk fisheries.

Following this approach, this ISSG group identified and updated the list of métiers that posed a bycatch risk to PETS by fishing ground in 2019 for the North Atlantic and the North Sea based on the methodology used by ICES WGBYC (2013 and 2019) and the fishPi project.

The assessment update should be considered as a first step towards developing specific regional sampling plans to monitor PETS bycatch. This update showed how monitoring coverage of passive/static gears was relatively low compared to the identified risk of bycatch in most of the Atlantic and North Sea grounds.

The next step for this subgroup, is to focus on some specific case studies taking into account different gears, areas and PETS etc. Under 2020 work plan, five case studies have been identified by the subgroup members as potential candidates for future regional sampling programmes. The selection is based on several criteria: high risk bycatch fisheries, PETS species status, lack of monitoring of these fisheries etc. The five case studies proposed by the subgroup are:

- Subarea 6, 7 (Gillnets, GNS/GTR/GND) *Halichoerus grypus* and *Phoca vitulina* seals PETS species
- Subarea 7 (Longlines LLS) *Morus bassanus* seabirds PETS species

- Subarea 7 (Gillnets) *Lamna nasus*, *Squalus acanthias*, *Dipturusbatis* and *Dipturus intermedius* Elasmobranch species
- Areas 2, 4, 5, 6, 7 and 8. rare/protected fish on board freezertrawlers
- Area 8 (Bay of Biscay) Common dolphins (*Delphinus delphis*)

These case studies will be discussed during the RCG annual meeting to be held from the 8 to 12 June.

4.5 Working Group on Marine Mammal Ecology (WGMME)

ToR C for the 2020 ICES WGMME meeting was 'Review selected aspects of marine mammal-fishery interactions', with the details to be agreed between WGMME and WGBYC in consultation with the ICES Secretariat prior to the meeting. This ToR reflects common interests between WGMME and WGBYC, recognising that some aspects of marine mammal ecology and marine mammal interactions with fisheries (specifically bycatch) may otherwise not be covered by either group. In principle, WGMME aims to assemble data and qualitative information available from other sources not covered by WGBYC. Following is an overview of the topics and main conclusions of WGMME ToR C in 2020 (ICES 2020).

A critical gap hindering the ability of both WGMME and WGBYC to properly address marine mammal interactions with fisheries is the lack of quantitative conservation objectives for marine mammals and agreed limits with regards to bycatch mortality. WGMME provides examples of when the following approaches to setting mortality limits are recommended and have been applied: a fixed percentage of total abundance as a threshold (e.g. ASCOBANS[18]), Potential Biological Removal (PBR) (e.g. US MMPA[19]), and Removals Limit Algorithm (RLA).

WGMME provides a summary of Regulation (EU) 2019/1241 on the conservation of fisheries resources and the protection of marine ecosystems through technical measures, with regards to bycatch objectives and targets, and obligations on bycatch reporting and mitigation.EU 2019/1241 now mandates MS to report bycatch of all sensitive species listed on HD Annex II and Annex IV (a), thus including grey seals, harbour seals, harp seals, Baltic ringed seals, and Saimaa ringed seals. There are, however, serious hurdles to overcome in order to implement efficient and effective fisheries monitoring schemes; given the difficulties seen with the now repealed Regulation 812/2004, the effectiveness of reporting of dead marine mammals caught in fishing is as yet, unknown. This in turn stresses the importance of stranding networks, necropsies and trained veterinary pathologists to assess a minimum bycatch.

Records of dead animals and analyses of possible causes of death are considered a first step in identifying possible bycatch issues and to gain baseline knowledge or recognize changes in this type of interaction. Strandings have traditionally been used to provide minimum estimates of bycatch, since issues such as currents, weather, and accessibility influence the probability of a bycaught animal reaching the coast and, once stranded, being discovered. In many areas however, registration of stranding events and subsequent necropsies of at least a sample of the animals are not available, and it is therefore unlikely that bycatch issues could be recognised.

While estimating bycatch levels falls under the remits of WGBYC, there are aspects of fisheries interactions which are not covered by the group; WGBYC lists strandings that have been identified as bycaught, however, WGMME (ICES 2019) recognised that coverage was incomplete with

[18]Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seashttps://www.ascobans.org/en/species/threats/bycatch

[19] U.S. Marine Mammal Protection Act. https://www.mmc.gov/priority-topics/fisheries-interactions-with-marine-mammals/mmpa-provisions-for-managing-fisheries-interactions-with-marine-mammals/

regards to regions and species monitored. This is largely due to WGBYC's focus on collating and analysing information provided in response to the requirements of the now repealed Regulation 812/2004, requiring monitoring of bycatches of small cetaceans in Member States. Thus, the extent and magnitude of seal-fisheries interaction and bycatch interactions, and bycatches in non-Member States, may have been underestimated and in some cases gone undetected. Therefore, WGMME produced a first overview of registration and necropsies of marine mammals in ICES and adjacent waters, indicating marine mammal strandings that may not be covered by ICES WGBYC. WGMME noted that ICES WGBYC started tallying numbers of strandings identified as bycatch because some Member State reported this as a measure of minimum bycatch in their EC 812/2004 reports.

WGMME summarises information on stranding records of marine mammals and seal-fisheries interactions provided by member countries and other sources. At the 2020 meeting, information on stranded animals was compiled from Belgium, Denmark, Ireland, France, Germany, Iceland, Netherlands, Norway, Spain, Sweden and UK. Information on seal-fisheries interactions was compiled from HELCOM, Belgium, Germany, Ireland, Latvia, Netherlands and UK. WGBYC had communicated with WGMME ahead of their meeting, that for WGBYC 2020, the group intended to extend their review of the bycatch data within the strandings network, given the expertise to do so within WGBYC. Ahead of next year, further discussion will need to be had, taking into account the ICES Bycatch Roadmap.

4.6 The HELCOM Roadmap on fisheries data

The HELCOM Roadmap on fisheries data in order to assess incidental bycatches and fisheries impact on benthic biotopes in the Baltic Sea[20] has been finally adopted by all Contracting Parties to the Helsinki Convention during the HELCOM 41 meeting which took place on 4–5 March 2020.

The aim of the Roadmap is to recognise the fisheries data available and data gaps, in order to make the two related HELCOM indicators operational. Possible solutions to cover identified data gaps and relevant actors to be involved, have also been suggested.

The two HELCOM indicators: Number of drowned mammals and water birds in fishing gear and Cumulative impact on benthic biotopes require fisheries data in order to be used for assessments of the state of the environment of the Baltic Sea. Data gaps for the indicator Number of drowned mammals and water birds in fishing gear (bycatch indicator), include species level bycatch data, especially for smaller vessels (below 15 m). Representative bycatch monitoring data is especially relevant for trammel nets (GTR) and set gillnets (GNS), but also for other passive gears such as fyke nets (FYK), longlines (LLS) or pots and traps (FPO). Fishing effort data are needed to extrapolate from bycatch rates to bycatch numbers but are often not available at the preferred resolution. Also gear characteristics (mesh size, net length and height), and soak time, in particular for static gears, are needed for precise assessments of fishing effort. Furthermore, effort metrics can be different for different métiers and thus not always comparable across métiers and between fleet segments (i.e. vessel sizes). Current recording rates of fishing positioning systems (e.g. VMS) are too low for precisely assessing static net effort and tracking systems are not currently required for small vessels (below 12 m). For these vessels, effort is, at best, only reported at the resolution of Baltic Squares or ICES rectangles.

The Roadmap proposes solutions to improve the quality of fishing effort data:

- changing the reporting of fishing effort to daily intervals (small boats, below 8 m, currently report once a month,
- expanding the obligation to keep a logbook to smaller vessels which would contain the most needed information for all vessels independent of their size; and
- increase of the precision of tracking devices.

The current revision of the EU Control Regulation 1224/2009)[21]provides an opportunity to ensure better monitoring and control of fishing operations, including implementation of a tracking system for vessels below 12 m. With respect to locating effort using passive gears such as gillnets, the use of smartphone apps by fishers could provide the opportunity to enhance data quality and quantity. This is especially the case for small vessels.

Solutions related to bycatch data can include:

- covering a certain% of métier and area under the DCF monitoring;
- research projects to collect data dedicated to bycatch in relevant fishing métiers coordinated between Contracting Parties;

[20] Full text of the HELCOM Roadmap adopted during the HELCOM 41 meeting can be found here: https://portal.helcom.fi/meetings/HELCOM%2041-2020-679/MeetingDocuments/Outcome%20of%20HELCOM%2041-2020.pdf

[21]Council Regulation (EC) No 1224/2009 of 20 November 2009 establishing a Community control system for ensuring compliance with the rules of the common fisheries policy, amending Regulations (EC) No 847/96, (EC) No 2371/2002, (EC) No 811/2004, (EC) No 768/2005, (EC) No 2115/2005, (EC) No 2166/2005, (EC) No 388/2006, (EC) No 509/2007, (EC) No 676/2007, (EC) No 1098/2007, (EC) No 1300/2008, (EC) No 1342/2008 and repealing Regulations (EEC) No 2847/93, (EC) No 1627/94 and (EC) No 1966/2006; https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32009R1224

- identification of possible hot-spot bycatch areas by risk-mapping; and
- improvement of recording of marine mammal and bird bycatch by making it easier for fishers to self-report (electronic logbooks, incentives).

Further, there is a need to enhance bycatch monitoring with onboard observers or with remote electronic monitoring (REM). Incentives and enforcement mechanisms for non-compliance are needed. Other options include allowing calculations of total bycatch numbers on the basis of a sub-sample of vessels or a reference fleet. Ensuring that bycatch monitoring is awarded a share and access to national and international funds for bycatch data collection is also crucial.

In the future, a discussion with Baltic Sea Fisheries Forum BALTFISH on the solutions proposed in the HELCOM Roadmap, with the aim to improve bycatch monitoring of marine birds and mammals, will be initiated. BALTFISH is a regional body involving all the eight EU member states bordering the Baltic Sea and providing a platform for discussion on important fisheries issues for this region. BALTFISH is based on the regionalisation of the EU Common Fisheries Policy and its main objective is to promote cooperation among fisheries administrations and other key stakeholders in developing sustainable fisheries in the Baltic Sea area.

4.7 ICES Bycatch Roadmap

WGBYC engaged with ICES in its development of the Roadmap for ICES Bycatch Advice. WGBYC welcome the initiative which ultimately should ensure more efficient and complete advice with regards to bycatch of sensitive species. The primary goal is to facilitate more efficient consolidation of data and knowledge to support robust bycatch assessment; this will ensure delivery of the immediate goal to "assess risk and impact of fleet activity for incidental bycatch, to be included in fisheries overviews by 2022."The draft roadmap confirmed WGBYCs important role in the advisory process, as the group that will handle all data that can be gathered through ICES data calls relative to the monitoring and estimation of sensitive species bycatch. WGBYC will also assemble and synthesise data and information from other groups, such as WGMME, and will determine which data and information is fit-for-use in the advisory process. WGBYC acknowledges that relationships with relevant expert groups that are likely to work with "bycatch assessment" relevant data/information will need to be maintained/established. WGBYC has already established good relationships with some including WGCATCH, WGMME and WGDEF. However, better engagement needs to be established with WGHARP and JWGBIRD. It should also be noted that communication between groups is a two-way process, and the relevant working groups should be encouraged to contact WGBYC if they have information that falls within the scope of WGBYC's role (as set out in the roadmap) and/or WGBYCs ToRs. The roadmap has now been published https://www.ices.dk/sites/pub/Publication%20Reports/Advice/2020/2020/Roadmap_ICES_Bycatch_Advice.pdf

Table 26. Preliminary bird sampling list by ecoregion and species status. If, to one's knowledge, the species has not been recorded in the region, the status box has been left blank (* marked variation in status within region, generally less common offshore).

	species	scientific name	Barents Sea	Norwegian Sea	Faroes	Iceland Sea	Oceanic North-East Atlantic	Azores	Bay of Biscay and Iberian Coast	Celtic Seas	Greater North Sea	Baltic Sea
benthic feeding ducks	Common Pochard	*Aythya ferina*	VAG	RAR	VAG	RAR	VAG?	VAG	RAR	RAR	RAR	REG*
	Tufted Duck	*Aythya fuligula*	RAR	REG*	RAR	REG*	VAG?	RAR	RAR	RAR	REG*	COM*
	Greater Scaup	*Aythya marila*	REG*	REG*	RAR	REG*	VAG?	VAG	RAR	RAR	RAR	COM*
	Steller's Eider	*Polysticta stelleri*	REG*	REG*	VAG	RAR	VAG?	VAG	VAG	VAG	VAG	REG*
	King Eider	*Somateria spectabilis*	REG*	REG*	VAG	VAG	VAG?	VAG	VAG	VAG	RAR	RAR
	Common Eider	*Somateria mollissima*	COM*	COM*	COM*	COM*	VAG?	RAR	VAG	REG*	REG*	COM*
	Velvet Scoter	*Melanitta fusca*	REG*	REG*	VAG	VAG			VAG	VAG	RAR*	COM*
	Common Scoter	*Melanitta nigra*	REG*	COM*	VAG	REG*	VAG?	RAR	REG*	REG*	REG*	COM*
	Long-tailed Duck	*Clangula hyemalis*	REG*	REG*	RAR	REG*	VAG?	VAG	VAG	RAR	RAR	COM*
	Common Goldeneye	*Bucephala clangula*	REG*	REG*	RAR	RAR	VAG?	VAG	RAR	RAR	REG*	COM*
mergansers	Smew	*Mergellus albellus*	RAR	RAR	VAG	RAR			VAG	RAR	RAR*	REG*
	Goosander	*Mergus merganser*	REG*	REG*	VAG	RAR	VAG?	VAG	VAG	RAR*	RAR*	COM*
	Red-breasted Merganser	*Mergus serrator*	REG*	REG*	RAR	COM*	VAG?	VAG	VAG	REG*	REG*	COM*
divers	Red-throated Diver	*Gavia stellata*	REG*	REG*	REG*	REG*	VAG?	VAG	RAR	REG	REG	COM*
	Black-throated Diver	*Gavia arctica*	REG*	REG*	VAG		VAG?	VAG	VAG	RAR	REG*	COM*
	Great Northern Diver	*Gavia immer*	REG*	REG*	RAR*	REG*	VAG?	RAR	RAR	RAR*	RAR*	RAR*
	White-billed Diver	*Gavia adamsii*	REG*	REG*	RAR*					VAG	VAG	RAR*

alba-trosses	Black-browed Albatross	*Thalassarche melanophris*	VAG	VAG	VAG	VAG	VAG	VAG	VAG	VAG	VAG	
petrels and storm petrels	Wilson's Storm Petrel	*Oceanites oceanicus*		VAG	VAG	VAG	COM	COM	RAR	VAG	VAG	
	European Storm Petrel	*Hydrobates pelagicus*	REG	REG	COM	COM	REG	REG	COM	COM	REG	VAG
	Band-rumped Storm Petrel	*Oceanodroma castro*					REG	REG	REG			
	Monteiro's Storm Petrel	*Oceanodroma monteiroi*					RAR	REG				
	Swinhoe's Petrel	*Oceanodroma monorhis*		VAG			VAG	VAG	VAG	VAG	VAG	
	Leach's Storm Petrel	*Oceanodroma leucorhoa*	VAG	REG	COM	COM	REG	REG	RAR	REG	VAG	VAG
	White-faced Storm Petrel	*Pelagodroma marina*					VAG	VAG				
	Desertas Petrel	*Pterodroma deserta*					RAR	RAR	VAG			
	Zino's Petrel	*Pterodroma madeira*					RAR	RAR	VAG	VAG		
	Bulwer's Petrel	*Bulweria bulwerii*					RAR	REG				
Fulmar and shearwaters	Northern Fulmar	*Fulmarus glacialis*	COM	COM	COM	COM	REG	RAR	REG	COM	COM	VAG
	Scopoli's Shearwater	*Calonectris diomedea*					RAR	RAR	RAR	VAG		
	Cory's Shearwater	*Calonectris borealis*		VAG	VAG		COM	COM	COM	REG	RAR	VAG
	Sooty Shearwater	*Ardenna grisea*	VAG	REG	REG	REG	RAR	RAR	REG	REG	RAR	VAG
	Great Shearwater	*Ardenna gravis*	VAG	RAR	REG	REG	REG	REG	REG	REG	RAR	
	Manx Shearwater	*Puffinus puffinus*	VAG	RAR	COM	REG	REG	REG	COM	COM	REG	VAG
	Balearic Shearwater	*Puffinus mauretanicus*		VAG	VAG		RAR	RAR	REG	RAR	VAG	VAG
	Yelkouan Shearwater	*Puffinus yelkouan*					VAG		RAR	VAG		
	Barolo Shearwater	*Puffinus baroli*					REG	REG	RAR	RAR	VAG	

Table 27. Preliminary marine mammal sampling list by ecoregion and species status. If, to one's knowledge, the species has not been recorded in the region, the status box has been left blank. * Marked variation in status within region (generally less common offshore).

species	scientific name	Barents Sea	Norwegian Sea	Faroes	Iceland Sea	Oceanic North-East Atlantic	Azores	Bay of Biscay & Iberian Coast	Celtic Seas	Greater North Sea	Baltic Sea
Harbour Porpoise	*Phocoena*	COM*	COM*	COM*	COM*	REG*	VAG	REG	COM	COM*	REG*
Rough-toothed Dolphin	*Steno bredansensis*					REG	VAG	VAG			
Common Bottlenose Dolphin	*Tursiops truncatus*	VAG	RAR	REG	VAG	REG	COM	COM	COM	COM	RAR
Atlantic Spotted Dolphin	*Stenella frontalis*					REG	COM	VAG			
Striped Dolphin	*Stenella coeruleoalba*		VAG	VAG	VAG	COM	COM	COM	RAR	RAR	VAG
Common Dolphin	*Delphinus delphis*	VAG	VAG	VAG	VAG	COM	COM	COM	COM	REG*	RAR
Fraser's Dolphin	*Lagenodelphis hosei*					VAG	VAG	VAG	VAG		
White-beaked Dolphin	*Lagenorhynchus albirostris*	COM	COM	REG	COM	VAG		RAR	COM	COM	RAR
Atlantic White-sided. Dolphin	*Lagenorhynchus acutus*	RAR	COM	COM	REG	REG		VAG	COM	REG*	VAG
Risso's Dolphin	*Grampus griseus*		VAG	RAR		REG	COM	REG	REG	REG*	
Melon-headed Whale	*Peponocephala electra*					REG		VAG	VAG		
Pygmy Killer Whale	*Feresa attenuata*					VAG		VAG			
False Killer Whale	*Pseudorca crassidens*					REG	REG	RAR	VAG	VAG	VAG
Killer Whale	*Orcinus orca*	REG	REG	REG	REG	RAR	RAR	RAR	RAR	RAR	VAG
Long-finned Pilot Whale	*Globicephala melas*	REG	COM	COM	COM	COM	RAR	COM	COM	REG*	
Short-finned Pilot Whale	*Globicephala macrorhynchus*						REG	VAG			

species	scientific name	Barents Sea	Norwegian Sea	Faroes	Iceland Sea	Oceanic North-East Atlantic	Azores	Bay of Biscay & Iberian Coast	Celtic Seas	Greater North Sea	Baltic Sea
Narwhal	*Monodon monoceros*	RAR	RAR	VAG	VAG				VAG	VAG	
Beluga	*Delphinapterus leucas*	REG	RAR	VAG	VAG				VAG	VAG	VAG
Cuvier's beaked Whale	*Ziphius cavirostris*	VAG	VAG	VAG	VAG	REG	REG	REG	RAR	VAG	
Northern Bottlenose Whale	*Hyperoodon ampullatus*	REG	REG	REG	REG	REG	REG	REG	REG	RAR	VAG
True's beaked Whale	*Mesoplodon mirus*					RAR	VAG	VAG	VAG		
Gervais' beaked Whale	*Mesoplodon europaeus*				VAG	RAR			VAG		
Sowerby's beaked Whale	*Mesoplodon bidens*	VAG	RAR	REG	VAG	REG	REG	REG	RAR	RAR	VAG
Gray's beaked Whale	*Mesoplodon grayi*									VAG	
Blainville's beaked Whale	*Mesoplodon densirostris*				VAG	RAR	REG	VAG	VAG		
Pygmy Sperm Whale	*Kogia breviceps*					RAR	RAR	RAR	VAG	VAG	
Dwarf Sperm Whale	*Kogia sima*					VAG	VAG	VAG	VAG		
Sperm Whale	*Physeter macrocephaluis*	REG	REG	REG	REG	REG	COM	REG	REG	RAR	
North Atlantic Right Whale	*Eubalaena glacialis*	VAG	VAG	VAG	VAG	VAG	VAG	VAG	VAG	VAG	
Bowhead Whale	*Balaena mysticetus*	RAR	RAR	VAG	VAG			VAG	VAG	VAG	
Humpback Whale	*Megaptera novaeangliae*	REG	REG	REG	REG	RAR	RAR	RAR	RAR	RAR	RAR
Common Minke Whale	*Balaenoptera acutorostratra*	COM	COM	COM	REG	RAR	REG	RAR	COM	COM*	RAR
Antarctic Minke Whale	*Balaeenoptera bonaerensis*	VAG									

species	scientific name	Barents Sea	Norwegian Sea	Faroes	Iceland Sea	Oceanic North-East Atlantic	Azores	Bay of Biscay & Iberian Coast	Celtic Seas	Greater North Sea	Baltic Sea
Sei Whale	*Balaenoptera borealis*	RAR	REG	RAR	REG	REG	REG	RAR	RAR	RAR	
Bryde's Whale	*Balaenoptera brydei*					RAR	RAR			VAG	
Fin Whale	*Balaenoptera physalus*	REG	REG	REG	REG	REG	REG	COM	REG	RAR	RAR
Blue Whale	*Balaenoptera musculus*	REG	REG	RAR	REG	REG	REG	RAR	RAR		
Walrus	*Odobenus rosmarus*	REG*	RAR	VAG	VAG				VAG	VAG	
Hooded Seal	*Cystophora cristata*	COM*	REG*	REG*	RAR		VAG			VAG	
Bearded Seal	*Erignathus barbatus*	REG*	RAR	RAR	RAR			VAG		VAG	
Atlantic Grey Seal	*Halichoerus grypus*	RAR	REG*	REG*	REG*		VAG	RAR	COM*	COM*	REG*
Mediterranean Monk Seal	*Monachus monachus*						VAG	VAG			
Harp Seal	*Pagophilus groenlandicus*	COM*	RAR	VAG	RAR		VAG			VAG	
Harbour Seal	*Phoca vitulina*	RAR	COM*	VAG	COM		VAG	VAG	COM*	COM*	REG*
Ringed Seal	*Pusa hispida*	COM*	REG*	VAG	RAR		VAG	VAG	VAG	VAG	REG*
Polar Bear	*Ursus maritimus*	REG	RAR		VAG						

Table 28. Bird species grouped together within one colour to show those that observers with only a basic knowledge of species ID could confuse.

	species	scientific name
benthic feeding ducks	Common Pochard	*Aythyaferina*
	Tufted Duck	*Aythyafuligula*
	Greater Scaup	*Aythyamarila*
	Steller's Eider	*Polystictastelleri*
	King Eider	*Somateria spectabilis*
	Common Eider	*Somateria mollissima*
	Velvet Scoter	*Melanittafusca*
	Common Scoter	*Melanittanigra*
	Long-tailed Duck	*Clangulahyemalis*
	Common Goldeneye	*Bucephala clangula*
mergansers	Smew	*Mergellusalbellus*
	Goosander	*Mergus merganser*
	Red-breasted Merganser	*Mergusserrator*
divers	Red-throated Diver	*Gaviastellata*
	Black-throated Diver	*Gaviaarctica*
	Great Northern Diver	*Gaviaimmer*
	White-billed Diver	*Gaviaadamsii*
al-ba-tross es	Black-browed Albatross	*Thalassarchemelanophris*

petrels and storm petrels	Wilson's Storm Petrel	*Oceanites oceanicus*
	European Storm Petrel	*Hydrobatespelagicus*
	Band-rumped Storm Petrel	*Oceanodromacastro*
	Monteiro's Storm Petrel	*Oceanodromamonteiroi*
	Swinhoe's Petrel	*Oceanodromamonorhis*
	Leach's Storm Petrel	*Oceanodromaleucorhoa*
	White-faced Storm Petrel	*Pelagodroma marina*
	Desertas Petrel	*Pterodroma deserta*
	Zino's Petrel	*Pterodroma madeira*
	Bulwer's Petrel	*Bulweriabulwerii*
Fulmar and shearwaters	Northern Fulmar	*Fulmarus glacialis*
	Scopoli's Shearwater	*Calonectrisdiomedea*
	Cory's Shearwater	*Calonectris borealis*
	Sooty Shearwater	*Ardennagrisea*
	Great Shearwater	*Ardenna gravis*
	Manx Shearwater	*Puffinuspuffinus*
	Balearic Shearwater	*Puffinusmauretanicus*
	Yelkouan Shearwater	*Puffinusyelkouan*
	Barolo Shearwater	*Puffinusbaroli*

grebes	Red-necked Grebe	*Podicepsgrisegena*
	Great Crested Grebe	*Podicepscristatus*
	Horned Grebe	*Podicepsauritus*
	Black-necked Grebe	*Podicepsnigricollis*
gannets	Northern Gannet	*Morusbassanus*
cormorants	European Shag	*Phalacrocoraxaristotelis*
	Double-crested Cormorant	*Phalacrocoraxauritus*
	Great Cormorant	*Phalacrocorax carbo*
rails	Eurasian Coot	*Fulicaatra*
gulls	Black-legged Kittiwake	*Rissa tridactyla*
	Ross's Gull	*Rhodostethiarosea*
	Ivory Gull	*Pagophilaeburnea*
	Sabine's Gull	*Xema sabini*
	Slender-billed Gull	*Chroicocephalusgenei*
	Black-headed Gull	*Chroicocephalusridibundus*
	Little Gull	*Hydrocoloeusminutus*
	Laughing Gull	*Leucophaeusatricilla*
	Audouin's Gull	*Ichthyaetusaudouinii*
	Mediterranean Gull	*Ichthyaetusmelanocephalus*

	Common Gull	*Laruscanus*
	Ring-billed Gull	*Larusdelawarensis*
	Great Black-backed Gull	*Larus marinus*
	Glaucous Gull	*Larushyperboreus*
	Iceland Gull	*Larusglaucoides*
	Herring Gull	*Larusargentatus*
	Yellow-legged Gull	*Larusmichahellis*
	Lesser Black-backed Gull	*Larusfuscus*
terns	Caspian Tern	*Hydroprognecaspia*
	Sandwich Tern	*Thalasseussandvicensis*
	Little Tern	*Sternulaalbifrons*
	Roseate Tern	*Sterna dougallii*
	Common Tern	*Sterna hirundo*
	Arctic Tern	*Sterna paradisaea*
	Black Tern	*Chlidoniasniger*
skuas	Great Skua	*Stercorarius skua*
	Pomarine Skua	*Stercorariuspomarinus*
	Arctic Skua	*Stercorariusparasiticus*
	Long-tailed Skua	*Stercorariuslongicaudus*

	Little Auk	*Allealle*
	Brünnich's Guillemot	*Urialomvia*
	Common Guillemot	*Uriaaalge*
	Razorbill	*Alca torda*
	Black Guillemot	*Cepphusgrylle*
auks	Atlantic Puffin	*Fraterculaarctica*

Table 29. Marine mammal species grouped together within one colour to show those that observers with only a basic knowledge of species ID could confuse.

species	scientific name
Harbour Porpoise	*Phocoena phocoena*
Rough-toothed Dolphin	*Steno bredansensis*
Common Bottlenose Dolphin	*Tursiops truncatus*
Atlantic Spotted Dolphin	*Stenella frontalis*
Striped Dolphin	*Stenella coeruleoalba*
Common Dolphin	*Delphinus delphis*
Fraser's Dolphin	*Lagenodelphis hosei*
White-beaked Dolphin	*Lagenorhynchus albirostris*
Atlantic White-sided. Dolphin	*Lagenorhynchus acutus*
Risso's Dolphin	*Grampus griseus*
Melon-headed Whale	*Peponocephala electra*

species	scientific name
Pygmy Killer Whale	*Feresa attenuata*
False Killer Whale	*Pseudorca crassidens*
Killer Whale	*Orcinus orca*
Long-finned Pilot Whale	*Globicephala melas*
Short-finned Pilot Whale	*Globicephala macrorhynchus*
Narwhal	*Monodon monoceros*
Beluga	*Delphinapterus leucas*
Cuvier's beaked Whale	*Ziphius cavirostris*
Northern Bottlenose Whale	*Hyperoodon ampullatus*
True's beaked Whale	*Mesoplodon mirus*
Gervais' beaked Whale	*Mesoplodon europaeus*
Sowerby's beaked Whale	*Mesoplodon bidens*
Gray's beaked Whale	*Mesoplodon grayi*
Blainville's beaked Whale	*Mesoplodon densirostris*
Pygmy Sperm Whale	*Kogia breviceps*
Dwarf Sperm Whale	*Kogia sima*
Sperm Whale	*Physeter macrocephaluis*
North Atlantic Right Whale	*Eubalaena glacialis*

species	scientific name
Bowhead Whale	*Balaenidae mysticetus*
Humpback Whale	*Megaptera novaeangliae*
Common Minke Whale	*Balaenoptera acutorostratra*
Antarctic Minke Whale	*Balaeenoptera bonaerensis*
Sei Whale	*Balaenoptera borealis*
Bryde's Whale	*Balaenoptera brydei*
Fin Whale	*Balaenoptera physalus*
Blue Whale	*Balaenoptera musculus*
Walrus	*Odobenus rosmarus*
Hooded Seal	*Cystophora cristata*
Bearded Seal	*Erignathus barbatus*
Atlantic Grey Seal	*Halichoerus grypus*
Mediterranean Monk Seal	*Monachus monachus*
Harp Seal	*Pagophilus groeenlandicus*
Harbour Seal	*Phoca vitlulina*
Ringed Seal	*Pusa hisipda*
Polar Bear	*Ursus maritimus*

Table 30. Reported monitoring practices for the sorting, pre-sorting and slipping/drop-out procedures identified during the fishing operation for different monitoring programmes.

Programme type	Country	Monitoring Programme	Métier Level 4	PETS Sampling protocol	PETS sampling method	Sorting (on the vessel)	Pre-sorting (on the vessel)	Drop-out (outside the vessel)	Slipping (outside the vessel)
Dedicated bycatch sampling	UK	Other	LLS	All	Visual	Yes	Yes	Yes	Yes
Routine sampling	FRA	EU-MAP	LHM	All	Visual/Volume	No	Yes	No	No
Routine sampling	FRA	EU-MAP	LLS	All	Visual/Volume	No	Yes	No	No
Routine sampling	Sweden	EU-MAP	FPO	All	Volume	Yes	Yes	No	No
Dedicated bycatch sampling	UK	TCM 2019/1241	GNS/GTR	All	Visual	Yes	Yes	Yes	Yes
Pilot project	IE	EU-MAP	GNS/GTR	All	Visual	Yes	Yes	Yes	Yes
Pilot project	Sweden	EU-MAP	GNS/GTR	Birds	Camera	No	Yes	Yes	No
Pilot project	Sweden	EU-MAP	GNS/GTR	Marine mammals	Camera	No	Yes	Yes	No
Routine sampling	IE	DCF	GNS/GTR	All	Visual	Yes	Yes	Yes	Yes
Routine sampling	Spain (AZTI)	DCF	GNS/GTR	All	Visual	Yes	Yes	No	No
Routine sampling	ESP_IEO	DCF	GNS/GTR	All	Visual	Yes	Yes	No	-
Routine sampling	UK (ENG/WAL)	DCF	GNS/GTR	All	Visual	Yes	Yes	No	No
Routine sampling	FRA	EU-MAP	GNS/GTR	All	Visual/Volume	No	Yes	No	No
Routine sampling	Sweden	EU-MAP	GNS/GTR	Birds	Visual/Volume	Yes	Yes	Yes	No
Routine sampling	Sweden	EU-MAP	GNS/GTR	Fish	Volume	Yes	Yes	No	No

Programme type	Country	Monitoring Programme	Métier Level 4	PETS Sampling protocol	PETS sampling method	Sorting (on the vessel)	Pre-sorting (on the vessel)	Drop-out (outside the vessel)	Slipping (outside the vessel)
Routine sampling	Sweden	EU-MAP	GNS/GTR	Marine mammals	Visual/Volume	Yes	Yes	Yes	No
Dedicated bycatch sampling	UK	TCM 2019/1241	PTM	All	Visual	Yes	Yes	Yes	Yes
Dedicated bycatch sampling	UK	TCM 2019/1241	OTM	All	Visual	Yes	Yes	Yes	Yes
Dedicated bycatch sampling	UK	Other	PS	All	Visual	Yes	Yes	Yes	Yes
Routine sampling	IE	DCF	PTM	All	Visual	Yes	Yes	Yes	Yes
Routine sampling	IE	DCF	OTB	All	Visual	Yes	Yes	Yes	Yes
Routine sampling	IE	DCF	OTT	All	Visual	Yes	Yes	Yes	Yes
Routine sampling	Spain (AZTI)	DCF	OTB	All	Visual	Yes	Yes	No	No
Routine sampling	Spain (AZTI)	DCF	PTB	All	Visual	Yes	Yes	No	No
Routine sampling	Spain (AZTI)	DCF	PS	All	Visual	Yes	Yes	No	Yes
Routine sampling	ESP_IEO	DCF	PS	All	Visual	Yes	Yes	-	Yes
Routine sampling	ESP_IEO	DCF	OTB	All	Visual	Yes	Yes	No	No
Routine sampling	ESP_IEO	DCF	PTB	All	Visual	Yes	Yes	No	No
Routine sampling	UK (ENG/WAL)	DCF	OTB	All	Visual	Yes	Yes	No	No
Routine sampling	UK (ENG/WAL)	DCF	OTT	All	Visual	Yes	Yes	No	No
Routine sampling	FRA	EU-MAP	OTB	All	Visual/Volume	No	Yes	No	No

Programme type	Country	Monitoring Programme	Métier Level 4	PETS Sampling protocol	PETS sampling method	Sorting (on the vessel)	Pre-sorting (on the vessel)	Drop-out (outside the vessel)	Slipping (outside the vessel)
Routine sampling	FRA	EU-MAP	PTB	All	Visual/Volume	No	Yes	No	No
Routine sampling	FRA	EU-MAP	PTM	All	Visual/Volume	No	Yes	No	No
Routine sampling	FRA	EU-MAP	PS	All	Visual/Volume	No	Yes	No	No
Routine sampling	Sweden	EU-MAP	OTB	All	Volume	Yes	No	No	No
Routine sampling	Sweden	EU-MAP	OTT	All	Volume	Yes	No	No	No
Routine sampling	SCO	EU-MAP	OTB	Protected Species	Visual	Yes	Yes	Yes	Yes
Routine sampling	SCO	EU-MAP	PTB	Protected Species	Visual	Yes	Yes	Yes	Yes
Routine sampling	SCO	EU-MAP	OTT	Protected Species	Visual	Yes	Yes	Yes	Yes
Routine sampling	SCO	EU-MAP	SSC	Protected Species	Visual	Yes	Yes	Yes	Yes
Routine sampling	IE	DCF	DRB	All	Visual	Yes	Yes	Don't know	Don't know
Routine sampling	UK (ENG/WAL)	DCF	DRB	All	Visual	Yes	Yes	No	No

5 ToR E

Identify potential research projects and funding opportunities to further understand PETS bycatch and its mitigation

Due to the impacts of the EC Special Request on emergency measures along with the constraints imposed by COVID-19, WGBYC was unable to deliver on this ToR.

6 ToR F

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

6.1 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 the 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 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 were also issued in 2018 and 2019. The format of the data call has evolved over the last few years, and recent developments in the 2019 call are described in 6.2.

An alternative possible source of data that is being considered for use by WGBYC is the ICES RDBES, which is currently in development. WGBYC members have been collaborating closely with relevant members of WGCATCH and the RDBES development core-group to ensure that the RDBES structure is able to hold data in the format that is required for WGBYC to meet its ToRs. Already some issues (described in more detail in the 2019 WGBYC report) related to recording and storing different elements of each monitored fishing operation, such as slipping, hauling and sorting, have been added to the RDBES data model and will permit the identification of true and false bycatch zeroes within the RDBES. This is not possible in the existing RDB database but has significant implications for bycatch assessments and so is an important step forward. At this year's WGBYC meeting, the ToR F subgroup have considered WGBYC's role in highlighting other possible refinements to the RDBES data model that would further improve the utility of the RDBES as a data source for bycatch assessments. This is described in 6.3.

Ultimately the most efficient solution will be to have a single database that hosts all the data that WGBYC (and other relevant ICES EWGs) needs to carry out its work. At present the upcoming RDBES seems the most appropriate route for this, but some questions remain regarding the suitability of the data held in that database. WGBYC previously (2019) carried out a comparison of the 2017 effort data contained in the current RDB against effort data acquired through the ICES/WGBYC data call. Significant discrepancies were found, not all of which could be explained at the time. Therefore, it was agreed that a similar comparison should be undertaken this year using 2018 fishing effort data from each dataset, to see if similar patterns are evident between years, and to help provide insights into what factors may be leading to the observed discrepancies. The results of this comparison are described in 6.4.

Some other specific tasks planned under this ToR for the 2020 meeting were not undertaken due to time limitations, as all members of the ToR F subgroup also participated fully in the Special Measures Request (ToR G reported in WKEMBYC, 2020) and various other ToRs.

6.2 ICES WGBYC data call

On 18 December 2019, WGBYC issued an official data call for the second time (see Annex 6: below for the full data call text). The data call aims to collect data describing total fishing effort, monitoring/sampling effort and protected species bycatch incidents from the calendar year 2018. The data support ICES annual advice on the impact of bycatch on small cetaceans and other protected or sensitive marine species, to answer a standing request from the European Commission for advice on the impacts of fisheries on the marine environment.

Data were formally requested from 18 of the 20 ICES countries (all except USA and Canada). In addition, six Mediterranean non-ICES countries were included in the call (Croatia, Cyprus, Greece, Italy, Malta and Slovenia). 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.

Most of the contacted countries submitted data (19 of 24 countries; Cyprus, Malta, Lithuania, Russia and Norway did not submit data) but the quality and quantity of the data provided varied widely among nations.

WGBYC reiterates that to facilitate efficient data submission and processing it is recommended that each nation nominates a single organisation 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. During 2019, updates were made to the data submission format and the template had two main changes. A "Quarter" field was added to the fishing effort table and a "data raised?" field was added to the bycatch event table. The raised field was a controlled vocabulary and the submitter could choose one of three options: (1) No, unraised sub-sample data provided, (2) No, due to 100% coverage, (3) Yes, to observed trip level.

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 (to be assessed at WGBYC 2021) will be the last time data collected under Regulation 812/2004 will be submitted to the group.

During the WGBYC meeting, it became apparent that the spatial scale at which fisheries data were submitted is not fixed within the template. Consequently, some data were received at ICES Subarea level, others by ICES Division (preferred) and others were aggregated over multiple Subareas or Divisions. For example, entries could be "1~5~6" or "27.2.b.2" where the former is not useable for generating métier specific bycatch rates and consequently cannot be used in the bycatch risk assessments carried out by the group. The Database Subgroup (DbSg) within WGBYC is discussing making the provision of data by single ICES Divisions a mandatory field in future data calls to address this issue.

In the latest data call, WGBYC requested, for EU countries:

1. Data describing fishing effort, monitoring/sampling effort and incidental bycatch of cetaceans in pelagic trawl, high opening trawl, bottom set net, and drift net fisheries in accordance with the reporting requirements of EC Council Regulation 812/2004.

2. Data describing monitoring/sampling effort and incidental bycatch of any non-cetacean protected species (i.e. species officially protected under national or international legislation), including all other marine mammals (*phocids*, etc.), all seabird species, all sea turtle species, and any protected, prohibited (see Table 1.4 of the WGEF 2019 report for a list of EU-prohibited elasmobranchs) or zero TAC elasmobranchs and protected fish species (see Table 18 ICES 2019a), from the same gear types as listed in point 1. For zero TAC elasmobranchs and protected fish species,

the preferred data format is for bycatch incidents to be raised to observed trip level whenever possible.

3. Data describing all fishing effort, all monitoring effort and incidental bycatch of all protected species (as defined in points 1 and 2 above) from any other gear types (demersal trawls, lines, gillnets, hooks etc.) under national data collection programmes (e.g. DCF etc.) or other monitoring and pilot programmes.

For non-EU countries:

1. Data from any non-EU countries describing fishing effort, monitoring/sampling effort and incidental bycatch of any protected species (as defined in points 1&2 above) by gear type and area.

With the recent repeal of Regulation 812/2004 it is envisaged that the data call text can be significantly simplified which should alleviate some of the confusion experienced by data submitters and should lead to more consistent data acquisition.

6.3 The role of WGBYC in the development of the RDBES

ICES aim to deliver a fully operational ICES Regional Database and Estimation System (RDBES) with a regional estimation system such that statistical estimates for fisheries assessments can be produced from detailed national sampling programme data in a transparent manner by 2022. In addition, data provision will be through the ICES RDBES because of Commission Implementing Decision (EU) 2016/1251[22] (EU MAP). For non-EU states with fisheries operating in the North Atlantic, there is a requirement to make fisheries data available to support fisheries management under OSPAR, HELCOM, and UNCLOS.

In relation to WGBYC's role and data needs, the data provided to the RDBES will be available to provide summaries of bycatch rates by species, gear type and area and will inform assessments of bycatch risk and the production of mortality estimates to provide insights into the potential effects of fisheries on Protected, Endangered and Threatened Species (PETS).

In the transition period until the RDBES is fully implemented, WGBYC is using data collected via annual Regulation 812/2004 reports and ICES data calls that have been issued annually for the last 3 years. These data are currently held in a standalone WGBYC database. WGBYC have also accessed data included in the Regional Data Base (RDB) for the last 3 years for various analytical purposes.

In 2018 and 2019, WGBYC undertook comparisons of the fishing effort data from both databases. Several discrepancies were found and a further comparison was carried out at the 2020 meeting to explore potential issues (section 6.4). Accurate fishing effort data are essential to the production of robust mortality estimates, and the observed discrepancies raised concerns and could have important implications in the calculation of bycatch estimates and risk assessments.

The reasons for the discrepancies may be of a different nature, from the way effort levels have been calculated by each Member State (e.g. official effort data coming from logbooks, or effort estimates raised based on a sampling approach), to whether the units considered have been standardised (e.g. days at sea or fishing days), missing data for some regions (e.g. Mediterranean in the RDB) or whether or not the formats required to upload the data to each database are the same, among others.

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[22] EU, 2016. Commission Implementing Decision (EU) 2016/1251 of 12 July 2016 adopting a multiannual Union programme for the collection, management and use of data in the fisheries and aquaculture sectors for the period 2017–2019 (notified under document C(2016) 4329).

It is therefore essential that for the next two years before the full implementation of RDBES, a collaborative effort is made between WGBYC, the Steering Committee of the RDBES (SCRDBES), and the Regional Coordination Groups (RCG). This collaboration and coordination between the groups should help minimise the discrepancies currently seen in the different databases and will improve confidence in the potential of the RDBES to hold data that are fully useable by WGBYC.

The SCRDBES is working on the new formats and the data model to be implemented. The RDBES data model is an evolution of the work already done in defining and using the current Regional Database (RDB) and the COST data models and functions. The current RDB data model provides a common data structure to describe commercial sampling data at a disaggregated level, and commercial landings and effort data at an aggregated level. The significant difference in the new RDBES model is that it provides a common structure to describe both the disaggregated sampling data and, most importantly, how it was sampled**.** Whilst the RDBES data model is designed to hold Statistically Sound Sampling Schemes (4S) data it will also be able to store data that are not sampled in a statistical manner. This is important so that data from current non- statistical programmes can be uploaded, and historical data can also be stored in the same database.

Considering the recording of PETS, the present version of the RDBES is ready to host the data needed to estimate incidental bycatch and record drop-outs and slipping events. With regards to incidental bycatches, the aim was to a) be able to accurately record positive incidental bycatch events (e.g., by extending the range of available taxonomic codes to marine mammals and birds), b) facilitate the correct distinction between non-observations (=missing values) and zero-observation (true 0s), c) accommodate different sampling methodologies (e.g., in bycatch studies it is frequent for observers to do a visual screening of the catch; in discard studies it is more typical for observers to collect weight-based samples) and d) be able to record the state of individuals (e.g., including codes for dead, wounded, alive, unknown, etc.). With regards to slipping and drop-outs the aim was to facilitate its reporting in a way that is clearly distinguishable from other fractions such as landings and discards.

In addition, in the RDBES data model the aggregated population data are generally used, e.g., in analyses of landings and effort at marine region level, these are kept in a commercial landings (CL) and commercial effort (CE) table. These data formats are collecting aggregated data from national commercial fisheries, allowing for both official and scientific estimates of landings and effort.

For WGBYC objectives, the commercial effort (CE) table format and the variables included are more important than the catch landings (CL) table. The data format of the CE table has been updated based on the work done by the core group involved in developing these specific tables. The final version of the CL table and the fields included with the corresponding required exchange formats can be found in: https://github.com/ices-tools-dev/RDBES/tree/master/Documents

The most notable aspect may be the inclusion of different variables related to fishing effort, such as Days at Sea and Fishing days, both official and estimates from scientific surveys. These variables are now considered as mandatory to be reported. There are other potentially important variables for WGBYC purposes, such as the number of hauls/sets, soak time etc. These fields are optional as they are not always currently collected within official statistics.

In addition, perhaps the biggest advance reached by this core group is that it is recommended to use the standardised effort calculation methodologies agreed during the Workshop that took place in 2016 in Nicosia (Ribeiro Castro et.al, 2016) under the umbrella of the STECF. This standardised methodology will minimise discrepancies between MS when providing effort information. It is worth mentioning as an added value of this meeting the creation of an R package (fecR package) that allows these calculations to be carried out with the agreed methodology which will also improve consistency.

With all of the above in mind, it is essential that WGBYC be an active member in all of the steps being taken towards the full implementation of the RDBES, in cooperation and coordination with the main groups (SCRDBES; RCG; WGCATCH) involved in the development of the RDBES. This will allow the needs of WGBYC to be taken into account and for possible further improvements to be proposed, as has happened already in the fields added to the table of the at sea sampling schemes based on the specific needs of WGBYC.

It is recommended that when the RDBES is fully operational and populated with at least a full calendar year's data that direct data comparisons should be carried out (in collaboration with the RCGs PETS subgroup) on the fishing effort, monitoring effort and bycatch data acquired through the ICES/WGBYC to fully judge the suitability of the RDBES as a single data source for WGBYC before discontinuing the annual ICES/WGBYC data call.

6.3.1 Non-ICES area data

WGBYC is required to obtain and analyse data from outside the ICES area as part of its assessments, namely from the Mediterranean (GFCM). At present, it is not clear to WGBYC members if fisheries data from Mediterranean countries will be hosted within the RDBES or if GFCM will develop and manage an independent database for Mediterranean fisheries. WGBYC recommend that GFCM are contacted about this topic because if full transition to using the RDBES occurs in the next few years and GFCM data are not hosted in the RDBES, then an annual data call, which is the current primary route for obtaining data from the Mediterranean, will no longer be required and alternative data acquisition processes will need to be put in place for accessing data to permit continuation of bycatch assessments from non-ICES EU waters.

6.4 Comparison of effort from different sources (RDB & WGBYC)

In 2019, WGBYC carried out a comparison of 2017 fishing effort data contained in the WGBYC database (acquired in the 2018 data call) with data for the same year contained in the RDB. Several discrepancies, some quite significant, were found and not all could be explained at the time. Consequently, it was agreed that a similar comparison should be undertaken at the 2020 meeting using 2018 fishing effort data as well, to see if it would help explain some of the observed discrepancies and to check if similar patterns were evident between years.

As a first step, fishing effort data were collated for each of the two years (2017 and 2018) into six categories using vessel size (small <10 m and large >10 m) and broad gear type (nets, midwater trawls and bottom (demersal) trawls) (Table 31). Green cells in Table 31 indicate categories with higher recorded fishing effort in the WGBYC database and brown cells indicate higher in the RDB. Overall for these categories the WGBYC database contains almost 90 000 DaS more than the RDB. The differences across years are consistent within categories with large vessel nets and bottom trawls having higher records in the WGBYC database and all other categories having higher recorded effort in the RDB.

To explore this more fully and to aid direct comparison we have plotted the 2017 and 2018 data by Member State in Figure 15. The six plots relate to the same vessel size/gear type categories shown in Table 31. Fishing effort Days at Sea (DaS) recorded in the WGBYC and RDB databases for 2017 and 2018. Green cells indicate that fishing effort is higher in the WGBYC database whereas brown cells show that it is higher in the RDB. The plots provide a visual representation of the absolute difference in terms of recorded DaS in each database, for each country that submitted data in each vessel size/gear type combination (Note: UK did not submit DaS data to the

RDB for 2017). As indicated in the plots, data bars above the zero line show higher days at sea in the RDB, whereas data bars below zero indicate higher days at sea in the WGBYC database.

Table 31. Fishing effort Days at Sea (DaS) recorded in the WGBYC and RDB databases for 2017 and 2018. Green cells indicate that fishing effort is higher in the WGBYC database whereas brown cells show that it is higher in the RDB.

Year	Vessel Size	Gear Type	WGBYC DaS	RDB DaS	Difference
2017	small	pelagic trawl	411	431	-20
2017	large	pelagic trawl	46523	67785	-21262
2017	small	nets	297508	322266	-24758
2017	large	nets	243357	167599	75758
2017	small	bottom trawl	16953	19113	-2160
2017	large	bottom trawl	415618	387216	28402
2018	small	pelagic trawl	146	433	-288
2018	large	pelagic trawl	42539	62534	-19995
2018	small	nets	196207	215884	-19677
2018	large	nets	162844	106513	56331
2018	small	bottom trawl	22728	28436	-5708
2018	large	bottom trawl	449891	427887	22004
			1894723	**1806097**	**88626**

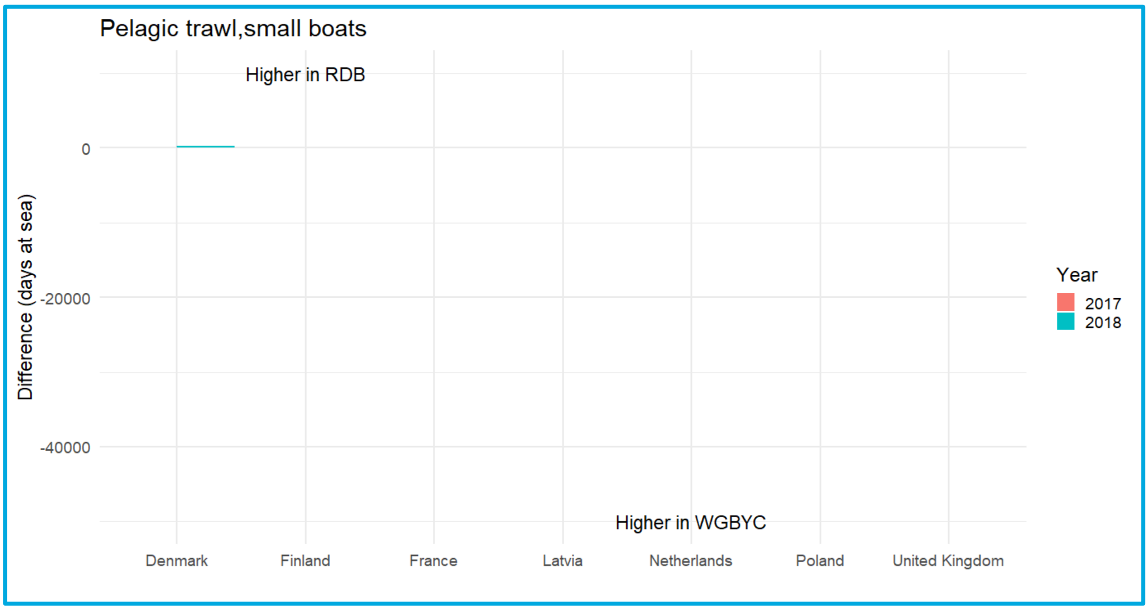

Figure 15. Comparative days at sea for <10 m pelagic trawls.

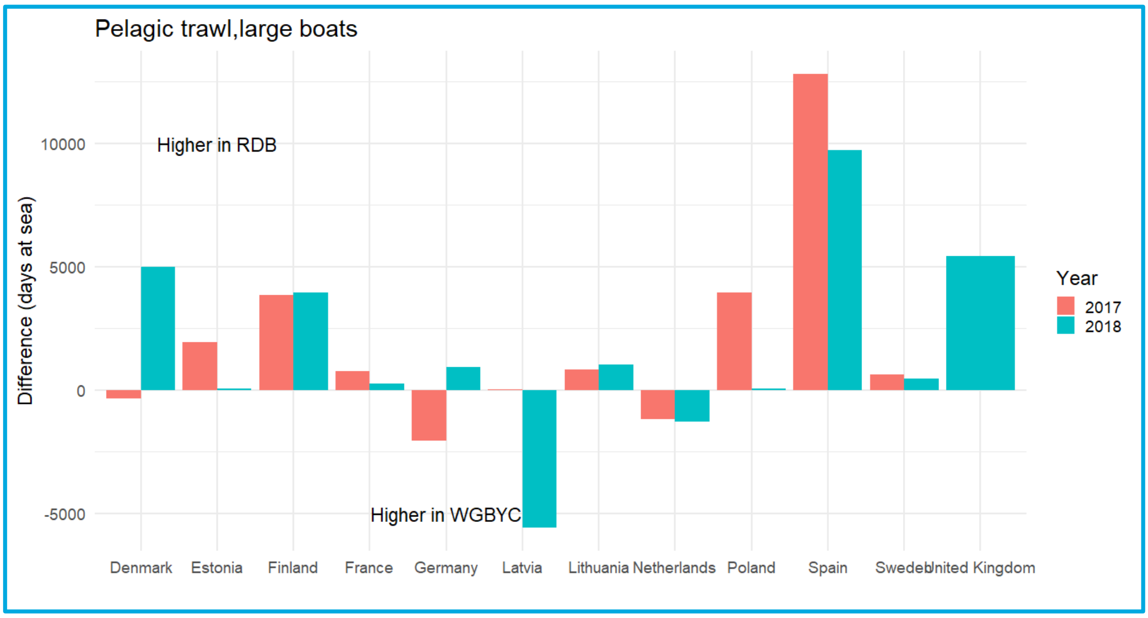

Figure 16. Comparative days at sea for >10 m pelagic trawls.

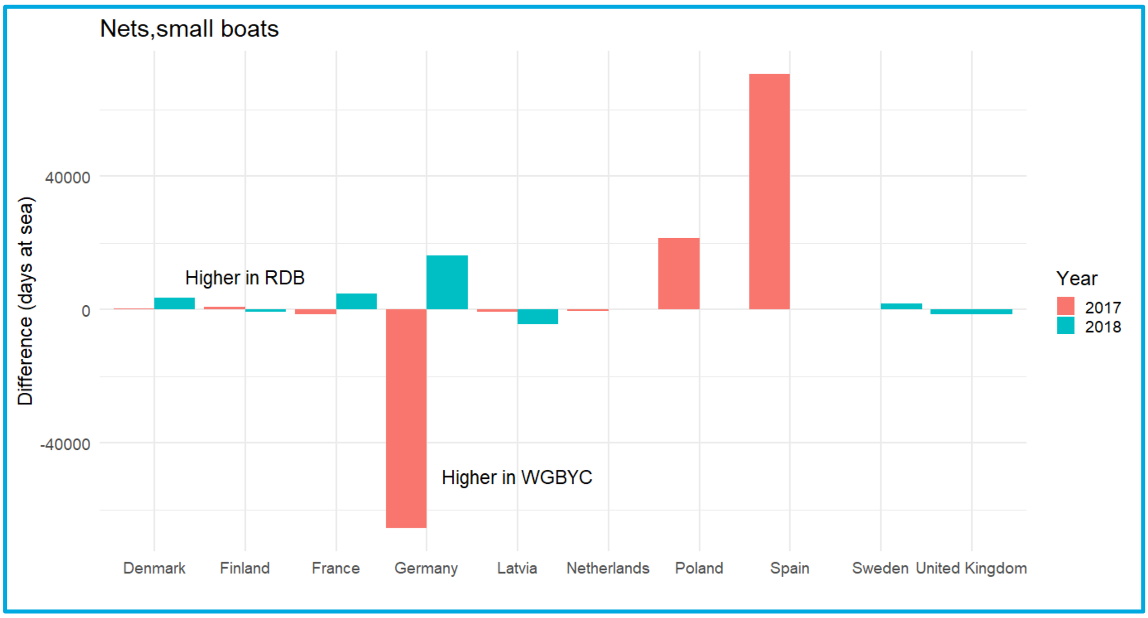

Figure 17. Comparative days at sea for <10 m nets.

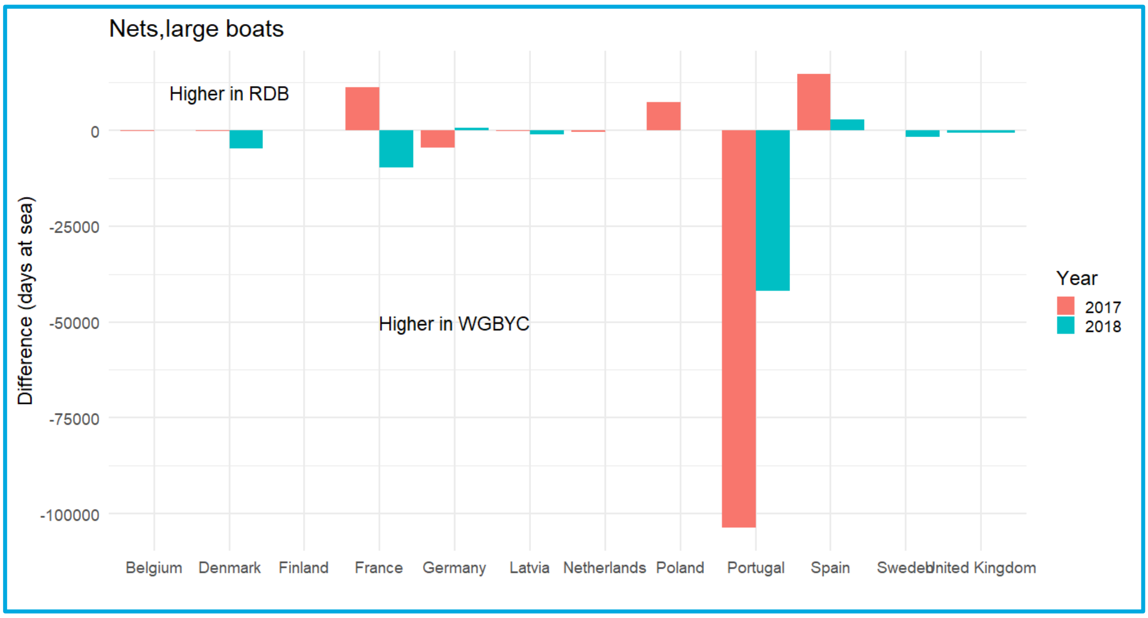

Figure 18. Comparative days at sea for >10 m nets.

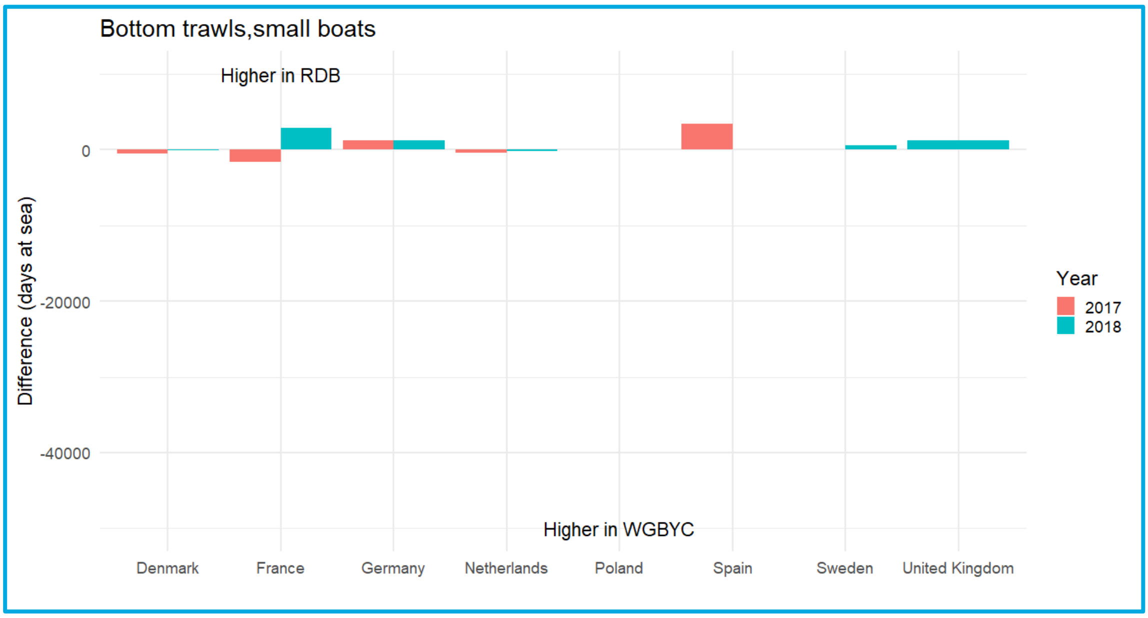

Figure 19. Comparative days at sea for <10 m bottom trawls.

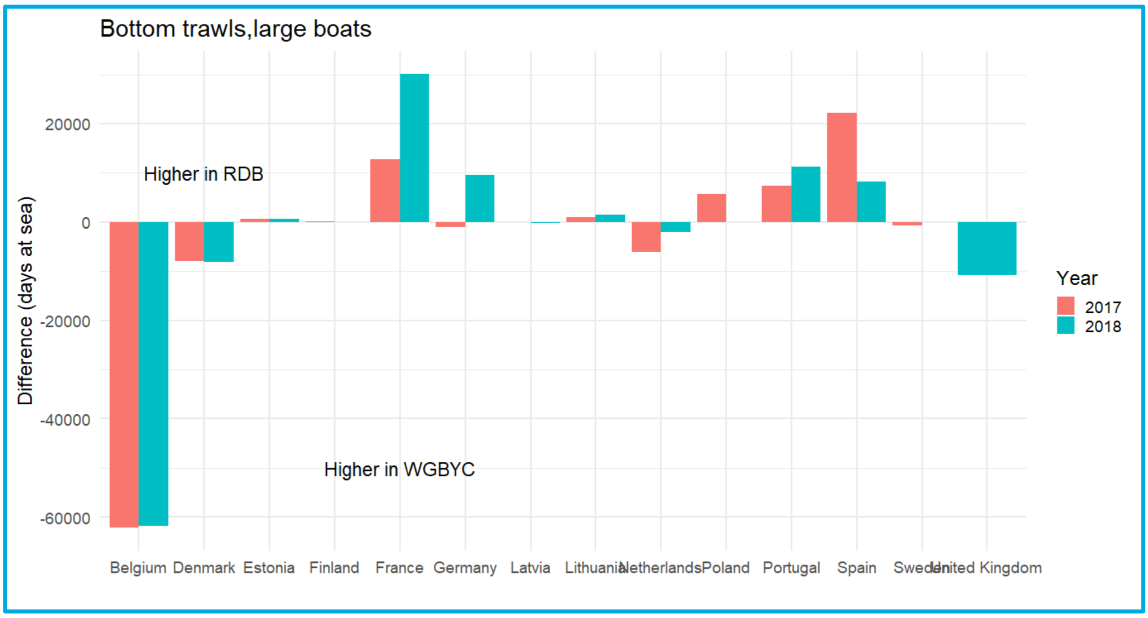

Figure 20. Comparative days at sea for >10 m bottom trawls.

In general, the plots show quite a lot of variability between countries but more consistency between years for each country. The plots for small pelagic and bottom trawls show the closest agreement in terms of DaS but both these categories are associated with much lower total effort levels than the other categories so that would be expected when looking at absolute differences. It is possible that some of the observed differences are related to gear type labelling issues in the data submissions to each database – for example for Portugal where all boats using nets are in fact polyvalent, it is possible that the effort is classified and reported differently in each database submission. The 2017 small boat netting data from Germany, which are much higher in the WGBYC, were explained last year by the effort recording system employed where even a single day's effort in a calendar month is recorded as 30 days of effort and this recording artefact may be dealt with differently in submissions to RDB. In the same category, Spain had much higher submissions to the RDB in 2017, but both countries had closer agreement in 2018. Spain also submitted much higher large boat pelagic trawl effort to the RDB in both years which raises further questions. The other very significant discrepancy is seen in the submission for large boat bottom trawls by Belgium who submitted much higher effort to WGBYC in both years, but no obvious explanation was found. Although some of the differences have been explained to some degree, after discussions in plenary it was agreed that some of the major differences should be looked at in more detail intersessionally and then a short questionnaire would be developed by the ToR F subgroup to be circulated at the 2020 WGCATCH meeting, which is attended by many of the national data submitters, and so may provide more clarity into why these significant discrepancies exist between databases.

6.5 Conclusions

- As the new RDBES will not be fully operational until at least 2022, ICES/WGBYC should continue to issue an annual formal data call to obtain data on fishing effort, monitoring effort, and bycatch data to form the basis of bycatch assessments.
- A fuller data comparison should be carried out at the 2021 WGBYC meeting to also include data on monitoring days to gauge how they compare between WGBYC and RDB databases.
- A short questionnaire should be developed to circulate to national data submitters at the 2020 WGCATCH meeting to help elucidate some of the observed discrepancies between databases.
- When the new RDBES is fully operational, carry out complete comparisons of fishing effort, monitoring effort and bycatch records before any decisions on full transition to RDBES as a sole data source are made.
- ICES should work with GFCM in relation to the acquisition of fishing effort, monitoring effort, and bycatch data from the Mediterranean where it falls under the remit of WGBYC.

7 ToR G

Address the special request from EU on emergency measures bycatch NE Atlantic

The work undertaken by the WGBYC subgroups regarding ToR G was reported in WKEMBYC (2020). Accompanying advice was published 26 May 2020[23].

[23] https://www.ices.dk/sites/pub/Publication%20Reports/Advice/2020/2020/eu.2020.04.pdf

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Annex 1: Turtle conservation strategies and bycatch risk assessment initiatives

Currently, in Europe the Natura 2000 network is a fundamental site-based protection tool for the protection of several species listed in Annex II and IV of the Habitats Directive (Council directive 92/43/EEC, HD) including sea turtles. Furthermore, the loggerhead turtle is an indicator species for the European Marine Strategy Framework Directive. This Annex provides a brief overview of i) regional/country-based turtle conservation strategies and ii) work within OSPAR to develop and assess a turtle status indicator.

iv. Regional/country-based turtle conservation Strategies

In the Mediterranean, a regional Action Plan for the conservation of sea turtles was developed within the framework of the Barcelona Convention in 1989 and updated in 1999 and 2007 (UNEP MAP RAC/SPA, 2007). In addition, there are several international conventions and their implementation by Mediterranean countries with national laws is of paramount importance for the conservation of sea turtle in the whole basin (see Table S25 in Casale et al. 2018).

Portugal – Has currently no specific Marine Turtle Conservation Plan, but turtles are protected by law.

Spain is finalising its National Loggerhead Turtle Conservation Strategy after a process initiated in 2008 that has counted with all the sea turtle experts. With regards to bycatch risk, the strategy reads:

“Sea turtles are not target species of fishing activities, but accidental capture in fishing gear or bycatch is considered to be the main threat, being, in Spain, especially intense in the Mediterranean and in the Gulf of Cadiz. Interaction with fishing gear can cause serious damage such as amputations, tears, drownings or severe decompression. In many cases this interaction leads to death. Virtually all fishing gear catch turtles, albeit to varying degrees. Longline fisheries, bottom trawls, fixed gillnets, fences and smaller fishing gear cause thousands of deaths annually in Spanish juvenile waters and also increasingly on sub-adults and adults. There are also catches and mortality of sea turtles in fixed stopping arts such as almadrabas (poundnets – tuna maze nets) and almadrabetas or morunas, or aquaculture or fattening structures and cages, being turtles attracted by these facilities and being trapped in nets or capes, dying drowned. The recent discovery in Spanish waters that some fishing gear causes decompression syndrome in sea turtles has raised alarm bells about the impact of fishing on these animals. In addition, many of the caught and released turtles alive die in the following months from injuries during their capture in fishing gear

In Italy there is a number of existing regional sea agreements (Mediterranean Sea Convention for the Protection on the marine Environment and the Coastal Region of the Mediterranean, Barcelona 1976, amended in 1995; Protocol Concerning Specifically protected Areas and Biological Diversity in the Mediterranean 1995; see Table S25 in Casale et al., 2018). These programmes should provide a platform that can be used to improve the conservation and management of protected habitats and species including sea turtles (Bastari et al., 2016; Fortuna et al., 2018).

Of particular note, the Adriatic Sea has been listed as a sub-region of the Marine Spatial Planning Directive EU Marine Strategy Framework Directive (MSFD; 2008/56/EC). In this area, for Italian waters, the Natura 2000 network includes 13 sites of community importance, 8 special areas for conservation, 1 special protection area and 1 proposed site of community importance, which partly list sea turtle. Recently, new insights have been proposed to achieve and improve conservation objectives and improve for wide-ranging species like sea turtles (Fortuna et al., 2018).

In addition, the macro-regional EU Strategy for the Adriatic and Ionian Region (EUSAIR) was launched in 2014 by the European Commission to coordinate the future of the region, including an environmental quality pillar, which focuses on the marine environment and transnational terrestrial habitats and biodiversity (EC, 2014).

Malta – Situated at the crossroads of turtle passage between the Eastern and Western Mediterranean, the Gulf of Gabes (Tunisia) and the Adriatic, Malta has a high density of loggerhead turtles and also an issue of great concern with bycatch and entanglement in surface longlines, gillnets, anchored FADs and entanglement in the corresponding ghost fishing. LIFE+ MIGRATE designed 4 NATURA 2000 sites for the conservation of the loggerhead turtle, and developed a set of guidelines for the mitigation of ghost fishing from the dolphin fish FAD fishery.

France – All sea turtle species and their habitats are protected by a national law (Arrêtéministériel du 14 octobre 2005) and France ratified the international conventions (Bern, Bonn, Barcelona, OSPAR) dedicated to environmental and species conservation, including sea turtle species. Furthermore, as European Member State, France is actively involved in the MSFD and Habitats Directive monitoring and reporting processes. Besides their missions, the Ministries and agencies in charge of fisheries and environment, as well as the national committee for fisheries, are involved in designing practical measures with NGOs. The permits procedure for operating on protected species is facilitated through a national scientific programme (Observatoire des Tortues Marines de France Métropolitaine) which allows stranding networks to operate easily on the field (Arrêtéministériel du 25 octobre 2016). National funding has increased since the MSFD monitoring programme has been launched.

USA – Under the Marine Turtle Conservation Act, the United States have a series of Recovery Plans for the Loggerhead and Leatherback Distinct Population Segments of relevance in the ICES and Mediterranean fishing zones.

v. <u>OSPAR plans for turtle status assessment</u>

In 2019, under the OSPAR POSH framework (action 26), France took the lead compiling available information on anthropogenic pressures impacting sea turtles and monitoring/conservation measures implemented for sea turtles in the OSPAR area. It further identified possible coordination and collaboration initiatives for the conservation of leatherback and loggerhead turtles listed in the OSPAR List of threatened and/or declining species (Ospar 2009, 2015; Baudouin & Claro 2019). Among the threats, bycatch was recognised as the most impacting anthropogenic pressure for the 2 species and coordinated actions regarding bycatch were recommended by national experts.

In April 2019, France launched a national study on sea turtle indicators in coordination with an expert consultation dedicated to MSFD descriptor 1 "biodiversity" sea turtle indicators of Good Environmental Status, and taking into account the context of Regional Sea conventions (OSPAR and Barcelona convention), which includes criteria D1C1 Bycatch. This consultation, planned for 2 years, proposed to include: 1) sharing data in the perspective of tests; 2) discussions through a mailing list; 3) 2 workshops (2019 & 2020). November 25, 2019, the first workshop was organised by-, and held at- the Muséum national d'Histoire naturelle in Paris about the Criteria/indicators, methods and thresholds for assessing a good environmental status in the frame of environmental policies. Besides French experts, experts from UK, Portugal, Spain, Italy, Monaco and Greece were invited by France of whom 18 attended the meeting physically or by visio conference. After the presentation of the background (policies and methods) by Andreas Palialexis (European Joint Research Centre), constraints of existing defined criteria/indicators, approach and first results of the tests performed with data shared by participants were discussed, and first recommendations were produced (UMS PatriNat2020). The second workshop will be co-organised with the JRC (provisional venue in ISPRA JRC Milano, 8–9 sept 2020).

Annex 2: List of participants

Participant	Country
Adam Woźniczka	Poland
Ailbhe Kavanagh	Ireland
Allen Kingston	United Kingdom
Ana Marçalo	Portugal
Bram Couperus	Netherlands
Cian Luck	Ireland
Estanis Mugerza	Spain
Evgenia Lefkaditou	Greece
Finn Larsen	Denmark
Guðjón Sigurðsson	Iceland
Hélène Peltier	France
Julia Carlström	Sweden
Julius Morkūnas	Lithuania
Katarzyna Kaminska	Poland
Kelly Macleod (co-chair)	United Kingdom
Kim Bærum	Norway
Laurent Dubroca	France
Marije Siemensma	Netherlands
Māris Plikšs	Latvia
Mikel Basterretxea	Spain
Mikko Olin	Finland
Nicole Hielscher	Germany
Peter Evans	United Kingdom
Ricardo Sagarminaga van Buiten	Spain
Sara Bonanomi	Italy
Sara Königson (co-chair)	Sweden
Sven Koschinski	Germany

Annex 3: Resolutions

Working Group on Bycatch of Protected Species (WGBYC)

Only experts appointed by national Delegates or appointed in consultation with the national Delegates of the expert's country can attend this Expert Group.

2019/OT/HAPISG03 The **Working Group on Bycatch of Protected Species** (WGBYC), chaired by Kelly Macleod, UK and Sara Königson, Sweden, will meet in Den Helder, Netherlands on 10–13 March 2020 to:

a) Review and summarise annual national reports (Reg812/2004) or data submitted through the annual data call and other published documents to collate bycatch rates and estimates in EU waters and wider North Atlantic;

b) Collate and review information from national (Regulation 812/2004) reports and elsewhere in the North Atlantic relating to the implementation of bycatch mitigation measures and ongoing bycatch mitigation trials and compile recent results on protected species bycatch mitigation;

c) Evaluate the range of (minimum/maximum) impacts of bycatch on protected species populations where possible to assess likely conservation level threats and prioritize areas where additional monitoring/mitigation is needed;

d) Continue to develop, improve and coordinate with other ICES WGs on methods for bycatch monitoring, research and assessment.

e) Identify potential research projects and funding opportunities to further understand PETS bycatch and its mitigation

f) 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).

g) Address the special request from EU on emergency measures bycatch NE Atlantic by;

  i) Evaluating pressures and threats due to commercial fisheries bycatches to harbour porpoises in the Baltic Sea and common dolphins in the Bay of Biscay.

  ii) Evaluating whether the described conservation measures within the request are appropriate.

Annex 4: Resolutions for next meeting

WGBYC–Working Group on Bycatch of Protected Species

Only experts appointed by national Delegates or appointed in consultation with the national Delegates of the expert's country can attend this Expert Group.

2020/OT/HAPISG03 The **Working Group on Bycatch of Protected Species** (WGBYC), chaired by Allen Kingston*, UK and Gudjon Sigurdsson*, Iceland, will meet in La Rochelle, France on [day]–[day] March 2021 to:

d) 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;

e) 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;

f) Evaluate the range of (minimum/maximum) impacts of bycatch on protected species populations where possible to assess likely conservation level threats;

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

h) 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.

i) Identify potential research projects and funding opportunities to further understand PETS bycatch and its mitigation

j) 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)The assessments will be carried out on the basis of the stock annex. The assessments must be available for audit on the first day of the meeting. Material and data relevant for the meeting must be available to the group on the dates specified in the 2021 ICES data call.

WGBYC will report by [day] [month] 2021 for the attention of ACOM.

Annex 5: Recommendations

Recommendation	Recipient	Has this recommendation been communicated to the recipient?
Annual reports submitted to WGFTB are adapted to ensure collection of information from national participants on the development and trials of mitigation methods to reduce bycatch of PETs	WGFTB	YES
WKCOFIBYC evaluate the extent and interpretation of elasmobranch and fish data obtained through the WGBYC 2020 data call with respect to raising (link to report and data call)	WKCO-FIBYC	YES
The RCG PETS subgroup work intersessionally with WGBYC to compare monitoring effort recorded in the RDBES with that submitted through WGBYC data call	RCG PETS	YES
The RCG PETS subgroup and WGBYC work intersessionally to review application of the FishPi bycatch risk approach for PETS regarding different taxonomic groupings, metiers and fishing grounds and to update assessments accordingly to inform coordinated sampling plans.	RCG PETS	YES
WGCATCH and WGSFD work with WGBYC to deliver estimates of fishing effort (including small-scale fisheries) for 2018 and 2019 prior to WGBYC 2021 meeting	WGCATCH, WGSFD	YES
WGCATCH should further consider the interpretation and application of the species sampling lists (section 4.1) in the context of data collection at sea and data storage in the RDBES, taking into account the spatial distribution and status of the different species.	WGCATCH	YES
WGMME and JWGBIRD to review the marine mammal and seabird species sampling lists (section 4.1) developed during WGBYC 2020, noting feedback from WGCATCH on their application.	WGMME, JWGBIRD	YES
WGEF compile an elasmobranch species sampling list [as per marine mammal and seabirds, section 4.1] by ecoregion that will support sampling protocols and RDBES structure/vocabulary	WGEF	YES
Participants of WGCATCH should complete a questionnaire, prepared intersessionally by WGBYC, to col-late information from national institutes with regards to how fishing effort data are processed and submitted to the RDBES [section 6.4].	WGCATCH	YES
WGCATCH to update the bycatch survey meta-database compiled and updated by WGBYC 2020.	WGCATCH	YES
WGBYC recommends to RDBES, WGCATCH and the RCGs that the WG's involvement in the development of the RDBES should continue, to ensure data needs are fully met when the RDBES becomes operational.		

Annex 6: Data call: data submission for ICES advisory work of the Working Group on Bycatch of Protected Species

1. Scope of the Data Call

This data call aims to collate data describing fishing effort, monitoring effort, and bycatch event records of protected species from 2018. These data will support the provision of ICES management advice on the wider effects of fishing activity, and for the activities of other relevant ICES Working Groups.

2. Rationale

ICES has a standing request from the European Commission to advise and inform on the impact of fisheries on the ecosystem and to give warnings of any serious threats 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. ICES currently provides advice on the effect of fishing on small cetaceans and other marine animals and the requested data will be used by the ICES advisory groups involved in the provision of such advice.

ICES summarizes information about the bycatch of marine mammals and other protected species as reported by EU Member States (MS) under Council Regulation (EC) No. 812/2004 (Reg 812/2004) (until August 2019) and other mechanisms. Thus far, the available data have been insufficient to allow robust assessments of the overall effect of EU fisheries on a variety of protected species (ICES 2019[24]). Reg 812/2004 was repealed in August 2019, and ICES has been preparing for the transition away from using MS Reg 812/2004 reports as the primary source of data on the bycatch of cetaceans (as well as other protected and endangered species). In the future, data provision will be through the ICES regional database and estimating system (RDBES) because of Commission Implementing Decision (EU) 2016/1251[25](EU MAP). This data call aims to improve consistency and completeness in the reporting of bycatch data at a regional scale.

The data will be used to provide summaries of bycatch rates by species / gear type and area and will inform estimates of bycatch risk. These will be designed to provide insights into the potential effects of fisheries on protected and endangered species.

The data will also be used to undertake a comparative assessment of fishing effort data acquired from different sources. Any inconsistencies between different fishing effort datasets will help inform the necessary transition away from Reg 812/2004 reports over to the RDBES as WGBYC's main source of effort data to underpin its advice.

[24]ICES Advice 2019. Bycatch of protected and potentially vulnerable marine vertebrates – review of national reports under Council Regulation (EC) No. 812/2004 and other informationhttps://www.ices.dk/sites/pub/Publication%20Reports/Advice/2019/2019/byc.eu.pdf

[25]EU, 2016. Commission Implementing Decision (EU) 2016/1251 of 12 July 2016 adopting a multiannual Union programme for the collection, management and use of data in the fisheries and aquaculture sectors for the period 2017-2019 (notified under document C(2016) 4329).

3. Legal framework

to oceans policy that includes fisheries. These agreements also include an obligation to support assessments of the effects of fisheries on protected and endangered species, and on the environment (UNCLOS FSA art 6).

For EU Member States this data call is under Council Regulation 812/2004, Regulation (EU) 2019/1241, the DCF regulation ((EC) No 2017/1004 and Commission Decision 2016/1251/EU), and in particular Article 17(3) of regulation (EC) No 2017/1004 which states that regarding "*...requests made by end-users of scientific data in order to serve as a basis for advice to fisheries management, Member States shall ensure that relevant detailed and aggregated data are updated and made available to the relevant end-users of scientific data within the deadlines set in the request,...*"

For non-EU states with fisheries operating in the North Atlantic, there is a requirement to make fisheries data available to support fisheries management under OSPAR, HELCOM, and UNCLOS.

These data are made available to facilitate the scientific basis for advice in support of marine policies. ICES also has a policy on data use, which governs decisions on who is given access and what they can do with the data; see http://ices.dk/marine-data/Documents/Data_Policy_RDB.pdf.

This data call follows the principles of personal data protection as referred to in paragraph (9) of the preamble in Regulation (EU) 2017/1004, and repealing Council Regulation (EC) No 199/2008.

4. Deadlines

ICES request that the data be delivered by the 7th of February 2020, to provide enough time for additional quality assurance and data handling procedures before the upcoming WGBYC meeting in March 2020. **Data submitted after this date cannot be processed and will not be taken into account at the WGBYC 2020 meeting.**

Data to report

Please NOTE: there have been changes to the template in relation to the previous WGBYC data call. Changes are highlighted in red (Annex 2: Tables 2-4).

5.1 Geographic and temporal scope

The geographical scope of this data call includes all areas covered by the monitoring and mitigation requirements of Reg 812/2004, and other North Atlantic (and adjacent) areas including:

Northwest Atlantic Fisheries Organisation (NAFO) Fishing Areas http://www.fao.org/fishery/area/Area21/en

ICES Fishing Areas (http://www.fao.org/fishery/area/Area27/en) on as detailed a level as possible (including the adjustments to the North East Atlantic Fisheries Commission (NEAFC) Regulatory Areas https://www.neafc.org/managing_fisheries/measures/ra_map)

Geographical subareas (GSA) of the General Fisheries Commission for the Mediterranean (GFCM) http://www.fao.org/gfcm/data/maps/gsas

The temporal scope is for data collected specifically in **2018**. Please refer to Section 6 – Annex 1 and 2 for specific guidance on the data submission process, format, data fields, and definitions.

All governments or intergovernmental commissions that request and receive advice from ICES, and all contracting parties to OSPAR and HELCOM, have signed international agreements under UNCLOS 1995 Fish Stocks agreement articles 5 and 6, as well as WSSD 2002 article 30. By signing, they agree to incorporate the effect of fisheries on other components of marine ecosystems, and to implement an ecosystem approach

5.2 Data types

Data covered by this data call include:

For EU countries:

Data describing fishing effort, monitoring/sampling effort and incidental bycatch of ***cetaceans*** *in pelagic trawl, high opening trawl, bottom set net, and drift net fisheries in accordance with the reporting requirements of* ***EC Council Regulation 812/2004;*** *and*

Data describing monitoring/sampling effort and incidental bycatch of ***any non-cetacean*** *protected species (i.e. species officially protected under national or international legislation), including all other marine mammals (phocids, etc), all seabird species, all sea turtle species, and any protected, prohibited (see Table 1.4 of the WGEF 2019 report for a list of EU-prohibited elasmobranchs) or zero TAC elasmobranchs and protected fish species (see Table 18 WGBYC 2019 report), from the same gear types as listed in point 1. For zero TAC elasmobranchs and protected fish species the preferred data format is for bycatch incidents to be raised to observed trip level whenever possible.*

Data describing all fishing effort, all monitoring effort and incidental bycatch of ***all protected species (as defined in points 1 and 2 above)*** *from any* ***other*** *gear types (demersal trawls, lines, gillnets, hooks etc.) under national data collection programmes (e.g. DCF etc.) or other monitoring and pilot programmes.*

For non-EU countries:

Data from any ***non-EU countries*** *describing fishing effort, monitoring/sampling effort and incidental bycatch of any protected species (as defined in points 1&2 above) by gear type and area.*

6. Data submission

Data submissions must conform to the present structure of the WGBYC format definition (http://datsu.ices.dk/web/selRep.aspx?Dataset=128). To facilitate the submission of the data ICES has developed an Excel template. The template can be found here: http://bycatch.ices.dk/upload/ReportingTemplate_Bycatch.zip

Once the Excel data submission template is completed (see Annex 1), go to the "Export_data" sheet and press the "Export data to XML" button to create a data file in XML format, then save it onto your computer or network. Note: please do not use the Excel automatic XML conversion function, as it will not produce the correct file.

Go to the bycatch portal http://bycatch.ices.dk

Press the 'Submit data' link and log in with your ICES sharepoint user credentials. If you do not have access to ICES sharepoint, please contact data.call@ices.dkfor assistance.

Full step-by-step instructions on how to submit data using the WGBYC data template is provided in Annex 1. The data format and look-up vocabularies are described in detail in Annex 2.

7. Contact information

For support concerning any issues about the data call content please contact the ICES Secretariat advice@ices.dkor the WG chairs Sara Königson (sara.konigson@slu.se) and Kelly Macleod (Kelly.Macleod@jncc.gov.uk).

8. Electronic outputs

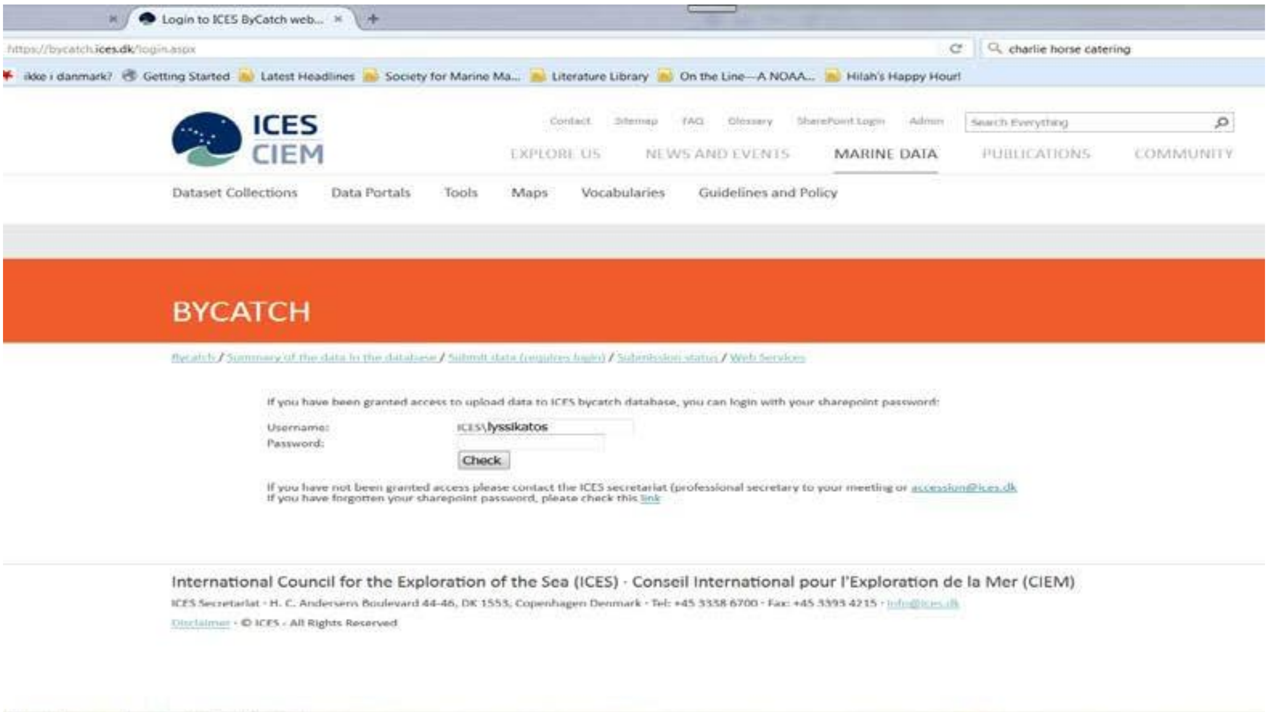
Data on fishing effort, monitored effort, and bycatch of protected species will be aggregated by ICES Areas and ecoregion if appropriate, as well as by GSA area in the Mediterranean. These data will be shown in maps and tables within ICES WGBYC reports and in ICES Advice[26]. Aggregated data will be visible and accessible in the ICES Publications Library.

[26] ICES Advice 2019.. Bycatch of protected and potentially vulnerable marine vertebrates – review of national reports under Council Regulation (EC) No. 812/2004 and other information https://www.ices.dk/sites/pub/Publication%20Reports/Advice/2019/2019/byc.eu.pdf

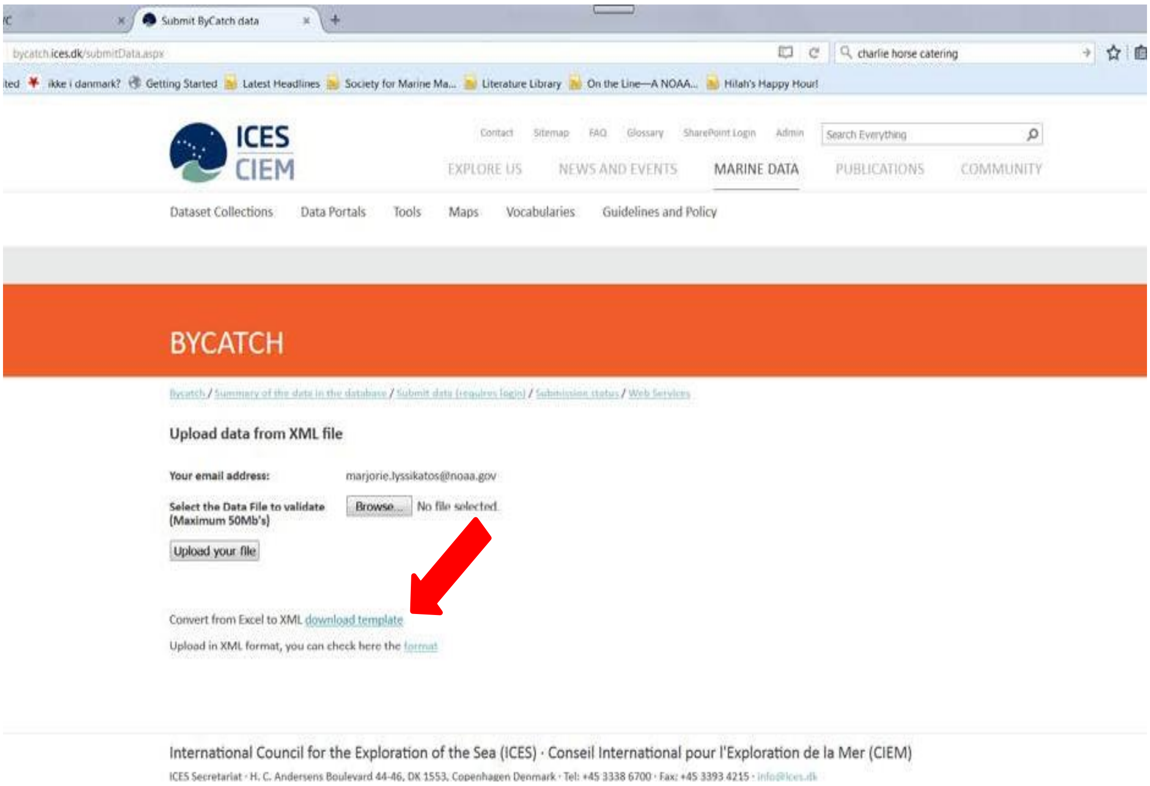
Annex 1. Data submission procedure

In the data submission template available from the ICES bycatch web-page, there are four worksheet tabs (Annex 2: Table 1 – File_information, Table 2 – Fishing_effort, Table 3 – Bycatch_monitor_effort, and Table 4 – Bycatch_event) that contain mandatory data elements (red columns). These require completion in order for data to be uploaded properly. Reporting of the non-mandatory data elements (green columns) is encouraged whenever available. The worksheets and their respective data entry fields are described in more detail in Annex 2 below. ICES Data Centre has broadened the list of vocabularies to support data entry into several fields. Below are the brief step-by-step instructions for entering and uploading data.

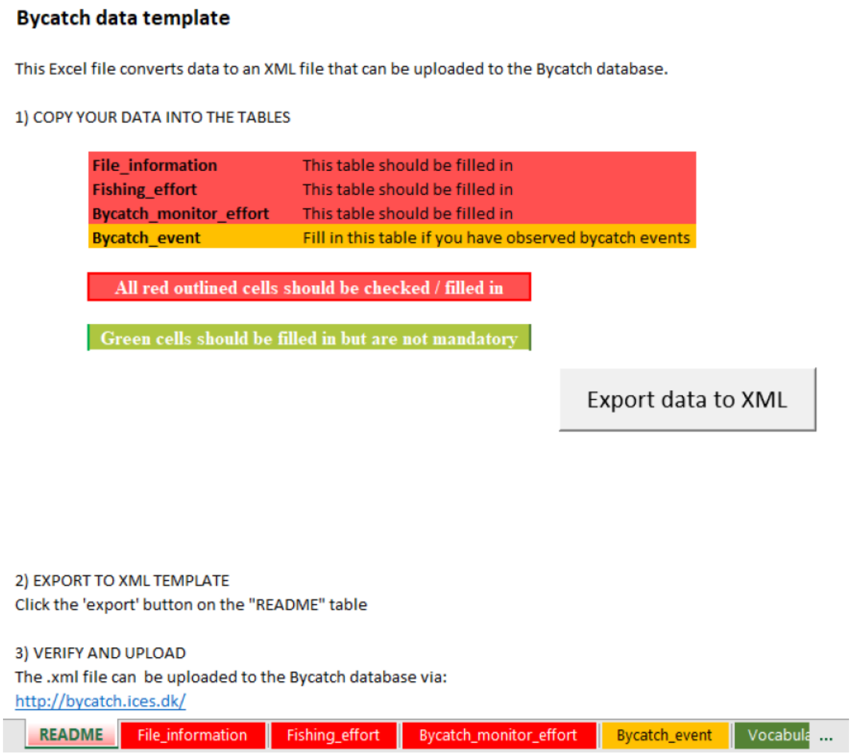
Step 1 is to click on the link provided here: http://bycatch.ices.dk/login.aspx to access the data entry and upload template from the data submission site. ICES sharepoint login credentials are required to login and can be requested at data.call@ices.dk.



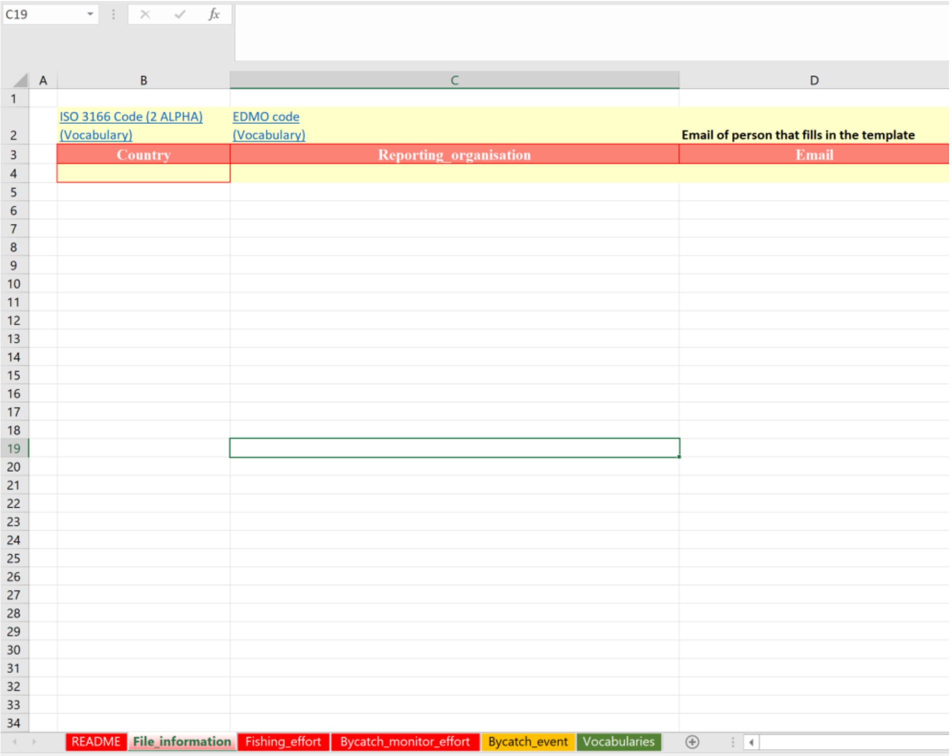
Step 2. After entering your username and password, download the template (see below).



Step 3 is to review the 'README' tab in the template.



Step 4. Begin entering your data starting with the 'File_Information' tab (Annex 2 – Table 1). **NOTE:you may choose to manually enter the data or cut and paste data from an electronic file. However, if you cut and paste, the values must match the values provided in the vocabularies/drop down lists. Otherwise, you are likely to receive error messages upon data upload.**



Step 5. Move on to the ‘Fishing Effort’ table. Then begin to populate the remaining columns and rows given the data.

Note: The fields in red are mandatory and the ones in green are optional.

Integer (YYYY)	Integer (MM)	Integer (Q)	AreaType	Vocabulary(multiple separated by [~]
Year	Month	Quarter	Area type	Area code

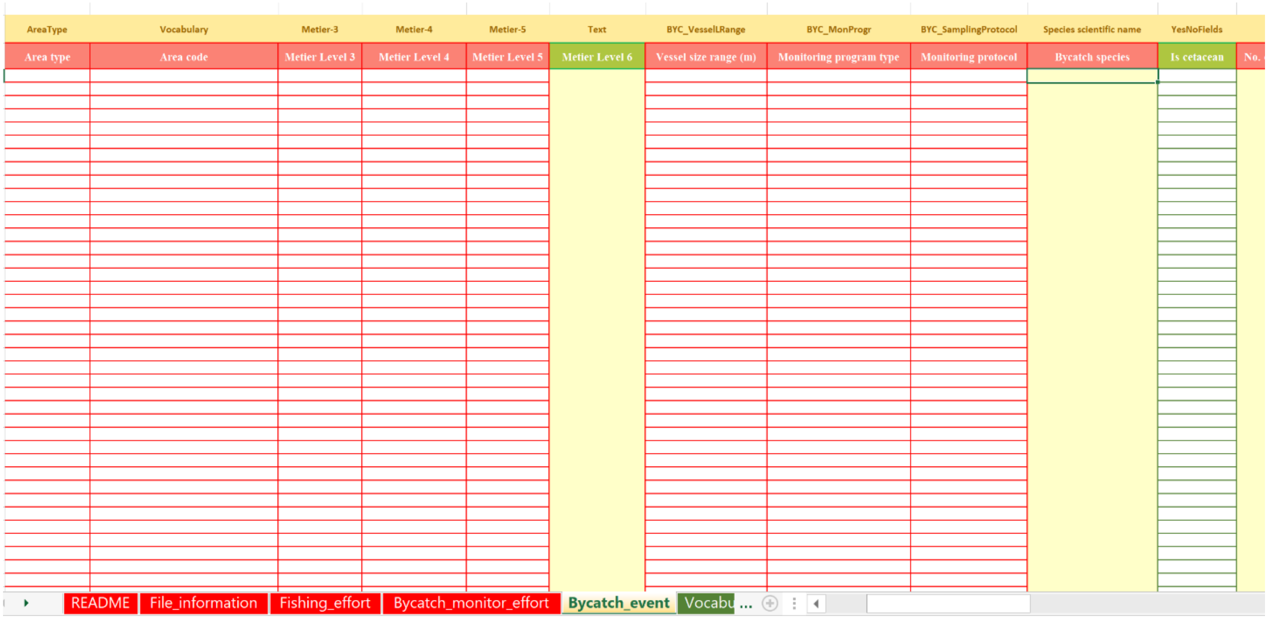
README | File_information | Fishing_effort | Bycatch_monitor_effort | Bycatch_event | Vocabularies | ElasmoList | FishList

Step 6. After completing the Fishing effort table, move on to the next tab ‘Bycatch_monitor_effort’ (Annex 2 – Table 3).

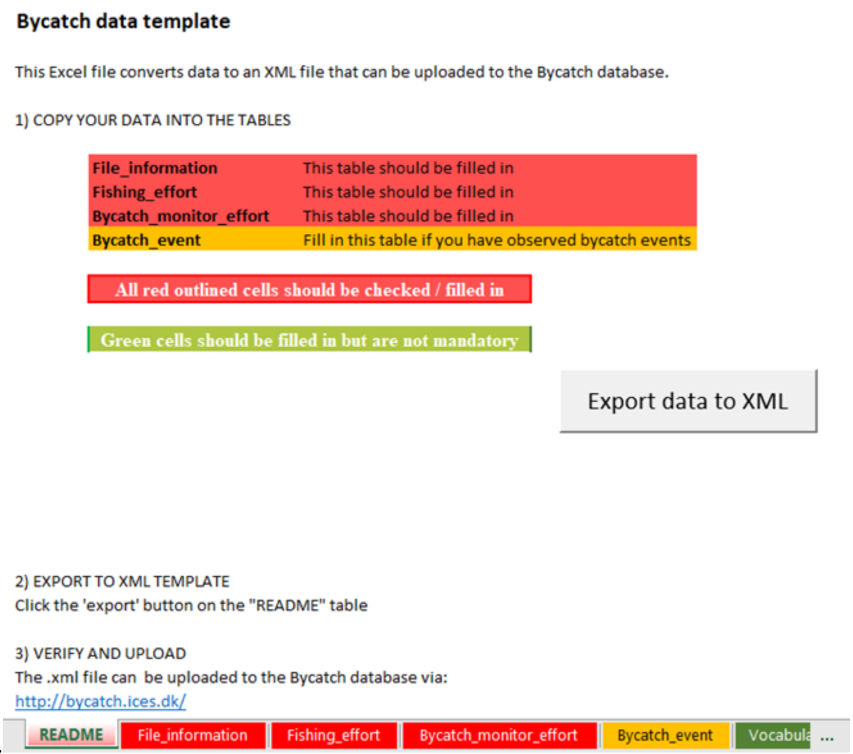
Integer (YYYY)		AreaType	Vocabulary	Metier-3	Metier-4	Metier-5	Text	BYC_VesselLRange
Year	Month	Area type	Area code	Metier Level 3	Metier Level 4	Metier Level 5	Metier Level 6	Vessel size range [r

README | File_information | Fishing_effort | Bycatch_monitor_ ...

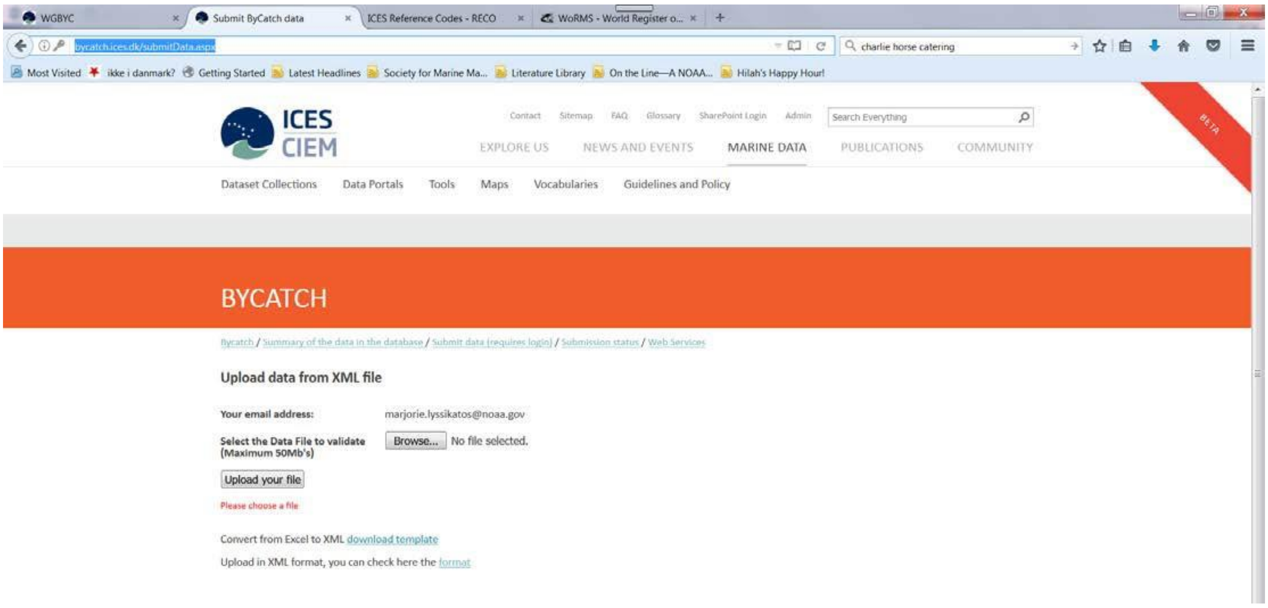
Step 7. After completing the Bycatch Monitoring effort table, move on to the next tab 'Bycatch_event' (Annex 2 – Table 3). This tab is where observed bycatch events, bycatch rates, and estimates for different species are entered and linked with the Bycatch monitored effort and the Fishing effort. Any bycatch record of year, month, gear, area, vessel size, monitor program type, and monitoring protocol should correspond to a record within the Bycatch monitored effort table.



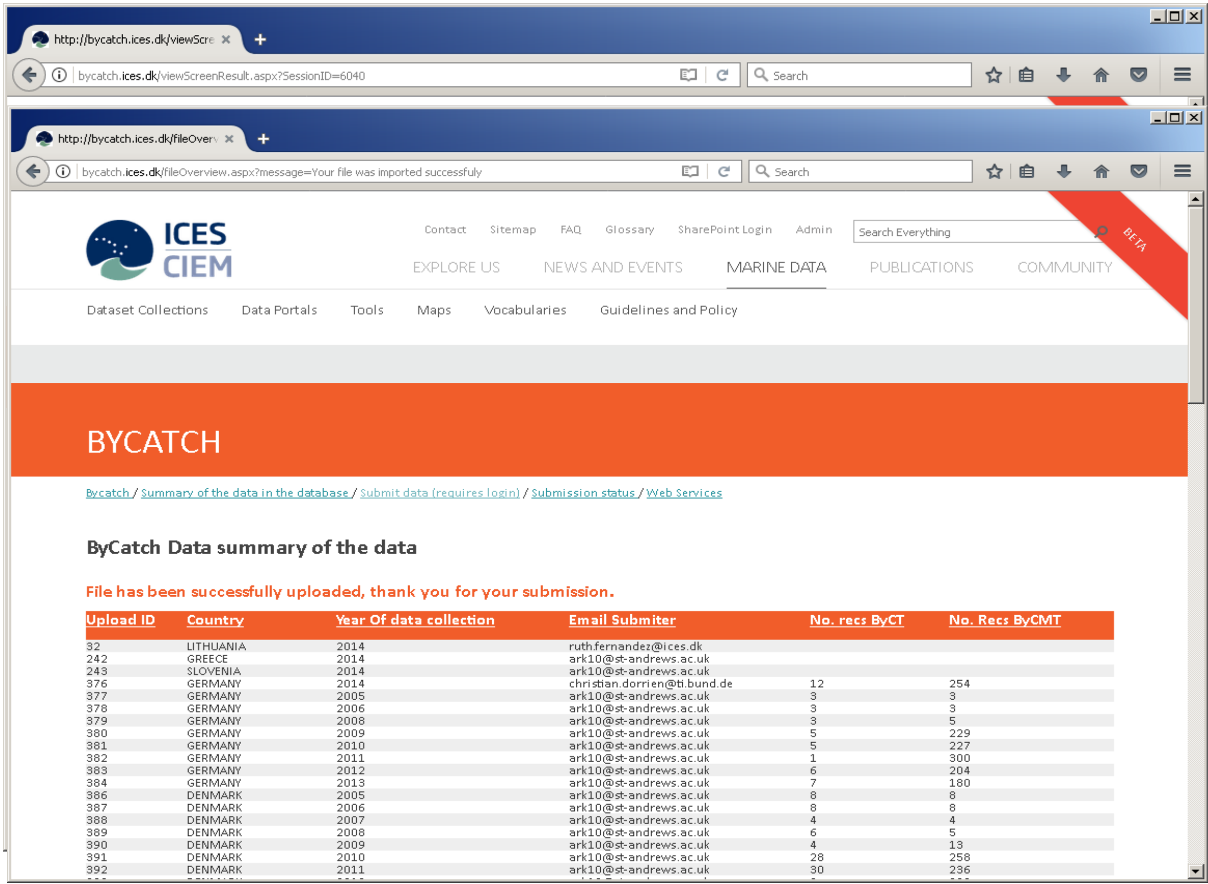
Step 8. Go back to the readme tab, export your data to XML file, and save the file locally in your computer.



Step 9. Go back to the http://bycatch.ices.dk/submitData.aspx link, and **browse** to your directory where you saved your XML file and then click 'Upload your File' to upload your data to the database.



Step 10. After data upload is initiated a message will appear, with the summary of your data, and any possible error messages. If the file has no errors, then you should see (below) the "Import the data to the database" button.



Step 11. Once you have clicked the "Import the data to the database" button, you will receive a message that the data have been successfully uploaded.

Annex 2. Data submission format in detail

There are four tables (worksheets) in the Excel file template for submission, in addition to a README. This Annex explains the type (character [char], numeric, or text) and meaning of each field, and whether the field is mandatory (M) or optional (O). Mandatory field headers are coloured red in the tables and must be completed; optional field headers are green. Changes to the template in relation to the previous WGBYC data call are highlighted in red (Tables 2-4).

Table 1 File Information Table

FIELD NAME	FIELD TYPE	OBLIGATION	DESCRIPTION	GUIDANCE
Country	Char	M	ISO 2-alpha country code	Use vocabulary link in template
Reporting_ organisation	Char	M	EDMO code of the organization responsible for the data.	Use vocabulary link in template
E-mail	Char	M	E-mail address for the point of contact about the data.	Valid e-mail address

Table 2Fishing_effort Table (for fishing effort)

FIELD NAME	FIELD TYPE	OBLIGATION	DESCRIPTION	GUIDANCE
Year	Numeric	M	Four-digit year (e.g. 2015)	Enter the year when the data were collected.
Month	Numeric	O	One or two-digit month (e.g 1 for January)	Enter the month when the data were collected.
Quarter	Numeric	M	Quarter 1-4	Enter the quarter when the data were collected.
Area type	Char	M	Area reference type	Specify which area reference codes you are using: ICES areas, GFSM GSAs, NAFO areas.
Area code	Char	M	Area code, where the majority of days at sea during the observed trip were observed	Use code options from the look-up lists for each area type.
Metier Level 3	Char	M	Generic gear group	Use vocabulary options provided in the template drop down list; if 'other' is selected, please provide explanation in the comment field.
Metier Level 4	Char	M	Gear type	Use vocabulary options provided in the template drop down list
Metier Level 5	Char	M	Target species group	Use vocabulary options provided in the template drop down list
Metier Level 6	Char	O	Mesh size and other selective devices	If applicable, briefly provide the mesh size ranges and other selective devices applicable for the métier, according to Appendix IV of the Commission Decision 2008/949/E
Vessel size range [m]	Char	M	The size range of vessel that was observed in metres	Use vocabulary options provided in the template drop down list.

FIELD NAME	FIELD TYPE	OBLIGA-TION	DESCRIPTION	GUIDANCE
Days at sea F	Numeric	M	Total number of days at sea corresponding to fishing time (e.g. 60)	Indicate total days at sea operating at Métier Level 5 according to Appendix IV of the Commission Decision 2008/949/E
Vessels F	Numeric	O	The total number of vessels	Indicate total number of vessels operating at Métier Level 5 according to Appendix IV of the Commission Decision 2008/949/E
Trips F	Numeric	M	The Total number of trips	Indicate total number trips operating at Métier Level 5 according to Appendix IV of the Commission Decision 2008/949/E
Total length of nets F [km]	Numeric	O	Total length of nets in kilometres (km)	Indicate total length of nets (km) deployed at Métier level reported according to Appendix IV of the Commission Decision 2008/949/E
Total kms*hour F	Numeric	O	Total soak time of nets in kilometres times hour (km*h) (this information is intended for fixed gears).	Indicate total soak time (km*h) fished at Métier level reported according to Appendix IV of the Commission Decision 2008/949/E
No. of hauls F	Numeric	O	Total number of hauls fished	Total number of hauls (aka tows or sets) fished at Métier level reported
Total towing time F	Numeric	O	Total time tow deployed for fishing in hours (h) (this information is intended for mobile gears)	Total tow time fished (h) at the Métier level reported.

Table 3 Bycatch Monitoring Effort Table ("Bycatch_monitor_effort" table)

FIELD NAME	FIELD TYPE	OBLIGA-TION	DESCRIPTION	GUIDANCE
Year	Numeric	M	Four-digit year (e.g. 2015)	Enter the year when the data were collected.
Month	Numeric	M	One or two digit month (e.g 1 for January)	Enter the month when the data were collected.
Area type	Char	M	Area reference type	Specify which area reference codes you are using: ICES areas, GFSM GSAs, NAFO areas

FIELD NAME	FIELD TYPE	OBLIGA-TION	DESCRIPTION	GUIDANCE
Area code	Char	M	Area code, where the majority of days at sea during the observed trip were observed	Use code options from the look-up lists for each area type.
Metier Level 3	Char	M	Generic gear group	Use vocabulary options provided in the template drop down list; if 'other' is selected, please provide explanation in the comment field.
Metier Level 4	Char	M	Gear type	Use vocabulary options provided in the template drop down list
Metier Level 5	Char	M	Target species group	Use vocabulary options provided in the template drop down list
Metier Level 6	Char	O	Mesh size and other selective devices	If applicable, briefly provide the mesh size ranges and other selective devices applicable for the métier, according to Appendix IV of the Commission Decision 2008/949/E
Vessel size range [m]	Char	M	The size range of vessel that was observed in metres	Use vocabulary options provided in the template drop down list.
Monitoring program	Char	M	Name of data collection program under which the data were collected.	Use vocabulary options provided in the template drop down list; if 'other' is selected please provide explanation in the comments field. You can check the vocabulary here: http://vocab.ices.dk/?ref=1500
Monitoring protocol	Char	M	The target species/taxa of the bycatch monitoring program	Use vocabulary options provided in the template drop down list. For example, 'marine mammals' implies the observers main role was to monitor the gear for interactions with marine mammals; You can check the vocabulary here: http://vocab.ices.dk/?ref=1501
Monitoring method	Char	M	Type of monitoring method used to collect the data	Use vocabulary options provided in the template drop down list. For example, "At sea observer" means that the data were collected visually by an observer onboard the vessel
Fishery target species	Char	O	Name of the main target species. Minimum specification – taxonomic group	If more than one species, separate scientific names by '~' e.g. Sprattus sprattus~Clupea harengus

FIELD NAME	FIELD TYPE	OBLIGATION	DESCRIPTION	GUIDANCE
			or common name; Maximum specification – scientific name of the species.	
Pinger characteristics	Char	O	Pinger (i.e. acoustic deterrent devices) specifications according to Annex II or Article 3.2 in Council Regulation (EC) 812/2004.	Indicate type of device being used. Use vocabulary options provided in the template drop down list; Set 1 or Set 2 (as defined in; https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32004R0812&from=EN), DDD = Dolphin Dissuasive Device; MIX = a mixture of acoustic deterrents used; other = devices other than Set 1, Set 2, DDD, or a mixture of various pinger types) If other pinger is used, please specify in the comments field. You can check the vocabulary here: http://vocab.ices.dk/?ref=1504
Other mitigation measures	Char	O	Other observed active or passive mitigation techniques used on the gear.	Other observed mitigation techniques could include escape panels and reflective gear.
Vessels Observed	Numeric	O	Total observed number of vessels	Indicate the total number of vessels that were monitored at the Métier level reported.
Trips Observed	Numeric	M	Total observed number of trips	Indicate the total number of trips that were monitored at the Métier level reported.
Days at sea Observed	Numeric	M	Total observed number of days at sea (e.g. 60)	Indicate total days at sea observed at the Métier level reported.
Hauls with pingers Observed [%]	Numeric	O	The percentage of hauls observed with pingers	Indicate the % of observed hauls that were equipped with pingers (acoustic deterrent devices)
Total length of nets Observed [km]	Numeric	O	Total observed length of nets in kilometres (km)	Indicated the total length of nets observed (km) at the Métier level reported.
Total km*hours Observed	Numeric	O	Total observed soak time of nets in kilometre hours (kmh) (this information is intended for fixed gears).	Indicate total observed soak time (kmh) at the Métier level reported.
No. of hauls Observed	Numeric	O	Total observed number of hauls	Total number of hauls (aka tows or sets) at the Métier level reported.

FIELD NAME	FIELD TYPE	OBLIGA-TION	DESCRIPTION	GUIDANCE
Total towing time Observed	Numeric	O	Total observed towing time in hours (h) (this information is intended for mobile gears)	Total tow time observed (h) at the Métier level reported.
Type of 812 monitoring	Text	O	Type of monitoring program under Council Regulation (EC) 812/2004.	Indicate type of monitoring program conducted in agreement with Article 4 and Annex III of Council Regulation (EC) 812/2004 Monitoring scheme, Pilot monitoring schemes or Scientific studies. You can check the vocabulary here: http://vocab.ices.dk/?ref=1505
Comments	Char	O	Provide additional information as appropriate.	Follow guidance for mandatory fields; comments for optional fields are encouraged but not required.

Table 4 Bycatch Event Table

FIELD NAME	FIELD TYPE	OBLI-GA-TION	DESCRIPTION	GUIDANCE
Year	Numeric	M	Four-digit year (e.g. 2015)	Enter the year when the data were collected.
Month	Numeric	M	One or two-digit month (e.g 1 for January)	Enter the month when the data were collected.
Area type	Char	M	Area reference type	Specify which area reference codes you are using: ICES areas, GFSM GSAs, NAFO areas
Area code	Char	M	Area code, where days at sea during the observed trip occurred.	Use code options from the look-up lists for each area type.
Metier Level 3	Char	M	Generic gear group	Use vocabulary options provided in the template drop down list; if ‘other’ is selected, please provide explanation in the comment field.
Metier Level 4	Char	M	Gear type	Use vocabulary options provided in the template drop down list
Metier Level 5	Char	M	Target species group	Use vocabulary options provided in the template drop down list

Metier Level 6	Char	O	Mesh size and other selective devices	If applicable, briefly provide the mesh size ranges and other selective devices applicable for the métieraccording to Appendix IV of the Commission Decision 2008/949/E
Vessel size range [m]	Char	M	The size range of vessel that was observed in metres	Use vocabulary options provided in the template drop down list.
Monitoring program type	Char	M	Name of data collection program under which the data were collected.	Use vocabulary options provided in the template drop down list; if 'other' is selected please provide explanation in the comments field. You can check the vocabulary here: http://vocab.ices.dk/?ref=1500
Monitoring protocol	Char	M	The target species/taxa by the human observer/monitoring program. See guidance if electronic monitoring was used.	Use vocabulary options provided in the template drop down list. For example, 'marine mammals' implies the observer's main role was to monitor the gear for interactions with marine mammals. You can check the vocabulary here: http://vocab.ices.dk/?ref=1501
Monitoring method	Char	M	Type of monitoring method done to collect data	Use vocabulary options provided in the template drop down list. For example, "At sea observer" means that the data were collected visually by an observer onboard the vessel
Bycatch species	Char	M	Name of species caught incidentally. Minimum specification – taxonomic group or common name; Maximum specification – scientific name of the species**.**	Use WoRMS to verify the valid species name http://www.marinespecies.org/
Is cetacean	Char	O	Yes; No	Indicate if the animal is a cetacean.
No. of specimens with pingers	Numeric	M	Total number of observed specimens incidentally caught in gear equipped with pingers.	Number of live and dead specimens caught in gear equipped with pingers.
No. of specimens without pingers	Numeric	M	Total number of observed specimens incidentally caught in gear NOT equipped with pingers.	Number of live and dead specimens caught in gear NOT equipped with pingers.
No. of incidents with pingers	Numeric	M	Number of fishing operations equipped with pingers that caught animals (dead and live animals)	For example, this would be the total number of fishing operations [e.g. haul] observed that were equipped with pingers and had incidental bycatch of that species.

No. of incidents without pingers	Numeric	M	Number of fishing operations that caught animals (dead and live animals)	For example, this would be the total number of fishing operations [e.g. haul] observed that were NOT equipped with pingers and had incidental bycatch of that species
Are the numbers raised?	Char	M	Information on whether the data were raised (extrapolated) or not. Data for elasmobranchs and bony fish are expected to be raised to observed trip level before submission. Data for other taxa are expected unraised.	Possible values are A (No - unraised sub-sample data provided), B (No - due to 100% coverage) or C (Yes - to observed trip level)
Bycatch rate with pingers	Numeric	O	The ratio of observed specimens incidentally taken as bycatch per unit of observed fishing effort from gear equipped with pingers.	Indicate per unit of observed fishing effort, the bycatch rate (i.e total number of specimens per days at sea observed), for a given species from gear that was equipped with pingers.
Bycatch rate without pingers	Numeric	O	The ratio of specimens incidentally taken as bycatch per unit of observed fishing effort from gear NOT equipped with pingers.	Indicate per unit of observed fishing effort, the bycatch rate (i.e total number of specimens per days at sea observed),) for a given species from gear that was NOT equipped with pingers.
Total Bycatch Estimate	Numeric	O	Estimated total number of animals taken as bycatch derived from observed incidental bycatch.	Provide the total bycatch estimate for each of the different species reported.
Coefficient of Variation [%]	Numeric	O	Coefficient of Variation (%)	Provide the estimated CV (standard deviation/bycatch estimate x 100) associated with the total bycatch estimate for each species.

Annex 7: Reviewer's reports

Technical Minutes

Review of ICES Report of the Working Group on Bycatch of Protected Species (WGBYC), 2020

Reviewers: (chair) Daniel Oesterwind, Thünen Institute of Baltic Sea Fisheries, Germany

Sheryl Hamilton, Institute for Marine and Antarctic Studies and Centre for Marine Socioecology, University of Tasmania, Australia

Nuno Oliveira, Portuguese Society for the Study of Birds, Marine Department, Portugal

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To the attention of ADGBYC 2020

General comments

The Review Group (RG) acknowledges the intense effort expended by the working group to produce the WGBYC report 2020.

The report is very concise and informative. WGBYC provides a useful and important summary and assessment of bycatch. Beside the focus on marine mammals, RGBYC highlights the great effort and information on marine turtles, seabirds and fishes. RGBYC acknowledges the close cooperation between ICES WGs that enhances efficiency.

RGBYC recommend the % bycatch observer coverage and fishing effort be presented for all member states if available, if these data are not available, please mention it in the report.

RGBYC noted that not much information on mitigation measures implementation, beside pingers for cetacean, is presented.

RGBYC noticed that some MS do not provide the requested by-catch data even if valuable work on bycatch assessment is being performed. Therefore, RGBYC suggests to discuss the chance to expand the data call to include other than national authorities (e.g. umbrella organizations, Universities or NGOs).

In addition, RGBYC endorse the opportunity to discuss and give advice on criterion, thresholds and GES within the MSFD and to include those work into the next ToRs.

RGBYC realised that editing is not part of the review but the report needs a good general edit. Some examples:

- Ensure all species have the scientific name plus common name for first time they are mentioned but only common name after that (e.g. scientific name for harbour porpoise in Finland paragraph at top of pg 4; add 'spiny dogfish' common name in last paragraph, pg 4; first paragraph, pg 5 add scientific name for albacore tuna and for harbour seal and 2nd paragraph add scientific name for grey seals; Pg 7: United Kingdom 2nd para add scientific names where relevant; etc
- Need to be consistent with either 'onboard', 'on-board' or 'on board'; 'data call', 'datacall', or 'Datacall'; "bycatch" rather than "by-catch".
- There are a number of spaces missing between words.
- Pg 10: remove comma from "1980's" Pg 14: remove comma from "1990's" Pg 15, Spain paragraphs – change "90's" to "1990s" and for other similar use of apostrophes.

- First paragraph, pg 5: "A total of 1227 and 800 fishing days at sea were reported for the set gillnet and midwater pair trawlers, respectively, targeting large pelagic fish."

For advice other than fish stock assessment advice:

Comments per section

__Executive summary__

- lines 204 – 205: How is an incident defined? Each individual or a fishing action with a bycatch (without indicating the number of individuals)
- lines 206 – 208: But RGBYC recommend that if the data are available, it should be used
- lines 211 – 212: but others as well.
- lines 226 – 227: It is unclear for RGBYC if it is known or just assumed that bycatch was the preliminary reason.
- line 235: the bycatch were not "calculated by km/hr"
- line 237: The wording is misunderstanding, RGBYC guess you mean high risk areas with more important need to mitigate bycatch?
- lines 255 – 257: There is no Baltic harbour porpoise in the NS, CS and BoB. RGBYC guess you mean harbour porpoise in general.
- line 263: Unclear to RGBYC
- lines 284 – 287: Any reason for that statement?

Review and summarize annual national reports submitted to the European Commission under Regulation 812/2004 and other published documents and collated bycatch rates and estimates in EU waters (Tor A)

__Section 1.2__

- lines 391 – 392: Maybe it should be highlighted in the WGBYC report, that Lithuania and Spain have not submitted a report within the last years

__Section 1.3__

- The Estonian information on 'Monitoring reported under (EC) Regulation 812/2004 by Member States' is missing
- There is no information about other taxa than marine mammal bycatch for Swedish water. RGBYC is wondering if this information was not available, or was overlooked.
- lines 411 – 413: Any evidence for this assumption?
- lines 428 – 433: Please refer back to the previous years' report, where you describe the period of performed observer programs and reasons for stopping it.
- line 435: is it 'and' or 'equally to', RGBYC assume you mean "equal"
- line 483: It is not clear for RGBYC which data you mean.
- line 484: does this mean that in 33 days at sea (122-89) 43 grey seals have been bycaught?
- line 496: Any idea what a large number is?
- line 501: Unclear for RGBYC why it is 8.6% or 9%

- Lines 541 – 555: Portugal reported no data for area 10. But data from the Azores (10.2) are listed in table 2. RGBYC highlights that IPMA has data about bycatch in beach seine fisheries, which might be not available for 2018, but it should keep in mind for the next time.
- line 567: “a” or “one Risso’s dolphin?
- line 580: 32 trips (=32 days at sea)?

Section 1.4

- RGBYC finds that there is a strong overlap with the former section e.g. Spain information
- Lines 616 – 620: RGBYC find the wording in paragraph describing “raised” and “unraised” data to be a bit confusing. RGBYC assume “raised” means that the observed bycatch data were extrapolated to obtain a bycatch estimate for total fishing effort. Whereas “unraised” data was the observed data only. Category B and C are not ‘essentially the same’ as would generate different errors around the estimate because one is based on 100% observer coverage and the other based on extrapolation of the observed bycatch for total fishing effort. However, they may be treated and assessed in a similar manner – suggest adjusting the text. In addition this means that only one category is “raised” (Line 616).
- Lines 635 – 641 (3rd paragraph): The bycatch numbers seem quite low, particularly for seals, cetaceans and seabirds. Given the relatively low (is it independent?) observer coverage, it is likely these are under-reported and are underestimates.

Section 1.5.1

- RGBYC highlights the information about the additional monitoring programs being undertaken.
- lines 669 – 670: This information is redundant and mentioned in section 1.3
- RGBYC highlights the need to expand the data call (as mentioned above). As it might be the case that other important projects and initiatives exist which are coordinated by other authorities and agencies (e.g. universities and NGO’s). For example, RGBYC knows that Portugal has collected data from vessels operating from Peniche harbour in 2018. Furthermore, a dedicated PET bycatch observer programme has been implemented under the lead of SPEA. Results are available under (http://berlengas.eu/sites/berlengas.eu/files/biblioteca/relatorio_final_c6.pdf.)

Section 1.5.2

- RGBYC recommends any information on seabird and/or fish bycatches from US is provided if available.

Section 1.6.1

- A better wording for the title might be ’Strandings networks to inform on marine mammal ‘because information on other taxas than cetacean is provided.
- RGBYC suggest shifting the information on spanish turtle strandings to section 1.6.2
- Lines 822 – 829 (German paragraph): note that freezing of carcasses may confound the interpretation of ‘trauma’ and evidence of bycatch mortality.
- RGBYC suggest discussing if a section about stranded seabirds might be valuable for the report.
- There is strong overlap about the Portuguese information in section 1.61 and 1.6.2
- RGBYC wonders that no Maltese data are provided.
- RGBYC suggest discussing how to get a better stranding data collection on EU level by including citizen science and other organizations in future.
- As mentioned in the text, the data on estimates of bycatch mortality from strandings is important given the paucity in independent observer coverage on vessels and the probable under-

reporting of bycatch. However, should continue to ensure MS meet the targets of observer coverage and bycatch reporting (RGBYC recommend to add this to the main conclusions).

- RGBYC call attention that the detection of stranded animals is relative to search effort/search coverage and an unknown proportion of dead individuals at sea will not present as strandings.

Conclusion

- RGBYC highlights that this is a great summary and provides important conclusions including concerns about observer coverage, reporting of data, the ability to compare data, the use of strandings as supplementary information but limitations with necropsy assessments of carcasses etc.
- The 9th dot point: RGBYC suggest writing "…in most Ecoregions and, depending on species-specific feeding behaviour, are mainly taken…"
- The use of electronic monitoring (EM) could be investigated as an alternative or to supplement onboard independent observers, particularly on small vessels where there is a lack of space to allow onboard observers. EM programs need to be correctly implemented including calibration with onboard observer data and verification of data (https://doi.org/10.1111/faf.12425).

Table 1:

- Please define what a colourless cell means. In addition, pale grey and colourless are hard to distinguish.

Table 2

- RGBYC suggest that the table legend is written to include summary definition of "raised" and 'unraised" data. E.g. 'rates were estimated where relevant data were provided'?
- Please add column for % observer coverage to Table 2 – this is especially important given 'raised' and 'unraised' data is presented. Data quality and reliability would vary in producing different 'bycatch rates', particularly reliability of estimates if observer coverage is very low.
- Add "DaS = Days at Sea' and round to nearest 'Days at Sea'.
- While RGBYC assumes that effort presented as "Days at Sea" means there is a standard effort metric for different fishing methods, this generates bycatch rates that could be misleading if different fishing gears will be compared. There are better metrics for different fishing gears (e.g. number of hauls) that more accurately reflect effort and enable better assessment of bycatch levels.

Table 3

- The difference in "Observed days at sea" for Reported vs Database is striking. Not sure if RGBYC understand why this is when the 'total number of incidents' and 'total number of specimens' is often the same between the two.

Table 4:

- RDGBY recommends ordering the table by ICES division as it is the first column. In addition 'Observed effort with no bycatch' instead of 'Total observed effort' makes it more clear.
- Note that there is likely low reliability in the zero bycatch for all of these divisions given the very low % of observed effort (< 1%) for many of them.

Collate and review information from National Regulation 812/2004 reports and elsewhere relating to the implementation of bycatch mitigation measures and ongoing bycatch mitigation trials, compile recent results and coordinate further work on protected species bycatch mitigation (ToR B)

Section 2.1

- RGBYC highlights that the section includes a very good summary, which is interesting to read and illustrate what different MS are implementing bycatch mitigation, although largely focussed on pinger implementation. Information for some MS who present reports are missing, which might be due to the fact that no relevant data has been reported on mitigation, but a general statement for Estonia, Finland, Italy, Latvia and Spain should be added. Furthermore, this section is mainly focusing on mitigation of marine mammal bycatch, mitigation on reptile bycatch is explored bellow in a specific section, but less attention is given to mitigation of seabirds or PET fishes.

- Denmark: Has it been shown that 10 KHz pingers at 200m distance spacing are effective?
- Finland: “probability to detect harbour porpoise…is low.” Should then state (if correct) “Therefore, no pingers or other technical mitigation were used in 2018.”
- France: great bycatch reduction of 65% with pingers.
- Poland: needs a good edit and simplification of sentences (there are lots of commas), a comparison between bycatch with pinger and no-pinger usage were very interesting.
- Portugal: Trial of FUMUNDA pingers – looks like very low bycatch levels (2 bottlenose dolphins in pingered nets only). RGBYC suggests that numbers are too low to be able to conclude these pingers were ineffective.
- Sweden: needs a good edit, in addition a comparison between bycatch with pinger and no-pinger usage were very interesting.

- Trials on mitigation measures to reduce seabird bycatch were also developed in Portugal under the scope of Life Berlengas and MedAves Pesca. RGBYC recommend including a summary of those results and to list it under section 2.3.

Section 2.3.1

- RGBYC recommend moving the following sentence (Bielli et al.) to the seabirds chapter “*For seabirds, nominal Bycatch per Unit Effort (BPUEs) decreased by 84.0 % in the presence of LEDs. Target species CPUE was not negatively affected by the presence of LEDs. This study highlights the efficacy of net illumination as a multi-taxa BRT for small-scale gillnet fisheries in Peru*.”

- A letter was published commenting on Bielli et al (2020) and questioning the model design and conclusion that LEDs reduced cetacean and turtle bycatch risk: *Authier, M., & Caurant, F. (2020). Design issues adumbrate conclusions on LED-mediated bycatch risk reduction of cetaceans and turtles in fishing nets: A comment on Bielli et al.(2020). Biological Conservation, 243, 108488.*

- Tulloch et al. (2019) did not adequately account for the efficacy of mitigation in this predominantly economic assessment e.g. the economic assessment rated exclusion devices high but these have not been effective in reducing cetacean bycatch mortality in trawl.

- RGBYC suggest to including: *Omeyer, L. C., 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. https://doi.org/10.3389/fmars.2020.00285* .

- Support the Conclusions of this section – these are good.

Section 2.3.3

- In Jiménez et al it was stated that “*No detectable differences in capture rate were recorded in the branch line weighting study*”, are there any information about seabirds available?

Evaluate the range of (minimum/maximum) impacts of bycatch on protected species populations where possible, furthering the bycatch risk approach to assess likely conservation level threats and prioritize areas where additional monitoring is needed (ToR C)

Section 3.1:

- RGBYC completely agree with opening paragraphs. These also relate to the comments above regarding the need to use better effort metrics for assessing and comparing bycatch rates.
- The start of the analyses and data exploration state that it was based on almost 14,000 static net hauls - the legends of Figure 2–10 could be clearer and should include that analyses have been performed for static nets.

Section 3.2:

- RGBYC highlights the important and useful assessment of estimating error around bycatch rates.
- RGBYC thinks that “Likely conservation level threats” were not very comprehensively assessed in this section. The exceptions were the PBR assessment for common dolphins based on French stranding data; the elasmobranch section (3.5.1) which includes methodology to assess bycatch mortality against MSY with trigger levels set; and the turtle section (3.6.1) which at least mentions assessment of bycatch with respect to population level impacts.

Section 3.3

- RGBYC noted that the section on dolphins/porpoise provide less details than Section 3.6 on turtles (which is also broken down into different sub-sections).

Section 3.4

- RGBYC noted that the section on seabirds provide less details than Section 3.6 on turtles (which is also broken down into different sub-sections).
- It is stated “*However, seabird bycatch events (i.e. occurrence of seabird bycatch during a fishing activity) might still be relatively rare.*” The high bycatch rates which is described for certain fishing areas and which is related to some metiers/seabird species barely support such idea. Although, a huge variability is often observed in estimated seabird bycatch rates.

Section 3.6

- In the figure 11, is shown a map with PTB - Bottom pair trawl in 9.a section, could you please check it for correctness.

Section 3.7

- RGBYC thinks that risk factor assessment seems to be a good approach given the available data and information and, importantly, accounting for bycatch monitoring/observer coverage levels.

Section 3.8

- RGBYC noted that the second dotpoint is relating to static nets i.e. numbers/km/hr, so you should state this. The Conclusions are good.
- Table 25, perhaps ordering it by Metier and then by ICES Division and so on will make it easier to read.

Continue to develop, improve and coordinate with other ICES WGs on methods for bycatch monitoring, research and assessment within the context of European legislation (e.g. MSFD) and regional conventions (e.g. OSPAR) (TOR D)

- Table 26, * means the same as in table 27? Please consider including it.
- A general comment to the species status in this tables: a species that is considered at least VAG in Azores and in European mainland, might be have a similar status in Oceanic North-East Atlantic. A review of the species status in Bay of Biscay and Iberian Coast and Azores is presented for

consideration in the draft report itself. Perhaps a similar revision might be considered for the remaining sea sections.

Conclusions

The report of the WGBYC is very interesting, well-structured and covers the terms of reference. The work is at a sufficient scientific standard for ICES to base its advice on bycatch of protected species and the main conclusions are in accordance with the WG report. The Working Group invested much working effort resulting in a positive progress concerning data management and information flow. The report underpins the importance of the Working Group. However, as in previous years, data reporting by some MS seems to be insufficient.

The RGBYC congratulates to the submitted Working Group Report.