WORKING GROUP ON BYCATCH OF PROTECTED SPECIES (WGBYC)

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i Executive summary

Six Terms of Reference (ToRs; Annex 2) were addressed during the meeting through plenary and subgroups. The 2019 report is structured in the same order as the ToRs. Contributions to ToRs were requested in advance of the meeting and all data submissions were requested via a formal WGBYC/ICES data call (Annex 7). The data call requested data on fishing effort, monitoring effort and protected species (marine mammals, seabirds, reptiles and fish) bycatch incidents in 2017. Of the 24 countries contacted, 20 responded to the data call. Many countries continue to submit data late (one-third) and the quality of the data submissions is variable. The data call referred to bycatch of fish, as per the list provided in Table 1D of the Commission Implementing Decision (EU) 2016/1251 adopting a Multiannual Union Programme (EU-MAP); however, WGBYC this year reviewed this list to create a priority fish bycatch list since many of the species on D1 are commercially caught and other scientific bodies, e.g. ICES expert groups, carry out assessments for these.

Member States (MS) reports on the implementation of Regulation 812/2004 during 2017 were reviewed. Most MS continue to monitor protected species bycatch using fisheries observers conducting sampling under the Data Collection Framework (DCF); only a few countries have a dedicated bycatch observer programme. With the upcoming repeal of Regulation 812/2004 in 2019, WGBYC will in future receive its data from monitoring under EU-MAP. Monitoring of smaller vessels (<15m) in the European fleet has to date generally been poor, and sampling designs under EU-MAP need to ensure representative coverage of relevant metiers for protected species bycatch. In 2017, bycatch records from the datacall included 148 cetaceans (5 species); 63 seals (4 species), 528 birds (22 species); 97,816 elasmobranchs (49 species) and 15 turtles (2 species) .. Equivalent data from non-EU countries was also received from the USA and Iceland.

MS's compliance with the pinger requirements of Regulation 812/2004 is difficult to gauge from the submitted reports, as there are reporting inconsistencies and in-complete information. Only the UK appears to comply fully and reported 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 between with fishing metiers and geographical areas.

WGBYC completed Bycatch Risk Assessments (BRA) for harbour porpoise and grey seals in the Celtic Seas (CS) and Greater North Sea (NS) ecoregions. Data were pooled from 2015-2017 and minimum and maximum bycatch rates extrapolated using 2017 fishing effort data for nets, bottom trawls and pelagic trawls. Bycatch rates of both species were highest in nets in both ecoregions; however, French data also included a high number of seal bycatch incidents in bottom trawls, but these records could not be verified during the meeting. The percentage mortality of the grey seal population in the CS and NS ecoregions due to bycatch was estimated at 1.5 - 2.8%. For harbour porpoise, in the NS between 0.33 - 0.59% in nets, and in the CS between 0.29 - 0.8% in nets and bottom trawls combined; both of these estimates are below the ASCOBANS 1.7% threshold defining unacceptable levels of interaction and below the 1% precautionary environmental limit. However, ICES ecoregions are arbitrary and are unlikely to reflect true population structure of harbour porpoise; the working group therefore conducted a further BRA using the latest definition of a Celtic Sea subpopulation and this suggested that levels of mortality in 2017 due to bycatch may be between 2.12 - 5.57% of that subpopulation. This demonstrates the importance of assessing population level impacts at appropriate spatial scales. It also worth noting that most of the observation data comes from DCF monitoring which likely biases bycatch rates downward. Additional estimates of harbour porpoise and common dolphin bycatch mortality

based on stranding data were also presented for the North Sea and Bay of Biscay/English Channel as WGBYC continue to assess the performance of those methods for estimating by-catch levels.

For the first time, WGBYC prepared comprehensive summaries of elasmobranch and seabird data from 2017, and calculated lower and upper confidence intervals around the bycatch rates using the available monitoring data. For both taxa, the main focus was placed on species of higher perceived conservation concern. Access to monthly fishing effort data was considered an important prerequisite for usefully extrapolating seabird bycatch data because of the seasonality in bycatch rates (driven by seasonality in seabird distribution and behaviours). Calculated confidence intervals around seabird bycatch rates were wide; though precision levels could be improved upon in future by generating multi-annual bycatch rates in or-der to utilise more data. Elasmobranch bycatch was very common in all ecoregions. The range of bycatch rates presented highlight those species, gears and areas where bycatch may be a particular concern; the data also contribute usefully to a more general scientific understanding of the distribution and abundance of some elasmobranch species.

WGBYC has made considerable progress forming relationships with other ICES expert groups; the relationship established with WGEF should help facilitate the work of both groups going forward. WGBYC also undertook a review of the risk assessment being used by the Regional Coordination Groups to develop regional sampling plans under EU-MAP. An exercise comparing levels of dedicated bycatch monitoring versus DCF monitoring effort in North Atlantic fishing grounds, high-lighted the trivial amount of dedicated PS monitoring days undertaken in 2017. In the North Sea for example, there were just 22 days of dedicated bycatch monitoring compared to 1829 days monitoring under the DCF.

WGBYC conducted a comparative analysis of the 2017 effort data contained within the WGBYC database with equivalent data from the ICES Regional Database. Significant differences were highlighted between the datasets from individual countries, gear and vessel size categories. Neither database was consistently better than the other, however, reliance solely on the RBD as the source of fishing effort data in future would require that all countries submit data to it in a usable format for WGBYC bycatch assessments (e.g. the UK's submission to the RBD could not be used in the comparative analysis because the UK did not provide effort to the RDB as "days at sea" which is not currently a mandatory field. Historically "days at sea" has been the common metric provided through Regulation 812/2004 reports and thus enables pooling of national datasets to estimate overall bycatch rates.

WGBYC has collated bycatch monitoring and fishing effort data since 2005. To date, the requests for these data and the required reporting format have gradually evolved. This presents challenges to using the entire dataset as data from the early years are not fully compatible with more recent years. WGBYC began the process of making the entire dataset usable this year but this requires further work. However, this is an invaluable exercise that will maximise the value of the dataset by providing a significant time series of data which will enable the group to look at inter-annual trends in bycatch rates by metier and area. This ongoing process will also identify core fields and data needs that will be required in future data calls and from the RDB, to ensure ongoing compatibility. It is of paramount importance to the work of WGBYC that the transition from using data from Regulation 812/2004 data collection and data storage structures can be accommodated in the RDB (and upcoming RDBES) so that the full time series is maintained and available for analysis.

ii Expert group information

Expert group name	Working Group on Bycatch of Protected (WGBYC)
Expert group cycle	Annual
Year cycle started	2019
Reporting year in cycle	1/1
Chair(s)	Sara Königson, Sweden
	Kelly Macleod, UK
Meeting venue(s) and dates	5-8 March 2019, Faro, Portugal, 20 participants

1 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)

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 metiers. 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 EC. The annual review of these reports are central to the work of WGBYC. WGBYC have 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.

Other appropriate data on cetacean bycatch may also be submitted through Reg.812/2004 reports. These data are most commonly linked to at-sea observations carried out for the purposes of fisheries monitoring in accordance with the EU Data Collection Framework Regulation 2017/1004 (DCF)[1]. The aims of the DCF are 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 non-dedicated protected species bycatch observers 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 state of play of the revision of the EU Technical Measures Regulation was presented and discussed. Following an agreement in substance between the European Parliament and the European Council, a final legal text is being prepared though it is not yet published. The main elements of the agreement are :

1. The existing Regulation 812/2004 is repealed. Corresponding and replacement provisions will be included in the new Technical Measures Regulation.
2. Measures to monitor, manage and mitigate bycatches of sensitive species (including but not limited to cetaceans, birds and turtles) will be 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 will be required to take the necessary steps to collect data on the relevant species.
3. The objectives of the new Regulation will be to ensure 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.
4. Provisions existing in Regulation 812/2004 concerning vessel sizes, areas and fishing gears where pingers are required or where monitoring of bycatches is mandatory have been retained.
5. Detailed technical descriptions of pingers will not be carried over from Regulation 812/2004. The Commission may request technical advice in order to develop a new description to be adopted as an Implementing Regulation.
6. Submission of annual reports on bycatches by Member States will cease to be a legal requirement. However, data collection should be incorporated in data exchange and storage systems accessible to scientific instances. The European Commission is to prepare triennial reports (the first of which is due in 2020) for presentation to Parliament and Council.

In discussion, it was brought forward that the existing minimum vessel LOAs where use of pingers is obligatory (12m) and where monitoring of bycatches is required (15m) are inappropriate as many bycatches are made from smaller vessels. It was also questioned how any failure by Member States to meet their responsibilities under the new Regulation would be followed up.

There are many obligations to monitor and introduce measures to reduce protected species bycatch out with those 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 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*

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

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

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 relevant[4] 23 EU MS were not affected by any part of Reg. 812/2004 (hereafter in this section termed "the Regulation") in 2017 (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, Italy, Germany, Ireland, Latvia, Netherlands, Poland, Portugal, Slovenia and the UK were obtained via the EC. The report from Sweden was submitted directly to WGBYC. Section 1.3 below summarizes text extracted directly from individual MS reports.

The quality and scope of the information provided in the annual reports continues to be variable, with some MS simply repeating the information provided in previous years. 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 2 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 under (EC) Regulation 812/2004 by Member States (including non-cetacean bycatch events when provided)[5]

In **Belgium**, no specific observer scheme was in place in 2017 to monitor bycatch of marine mammals. Fishing trips were only observed on board vessels with towed gear for the purposes of stock surveys and to fulfil other monitoring requirements. No bycatch of marine mammals was observed during fishing operations. Due to the small number of vessels affected, Belgium states that commercial fishing practices in the country have a limited impact on the marine mammal populations.

Denmark reported no specific monitoring programs for incidental bycatch of marine mammals during 2017 in the Danish pelagic trawl fishery. The reason for not continuing the monitoring programs carried out from 2006–2008 was that the observer schemes, with a coverage up to 7%, had no records of incidental bycatch of marine mammal species in this fishery. Neither was any specific monitoring according to the Regulation carried out in the Danish gillnet fishery. Instead, observer data on incidental catches of marine mammals from gillnets was collected under the Data Collection Regulation scheme (DCR). Monitoring was carried out on vessels <15 m in area

[4] The word "relavant" was inserted for clarification based on the reviewers' comments.

[5] Heading updated based on reviewers comments.

27.3.a (15 days at sea; 0.8% coverage; one bycaught harbour porpoise), vessels <15 m in area 27.4 (4 days at sea; 0.8% coverage; zero porpoise bycatch), and vessels >15 m in area 27.4 (15 days at sea; 0.5% coverage; zero porpoise bycatch). In addition, video monitoring continued in 2017 on board 9 different vessels fishing in areas 27.SD22-23 and 27.3a. The data have not yet been analyzed.

The **Estonian** national monitoring program of incidental catches of cetaceans in 2017 covered observations of 53 trips in pelagic trawl fisheries in area 3.d (SD 28, 29 and 32). The observations were carried out on 12 different vessels and 61 hauls. No incidental bycatch of cetaceans was observed in 2017. The observer coverage was 3.9%.

According to Estonian data, the incidental catches of cetaceans in areas where Estonian fishing effort is mainly situated (SD 32, 29, 28, 27) is zero. The reason is likely due to the very low density of cetaceans in these areas. According to the SAMBAH project (SAMBAH 2016) the probability of detection of harbour porpoise in Estonian EEZ is around 0% in both winter and summer. Estonia reported that there is no fishing effort using static gear with vessels larger than 15 m because static gears are used in fisheries by boats up to 10 m. However, no monitoring has been conducted to assess the incidental catches of cetaceans for boats up to 10 m, but according to interviews with fishermen there have been no cetacean catches.

Finland reported that in accordance with Article 6 of the Regulation, an observer program ran during years 2006 and 2007 and no harbour porpoises or other cetaceans were observed by authorities as bycatch or otherwise during this two-year period. As a result, no observer program has been in place since. Furthermore, it is stated that the Finnish National Fisheries Act obliges all vessels, regardless of size, to report in their logbooks harbour porpoise or cetaceans caught as bycatch. Authorities have not received any reports of bycaught harbour porpoises or cetaceans.

In **France**, the program Obsmer manages all the observations at sea required by various fishery regulations. During 2017, 701 trips and 855 fishing days were monitored by observers. A total of 208 trips representing 314 days at sea were monitored for towed gears in ICES areas 7 (including 7k), 8 and in the Mediterranean sea. A total of 296 trips and 383 days at sea were monitored for static gears in ICES area 8. In addition, 197 trips and 158 days at sea were dedicated to set nets in areas requiring pingers under the Regulation (Subareas 4 and 7). Five species of cetaceans, representing 80 individuals, were observed bycaught during the year 2017. Specifically, in midwater pair trawlers (PTM), 49 common dolphins were bycaught in division 27.8 a; 8 common dolphins and one harbour porpoise in 27.8 b and 5 pilot whales were bycaught in 27.8 c. In otter twin trawls (OTT), a harbour porpoise bycatch was observed in Division 27.7 g. In otter bottom trawls (OTB), one common dolphin (27.7 h) and one harbour porpoise (27.8 a) were recorded. In gillnets (GNS), a common dolphin was bycaught in 27.8 b. In trammel nets (GTR) 4 common dolphins and 4 harbour porpoises were bycaught in 27.8 b, and one in 27.8 a. In the Mediterranean Sea (GSA 07), a bottlenose dolphin and an unidentified dolphin were bycaught in otter bottom trawls (OTB). Additionally 2 striped dolphins were by caught in midwater otter trawls (OTM). The low coverage of metiers (1.5% for towed gears and <1% for static gears) by at sea observers did not allow production of estimates of total cetacean bycatch.

Germany monitored under the DCF observer programme, trying to follow the requirements of Reg. 812/2004 as much as possible. It was not always possible to achieve the sampling intensity required under the Regulation in some fleet segments for technical reasons and in other cases owing to a lack of capacity in the sampling programme, which is adapted to the requirements of the EU fisheries data collection programme (DCF). Sampling effort for fleet segments >= 15 m (pelagic trawls, Subareas 6, 7, 8) was 17.8 % and met the requirements of the Regulation (Annex III, point 3) while that for the sectors of pelagic trawls, in 3 a, b, c, d, 4 and 9 (Annex III, row E) as well as stationary gill nets and entangling nets, 6 a, 7 a, b, 8 a, b, c and 9 a (Annex III,

row C) and those in 3 b, c, d (Annex III, row G) did not. In fleet segment A (pelagic trawls, Subareas 6, 7, 8), a bycatch of one grey seal *(Halichoerus grypus)* was noted.

Ireland reported a total of 33 trips comprising 106 days at sea and 98 hauls were observed in pelagic trawl fisheries in 2017. All of this work was carried out as part of Data Collection Framework (DCF) monitoring and surveys. Following a period of intensive monitoring of set net fisheries from 2011 to 2013 no further regular monitoring of set net fisheries occurred until 2017 when one under 15m vessel was observed for two days. No cetacean bycatch was observed in pelagic fisheries in 2017. However 3 dolphins (one of which was released alive) were reported as caught in three separate events by demersal otter trawls during this time period.

A total of 7 common dolphins have been observed from a total of 1635 days at sea observed in pelagic trawls since monitoring under EC 812/2004 commenced in 2005. Of these, a total of 219 days were carried out as part of dedicated independent observer programmes from 2010 to 2012 in a range of pelagic trawl fisheries with no cetacean bycatch observed. Results to date suggest that the risk of bycatch of cetaceans and other protected species in Irish pelagic trawl fisheries is low.

In Italy, the observer program conducted under Regulation (EC) no. 812/2004 is an ad- hoc monitoring program in which observers are trained to collect not only data on cetacean bycatch, but also additional data on bycatch of other protected species under the Habitats Directive. A total of 196 days were monitored on board 15 pelagic pair trawlers between GSA 16 (3 vessels) and GSA 17 (12 vessels) in 2017, which represent 14.7% coverage of the national midwater trawl fleet. 3 bottlenose dolphins (*Tursiops truncatus*) were accidentally caught in GSA 17 (Chioggia, northern Adriatic Sea). Observers from the monitoring programme were also trained to collect bycatch data of other PETS under HD (i.e. loggerhead turtles) and species of conservation concern (e.g. sharks, pelagic rays and skates). 3 loggerhead turtles (*Caretta caretta*) and a large number of sharks and rays were taken as bycatch in GSA 17. However, the report records only 3 starry rays (*Raja asterias*) and 2 common eagle rays (*Myliobatis aquila*) were unintentionally caught in GSA 16.

The **Latvian** national monitoring program of incidental catches of cetaceans in 2017 covered observations of 513 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 2017; this is similar to previous reports from 2006–2016. Reported observer coverage was 10.3% of the pelagic trawl fishery with vessels 12–18 m in area 27.3.d (SD28.1- Gulf of Riga), and 9.7% with vessels 24–40 m in area 27.3.d (SD 25,26 and 28.2). Coverage was estimated using days at sea. The lack of observed bycatch over the full decadal time period indicates that cetacean monitoring under the Regulation has no practical significance in Latvian fisheries. Traditionally Latvian pelagic trawls fishery are targeting sprat and 90-93% of effort is allocated to SD28.2.and 28.1. Therefore, Latvia reiterated that continuation of its cetacean bycatch monitoring program is an unnecessary expenditure of financial and human resources. Latvia proposed to stop future observations for its fleet segments.

In the **Netherlands,** the monitoring of all protected species bycatch is implemented in the new Data Collection Framework (DCF) since January 2017. During 10 fishing trips, 71 days and 210 hauls were observed in fleet segment NLD003, and 78 days and 192 hauls were observed in fleet segment NLD004. With a total number of fleet days of 388 in fleet segment NLD003 and 776 in fleet segment NLD004, the coverage was 18.3% and 10.1% 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, two more observer trips were carried out on board foreign flagged trawlers which makes the total number of monitored trips by the Netherlands at twelve. The observer effort on board foreign trawlers consisted of 27 days (62 hauls), covering approximately 13.4% of the total Dutch monitoring effort. The data collected during the trips on foreign flagged vessels

will be made available to the ICES database on incidental bycatch. The observed bycatch rate of zero dolphins per day in the pelagic fishery in 2017 is in line with the findings in 2006 - 2016 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 ID of EU Decision 2016/2051. Seven bluefin tuna (*Thunnus thynnus*) were caught in five incidents by the NLD003 fleet segment in 2017; one grey seal (*Halichoerus grypus*) was caught in one incident; four porbeagles (*Lamna nasus*) were caught during four incidents in both fleet segments; one thresher shark (*Alopias sp*.) was caught in one incident. This report also presents the results of three monitoring day trips in set gill nets fishery and two day trips in trammel net fishery. In one of the gill net trips, two common guillemots (*Uria aalge*) and four red throated divers (*Gavia stellata*) were caught.

In **Poland**, the Cetacean Bycatch Monitoring Programme, which has been a part of the National Fishery Data Collection Programme since 2015, continued in 2017. Observers aim to monitor commercial catch and bycatch of cetaceans or other marine mammals, as well as seabirds and protected fish species, such as twaite shad (*Alosa fallax*) or Atlantic sturgeon (*Acipenser oxyrhynchus*). In summary, observation has been conducted on 8 vessels over 15 m operating from 4 ports, one vessel under 15 m (Kołobrzeg) and 4 fishing boats operating within the Gulf of Gdańsk. The observers spent 50 days at sea, including 24 days on vessels operating pelagic trawls (OTM), 8 days on trips where fishing has been carried out using bottom-set gillnets (GNS), 12 days on one bottom otter trawl (OTB) and 6 days on a vessel using drifting longlines (LLD). No cases of bycatch of any marine mammal or seabird was observed nor bycatch of other protected fish species.

In **Portugal,** monitoring of bycatch of cetaceans and other protected species on the mainland were provided by IPMA at-sea observations carried out under the National Biological Sampling Program (PNAB/EU-DCF). As in previous years, following the requirements of Reg.812/2004, Portugal is required to monitor fleet segments >= 15m 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 logistical reasons. A total of 14 trips and 46 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 0.11% of the fishing effort of boats operating off mainland Portuguese ports. The efforts on other métiers such as demersal trawls (OTB) and purse seine (PS) for Division 9.a were also presented. In 2017, onboard observers (DCF) recorded bycatch of 3 common dolphins (*Delphinus delphis*) in the purse seine fishery (PS) only, but one animal was released alive. During the same period, mortality of 2 *Larus michahellis* and 1 *Morus bassanus* were recorded in GNS and GTR.

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 2017.

In **Spain**, there is no dedicated observer programme for protected species bycatch. Monitoring is carried out under the DCF observer programme, and protected species are routinely recorded by the IEO and AZTI. Spain did not submit the Reg. 812/2004 annual report to the EC this year. Data on total effort, monitoring effort and bycatch events for the Spanish fishing fleets operating in ICES major fishing area 27 (Subarea 7 and Divisions 6b, 9a, 14b, 2a and 2b) in 2017 (collected under the DCF observer programme) were provided through the WGBYC data call (Annex 7). The data include one cetacean bycatch event of a single common dolphin (*Delphinus delphis*) by a bottom trawler in Subarea 7. Bycatch events of 10 fish species, including 9 elasmobranchs, have

been reported for 2017. Spain has not officially reported any data from the Spanish fishing fleet operating in Subareas 1, 8 and 12 or from the fleet operating in the Mediterranean Sea and the NAFO Regulatory area (major fishing area 21).

Sweden reported monitoring effort included in the 812/2004 report for data collected within the EU Data Collection Framework, where on-board observation was carried out in trawl fisheries but also pot fisheries for crayfish. In the bottom trawl fisheries (OTB) 54 days at sea (DaS) were observed out of a total effort of 8687 DaS including all areas around Sweden. In the pelagic trawl (OTT) métier 74 DaS were observed of a total of 7661 DaS. In the pot and trap (FPO) fisheries, 11 trips were observed of a total of 16038 DaS. In longline fisheries (LLS) 4 DaS were observed out of a total of 459 DaS. No bycatch of cetaceans was observed in these fisheries. Catch of other protected species were not included in the report. Also, there has been a pilot project with on-board observers dedicated to observing bycatch of marine mammals in gillnet fisheries in the south of the country. All together there was 36 observed DaS and two harbour porpoises were caught in Area 23 in large meshed gillnets. One tufted duck, one common eider, one great cormorant, three razorbills and three common guillemot were caught in Area 23 in cod gill nets or gill nets with large meshes. Due to the low monitored effort, no total bycatch numbers can be estimated. Total effort of gillnet fisheries were 19471 DaS.

For the **United Kingdom**, in 2017, 217 dedicated protected species bycatch monitoring days were conducted during 157 trips on board static net vessels and 114 dedicated bycatch monitoring days during 41 trips on pelagic trawlers. Cetacean bycatch was observed in static net gears (large mesh tangle and trammel nets and gillnets) in Subarea 7: 5 harbour porpoises (*Phocoena phocoena*) and 3 common dolphins (*Delphinus delphis*). The UK's dedicated bycatch monitoring program records all protected species bycatch and further documented 3 grey seals (*Halichoerus grypus)* and 17 seabirds (15 common guillemots [*Uria aalge*] and 2 cormorants [*Phalacrocorax carbo*]). Rarer and/or protected fish species recorded included 20 small-eyed ray (*Raja microocellata*), 2 marbled electric ray (*Torpedo marmorata*), 1361 common skate (*Dipturus batis*), 216 blue shark (*Prionace glauca),* 69 undulate ray (*Raja undulata*), 32 tope (*Galeorhinus galeus*), 44 porbeagle shark (*Lamna nasus*) and 4 shads (Alosa spp). One sunfish (*Mola mola*) was also recorded.

Under other English, Welsh and Northern Irish fishery monitoring programmes 72 and 466 days of non-dedicated sampling in static net (including drift net) and demersal trawl fisheries, respectively, was conducted. 14 days monitoring were also achieved in midwater trawl and line fisheries. All of these monitoring days (n=552) were conducted under the national discard sampling programmes to meet requirements of the Data Collection Framework. There were no records of marine mammal bycatch recorded during this monitoring effort.

To estimate total bycatch in the UK static net fleet, key assumptions were made in the treatment of the underlying fishing effort and observed monitoring data. Therefore, bycatch estimates are likely biased, and will likely underestimate bycatch for larger offshore vessels and overestimate for smaller inshore vessels. However, with this caveat in mind, the "best" estimate of harbour porpoise bycatch for 2017 in all UK net fisheries in the absence of pingers is 1,282 animals (range:718 - 2402; CV=0.08), and if all over 12 m boats used pingers in relevant areas the estimate is 1,098 animals (range: 587-2615; CV=0.10). Bycatch estimates for common dolphins and seals in 2017 are 258 (range 140-737) and 572 (range 429-1077) respectively.

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 2019 meeting, a WGBYC/ICES data call (Annex 7) requesting 2017 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 bycatch data obtained through the data call and extracted from the WGBYC database (section 6) for 2017.

The total number of specimens or number of incidents of marine mammal, seabird 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 2017 are summarised in Table 2. A total of 63 seals (four species; 4 animals unidentified to species) and 148 cetaceans (from five species: 75 common dolphins; 59 harbour porpoises 6 long-finned pilot whales, 3 striped dolphin and 4 bottlenose dolphins and an unidentified delphinid) were observed bycaught in 2017[6]. Bycatch rates were calculated by dividing the total number of observed bycaught specimens for a given species by the total number of observed days in each fishery stratum (Table 2). This method was also used to summarise seabird and elasmobranch bycatches given the increased reporting frequency for those taxa in 2017. A total of 528*** seabird specimens and 14 associated bycatch rates are reported for at least 20 bird species. A total of 97,816[7] elasmobranch specimens and 10 associated bycatch rates are reported for 49*** elasmobranch species (Table 2).

Bycatch estimates were provided by certain countries for some seabird, elasmobranch, marine mammal and turtle species in some parts of Icelandic and Mediterranean waters for 2017. For other areas, a notable bycatch rate for non-marine mammal species consisted primarily of a range of elasmobranch species taken mostly in pelagic trawl fisheries in the Greater North Sea (Spiny dogfish *Squalus acanthias,* in Division 27.4.a) and in bottom-trawl and net fisheries in the Greater North Sea and Celtic Seas (Table 2).

[6] Numbers of bycaught marine mammals have been updated after the Advice Drafting Group (ADGBYC)

[7] Numbers of bycaught birds and elasmobranch species have been updated after the Advice Drafting Group (ADGBYC)

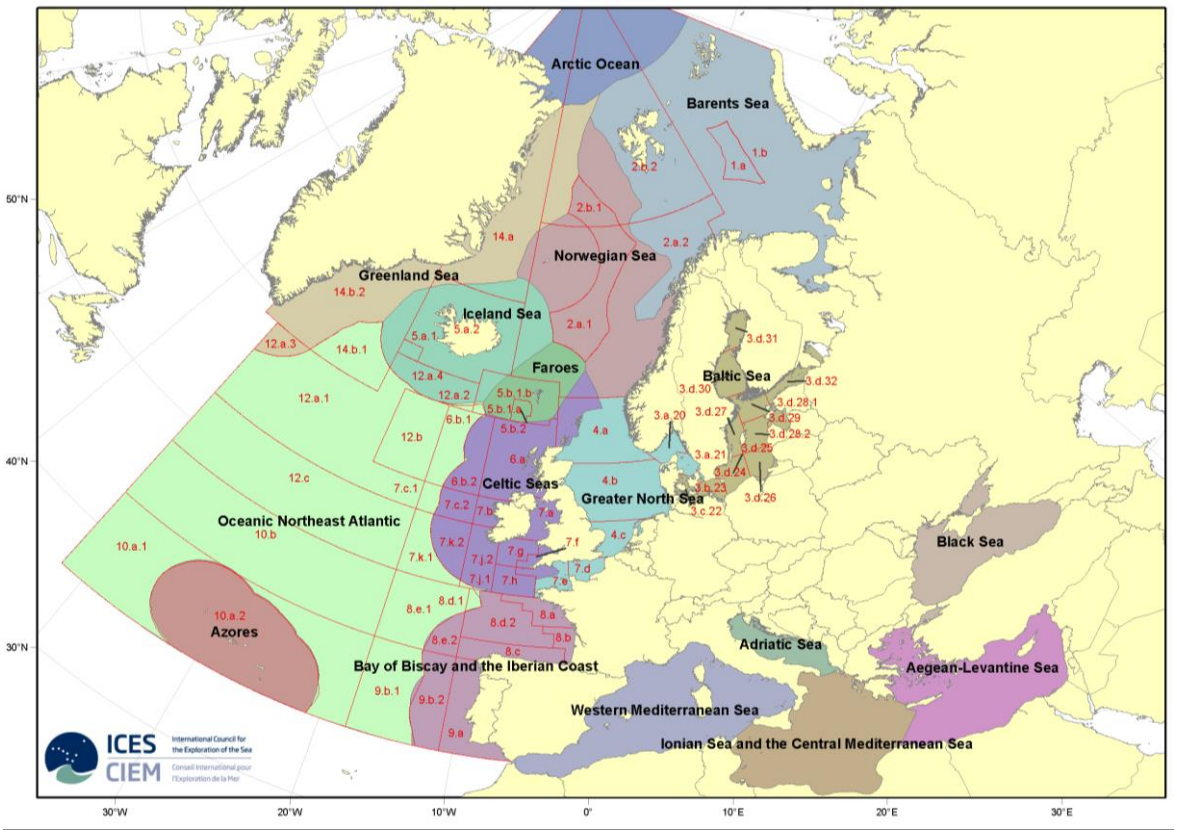

Figure 1. Map of ICES Ecoregions including ICES Statistical Areas, ices.dk. February 2017.

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) by-catch rates for each stratum.

A compilation of all 2017 monitored strata with and without bycatch estimates re-ported through the WGBYC data call are summarized in Table 2. Data were aggregated by ecoregion and ICES Division for consistency across taxa and improve the accessibility or transferability of these data to other ICES Working Groups (WGs). No extrapolated bycatch estimates were provided. In this section, WGBYC has not computed total bycatch estimates due to uncertainty associated with incomplete spatial/temporal dedicated monitoring coverage and completeness of total fishing effort data as reported to WGBYC (ICES 2014). However, bycatch risk assessments based on observed specimens, observed days monitored and fishing effort are carried out by WGBYC where more data are available for certain species and metiers (see ToR C).

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 bycatch numbers provided in the Reg 812/2004 reports and the data provided through the datacall. The data call resulted in higher numbers in some regions for observation days at sea, number of incidents and number of specimens. One MS submitted more detailed information with regards to bycatch of cetaceans through the Reg. 812/2004 report than was submitted through the data call, reporting 1 bottlenose dolphin and 2 striped dolphin bycatch in the Mediterranean in bottom and pelagic trawls respectively.

1.5 Other monitoring programmes and associated bycatch estimates

1.5.1 EU Member States

Although not in the Portuguese Reg. 812/2004 report, for the **Azores** region (ICES area 10), a study was conducted in the pole and line fishery which targets tuna (Cruz et al. 2018). Based on data collected by observers on ~50% of vessels operating from 1998 to 2012, the influence of various environmental and fisheries-related factors in common dolphin bycatch was investigated and fleet-wide estimates of total bycatch using design-based and model-based methods calculated. Total bycatch calculated from the traditional stratified ratio estimation approach was 196 (95% CI: 186–205), while the negative binomial GAM estimated 262 (95% CI: 249–274) dolphins. This work concludes that rates of common dolphin bycatch in the pole-and-line tuna fishery in the Azores are low, despite considerable variations between years

Denmark runs a large video monitoring project on Danish gill net vessels which ran between Spring 2016-2018. This video monitoring was used to increase the monitoring coverage of gill netters and develop new monitoring methods for future monitoring programs. Results from this monitoring project, which included 15 vessels, should provide a more reliable basis for estimating bycatch of marine mammals and seabirds in those fisheries. In 2017, video monitoring was carried out on board 9 different vessels fishing in areas 27.SD22-23 and 27.3a. The results are currently being processed.

Greece does not submit a Reg. 812/2004 annual report to the EC, due to no fishing activity of Greek vessels under the condition 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 under the premises of the Commission Implementing Decision (EU) 2016/1251 within the Data Collection Framework. In 2017, Greece conducted a pilot study on incidental bycatch in Greek fisheries. This pilot study covered the main métiers of the Greek fleet (GTR, GNS, OTB, PS, FPO and LLS related métiers); however, due to administrative difficulties the pilot was limited only to the north part of the GSA 22 area (Aegean Sea). A total of 822 days at sea were monitored. The observed coverage of the total fishing effort for 2017 was 0.073%.[8] No cetacean or birds bycatch incidents were recorded. One turtle (*Caretta caretta*) bycatch was recorded in gill nets. Several sharks and rays were caught: 93 Spiny Dogfishes (*Squalus acanthias*) in 5 incidents and in three different métiers, 9 Common Smoothhounds (*Mustelus mustelus*) in 6 incidents and in three different métiers, 13 Gulper sharks (*Centrophorus granulosus*) in one incident in trammel nets, 2 Blue skates (*Dipturus batis*) in one incident in a bottom otter trawl, one Angular roughshark (*Oxynotus centrina*) in a bottom trawl and one spiny butterfly ray (*Gymnura altavela*) in a trammel net. Finally, two PET Osteichthyes were recorded: Twaite shad (*Alosa fallax*), 49 individuals in 12 incidents from three métiers, and short-snouted seahorse (*Hippocampus hippocampus*), 4 specimens in 3 incidents from 2 métiers. Purse seines were also monitored but bycatch of PETS was not recorded.

In the **Netherlands,** bycatch of harbour porpoises in the Dutch fishery has been under investigation through REM (Remote Electronic Monitoring) in which 10 vessels participated. In one observation day in 2017, 4 red throated divers and 2 common guillemots were reported as bycatch in a gill net fishery targeting bass from the beach, in very shallow water. This type of fishery is very different from the overall effort recorded in the Dutch set gill net fishery, which generally targets sole in the North Sea.

[8] Sentence added based on the reviewers' comments.

A recently published work for the northwest **Spanish** sub-region (Saavedra et al. 2018) shows analysis of a 10-year time-series of data collected from multidisciplinary research surveys to estimate common dolphin (*Delphinus delphis*) abundance and trends in continental shelf waters. Data obtained from dedicated dual-platform surveys were used to correct the detection bias in the data collected using single-platforms (attraction toward the observation platform and animals missed on the track-line), to obtain absolute abundance estimates for calculating bycatch limits. The estimated safe bycatch limit for this area calculated from these abundance values were 218 [153, 310], 81 [56, 115] and 383 [268, 546] per year, respectively.

1.5.2 Non-EU Member States

WGBYC is working towards incorporating monitoring effort, fishing effort and bycatch data from non-EU states/countries that have fishing fleets in the North Atlantic. Iceland joined WGBYC in 2017 and has provided a summary of its PETS monitoring and bycatch below. An overview of marine mammal, seabird and turtle bycatch estimates and coverage rates from the US Northwest Atlantic are also included below.

Monitoring in **Icelandic waters** during 2017 included 71 trips/days on lumpsucker gillnet vessels, 60 trips/days on cod gillnet vessels, 72 trips/377 days on demersal trawl vessels, 143 trips/192 days on long line vessels fishing within the Icelandic EEZ. This monitoring effort amounted to 0.5-2% coverage of the relevant fleets[†††].

Observed marine mammal bycatch in the lumpsucker fishery was 16 harbour porpoises, 34 harbour seals, 4 grey seals, 3 harp seals, and 1 ringed seal. Observed seabird bycatch in the lumpsucker fishery was 62 common eider, 20 black guillemots, 47 common guillemots, 1 Brünnich's guillemot, 10 cormorant/shags, 2 long tailed duck, 1 common loon, 1 razorbill and 1 northern gannet. Observed marine mammal bycatch in the cod fishery was 28 harbour porpoises and 1 ringed seal. Observed seabird bycatch in the cod fishery was 3 northern fulmars, 2 gannets, and 8 common guillemots. Observed marine mammal bycatch in the demersal trawl fishery was 1 harp seal while no seabirds were observed in that fishery. Observed seabird bycatch in the longline fishery was 69 northern fulmars, 24 northern gannets, 5 lesser black-backed gulls, and 35 herring gulls.

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 raised 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 raised seabird bycatch in the lumpsucker fishery was 8339 (4837–11841) birds, thereof 3508 (2140–4876) common eiders, 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 common loons.

US Northwest Atlantic 2017 bycatch estimates (mortality and serious injuries for small cetaceans and pinnipeds) (Table 4) 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 2017 should be treated as preliminary. Final 2017 estimates are expected to be published in the 2019 US Atlantic and Gulf Of Mexico Marine Mammal Stock Assessment Report during 2020. Earlier US Marine Mammal Stock Assessment Reports can also be found online https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-region. Reported sea turtle bycatch estimates from gillnet fisheries were extracted from the referenced literature.

In summary, during 2017 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 12% and 9%, respectively for each area. Harbour porpoise, common dolphin, grey seal, harbour seal, harp seal, and offshore bottlenose dolphin were observed as bycatch in New England gillnet fisheries. Harbour porpoise, common dolphin and harbour seal were observed as bycatch in mid-Atlantic gillnet fisheries. Total 2017 bycatch estimates and relative standard error (CV) attributed to gillnet fisheries for these species ranged from three (CV=0.62) harbour seals to 930 (CV=0.16) grey seals (Table 4) (Orphanides *in review*).

Sea turtle bycatch reported for the US Northwest Atlantic remains unchanged from what was reported in WGBYC in 2018 (ICES 2018a). 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 4).

Observer coverage in 2017 New England and mid-Atlantic bottom-trawl fisheries targeting fish species only was 12% and 14%, respectively. Only white-sided *(Lagenorhynchus acutus)* dolphin and grey seal were observed as bycatch in New England bottom-trawl fisheries. In the mid-Atlantic region, common dolphin, Risso's dolphin, offshore bottlenose dolphin, and grey seal were observed as bycatch in bottom-trawl fisheries. Total 2017 bycatch estimates and relative standard error (CV) attributed to bottom-trawl fisheries for these species ranged from 15 (CV=0.64) white-sided dolphins to 380 (CV=0.23) common dolphins (Lyssikatos *et al. in prep*) (Table 4).

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

In the absence of at-sea observer monitoring programmes or when monitoring effort is low, data from other sources such as cetacean strandings can be assessed to highlight the occurrence of bycatch. Belgium, Denmark, Franceand Portugal have reported on assessments of auxiliary data in their Reg. 812/2004 reports or directly to WGBYC.

In 2017 the Royal Belgian Institute of Natural Sciences (RBINS)/Operational Directorate for the Natural Environment (OD Nature) in **Belgium** provided data of marine mammals strandings along the Belgian coast in 2017: 93 stranded harbour porpoises (*Phocoena phocoena*) were recorded - a much lower number than in 2016, but close to the 10-year average. The cause of death of the stranded animals was systematically established where possible. Of the 34 animals examined, 9 were found to have been caught incidentally in fishing operations (26.5 %), although it is not possible to be sure in what type of fishing gear. It is, however, known that the recreational use of tangle nets at sea or on shore was not the cause, as the legal ban on those fishing methods is enforced.

Concerning strandings **in Denmark**, the Danish report states that the number of stranded harbour porpoises decreased since 2008, from 224 to 74 with an annual average of 135 individuals with some animals believed to have been bycaught. It further explains that there is no organized network of volunteers in Denmark who systematically search for stranded marine mammals, therefore there are some uncertainties in the numbers.

France reports that between the 1st of February 2017 and the 31st of March, 793 cetaceans were found stranded along the French Atlantic coasts. 84% of them were common dolphins, and most of them presented evidence of death in fishing gears. An approach was tested that could help to identify the fisheries potentially involved in any given stranding event. To do this it was examined how the likely distributions of mortality of bycaught dolphins inferred from carcass drift

modelling coincide with fishing effort statistics in the same area at the same dates for different fleets, generated from the Vessel Monitoring System (VMS). Using reverse drift modelling, two main mortality areas were identify during these events (one coastal and one along the continental slope of the bay of Biscay), and 3,690 common dolphins (95% CI = 2,230-6,900]) were estimated to have died in fishing gears of the Bay of Biscay during February and March 2017. The relationship between origin of stranded bycaught dolphins and fishing effort distribution during the different stranding events was strongly positive for French midwater pair trawlers, Spanish otter bottom trawlers and French Danish seiners. Co-occurrence highlights a risk but does not prove an interaction of fishing effort with common dolphins nor its intensity. Beyond this diversity of gears, two characteristics appeared to be shared: targeting predatory fishes (sea bass and hake) in winter and using high vertical opening gears.

Portugal runs local strandings networks around the country coordinated by the Portuguese Wildlife Society and the Institute for Nature Conservation and Forests (ICNF). In 2017, stranding results were presented for the southern Portuguese coast only (Algarve), where 47 cetaceans were recovered stranded, 23,4% of which evidences of death in fishing gears. Species concerned mostly common dolphins (n=18 ind., bycatch for 38.9%), minke whales (n=6 ind., bycatch for 16.7%) and bottlenose dolphins (n=5 ind., bycatch for 20%). Particularly for these species, most evidence relied on interaction with fixed net fisheries (either gill/trammel nets or illegal coastal driftnets).

1.7 Conclusions

- The quality and scope of the information provided by the reports for 2017 continues to be variable, with some MS simply repeating the information provided in previous years.
- Most countries rely on the DCF sampling programme to monitor marine mammal and other protected species bycatch, only a few countries have a dedicated onboard observer protected species bycatch monitoring programme for the purposes of meeting the requirements of Reg. 812/2004.
- Relying only on observations carried out under the DCF may lead to 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. WGBYC continues to have insufficient data to provide bycatch rates according to pinger functionality and/or presence/absence in relevant métiers.
- Only UK, Iceland and Italy reported extrapolated bycatch estimates for some species of cetaceans, birds, marine turtles and seals.
- 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 monitoring vessel sizes and gear types only mandatory in the Reg. 812/2004 (>15 m for set-nets and pelagic trawls). Increased sampling is required on smaller vessels, which make up the majority of the European fleet and would likely account for a significant proportion of bycatch.
- Nonetheless, the data available provide an indication of bycatch rates for various taxa by gear and ecoregion. Bycatch of marine mammals was observed in all ecoregions in nets, purse seines, rod-and pole and trawl gears (pelagic and bottom trawl). The Mediterranean is the only EU region from which bycatch of marine turtles has been recorded based on the data submitted to the WGBYC database. Seabirds are also bycaught in most ecoregions, and –depending on species specific feeding behaviour- are mainly taken in nets and longlines.

- 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 nets in the Celtic Sea. A notably high bycatch rate for some vulnerable species on the IUCN red list of threatened species was observed in the Greater North Sea ecoregion for trawl gears.
- WGBYC is working toward incorporating monitoring effort, fishing effort and bycatch data from non-EU countries that have fishing fleets operating in the North Atlantic and adjoining seas. In 2017, 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 and cetaceans. In both countries, the gear of most concern is set nets and also longlines for birds in Iceland.
- Information from cetacean strandings schemes, was presented by a few countries (France, Denmark, Netherlands, Portugal, and Belgium). France had very large numbers of stranded cetaceans in the Bay of Biscay in 2017 (n = 793), 84 % of which were common dolphins, most showing evidence of having been bycaught. The numbers of stranded bycaught animals recorded on the shores of the Bay of Biscay demonstrates that a dedicated bycatch observer/Remote Electronic Monitoring programme is required for relevant fisheries in this area.
- Information provided through the Member States' Reg. 812/2004 reports and other additional and relevant sources of information is limited. For many areas and métiers, there is insufficient monitored effort to enable any assessment of the over-all impact of fisheries on cetaceans or other protected species.
- WGBYC hopes that the consistency of bycatch data at a regional scale will be improved through EU-MAP and thereby ICES WGBYC will be able to give better advice on the impact of fisheries on protected and potentially vulnerable species. However, this will only be achieved if Member States sampling takes full-account of the necessary sampling protocols for PETS and carry out bycatch monitoring in the relevant métiers with sufficient observer coverage

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; * 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; **** Data made available at the meeting.**

Coastal Member State of the EU	Monitoring (Art. 4-5) Fishing in areas affected	Report Reg 812/2004 & effort data provided											
		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Estonia EE	Yes												
Finland FI	Yes												
Latvia LV	Yes												
Lithuania LT	Yes												
Poland PL	Yes												
Italy IT	Yes												
Slovenia 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												

Table 2[9] Total number of bycatch specimens or *number of incidents reported and bycatch rates derived from the ICES WGBYC data call for 2017 data. In most Member States, data submitted to ICES WGBYC data call reflect the same data as in the Reg. 812/2004 report. However, Germany, France, Denmark and Spain had additional information not included in this table. Bycatch numbers and rates are grouped by ecoregion, taxa, métier and species.

Ecoregion	Area Code	Metier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	Total No. Specimens	Bycatch Rate (Specimen/DaS)
Azores	27.10.a.2	Longlines	Elasmobranch	*Deania calcea*	1,226	10,392	4	58	0.047
Azores	27.10.a.2	Longlines	Elasmobranch	*Isurus oxyrinchus*	1,226	10,392	19	31	0.025
Azores	27.10.a.2	Longlines	Elasmobranch	*Alopias superciliosus*	1,226	10,392	2	2	0.002
Azores	27.10.a.2	Longlines	Elasmobranch	*Dipturus batis*	1,226	10,392	45	113	0.092
Azores	27.10.a.2	Longlines	Elasmobranch	*Alopias vulpinus*	1,226	10,392	2	2	0.002
Azores	27.10.a.2	Longlines	Elasmobranch	*Dalatias licha*	1,226	10,392	52	178	0.145
Azores	27.10.a.2	Longlines	Elasmobranch	*Centrophorus granulosus*	1,226	10,392	16	70	0.057
Azores	27.10.a.2	Longlines	Elasmobranch	*Centrophorus squamosus*	1,226	10,392	1	1	0.001
Azores	27.10.a.2	Longlines	Elasmobranch	*Isurus paucus*	1,226	10,392	4	4	0.003
Azores	27.10.a.2	Longlines	Elasmobranch	*Pteroplatytrygon violacea*	1,226	10,392	2	2	0.002
Azores	27.10.a.2	Longlines	Elasmobranch	*Raja clavata*	1,226	10,392	82	1293	1.055

[9] New data were included for western Mediterranean after the Advice Drafting Group (ADG) 2019 when a new extraction from the databse was carried out. The naming of the Mediterranean areas "Ionian Sea and Central Mediterranen sea, Adriatic Sea, Aegean-Levantine Sea" was corrected.

Ecoregion	Area Code	Metier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	Total No. Specimens	Bycatch Rate (Specimen/DaS)
Azores	27.10.a.2	Longlines	Elasmobranch	*Etmopterus pusillus*	1,226	10,392	47	353	0.288
Azores	27.10.a.2	Longlines	Elasmobranch	*Etmopterus spinax*	1,226	10,392	56	2413	1.968
Azores	27.10.a.2	Hooks and lines	Elasmobranch	*Deania calcea*	1,576	26,457	2	87	0.055
Azores	27.10.a.2	Hooks and lines	Elasmobranch	*Dipturus batis*	1,576	26,457	1	4	0.003
Azores	27.10.a.2	Hooks and lines	Elasmobranch	*Dalatias licha*	1,576	26,457	2	2	0.001
Azores	27.10.a.2	Hooks and lines	Elasmobranch	*Raja clavata*	1,576	26,457	48	268	0.170
Azores	27.10.a.2	Hooks and lines	Elasmobranch	*Etmopterus pusillus*	1,576	26,457	3	17	0.011
Azores	27.10.a.2	Hooks and lines	Elasmobranch	*Etmopterus spinax*	1,576	26,457	3	18	0.011
Azores	27.10.a.2	Longlines	Marine Mammal	*Globicephala melas*	1,226	10,392	1	1	0.001
Azores	27.10.a.2	Hooks and lines	Marine Mammal	*Delphinus delphis*	1,576	26,457	1	1	0.001
Baltic Sea	27.3.b.23	Nets	Marine Bird	*Uria aalge*	17	2,446	2	3	0.176
Baltic Sea	27.3.b.23	Nets	Marine Bird	*Phalacrocorax carbo*	17	2,446	1	1	0.059
Baltic Sea	27.3.b.23	Nets	Marine Bird	*Somateria mollissima*	17	2,446	1	1	0.059
Baltic Sea	27.3.b.23	Nets	Marine Bird	*Alca torda*	17	2,446	1	3	0.176
Baltic Sea	27.3.b.23	Nets	Marine Bird	*Aythya fuligula*	17	2,446	1	1	0.059
Baltic Sea	27.3.c.22	Nets	Marine Bird	*Aythya marila*	15	52,419	1	8	0.523

Ecoregion	Area Code	Metier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	Total No. Specimens	Bycatch Rate (Specimen/DaS)
Baltic Sea	27.3.d.29	Nets	Marine Bird	*Phalacrocorax carbo*	23	13,302	4	8	0.348
Baltic Sea	27.3.d.29	Nets	Marine Bird	*Somateria mollissima*	23	13,302	4	13	0.565
Baltic Sea	27.3.d.30	Nets	Marine Bird	*Mergus*	25	26,017	2	13	0.520
Baltic Sea	27.3.d.30	Nets	Marine Bird	*Marine Bird*	25	26,017	1	1	0.040
Baltic Sea	27.3.d.30	Nets	Marine Bird	*Phalacrocorax carbo*	25	26,017	13	29	1.160
Baltic Sea	27.3.d.30	Nets	Marine Bird	*Somateria mollissima*	25	26,017	2	7	0.280
Baltic Sea	27.3.d.30	Nets	Marine Bird	*Mergus merganser*	25	26,017	5	8	0.320
Baltic Sea	27.3.d.30	Nets	Marine Bird	*Clangula hyemalis*	25	26,017	1	2	0.080
Baltic Sea	27.3.d.30	Nets	Marine Bird	*Aythya fuligula*	25	26,017	1	1	0.040
Baltic Sea	27.3.d.30	Traps	Marine Bird	*Somateria mollissima*	14	11,437	1	1	0.071
Baltic Sea	27.3.d.32	Nets	Marine Bird	*Mergus*	8	8,861	2	8	1.000
Baltic Sea	27.3.d.32	Nets	Marine Bird	*Phalacrocorax carbo*	8	8,861	9	29	3.625
Baltic Sea	27.3.d.32	Nets	Marine Bird	*Somateria mollissima*	8	8,861	3	3	0.375
Baltic Sea	27.3.d.32	Nets	Marine Bird	*Mergus merganser*	8	8,861	3	9	1.125
Baltic Sea	27.3.d.32	Nets	Marine Bird	*Podiceps cristatus*	8	8,861	2	3	0.375
Baltic Sea	27.3.d.32	Nets	Marine Bird	*Aythya marila*	8	8,861	1	1	0.125

Ecoregion	Area Code	Metier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	Total No. Specimens	Bycatch Rate (Specimen/DaS)
Baltic Sea	27.3.d.32	Nets	Marine Bird	*Clangula hyemalis*	8	8,861	1	2	0.250
Baltic Sea	27.3.d.32	Nets	Marine Bird	*Anas platyrhynchos*	8	8,861	2	2	0.250
Baltic Sea	27.3.d.32	Traps	Marine Bird	*Phalacrocorax carbo*	12	6,920	5	5	0.417
Baltic Sea	27.3.d.32	Traps	Marine Bird	*Mergus merganser*	12	6,920	1	1	0.083
Baltic Sea	27.3.b.23	Nets	Marine Mammal	*Phocoena phocoena*	17	2,446	1	2	0.118
Baltic Sea	27.3.d.28.1	Traps	Marine Mammal	*Halichoerus grypus*	13	2,615	1	1	0.077
Baltic Sea	27.3.d.29	Pelagic trawls	Marine Mammal	*Halichoerus grypus*	13	1,569	1	1	0.077
Baltic Sea	27.3.d.32	Nets	Marine Mammal	*Halichoerus grypus*	8	8,861	1	2	0.250
Baltic Sea	27.3.d.32	Traps	Marine Mammal	*Halichoerus grypus*	12	6,920	2	3	0.250
Barents Sea	27.1.b	Bottom trawls	Elasmobranch	*Amblyraja radiata*	2	59	1	38	19.00
Bay of Biscay and the Iberian Coast	27.8.a	Bottom trawls	Elasmobranch	*Hexanchus griseus*	123	46,469	1	1	0.008
Bay of Biscay and the Iberian Coast	27.8.a	Bottom trawls	Elasmobranch	*Dipturus batis*	123	46,469	3	3	0.024
Bay of Biscay and the Iberian Coast	27.8.a	Bottom trawls	Elasmobranch	*Dipturus oxyrinchus*	123	46,469	1	1	0.008
Bay of Biscay and the Iberian Coast	27.8.a	Bottom trawls	Elasmobranch	*Squalus acanthias*	123	46,469	4	16	0.130
Bay of Biscay and the Iberian Coast	27.8.a	Bottom trawls	Elasmobranch	*Raja undulata*	123	46,469	12	44	0.358
Bay of Biscay and the Iberian Coast	27.8.a	Nets	Elasmobranch	*Dalatias licha*	169	30,069	1	1	0.006

Ecoregion	Area Code	Metier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	Total No. Specimens	Bycatch Rate (Specimen/DaS)
Bay of Biscay and the Iberian Coast	27.8.a	Nets	Elasmobranch	*Leucoraja circularis*	169	30,069	3	60	0.354
Bay of Biscay and the Iberian Coast	27.8.a	Nets	Elasmobranch	*Raja undulata*	169	30,069	20	37	0.218
Bay of Biscay and the Iberian Coast	27.8.a	Pelagic trawls	Elasmobranch	*Cetorhinus maximus*	45	5,534	1	1	0.022
Bay of Biscay and the Iberian Coast	27.8.a	Pelagic trawls	Elasmobranch	*Squalus acanthias*	45	5,534	1	1	0.022
Bay of Biscay and the Iberian Coast	27.8.b	Bottom trawls	Elasmobranch	*Raja undulata*	25	10,938	6	41	1.658
Bay of Biscay and the Iberian Coast	27.8.b	Longlines	Elasmobranch	*Hexanchus griseus*	18	6,790	1	1	0.057
Bay of Biscay and the Iberian Coast	27.8.b	Longlines	Elasmobranch	*Raja undulata*	18	6,790	3	3	0.170
Bay of Biscay and the Iberian Coast	27.8.b	Nets	Elasmobranch	*Hexanchus griseus*	221	20,688	3	3	0.014
Bay of Biscay and the Iberian Coast	27.8.b	Nets	Elasmobranch	*Raja microocellata*	221	20,688	9	43	0.194
Bay of Biscay and the Iberian Coast	27.8.b	Nets	Elasmobranch	*Raja undulata*	221	20,688	63	204	0.922
Bay of Biscay and the Iberian Coast	27.8.c	Pelagic trawls	Elasmobranch	*Gymnura altavela*	86	2,770	1	1	0.012
Bay of Biscay and the Iberian Coast	27.9.a	Bottom trawls	Elasmobranch	*Galeus melastomus*	63	33,555	7	105	1.667
Bay of Biscay and the Iberian Coast	27.9.a	Bottom trawls	Elasmobranch	*Raja montagui*	63	33,555	9	33	0.524
Bay of Biscay and the Iberian Coast	27.9.a	Bottom trawls	Elasmobranch	*Squalus acanthias*	63	33,555	1	3	0.048
Bay of Biscay and the Iberian Coast	27.9.a	Bottom trawls	Elasmobranch	*Raja clavata*	63	33,555	14	61	0.968
Bay of Biscay and the Iberian Coast	27.9.a	Bottom trawls	Elasmobranch	*Galeorhinus galeus*	63	33,555	2	10	0.159

Ecoregion	Area Code	Metier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	Total No. Specimens	Bycatch Rate (Specimen/DaS)
Bay of Biscay and the Iberian Coast	27.9.a	Bottom trawls	Elasmobranch	*Raja undulata*	63	33,555	19	58	0.921
Bay of Biscay and the Iberian Coast	27.9.a	Bottom trawls	Elasmobranch	*Etmopterus spinax*	63	33,555	1	16	0.254
Bay of Biscay and the Iberian Coast	27.9.a	Nets	Elasmobranch	*Rostroraja alba*	21	118,720	2	12	0.571
Bay of Biscay and the Iberian Coast	27.8.a	Nets	Marine Bird	*Uria aalge*	169	30,069	2	4	0.024
Bay of Biscay and the Iberian Coast	27.8.a	Nets	Marine Bird	*Phalacrocorax carbo*	169	30,069	1	2	0.012
Bay of Biscay and the Iberian Coast	27.8.b	Nets	Marine Bird	*Uria aalge*	221	20,688	3	3	0.014
Bay of Biscay and the Iberian Coast	27.8.b	Nets	Marine Bird	*Puffinus mauretanicus*	221	20,688	2	4	0.018
Bay of Biscay and the Iberian Coast	27.9.a	Nets	Marine Bird	*Morus bassanus*	21	118,720	1	1	0.048
Bay of Biscay and the Iberian Coast	27.9.a	Nets	Marine Bird	*Larus michahellis*	21	118,720	1	2	0.095
Bay of Biscay and the Iberian Coast	27.8.a	Bottom trawls	Marine Mammal	*Phocoena phocoena*	123	46,469	1	1	0.008
Bay of Biscay and the Iberian Coast	27.8.a	Nets	Marine Mammal	*Delphinus delphis*	169	30,069	1	1	0.006
Bay of Biscay and the Iberian Coast	27.8.a	Pelagic trawls	Marine Mammal	*Delphinus delphis*	45	5,534	6	49	1.101
Bay of Biscay and the Iberian Coast	27.8.b	Nets	Marine Mammal	*Phocoena phocoena*	221	20,688	4	4	0.018
Bay of Biscay and the Iberian Coast	27.8.b	Nets	Marine Mammal	*Delphinus delphis*	221	20,688	5	5	0.023
Bay of Biscay and the Iberian Coast	27.8.b	Pelagic trawls	Marine Mammal	*Phocoena phocoena*	9	1,709	1	1	0.118
Bay of Biscay and the Iberian Coast	27.8.b	Pelagic trawls	Marine Mammal	*Delphinus delphis*	9	1,709	6	8	0.941

Ecoregion	Area Code	Metier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	Total No. Specimens	Bycatch Rate (Specimen/DaS)
Bay of Biscay and the Iberian Coast	27.8.c	Pelagic trawls	Marine Mammal	*Globicephala melas*	86	2,770	1	5	0.058
Bay of Biscay and the Iberian Coast	27.9.a	Seines	Marine Mammal	*Delphinus delphis*	40	14,269	1	2	0.050
Celtic Seas	27.7	Bottom trawls	Elasmobranch	*Galeus melastomus*	117	NULL	30	210	1.795
Celtic Seas	27.7	Bottom trawls	Elasmobranch	*Dipturus batis*	117	NULL	94	1064	9.094
Celtic Seas	27.7	Bottom trawls	Elasmobranch	*Squalus acanthias*	117	NULL	1	1	0.009
Celtic Seas	27.7	Bottom trawls	Elasmobranch	*Raja clavata*	117	NULL	33	113	0.966
Celtic Seas	27.7	Bottom trawls	Elasmobranch	*Leucoraja circularis*	117	NULL	2	4	0.034
Celtic Seas	27.7	Bottom trawls	Elasmobranch	*Galeorhinus galeus*	117	NULL	1	4	0.034
Celtic Seas	27.7	Bottom trawls	Elasmobranch	*Raja undulata*	117	NULL	4	18	0.154
Celtic Seas	27.7	Bottom trawls	Elasmobranch	*Etmopterus spinax*	117	NULL	5	29	0.248
Celtic Seas	27.6.a	Bottom trawls	Elasmobranch	*Dipturus intermedius*	173	1,574	12	19	0.110
Celtic Seas	27.6.a	Bottom trawls	Elasmobranch	*Dipturus nidarosiensis*	271	1,574	1	7	0.026
Celtic Seas	27.6.a	Bottom trawls	Elasmobranch	*Hexanchus griseus*	173	1,574	5	11	0.064
Celtic Seas	27.6.a	Bottom trawls	Elasmobranch	*Dipturus batis*	173	1,574	2	2	0.012
Celtic Seas	27.6.a	Bottom trawls	Elasmobranch	*Dipturus batis*	271	1,574	5	33	0.122
Celtic Seas	27.6.a	Bottom trawls	Elasmobranch	*Dipturus batis*	96	1,133	57	181	1.885

Ecoregion	Area Code	Metier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	Total No. Specimens	Bycatch Rate (Specimen/DaS)
Celtic Seas	27.6.a	Bottom trawls	Elasmobranch	*Dalatias licha*	173	1,574	2	10	0.058
Celtic Seas	27.6.a	Bottom trawls	Elasmobranch	*Chlamydoselachus anguineus*	173	1,574	1	1	0.006
Celtic Seas	27.6.a	Bottom trawls	Elasmobranch	*Somniosus microcephalus*	173	1,574	2	2	0.012
Celtic Seas	27.6.a	Bottom trawls	Elasmobranch	*Dipturus oxyrinchus*	173	1,574	29	186	1.076
Celtic Seas	27.6.a	Bottom trawls	Elasmobranch	*Squalus acanthias*	173	1,574	10	208	1.204
Celtic Seas	27.6.a	Bottom trawls	Elasmobranch	*Centroscymnus coelolepis*	271	1,574	1	1	0.004
Celtic Seas	27.6.a	Bottom trawls	Elasmobranch	*Raja clavata*	271	1,574	26	149	0.550
Celtic Seas	27.6.a	Bottom trawls	Elasmobranch	*Amblyraja radiata*	271	1,574	2	3	0.011
Celtic Seas	27.6.a	Longlines	Elasmobranch	*Squalus acanthias*	51	779	1	1	0.020
Celtic Seas	27.6.a	Pelagic trawls	Elasmobranch	*Lamna nasus*	27	315	2	2	0.074
Celtic Seas	27.6.a	Pelagic trawls	Elasmobranch	*Squalus acanthias*	27	315	2	4	0.148
Celtic Seas	27.6.b	Bottom trawls	Elasmobranch	*Prionace glauca*	12	1,533	1	1	0.083
Celtic Seas	27.6.b	Bottom trawls	Elasmobranch	*Dipturus batis*	36	1,533	5	9	0.250
Celtic Seas	27.6.b	Bottom trawls	Elasmobranch	*Raja clavata*	12	1,533	1	2	0.167
Celtic Seas	27.7.a	Bottom trawls	Elasmobranch	*Dipturus batis*	72	2,935	4	10	0.139
Celtic Seas	27.7.b	Bottom trawls	Elasmobranch	*Dipturus batis*	51	2,397	11	27	0.529

Ecoregion	Area Code	Metier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	Total No. Specimens	Bycatch Rate (Specimen/DaS)
Celtic Seas	27.7.f	Bottom trawls	Elasmobranch	*Dipturus batis*	7	940	2	25	3.685
Celtic Seas	27.7.f	Bottom trawls	Elasmobranch	*Dipturus batis*	29	940	2	5	0.172
Celtic Seas	27.7.f	Bottom trawls	Elasmobranch	*Raja microocellata*	7	940	1	90	13.266
Celtic Seas	27.7.f	Bottom trawls	Elasmobranch	*Squalus acanthias*	7	940	1	20	2.948
Celtic Seas	27.7.f	Bottom trawls	Elasmobranch	*Squalus acanthias*	29	940	2	4	0.138
Celtic Seas	27.7.f	Nets	Elasmobranch	*Lamna nasus*	62	-	4	4	0.064
Celtic Seas	27.7.f	Nets	Elasmobranch	*Squatina squatina*	62	-	1	1	0.016
Celtic Seas	27.7.f	Nets	Elasmobranch	*Prionace glauca*	62	-	1	2	0.032
Celtic Seas	27.7.f	Nets	Elasmobranch	*Hexanchus griseus*	62	-	1	1	0.016
Celtic Seas	27.7.f	Nets	Elasmobranch	*Dipturus batis*	62	-	1	1	0.016
Celtic Seas	27.7.f	Nets	Elasmobranch	*Raja microocellata*	62	-	4	6	0.096
Celtic Seas	27.7.f	Nets	Elasmobranch	*Squalus acanthias*	62	-	23	89	1.425
Celtic Seas	27.7.f	Nets	Elasmobranch	*Galeorhinus galeus*	62	-	11	16	0.256
Celtic Seas	27.7.g	Bottom trawls	Elasmobranch	*Dipturus intermedius*	97	4,425	2	3	0.031
Celtic Seas	27.7.g	Bottom trawls	Elasmobranch	*Tetronarce nobiliana*	36	4,425	4	4	0.111
Celtic Seas	27.7.g	Bottom trawls	Elasmobranch	*Hexanchus griseus*	97	4,425	1	1	0.010

Ecoregion	Area Code	Metier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	Total No. Specimens	Bycatch Rate (Specimen/DaS)
Celtic Seas	27.7.g	Bottom trawls	Elasmobranch	*Dipturus batis*	35	10,185	16	46	1.331
Celtic Seas	27.7.g	Bottom trawls	Elasmobranch	*Dipturus batis*	97	4,425	48	1058	10.858
Celtic Seas	27.7.g	Bottom trawls	Elasmobranch	*Dipturus batis*	36	4,425	18	100	2.778
Celtic Seas	27.7.g	Bottom trawls	Elasmobranch	*Dipturus batis*	216	13,626	163	517	2.394
Celtic Seas	27.7.g	Bottom trawls	Elasmobranch	*Squalus acanthias*	35	10,185	2	16	0.463
Celtic Seas	27.7.g	Bottom trawls	Elasmobranch	*Squalus acanthias*	97	4,425	16	598	6.137
Celtic Seas	27.7.g	Bottom trawls	Elasmobranch	*Squalus acanthias*	36	4,425	4	6	0.167
Celtic Seas	27.7.g	Bottom trawls	Elasmobranch	*Raja undulata*	216	13,626	7	16	0.074
Celtic Seas	27.7.g	Nets	Elasmobranch	*Dipturus batis*	26	-	1	1	0.038
Celtic Seas	27.7.g	Nets	Elasmobranch	*Lamna nasus*	26	-	17	32	1.215
Celtic Seas	27.7.g	Nets	Elasmobranch	*Prionace glauca*	26	-	20	218	8.278
Celtic Seas	27.7.g	Nets	Elasmobranch	*Dipturus batis*	26	-	2	2	0.076
Celtic Seas	27.7.g	Nets	Elasmobranch	*Squalus acanthias*	26	-	33	272	10.329
Celtic Seas	27.7.g	Nets	Elasmobranch	*Galeorhinus galeus*	26	-	1	2	0.076
Celtic Seas	27.7.g	Seines	Elasmobranch	*Dipturus intermedius*	12	92	1	2	0.163
Celtic Seas	27.7.g	Seines	Elasmobranch	*Dipturus batis*	12	92	4	12	0.981

Ecoregion	Area Code	Metier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	Total No. Specimens	Bycatch Rate (Specimen/DaS)
Celtic Seas	27.7.g	Seines	Elasmobranch	*Dipturus batis*	5	1,033	1	1	0.200
Celtic Seas	27.7.g	Seines	Elasmobranch	*Squalus acanthias*	12	92	3	17	1.389
Celtic Seas	27.7.h	Bottom trawls	Elasmobranch	*Tetronarce nobiliana*	43	10,296	5	5	0.116
Celtic Seas	27.7.h	Bottom trawls	Elasmobranch	*Prionace glauca*	43	10,296	1	2	0.047
Celtic Seas	27.7.h	Bottom trawls	Elasmobranch	*Dipturus batis*	200	10,296	69	461	2.304
Celtic Seas	27.7.h	Bottom trawls	Elasmobranch	*Dipturus batis*	43	10,296	81	430	10.000
Celtic Seas	27.7.h	Bottom trawls	Elasmobranch	*Dipturus batis*	9	1,043	2	4	0.444
Celtic Seas	27.7.h	Bottom trawls	Elasmobranch	*Torpedo marmorata*	43	10,296	2	2	0.047
Celtic Seas	27.7.h	Bottom trawls	Elasmobranch	*Squalus acanthias*	200	10,296	18	210	1.050
Celtic Seas	27.7.h	Bottom trawls	Elasmobranch	*Squalus acanthias*	43	10,296	12	28	0.651
Celtic Seas	27.7.h	Bottom trawls	Elasmobranch	*Galeorhinus galeus*	43	10,296	1	1	0.023
Celtic Seas	27.7.h	Nets	Elasmobranch	*Dipturus batis*	28	2,078	3	551	19.930
Celtic Seas	27.7.h	Nets	Elasmobranch	*Lamna nasus*	28	2,078	9	18	0.651
Celtic Seas	27.7.h	Nets	Elasmobranch	*Tetronarce nobiliana*	28	2,078	1	1	0.036
Celtic Seas	27.7.h	Nets	Elasmobranch	*Prionace glauca*	28	2,078	1	1	0.036
Celtic Seas	27.7.h	Nets	Elasmobranch	*Torpedo marmorata*	28	2,078	1	1	0.036

Ecoregion	Area Code	Metier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	Total No. Specimens	Bycatch Rate (Specimen/DaS)
Celtic Seas	27.7.h	Nets	Elasmobranch	*Squalus acanthias*	14	2,078	3	4	0.279
Celtic Seas	27.7.h	Nets	Elasmobranch	*Squalus acanthias*	28	2,078	9	243	8.789
Celtic Seas	27.7.h	Nets	Elasmobranch	*Galeorhinus galeus*	28	2,078	7	9	0.326
Celtic Seas	27.7.h	Nets	Elasmobranch	*Raja undulata*	28	2,078	4	5	0.181
Celtic Seas	27.7.j	Bottom trawls	Elasmobranch	*Dipturus nidarosiensis*	66	4,636	1	1	0.015
Celtic Seas	27.7.j	Bottom trawls	Elasmobranch	*Hexanchus griseus*	66	4,636	6	17	0.257
Celtic Seas	27.7.j	Bottom trawls	Elasmobranch	*Dipturus batis*	66	4,636	7	87	1.316
Celtic Seas	27.7.j	Bottom trawls	Elasmobranch	*Dipturus batis*	25	4,636	5	22	0.880
Celtic Seas	27.7.j	Bottom trawls	Elasmobranch	*Dalatias licha*	66	1,375	1	13	0.197
Celtic Seas	27.7.j	Nets	Elasmobranch	*Dipturus batis*	12	1,375	5	806	68.914
Celtic Seas	27.7.j	Nets	Elasmobranch	*Lamna nasus*	12	1,375	2	2	0.171
Celtic Seas	27.7.j	Nets	Elasmobranch	*Squatina squatina*	179	1,375	2	3	0.017
Celtic Seas	27.7.j	Nets	Elasmobranch	*Dipturus batis*	179	1,375	39	95	0.531
Celtic Seas	27.7.j	Nets	Elasmobranch	*Squalus acanthias*	12	1,375	5	10	0.855
Celtic Seas	27.7.j	Nets	Elasmobranch	*Galeorhinus galeus*	12	1,375	3	5	0.428
Celtic Seas	27.7.j	Pelagic trawls	Elasmobranch	*Lamna nasus*	1	30	1	1	1.000

Ecoregion	Area Code	Metier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	Total No. Specimens	Bycatch Rate (Specimen/DaS)
Celtic Seas	27.7.j	Seines	Elasmobranch	*Dipturus batis*	5	627	3	16	3.200
Celtic Seas	27.6.a	Bottom trawls	Marine Bird	*Larus argentatus*	271	1,574	1	1	0.004
Celtic Seas	27.7.f	Nets	Marine Bird	*Uria aalge*	62	-	8	10	0.160
Celtic Seas	27.7.g	Bottom trawls	Marine Bird	*Morus bassanus*	97	4,425	1	1	0.010
Celtic Seas	27.7.j	Nets	Marine Bird	*Uria aalge*	179	1,375	1	3	0.017
Celtic Seas	27.7	Bottom trawls	Marine Mammal	*Delphinus delphis*	117	-	1	1	0.009
Celtic Seas	27.6.a	Bottom trawls	Marine Mammal	*Phocidae*	271	1,574	1	1	0.004
Celtic Seas	27.6.a	Pelagic trawls	Marine Mammal	*Halichoerus grypus*	29	161	1	1	0.034
Celtic Seas	27.7.b	Pelagic trawls	Marine Mammal	*Halichoerus grypus*	7	83	1	1	0.143
Celtic Seas	27.7.f	Nets	Marine Mammal	*Phocoena phocoena*	62	-	3	4	0.064
Celtic Seas	27.7.f	Nets	Marine Mammal	*Delphinus delphis*	62	-	1	1	0.016
Celtic Seas	27.7.f	Nets	Marine Mammal	*Halichoerus grypus*	62	-	1	1	0.016
Celtic Seas	27.7.g	Bottom trawls	Marine Mammal	*Phocoena phocoena*	97	4,425	1	1	0.010
Celtic Seas	27.7.g	Bottom trawls	Marine Mammal	*Delphinus delphis*	216	13,626	2	2	0.009
Celtic Seas	27.7.h	Bottom trawls	Marine Mammal	*Delphinus delphis*	200	10,296	1	1	0.005
Celtic Seas	27.7.h	Nets	Marine Mammal	*Delphinus delphis*	28	2,078	1	1	0.036

Ecoregion	Area Code	Metier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	Total No. Specimens	Bycatch Rate (Specimen/DaS)
Celtic Seas	27.7.j	Nets	Marine Mammal	*Delphinus delphis*	179	1,375	1	1	0.006
Celtic Seas	27.7.j	Nets	Marine Mammal	*Halichoerus grypus*	179	1,375	2	2	0.011
Celtic Seas	27.7.j	Nets	Marine Mammal	*Phocidae*	179	1,375	2	2	0.011
Faroes	27.5.b	Bottom trawls	Elasmobranch	*Dalatias licha*	10	-	3	4	0.391
Greater North Sea	27.3.a.20	Bottom trawls	Elasmobranch	*Scyliorhinus canicula*	61	10,032	4	10	0.164
Greater North Sea	27.3.a.20	Bottom trawls	Elasmobranch	*Dipturus linteus*	61	10,032	7	29	0.475
Greater North Sea	27.3.a.20	Bottom trawls	Elasmobranch	*Squalus acanthias*	61	10,032	14	476	7.803
Greater North Sea	27.3.a.20	Bottom trawls	Elasmobranch	*Raja clavata*	61	10,032	5	10	0.164
Greater North Sea	27.3.a.20	Bottom trawls	Elasmobranch	*Amblyraja radiata*	61	10,032	37	871	14.279
Greater North Sea	27.3.a.20	Bottom trawls	Elasmobranch	*Mustelus asterias*	61	10,032	1	1	0.016
Greater North Sea	27.3.a.20	Bottom trawls	Elasmobranch	*Etmopterus spinax*	61	10,032	16	159	2.607
Greater North Sea	27.3.a.21	Bottom trawls	Elasmobranch	*Scyliorhinus canicula*	28	2,902	1	5	0.179
Greater North Sea	27.3.a.21	Bottom trawls	Elasmobranch	*Squalus acanthias*	28	2,902	3	14	0.500
Greater North Sea	27.3.a.21	Bottom trawls	Elasmobranch	*Raja clavata*	28	2,902	1	3	0.107
Greater North Sea	27.3.a.21	Bottom trawls	Elasmobranch	*Amblyraja radiata*	28	2,902	2	3	0.107
Greater North Sea	27.4.a	Bottom trawls	Elasmobranch	*Dipturus intermedius*	149	1,405	2	5	0.034

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Greater North Sea	27.4.a	Bottom trawls	Elasmobranch	*Dipturus intermedius*	290	1,832	5	25	0.086
Greater North Sea	27.4.a	Bottom trawls	Elasmobranch	*Cetorhinus maximus*	149	1,405	2	2	0.013
Greater North Sea	27.4.a	Bottom trawls	Elasmobranch	*Dipturus nidarosiensis*	290	1,832	2	12	0.041
Greater North Sea	27.4.a	Bottom trawls	Elasmobranch	*Galeus melastomus*	12	361	9	22	1.833
Greater North Sea	27.4.a	Bottom trawls	Elasmobranch	*Dipturus batis*	28	747	6	7	0.250
Greater North Sea	27.4.a	Bottom trawls	Elasmobranch	*Dipturus batis*	149	1,405	3	4	0.027
Greater North Sea	27.4.a	Bottom trawls	Elasmobranch	*Dipturus batis*	290	1,832	9	61	0.210
Greater North Sea	27.4.a	Bottom trawls	Elasmobranch	*Dipturus batis*	12	361	3	16	1.333
Greater North Sea	27.4.a	Bottom trawls	Elasmobranch	*Dalatias licha*	149	1,405	1	1	0.007
Greater North Sea	27.4.a	Bottom trawls	Elasmobranch	*Dipturus oxyrinchus*	149	1,405	4	6	0.040
Greater North Sea	27.4.a	Bottom trawls	Elasmobranch	*Dipturus oxyrinchus*	12	361	3	2	0.167
Greater North Sea	27.4.a	Bottom trawls	Elasmobranch	*Dipturus linteus*	12	361	5	14	1.167
Greater North Sea	27.4.a	Bottom trawls	Elasmobranch	*Squalus acanthias*	149	1,405	4	4	0.027
Greater North Sea	27.4.a	Bottom trawls	Elasmobranch	*Squalus acanthias*	12	361	2	40	3.333
Greater North Sea	27.4.a	Bottom trawls	Elasmobranch	*Raja clavata*	290	1,832	20	175	0.603
Greater North Sea	27.4.a	Bottom trawls	Elasmobranch	*Leucoraja circularis*	149	1,405	3	19	0.128

Ecoregion	Area Code	Metier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	Total No. Specimens	Bycatch Rate (Specimen/DaS)
Greater North Sea	27.4.a	Bottom trawls	Elasmobranch	*Amblyraja radiata*	290	1,832	45	2428	8.372
Greater North Sea	27.4.a	Bottom trawls	Elasmobranch	*Amblyraja radiata*	12	361	8	61	5.083
Greater North Sea	27.4.a	Bottom trawls	Elasmobranch	*Amblyraja radiata*	28	747	13	35	1.250
Greater North Sea	27.4.a	Bottom trawls	Elasmobranch	*Mustelus asterias*	290	1,832	1	3	0.010
Greater North Sea	27.4.a	Bottom trawls	Elasmobranch	*Etmopterus spinax*	12	361	10	1573	131.083
Greater North Sea	27.4.a	Pelagic trawls	Elasmobranch	*Squalus acanthias*	36	311	25	57392.3	1594.231
Greater North Sea	27.4.a	Seines	Elasmobranch	*Raja clavata*	23	162	2	4	0.174
Greater North Sea	27.4.a	Seines	Elasmobranch	*Amblyraja radiata*	23	162	7	297	12.913
Greater North Sea	27.4.b	Bottom trawls	Elasmobranch	*Dipturis batis*	221	2,074	1	1	0.005
Greater North Sea	27.4.b	Bottom trawls	Elasmobranch	*Raja montagui*	36	15,253	7	50.15	1.393
Greater North Sea	27.4.b	Bottom trawls	Elasmobranch	*Squalus acanthias*	36	15,253	2	12.38	0.344
Greater North Sea	27.4.b	Bottom trawls	Elasmobranch	*Raja clavata*	36	24,145	3	1	0.028
Greater North Sea	27.4.b	Bottom trawls	Elasmobranch	*Raja clavata*	221	2,074	2	3	0.014
Greater North Sea	27.4.b	Bottom trawls	Elasmobranch	*Raja clavata*	36	15,253	6	49.71	1.381
Greater North Sea	27.4.b	Bottom trawls	Elasmobranch	*Mustelus mustelus*	36	15,253	1	24.54	0.682
Greater North Sea	27.4.b	Bottom trawls	Elasmobranch	*Amblyraja radiata*	221	2,074	4	79	0.357

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Greater North Sea	27.4.b	Bottom trawls	Elasmobranch	*Amblyraja radiata*	36	15,253	155	597.85	16.607
Greater North Sea	27.4.b	Bottom trawls	Elasmobranch	*Amblyraja radiata*	36	24,145	14	78	2.167
Greater North Sea	27.4.c	Bottom trawls	Elasmobranch	*Raja montagui*	21	30,036	6	254.96	12.141
Greater North Sea	27.4.c	Bottom trawls	Elasmobranch	*Raja clavata*	21	30,036	27	556.67	26.508
Greater North Sea	27.4.c	Nets	Elasmobranch	*Galeorhinus galeus*	3	115	4	4	1.333
Greater North Sea	27.7.d	Bottom trawls	Elasmobranch	*Raja microocellata*	179	20,164	4	43	0.240
Greater North Sea	27.7.d	Bottom trawls	Elasmobranch	*Squalus acanthias*	96	18,811	1	1	0.010
Greater North Sea	27.7.d	Bottom trawls	Elasmobranch	*Raja undulata*	96	18,811	15	37	0.386
Greater North Sea	27.7.d	Bottom trawls	Elasmobranch	*Raja undulata*	179	20,164	91	1827	10.211
Greater North Sea	27.7.d	Bottom trawls	Elasmobranch	*Raja undulata*	5	10,624	8	50	10.000
Greater North Sea	27.7.d	Nets	Elasmobranch	*Dipturus batis*	28	10,624	4	4	0.143
Greater North Sea	27.7.d	Nets	Elasmobranch	*Dasyatis pastinaca*	28	10,624	1	1	0.036
Greater North Sea	27.7.d	Nets	Elasmobranch	*Raja microocellata*	94	10,624	1	1	0.011
Greater North Sea	27.7.d	Nets	Elasmobranch	*Raja microocellata*	28	10,624	4	4	0.143
Greater North Sea	27.7.d	Nets	Elasmobranch	*Galeorhinus galeus*	28	10,624	4	4	0.143
Greater North Sea	27.7.d	Nets	Elasmobranch	*Raja undulata*	94	10,624	33	85	0.906

Ecoregion	Area Code	Metier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	Total No. Specimens	Bycatch Rate (Specimen/DaS)
Greater North Sea	27.7.d	Nets	Elasmobranch	*Raja undulata*	28	10,624	31	86	3.071
Greater North Sea	27.7.d	Pelagic trawls	Elasmobranch	*Lamna nasus*	39	138	2	2	0.051
Greater North Sea	27.7.d	Pelagic trawls	Elasmobranch	*Raja clavata*	15	52	1	1	0.067
Greater North Sea	27.7.d	Pelagic trawls	Elasmobranch	*Mustelus asterias*	39	138	34	202.17	5.184
Greater North Sea	27.7.d	Pelagic trawls	Elasmobranch	*Raja undulata*	21	3,152	4	72	3.509
Greater North Sea	27.7.d	Seines	Elasmobranch	*Raja undulata*	21	913	5	16	0.762
Greater North Sea	27.7.e	Bottom trawls	Elasmobranch	*Lamna nasus*	167	15,655	1	1	0.006
Greater North Sea	27.7.e	Bottom trawls	Elasmobranch	*Tetronarce nobiliana*	167	15,655	5	6	0.036
Greater North Sea	27.7.e	Bottom trawls	Elasmobranch	*Cetorhinus maximus*	102	15,655	2	2	0.020
Greater North Sea	27.7.e	Bottom trawls	Elasmobranch	*Prionace glauca*	167	15,655	2	2	0.012
Greater North Sea	27.7.e	Bottom trawls	Elasmobranch	*Dipturus batis*	102	15,655	10	206	2.025
Greater North Sea	27.7.e	Bottom trawls	Elasmobranch	*Dipturus batis*	167	15,655	35	150	0.898
Greater North Sea	27.7.e	Bottom trawls	Elasmobranch	*Torpedo marmorata*	167	15,655	9	12	0.072
Greater North Sea	27.7.e	Bottom trawls	Elasmobranch	*Squalus acanthias*	102	15,655	10	372	3.656
Greater North Sea	27.7.e	Bottom trawls	Elasmobranch	*Squalus acanthias*	167	15,655	4	6	0.036
Greater North Sea	27.7.e	Bottom trawls	Elasmobranch	*Galeorhinus galeus*	167	15,655	4	6	0.036

Ecoregion	Area Code	Metier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	Total No. Specimens	Bycatch Rate (Specimen/DaS)
Greater North Sea	27.7.e	Bottom trawls	Elasmobranch	*Raja undulata*	102	15,655	60	1407	13.829
Greater North Sea	27.7.e	Bottom trawls	Elasmobranch	*Raja undulata*	167	15,655	129	287	1.719
Greater North Sea	27.7.e	Dredges	Elasmobranch	*Raja undulata*	18	12,563	1	1	0.056
Greater North Sea	27.7.e	Nets	Elasmobranch	*Dipturus batis*	131	12,563	2	2	0.015
Greater North Sea	27.7.e	Nets	Elasmobranch	*Prionace glauca*	131	12,563	3	4	0.031
Greater North Sea	27.7.e	Nets	Elasmobranch	*Dasyatis pastinaca*	131	12,563	2	2	0.015
Greater North Sea	27.7.e	Nets	Elasmobranch	*Raja microocellata*	68	12,563	1	1	0.015
Greater North Sea	27.7.e	Nets	Elasmobranch	*Raja microocellata*	131	12,563	5	10	0.076
Greater North Sea	27.7.e	Nets	Elasmobranch	*Squalus acanthias*	131	12,563	3	19	0.145
Greater North Sea	27.7.e	Nets	Elasmobranch	*Galeorhinus galeus*	131	12,563	9	9	0.069
Greater North Sea	27.7.e	Nets	Elasmobranch	*Raja undulata*	68	12,563	32	143	2.114
Greater North Sea	27.7.e	Nets	Elasmobranch	*Raja undulata*	131	12,563	4	145	1.108
Greater North Sea	27.7.e	Pelagic trawls	Elasmobranch	*Lamna nasus*	10	41	1	2	0.200
Greater North Sea	27.7.e	Pelagic trawls	Elasmobranch	*Alopias vulpinus*	10	41	1	3	0.300
Greater North Sea	27.7.e	Pelagic trawls	Elasmobranch	*Alopias vulpinus*	3	41	1	1	0.333
Greater North Sea	27.7.e	Seines	Elasmobranch	*Dipturus batis*	2	51	2	9	5.964

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Greater North Sea	27.7.e	Seines	Elasmobranch	*Squalus acanthias*	2	51	1	9	5.964
Greater North Sea	27.4.a	Bottom trawls	Marine Bird	*Morus bassanus*	290	1,832	6	16	0.055
Greater North Sea	27.4.c	Nets	Marine Bird	*Uria aalge*	5	1,757	1	2	0.400
Greater North Sea	27.4.c	Nets	Marine Bird	*Gavia stellata*	5	1,757	1	4	0.800
Greater North Sea	27.7.d	Nets	Marine Bird	*Uria aalge*	28	10,624	1	1	0.036
Greater North Sea	27.7.d	Pelagic trawls	Marine Bird	*Larus argentatus*	21	3,152	1	1	0.049
Greater North Sea	27.7.e	Nets	Marine Bird	*Uria aalge*	131	12,563	3	4	0.031
Greater North Sea	27.7.e	Nets	Marine Bird	*Phalacrocorax carbo*	131	12,563	2	2	0.015
Greater North Sea	27.3.a.20	Nets	Marine Mammal	*Phocoena phocoena*	15	5,813	0	1	0.067
Greater North Sea	27.4.a	Bottom trawls	Marine Mammal	*Phocidae*	290	1,832	1	1	0.003
Greater North Sea	27.7.e	Nets	Marine Mammal	*Phocoena phocoena*	131	12,563	1	1	0.008
Greater North Sea	27.7.e	Nets	Marine Mammal	*Delphinus delphis*	131	12,563	2	2	0.015
Greater North Sea	27.7.e	Nets	Marine Mammal	*Halichoerus grypus*	68	12,563	1	1	0.015
Greater North Sea	27.7.e	Nets	Marine Mammal	*Halichoerus grypus*	131	12,563	2	2	0.015
Greenland Sea	27.14.b.2	Bottom trawls	Elasmobranch	*Deania calcea*	84	333	1	1	0.012
Greenland Sea	27.14.b.2	Bottom trawls	Elasmobranch	*Dipturus batis*	84	333	13	16	0.190

Ecoregion	Area Code	Metier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	Total No. Specimens	Bycatch Rate (Specimen/DaS)
Greenland Sea	27.14.b.2	Bottom trawls	Elasmobranch	*Centroscymnus coelolepis*	84	333	6	6	0.071
Greenland Sea	27.14.b.2	Bottom trawls	Elasmobranch	*Amblyraja radiata*	84	333	16	29	0.345
Iceland Sea	27.5.a.2	Longlines	Marine Bird	*Larus argentatus*	132	13,372	1	35	0.265
Iceland Sea	27.5.a.2	Longlines	Marine Bird	*Fulmarus glacialis*	132	13,372	9	69	0.523
Iceland Sea	27.5.a.2	Longlines	Marine Bird	*Morus bassanus*	132	13,372	3	24	0.182
Iceland Sea	27.5.a.2	Longlines	Marine Bird	*Larus fuscus*	132	13,372	1	5	0.038
Iceland Sea	27.5.a.2	Nets	Marine Bird	*Uria aalge*	131	12,813	13	55	0.420
Iceland Sea	27.5.a.2	Nets	Marine Bird	*Cepphus grylle*	131	12,813	6	20	0.153
Iceland Sea	27.5.a.2	Nets	Marine Bird	*Uria lomvia*	131	12,813	1	1	0.008
Iceland Sea	27.5.a.2	Nets	Marine Bird	*Somateria mollissima*	131	12,813	13	62	0.473
Iceland Sea	27.5.a.2	Nets	Marine Bird	*Gavia immer*	131	12,813	1	1	0.008
Iceland Sea	27.5.a.2	Nets	Marine Bird	*Phalacrocoracidae*	131	12,813	6	10	0.076
Iceland Sea	27.5.a.2	Nets	Marine Bird	*Fulmarus glacialis*	131	12,813	2	3	0.023
Iceland Sea	27.5.a.2	Nets	Marine Bird	*Morus bassanus*	131	12,813	3	3	0.023
Iceland Sea	27.5.a.2	Nets	Marine Bird	*Clangula hyemalis*	131	12,813	2	2	0.015
Iceland Sea	27.5.a.2	Nets	Marine Bird	*Alca torda*	131	12,813	1	1	0.008

Ecoregion	Area Code	Metier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	Total No. Specimens	Bycatch Rate (Specimen/DaS)
Iceland Sea	27.5.a.2	Bottom trawls	Marine Mammal	*Pagophilus groenlandicus*	377	9,382	1	1	0.003
Iceland Sea	27.5.a.2	Nets	Marine Mammal	*Phocoena phocoena*	131	12,813	37	44	0.336
Iceland Sea	27.5.a.2	Nets	Marine Mammal	*Phoca vitulina*	131	12,813	19	34	0.260
Iceland Sea	27.5.a.2	Nets	Marine Mammal	*Halichoerus grypus*	131	12,813	4	4	0.031
Iceland Sea	27.5.a.2	Nets	Marine Mammal	*Pagophilus groenlandicus*	131	12,813	2	3	0.023
Iceland Sea	27.5.a.2	Nets	Marine Mammal	*Phoca hispida*	131	12,813	2	2	0.015
Norwegian Sea	27.2.a	Bottom trawls	Elasmobranch	*Dipturus nidarosiensis*	2	14	1	29	14.500
Norwegian Sea	27.2.a.2	Bottom trawls	Elasmobranch	*Raja oxyrinchus*	87	140	3	3	0.034
Norwegian Sea	27.2.a.2	Bottom trawls	Elasmobranch	*Dipturus batis*	87	140	20	50	0.575
Norwegian Sea	27.2.a.2	Bottom trawls	Elasmobranch	*Raja clavata*	87	140	2	3	0.034
Norwegian Sea	27.2.a.2	Bottom trawls	Elasmobranch	*Amblyraja radiata*	87	140	42	128	1.471
Ionian Sea and Central Mediterranen sea	16	Pelagic trawls	Elasmobranch	*Myliobatis aquila*	23	2,620	4	11	0.478
Ionian Sea and Central Mediterranen sea	16	Pelagic trawls	Elasmobranch	*Raja asterias*	23	2,620	3	4	0.174
Adriatic Sea	17	Bottom trawls	Elasmobranch	*Dipturus oxyrinchus*	30	35,727	1	1	0.033
Adriatic Sea	17	Pelagic trawls	Elasmobranch	*Aetomylaeus bovinus*	173	12,556	1	1	0.006
Adriatic Sea	17	Pelagic trawls	Elasmobranch	*Mustelus punctulatus*	173	12,556	20	35	0.202

Ecoregion	Area Code	Metier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	Total No. Specimens	Bycatch Rate (Specimen/DaS)
Adriatic Sea	17	Pelagic trawls	Elasmobranch	*Prionace glauca*	173	12,556	1	1	0.006
Adriatic Sea	17	Pelagic trawls	Elasmobranch	*Myliobatis aquila*	173	12,556	9	13	0.075
Adriatic Sea	17	Pelagic trawls	Elasmobranch	*Pteroplatytrygon violacea*	173	12,556	13	18	0.104
Adriatic Sea	17	Pelagic trawls	Elasmobranch	*Squalus acanthias*	173	12,556	14	18	0.104
Adriatic Sea	17	Pelagic trawls	Elasmobranch	*Raja clavata*	173	12,556	1	2	0.012
Adriatic Sea	17	Pelagic trawls	Elasmobranch	*Mustelus mustelus*	173	12,556	5	10	0.058
Aegean-Levantine sea	22	Bottom trawls	Elasmobranch	*Oxynotus centrina*	88	26,928	2	2	0.023
Aegean-Levantine sea	22	Bottom trawls	Elasmobranch	*Dipturus batis*	88	26,928	1	2	0.023
Aegean-Levantine sea	22	Bottom trawls	Elasmobranch	*Squalus acanthias*	88	26,928	5	8	0.091
Aegean-Levantine sea	22	Bottom trawls	Elasmobranch	*Mustelus mustelus*	88	26,928	3	3	0.034
Aegean-Levantine sea	22	Longlines	Elasmobranch	*Squalus acanthias*	91	84,082	3	45	0.495
Aegean-Levantine sea	22	Longlines	Elasmobranch	*Mustelus mustelus*	91	84,082	4	5	0.055
Aegean-Levantine sea	22	Nets	Elasmobranch	*Centrophorus granulosus*	426	401,221	2	13	0.031
Aegean-Levantine sea	22	Nets	Elasmobranch	*Squalus acanthias*	426	401,221	2	40	0.094
Aegean-Levantine sea	22	Nets	Elasmobranch	*Mustelus mustelus*	426	401,221	1	1	0.002
Aegean-Levantine sea	22	Nets	Elasmobranch	*Gymnura altavela*	426	401,221	1	1	0.002

Ecoregion	Area Code	Metier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	Total No. Specimens	Bycatch Rate (Specimen/DaS)
Adriatic Sea	17	Pelagic trawls	Marine Mammal	*Tursiops truncatus*	173	12,556	1	3	0.017
Adriatic Sea	17	Pelagic trawls	Marine Turtle	*Caretta caretta*	173	12,556	3	3	0.017
Adriatic Sea	22	Nets	Marine Turtle	*Caretta caretta*	426	401,221	1	1	0.002
Western Mediterranean	1	Bottom trawls	Elasmobranch	*Centrophorus granulosus*	118	22,537	4	5	0.042
Western Mediterranean	1	Bottom trawls	Elasmobranch	*Dalatias licha*	118	22,537	1	9	0.076
Western Mediterranean	1	Bottom trawls	Elasmobranch	*Etmopterus spinax*	118	22,537	57	2945	24.958
Western Mediterranean	1	Bottom trawls	Elasmobranch	*Heptranchias perlo*	118	22,537	8	13	0.110
Western Mediterranean	1	Bottom trawls	Elasmobranch	*Leucoraja circularis*	118	22,537	4	4	0.034
Western Mediterranean	1	Bottom trawls	Elasmobranch	*Raja clavata*	118	22,537	17	46	0.3898
Western Mediterranean	2	Bottom trawls	Elasmobranch	*Centrophorus granulosus*	50	952	1	5	0.1
Western Mediterranean	2	Bottom trawls	Elasmobranch	*Dalatias licha*	50	952	25	48	0.96
Western Mediterranean	2	Bottom trawls	Elasmobranch	*Etmopterus spinax*	50	952	176	4945	98.9
Western Mediterranean	2	Bottom trawls	Elasmobranch	*Hexanchus griseus*	50	952	2	2	0.04
Western Mediterranean	2	Bottom trawls	Elasmobranch	*Rostroraja alba*	50	952	3	3	0.06
Western Mediterranean	5	Bottom trawls	Elasmobranch	*Etmopterus spinax*	98	9,165	24	1954	19.939
Western Mediterranean	5	Bottom trawls	Elasmobranch	*Heptranchias perlo*	98	9,165	5	5	0.051

Ecoregion	Area Code	Metier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	Total No. Specimens	Bycatch Rate (Specimen/DaS)
Western Mediterranean	5	Bottom trawls	Elasmobranch	*Hexanchus griseus*	98	9,165	2	2	0.020
Western Mediterranean	5	Bottom trawls	Elasmobranch	*Leucoraja circularis*	98	9,165	1	1	0.010
Western Mediterranean	5	Bottom trawls	Elasmobranch	*Mustelus mustelus*	98	9,165	8	18	0.184
Western Mediterranean	5	Bottom trawls	Elasmobranch	*Raja clavata*	98	9,165	54	671	6.847
Western Mediterranean	6	Bottom trawls	Elasmobranch	*Dalatias licha*	253	78,733	1	1	0.004
Western Mediterranean	6	Bottom trawls	Elasmobranch	*Etmopterus spinax*	253	78,733	60	1123	4.439
Western Mediterranean	6	Bottom trawls	Elasmobranch	*Leucoraja circularis*	253	78,733	1	2	0.008
Western Mediterranean	6	Bottom trawls	Elasmobranch	*Mustelus mustelus*	253	78,733	4	11	0.0435
Western Mediterranean	6	Bottom trawls	Elasmobranch	*Raja clavata*	253	78,733	31	100	0.395
Western Mediterranean	6	Bottom trawls	Elasmobranch	*Squalus acanthias*	253	78,733	1	1	0.004
Western Mediterranean	7	Bottom trawls	Elasmobranch	*Dalatias licha*	180,75	11,661	2	60	0.332
Western Mediterranean	7	Bottom trawls	Elasmobranch	*Etmopterus spinax*	180,75	11,661	12	217	1.200
Western Mediterranean	7	Bottom trawls	Elasmobranch	*Raja clavata*	180,75	11,661	18	47	0.260
Western Mediterranean	7	Bottom trawls	Elasmobranch	*Squalus acanthias*	96,25	3,486	4	42	0.436
Western Mediterranean	1~5~6	Longlines	Elasmobranch	*Alopias vulpinus*	570	7,789	3	3	0.005
Western Mediterranean	1~5~6	Longlines	Elasmobranch	*Isurus oxyrinchus*	570	7,789	2	2	0.003

Ecoregion	Area Code	Metier3	Taxa	Species	Total Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Incidents	Total No. Specimens	Bycatch Rate (Specimen/DaS)
Western Mediterranean	1~5~6	Longlines	Elasmobranch	*Mobula mobular*	570	7,789	6	7	0.012
Western Mediterranean	7	Longlines	Marine Bird	*Puffinus mauretanicus*	8	3,115	1	1	0.125
Western Mediterranean	1~5~6	Longlines	Marine Bird	*Larus audouinii*	570	7,789	3	5	0.009
Western Mediterranean	1~5~6	Longlines	Marine Bird	*Larus michahellis*	570	7,789	2	2	0.003
Western Mediterranean	1~5~6	Longlines	Marine Bird	*Puffinus mauretanicus*	570	7,789	3	3	0.005
Western Mediterranean	1~5~6	Longlines	Marine Bird	*Puffinus yelkouan*	570	7,789	1	2	0.003
Western Mediterranean	6	Bottom trawls	Marine mammal	*Stenella coeruleoalba*	253	78,733	1	1	0.004
Western Mediterranean	7	Bottom trawls	Marine mammal	*Delphinidae*	180,75	11,660	1	1	0.005
Western Mediterranean	7	Longlines	Marine mammal	*Tursiops truncatus*	20	7,301	1	1	0.05
Western Mediterranean	7	Pelagic trawls	Marine mammal	*Stenella coeruleoalba*	6	370	1	2	0.333
Western Mediterranean	1~5~6	Longlines	Marine Turtle	*Caretta caretta*	570	7,789	8	10	0.017
Western Mediterranean	1~5~6	Longlines	Marine Turtle	*Dermochelys coriacea*	570	7,789	1	1	0.001

Table 3[10]. Marine mammal bycatch reported in the Regulation 812/2004 reports compared with data submitted to the database for data collection during 2017.

			Reported			Database			
Species	**ICES Subarea**	**Level 3 Metier**	**Observed days at sea**	**Total number incidents**	**Total number specimens**	**Observed days at sea**	**Total number of incidents**	**Total number of specimens**	**Bycatch rate (Number of specimens/days at sea observed [11]**
Phocoena phocoena	27.3.b.23	Nets	36	1	2	17	1	2	0.12
	27.8.a	Bottom trawls	123	1	1	123	1	1	0.01
	27.8.b	Nets	221	4	4	221	4	4	0.02
	27.8.b	Pelagic trawls	9	1	1	9	1	1	0.12
	27.7.g	Bottom trawls	97	1	1	97	1	1	0.01
	27.7.f	Nets	62	3	4	62	3	4	0.06
	27.3.a.20	Nets	15	1	0	15	1	1	0.07
	27.7.e	Nets	131	1	1	131	1	1	0.01
	27.5.a.2***	Nets	-	-	-	131	37	44	0.34
Subtotal			*694*	*13*	*15*	*806*	*50*	*59*	
Delphinus delphis	27.10.a.2^	Rods and lines				1576	1	1	0.0006
	27.8.a	Nets	169	1	1	169	1	1	0.01

[10] Data for FAO area 37, GSA 06 and GSA 07 have been added after the Advice Drafting Group (ADGBYC) 2019 when a new extraction of the database was carried out.

[11] Some numbers that had been rounded to zero corrected based on the reviewers' report.

Species	ICES Subarea	Level 3 Metier	Reported			Database			
			Observed days at sea	Total number incidents	Total number specimens	Observed days at sea	Total number of incidents	Total number of specimens	Bycatch rate (Number of specimens/days at sea observed [11]
	27.8.b	Nets	221	5	5	221	5	5	0.02
	27.8.a	Pelagic trawls	45	6	49	45	6	49	1.10
	27.8.b	Pelagic trawls	9	6	8	9	6	8	0.94
	27.9.a*	Seines	40	1	3	40	1	2	0.05
	27.7	Bottom trawls				117	1	1	0.01
	27.7.g	Bottom trawls	216	2	3	216	2	2	0.01
	27.7.h	Bottom trawls	200	1	1	200	1	1	0.005
	27.7.f	Nets	62	1	1	62	1	1	0.02
	27.7.h	Nets	28	1	1	28	1	1	0.04
	27.7.j	Nets				179	1	1	0.01
	27.7.e	Nets	131	2	2	131	2	2	0.02
Subtotal			*1121*	*26*	*74*	*2993*	*29*	*75*	
Globicephala melas	27.10.a.2^	Longlines				1226	1	1	0.0008
	27.8.c	Pelagic trawls	86	1	5	86	1	5	0.058
Subtotal			*86*	*1*	*5*	*1312*	*2*	*6*	
Tursiops truncatus	GSA07**	Bottom trawls		1	1				

Species	ICES Subarea	Level 3 Metier	Reported			Database			
			Observed days at sea	Total number incidents	Total number specimens	Observed days at sea	Total number of incidents	Total number of specimens	Bycatch rate (Number of specimens/days at sea observed [11]
	GSA07	Longlines				*20*	*1*	*1*	0.05
	GSA17	Pelagic trawls	173	1	3	173	2	4	0.02
Subtotal			*173*	*2*	*4*	*193*	*1*	*3*	
Stenellla coerorule-oalba	GSA06	Bottom trawls				253	1	1	0.004
	GSA07	Pelagic trawls		1	2	6	1	2	0.33
Subtotal				*1*	*2*	*259*	*2*	*3*	
Delphinidae	GSA07	Bottom trawls				*181*	*1*	*1*	0.005
Subtotal						*181*	*1*	*1*	0.005
Halichoerus grypus	27.3.d.32	Nets				8	1	2	0.25
	27.3.d.29	Pelagic trawls				13	1	1	0.08
	27.3.d.28.1	Traps				13	1	1	0.08
	27.3.d.32	Traps				12	2	3	0.25
	27.7.f	Nets	62	1	1	62	1	1	0.02
	27.7.j	Nets				179	2	2	0.01
	27.6.a	Pelagic trawls	29	1	1	29	1	1	0.03

Species	ICES Subarea	Level 3 Metier	Reported			Database			
			Observed days at sea	Total number incidents	Total number specimens	Observed days at sea	Total number of incidents	Total number of specimens	Bycatch rate (Number of specimens/days at sea observed [11]
	27.7.b	Pelagic trawls	7	1	1	7	1	1	0.14
	27.7.e	Nets				68	1	1	0.01
	27.7.e	Nets	131	2	2	131	2	2	0.02
	27.5.a.2***	Nets				131	4	4	0.03
Subtotal			*229*	*5*	*5*	*653*	*17*	*19*	
Phoca vitulina	27.5.a.2***	Nets				131	19	34	0.26
Subtotal						*131*	*19*	*34*	
Pusa hispida	27.5.a.2***	Nets				131	2	2	0.02
Subtotal						*131*	*2*	*2*	
Pagophilus groenlandicus	27.5.a.2***	Bottom trawls				377	1	1	0.003
	27.5.a.2***	Nets				131	2	3	0.02
Subtotal						*508*	*3*	*4*	
TOTAL			**2303**	**48**	**105**	**7161**	**127**	**207**	

*** animals released alive were not included in the database, but mentioned in the report**

**** mentioned in the report but data not entered in the database**

***** not an EU Member State, no 812/2004 report submited but data added to the database**

^incidents from the Azores (Division 10.a) not included in the 812/2004 report from Portugal.

Table 4. Summary of fished and observed effort in the US Northwest Atlantic Ecoregion, and observed number of PET specimens bycaught. Bycatch estimates for the metier (Level 3) and their source are also given.

Area	Gear Type (Metier level 3)	Species	Total Observer Effort (metric tons)	Total Fishing Effort (metric tons)	Total No. Specimens	Bycatch Rates S(pecimens/DaS)	Bycatch Estimate (CV)	Source
New England	Sink Gillnets	*Phocoena phocoena*	1635	13624	19	-	136 (CV=0.28)	Orphanides (in review)
New England	Sink Gillnets	*Delphinus delphis*	1635	13624	20	-	133 (CV=0.28)	Orphanides (*in review*)
New England	Sink Gillnets	*Halichoerus grypus*	1635	13624	158	-	930 (CV=0.16)	Orphanides (*in review*)
New England	Sink Gillnets	*Phoca vitulina*	1635	13624	63	-	298 (CV=0.18)	Orphanides (*in review*)
New England	Sink Gillnets	*Pagophilus groenlandicus*	1635	13624	6	-	44 (CV=0.37)	Orphanides (*in review*)
New England	Sink Gillnets	*Tursiops truncatus*	1635	13624	1	-	8 (CV=0.92)	Orphanides (*in review*)
Mid-Atlantic	Sink Gillnets	*Phocoena phocoena*	718	7979	1	-	9 (CV=.95)	Orphanides (*in review*)
Mid-Atlantic	Sink Gillnets	*Delphinus delphis*	718	7979	2	-	22 (CV=0.71)	Orphanides (*in review*)
Mid-Atlantic	Sink Gillnets	*Phoca vitulina*	718	7979	1	-	3 (CV=0.62)	Orphanides (*in review*)
New England	Bottom Trawls	*Lagenorhynchus acutus*	635	5201	2	-	15 (CV=0.64)	Lyssikatos *et al.* (in prep)
New England	Bottom Trawls	*Halichoerus grypus*	635	5201	2	-	16 (CV=0.66)	Lyssikatos *et al. (*in prep)
Mid-Atlantic	Bottom Trawls	*Delphinus delphis*	1197	8592	66	-	380 (CV=0.23)	Lyssikatos *et al.* (in prep)
Mid-Atlantic	Bottom Trawls	*Grampus griseus*	1197	8592	7	-	43 (CV=0.51)	Lyssikatos *et al.* (in prep)
Mid-Atlantic	Bottom Trawls	*Halichoerus grypus*	1197	8592	5	-	26 (CV=0.40)	Lyssikatos *et al*. (in prep)
Mid-Atlantic	Bottom Trawls	*Tursiops truncatus*	1197	8592	3	-	22 (CV=0.66)	Lyssikatos *et al.* (in prep)
Georges Bank to Mid-Atlantic	Sink Gillnets	*Caretta caretta*	4902	51533	27	-	705 (CV=0.29)	Murray 2018

Area	Gear Type (Metier level 3)	Species	Total Observer Effort (metric tons)	Total Fishing Effort (metric tons)	Total No. Specimens	Bycatch Rates S(pecimens/DaS)	Bycatch Estimate (CV)	Source
Georges Bank to Mid-Atlantic	Sink Gillnets	*Lepidochelys kempii*	4902	51533	7	-	145 (CV=0.43)	Murray 2018
Georges Bank to Mid-Atlantic	Sink Gillnets	*Dermochelys coriacea*	4902	51533	2	-	27 (CV=0.71)	Murray 2018

2 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)

2.1 Mitigation compliance carried out under (EC) Reg. 812/2004 -Mandatory and voluntary mitigation measures

Relevant text extracted from Member States (EC) Reg. 812/2004 reports pertaining to mitigation compliance is summarized 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 results from presentations provided to WGBYC from Iceland and Portugal that described ongoing bycatch mitigation research trials and summaries from relevant literature.

2.1.1 Member states

Belgium reports that the use of acoustic deterrent devices, or 'pingers', has not yet become standard practice in Belgian tangle net fishing. Furthermore, it should be noted that the number of national fleet vessels using this fishing method is limited (at present only two vessels) and do not meet the basic conditions, i.e. length of fleet, to be subject to this requirement. As in other recent years, there was no scientific monitoring of the use of pingers on vessels in 2017.

In **Denmark**, a total of 22 Danish vessels were obliged to use pingers in 2017. In 3.d.24/3.c.22 only a few vessels are required to use pingers (2%), compared to 63% of the vessels operating in 3.a & 4. The pinger type "AQUAmark100" has generally been used in the Danish gill net 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 Fishermen Association has informed, that a 10 kHz pinger is the most widely used pinger in Danish fisheries due to the option of changing the batteries. The 10 kHz pinger, however, does not have the same effect as the AquaMark 100, so the distance between these is mandatory and has to be 100 m. The latest derogation was issued in relation to AquaMark 100, however, other devices with the same specifications can also be used with increased spacing. More studies on new devices are planned in collaboration with DTU Aqua and the fisheries organisations.

Monitoring of pingers is a mandatory part of the general inspection of gill net vessels in Denmark. When a gear is checked during a fishery inspection operation, the fisheries inspector registers if there is a requirement to use pingers in the particular area. If there is a requirement, it is checked whether the pingers are active and deployed with the correct spacing. In 2017, the Danish fisheries inspection did not conduct any inspections. This is primarily due to a large organizational change and transfer of responsibility to another ministry (formerly the Ministry of Food,

Agriculture and Fisheries, now the Ministry of Foreign Affairs). For the same reasons, no inspections were carried out on foreign vessels in 2017. It is expected, that the Danish Fisheries Inspection Agency will conduct inspections again in 2019 at the same level as previous years.

The Danish fisheries authorities has in previous annual reports mentioned the inspection of mandatory pingers on net gears used by vessels from other Member States, in cases where infringements have been noted. Denmark has no knowledge of whether the Commission has followed up upon these infringements with the respective Member States. The Danish Fisheries authorities note that there is a need for trilateral communication with the Member States in question, a task the Commission should be lead on, also so that any infringements will be prosecuted.

Denmark has conducted two mitigation trials since May 2018. One tested whether pingers could reduce the depredation by cormorants on fish caught in pound nets. The trial was conducted as a controlled sequential experiment, using 3 kHz pingers manufactured by Future Oceans. Preliminary results shows that the mean dive time of cormorants inside the pound net was significantly shorter (79 s vs. 114 s) when pingers were deployed than in the control period. Further analyses are needed to determine if the shorter dive time results in reduced depredation.

The second trial was a continuation of a controlled experiment conducted in early 2018, which tested if light (Fishtek NetLight prototype) or pingers (Future Oceans, 3 kHz) could reduce the amount of seabird bycatch in the cod gillnet fishery. The lights were deployed with 20 m spacing on both the lead and bottom line, however in a zigzag setup creating lights every 10 m. Pingers were deployed with a spacing of 20 m. A total of 165 strings of nets were fished, of which 82 were control strings, 42 were strings with lights and 41 were pinger strings. Altogether 52 seabirds were caught, of which 30 were common eiders and 10 were common guillemots. The preliminary analyses showed no significant effects of lights or pingers on bycatch of seabirds.

Denmark is also continuing the development and testing of fishing gear as alternatives to gill nets for catching cod. This includes both small-scale Danish seines, baited pots and Pontoon traps.

In **Estonia**, there was no static gear fishery in ICES Division 24 where pinger use is obligatory for boats >12 m under Reg. 812/2004. Therefore, no pingers were used by the Estonian fleet. No other pinger use was implemented.

In **France**, 77 vessels operating in Subarea 7 in 2017 were obliged to use pingers under Reg. 812/2004, but only 9 vessels operating with static gears (GNS-GTR) deployed pingers (STM DDD03L) in Subarea 7. No studies were carried out in 2017 to evaluate the effect of pingers on cetacean bycatch.

In 2017, **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 that are commercially available. In order to carry out compliance monitoring, the personnel of the competent federal and state authorities were equipped with Pinger Detector Amplifiers (Etec model PD1102) and trained accordingly. The detectors determine whether a pinger in the water actually emits its ultrasonic signals. However, pinger signals are masked by the inspection vessel noise when pingers are checked when nets are already in place. The relevant provision (Article 2(2) of Reg. 812/2004) merely requires pingers to be operational when setting the gear. Thus, no penalties could be imposed for any infringements found using the current procedure. In 2017, federal fishing protection vessels inspected a total of five fishing vessels obliged to use pingers. No violations were found. In the state of Mecklenburg-Vorpommern (Baltic Sea), no inspections of acoustic deterrent devices were carried out in 2017. The eight gillnetters ≥12 m registered in Mecklenburg-Vorpommern with a licence allowing the use of static nets were not encountered in ICES Division 3.24 during the setting of gillnets in the course of sea inspections. The fishing gear listed in Annex I to Reg. 812/2004 was not used in the territories of the Länder of Lower

Saxony and Bremen (North Sea) during the periods described in the Regulation and therefore no controls were carried out. Coastal waters of Schleswig-Holstein in the Baltic Sea do not fall within the scope of Annex I of Reg. 812/2004. During 2016, no activities of vessels requiring deterrent devices were seen in the coastal waters of Schleswig-Holstein in the North Sea.

In 2017, the Thünen Institute successfully completed a BMEL-funded innovation project launched in August 2012. Under this project, a new type of warning device ('Porpoise Alert', PAL) was developed and its effectiveness in commercial fishing with static nets was tested. The PAL has led to a statistically significant reduction in the bycatch of porpoises of around 70 % in the western Baltic Sea (Dorrien and Chladek, 2018). Since the spring of 2017, the Baltic Sea Information Centre in Eckernförde has provided 1,680 PAL devices to fishermen in Schleswig-Holstein. The Ministry of Energy, Agriculture, the Environment, Nature and Digitalization of Schleswig-Holstein aims at having a validation and testing study conducted.

Currently, the project STELLA at the Thünen-Institute for Baltic Sea Fisheries funded by the Federal Agency for Nature Conservation (BfN) is developing a holistic approach to minimize conflict between gillnet fisheries and nature conservation goals. Within this project, modified gillnets reducing bycatch of harbour porpoises (and birds) are being developed. To this end, a simulation study determining the "ideal" object to enhance the acoustic reflectivity of gillnets was carried out. So far, small acrylic glass spheres have been identified to create an echo as strong as a table tennis ball - thus an object 5 times their size. This is due to resonance effects at 130kHz. This has been confirmed in an experiment in a large acoustic tank. Additionally, a prototype gillnet was equipped with the spheres (distance between spheres = 30cm) and echogram images were taken at 38 kHz and 120kHz of both the modified and a standard net. In the 120 kHz echogram the rows of spheres are clearly visible, while the standard netting is not visible at all. Floatline and leadline are visible for both nets. The next steps include a behavioural study of porpoises around the modified nets as well as a commercial trial of the modified gillnets.

In **Ireland**, the number of vessels currently using pingers is unknown. Extensive research on the practicalities and spacing of gillnet pingers has previously been carried out by BIM 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 also reported previously. 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 500m for digital devices from 13 June 2007 for a period of two years. This derogation has not yet been renewed.

ADDs can reduce harbour porpoise bycatch in set net fisheries. Numerous trials have shown that pingers of several types can reduce porpoise bycatch by around 90%. ADDs are, however, expensive where many are required (e.g. for set net fisheries), require periodic maintenance to check and replace batteries and can interfere with net setting and hauling. There is still ambivalence towards ADDs from NGOs due to perceived habitat exclusion and environmental noise effects. The seriousness of these effects is unproven. Habituation has also been cited as a reason that ADDs don't work although again there is no evidence that this is an issue. DDD devices have potential to work in pelagic trawl fisheries where incidental bycatch of common dolphins may occur.

In **Italy**, interactive pingers (DiD 01) were voluntarily used by a few midwater pair trawlers in GSA 17 (northern Adriatic subarea). Between March and June 2017, 51 fishing operations (25 with pingers and 26 without) were monitored to evaluate the interaction between bottlenose dolphin (*Tursiops truncatus*) and midwater pair trawlers and to assess the effectiveness of pingers by using passive acoustic method and photo-identification techniques. A significantly high number of clicks was detected in nets without pingers. With pingers, no clicks were recorded during hauling, 1,570 click during trawling and 745 during steaming; on the other hand, without pinger,

366 signals were recorded during hauling, 23,583 during trawling and 4,291 during steaming. These preliminary results confirm that the use of the interactive pinger can influence the presence of dolphins during fishing operations. Excluder devices have been previously tested (e.g. FLEXGRID, SUPERSHOOTER) but proved unsuitable for reducing bycatch in midwater trawls. New mitigation measures should be developed and trials are needed to monitor protected species and species of conservation concern.

According to the report from **Latvia**, no vessels were fishing with static gear covered by Reg. 812/2004 in 2017. Thus, pingers were not deployed and no scientific studies and pilot projects aimed at monitoring and assessing the effects of pinger use were conducted.

In the **Netherlands**, the use of pingers is obligatory in ICES Subarea 4 for vessels larger than 12m in the period 1 August until 31 October, using nets that do not exceed 400m in length (the regulation intends to cover set net fishery at wrecks, where relatively short net lengths are being used). The vast majority of the Dutch set gillnet fleet fishes in this period for sole with much longer nets. If some vessels are required to use pingers, this is not registered or known by government authorities, nor are the fishermen aware that they should use pingers. Most likely, no acoustic deterrents are in use by Dutch gill net fishers. However, the number of vessels larger that 12m fishing on wrecks (that is with nets that do not exceed 400m) is most likely very low, if not zero.

In **Poland**, the Ministry of Agriculture and Rural Development in 2008 purchased 500 AQUATEC AQUAmark pingers and handed them on to the owners of fishing vessels. In 2015 a detailed test of the functioning of the pingers was conducted using a pinger tester (253 pingers had to be replaced). Since the end of 2015, the Ministry of Maritime Economy and Inland Navigation has not controlled the inventory of pingers on fishing vessels nor monitored the exchange of pingers between vessels. Vessel owners have been informed that they, not the administrative bodies, were responsible for the equipment of their ships with pingers, where it was required. At the same time, they have been made aware that they were obliged to replace malfunctioning devices with functioning ones. Group purchase of new pingers is planned after the entry into force of the Regulation on Technical Measures in this fishery, based on the resources of the European Maritime and Fisheries Fund for the period 2014-2020. In 2017, during controls of fishing vessels conducted by Sea Fishery Inspectors from District Sea Fishery Inspectorate in Szczecin - in charge of supervision over commercial fishery in the Polish part of ICES Division 24, no case of absence of pingers was recorded. In 2017, the Polish sea fishery administration also did not receive any information from abroad on violation of Reg. 812/2004 by fishing vessels flagged in Poland.

In **Portugal**, according to Articles 2 and 3 of the Reg. 812/2004 the use of acoustic deterrent devices are not mandatory for the ICES Division 9a. However, some information is gathered based on voluntary opportunistic deployments since 2011-2012. Field tests performed up to 2015 were conducted within the scope of the projects SafeSea EEAGrants (2008-2010) and Life+ MarPro (2011-2017). These past trials were conducted with FUMUNDA 10 kHz and 70 kHz pingers. For the northwestern coast, during 2011-2012, field assays were performed in 7 boats using trammel nets. In these trials, the cetacean species interacting the most (96.7 %) was the common dolphin. 11 common dolphins were bycaught in control nets and 2 common dolphins in nets using pingers. For the Southern Portuguese coast, during 2014-2015, field assays were performed in 1 fishing boat using gillnets. The bottlenose dolphin was the only species observed to interact with gillnets with levels of fish and gear damage. These trials indicated that the use of this type of pingers was not an effective tool to reduce interactions and bycatch of bottlenose dolphins in set nets. In fact, throughout the 2-year study there was the bycatch of 2 bottlenose dolphins that occurred in pingered nets only.

A presentation to WGBYC from Paulo Vasconcelos described the preliminary results of a pilot study performed by the IPMA - Olhão to test the effect of pingers in reducing the interactions between dolphins and gillnets operated by the small-scale fishing boats based in the fishing harbour of Quarteira (Algarve coast - southern Portugal). The experiments were performed within the framework of a partnership established between the IPMA - Olhão and the Quarteira's fishery association (QUARPESCA - Associação dos Armadores Pescadores de Quarteira) and were carried out onboard the small-scale fishing vessel "Zé Rita" (Q-1169-L: 7.12 m length overall; 72 hp) with a crew composed by the skipper and one fisherman. The fishing operations were performed with gillnets (50 m panel length; # 60 mm mesh size) equipped with pingers (FISHTEK Marine®: Dolphin Anti-Depredation Pinger - Model BP40): ≈ 50 net panels with pingers *vs.* ≈ 50 nets panels without pingers (experimental control). All experiments were followed by one fishery observer onboard and the sampling of the catches was performed by 3-4 fishery biologists at the wholesale market immediately upon the boat arrival at the fishing harbour. The fishery observer onboard registered diverse information in fishing logbooks (e.g. date, location, fishing bank, number of net panels with and without pingers, time and coordinates at setting and hauling the nets, fishing depth, dolphins sightings, interactions, damages and/or predation) and monitored the entire fishing surveys using a GPS tracking device (vessel position, vessel speed, distance covered). The fishery biologists separated the catches obtained with and without pingers, subdivided the species (target, commercial, bycatch and discard species), photographed the specimens for subsequent measurement of individual length and recorded the total weight of the catches. Overall, the pilot study comprised 31 fishing surveys performed during approximately six months (May - October 2018), covering a considerable fishing area (≈ 96 nmi^2) and depth range (6 - 49 m) depending on the main target species. These fishing surveys targeted mainly two highly priced fish species (striped red mullet - *Mullus surmuletus* and European hake - *Merluccius merluccius*), although accompanied by several other commercially valuable fish species due to the multispecific character of this small-scale fishery. The fishing experiments involved a total of 3014 net panels (≈ 150.7 km), including 1493 net panels with pingers (≈ 74.7 km) and 1521 net panels without pingers (≈ 76.0 km). The overall catches included 55 species (commercial and bycatch species), comprising 23,348 individuals with a total weight of 3,137.6 kg, mostly of commercially valuable species (2,887.5 kg). The current raw data (unstandardised catches) displays slightly balanced catches between nets equipped with pingers (1,686.5 kg) and nets without pingers (1,451.1 kg). Further developments of this study in terms of data treatment and statistical analyses will imply the standardisation of the catches (number and weight) of the commercial, bycatch and discard species (e.g. 50 panels, 1000 m net, 3 h soaking time), followed by the comparison of diverse descriptor parameters of the catches (e.g. catch per unit effort - CPUE, bycatch per unit effort - BCPUE, gross profit per unit effort - PPUE, bycatch rate - BR, discard rate - DR) obtained from gillnets with and without pingers.

Moreover, a new project conducted by CCMAR-University of Algarve which started at the end of 2017 (Mar2020-iNOVPESCA), will approach mitigation strategies regarding reducing interactions of cetaceans and Algarve coastal fisheries, especially purse seining (PS) and set nets (GNS+GTR). Pinger type to be used will be DDD and DiD (STM Products, Verona, Italy) with models adapted to set nets and purse seining. Trials were commenced in the Spring of 2018.

Sweden reported that the implementation of pingers as required under Reg. 812/2004, most likely are not being implemented in regulated fisheries in Sweden. However, in 2015 a project started with the purpose of implementing pingers on a voluntary basis. After discussions with fishermen, Banana pingers were chosen for the project. The fishermen regard the Banana pinger to be practical to use and that the bycatch of harbour porpoises has decreased. The voluntarily pinger use has continued in 2017 and during that year 9 fishermen used pingers voluntarily. Seven fishermen are using pingers in the lumpsucker gillnet fishery and three fishermen are

using pingers in the cod gillnet fishery. Fishermen are reporting their fishing effort and use of pingers to the Swedish University of Agriculture Science.

In the Swedish small-scale coastal fisheries, alternative fishing gear is still being developed. Examples of alternative gears under development are cod pots, fyke nets for cod, seine nets for flatfish, vendace and cod and trap-nets for cod. In 2017 to 2018 there has been an implementation project with the purpose of fulfilling the use of cod pots in the South Baltic Sea. Two fishermen are now fishing commercially with cod pots as an alternative to gillnets.

In 2017, 24 **UK** registered vessels of ≥12m fished with gear types (bottom set-nets and entangling nets) and in areas specified as requiring acoustic deterrent devices under Reg. 812/2004. All relevant skippers are aware of the requirements of the Regulation. The 22 inspections carried out at sea by UK authorities in 2017, found a high level of compliance and only one warning was issued. These vessels represent just 2% of the UK's static net fleet in terms of vessel numbers, but were responsible for 13% of the total days at sea and 45% of landings by weight by the netting sector.

These vessels mainly use the DDD-03L acoustic deterrent device, authorized for use by the UK Government under derogation. Guidance for the correct deployment and use of these devices is provided by the UK's Marine Management Organisation. These pingers continue to be effective at reducing harbour porpoise bycatch; since 2008, observed bycatch rates in pingered nets are 83% lower than in unpingered nets. Their effectiveness for other cetacean species, such as common dolphin, is currently unknown due to low sample sizes precluding a statistically robust comparison.

2.1.2 Mitigation trials outside the EU

In Iceland, porpoise alerting devices (PALs) were tested in April 2018 in the cod gillnet fishery. Two commercial vessels were used for the experiment, one in Hunafloi in northern Iceland, and one on the southeast coast, known hot spots for cetacean bycatch. In each area, three paired sets of 12 nets were set, where half of the sets were set with PALs according to the manufacturer's description (four PALs per set). One nautical mile was between the paired sets to avoid interaction from the devices on the control sets. A total of 98 sets were hauled over a week. A total of 23 porpoises were caught in the trial. Twelve of those animals were caught in the sets with PALs, and eleven in the control sets. No significant difference was therefore observed between the PAL and control sets. Interestingly, almost all the bycaught porpoises in the PAL sets (eleven out of twelve) were large adult males, while the gender ratio was six males and five females in the control sets. Interestingly, eight of the twelve porpoises caught in the PAL sets were found right by the PAL device, suggesting possible attraction of adult males towards the PAL devices.

In USA 2018, the NOAA Fisheries Northeast Fisheries Science Center in Woods Hole Massachusetts had no new gear-related projects investigating methods to reduce bycatch of marine mammals or sea turtles beyond what was reported last year in ICES (2019) annual report - Sec. 4.1.2. Final contract reports describing research results can be found here: https://www.nefsc.noaa.gov/read/protspp/PR_gear_research/

2.1.3 Protected species bycatch mitigation studies from recent literature (2018–19)

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 (2018 and 2019), 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.

2.1.3.1 Fishing gear optimization and alternative gears

2.1.3.1.1 Marine mammals

No new mitigation studies for marine mammals were found in the literature.

2.1.3.1.2 Seabirds

Field et al. (2019) reports on work conducted in the coastal fisheries of the Baltic Sea; a collaborative project between the Lithuanian Ornithological Society, the Polish National Marine Fisheries Research Institute, the Royal Society for the Protection of Birds and BirdLife International conducted with Lithuanian and Polish inshore fishers to test potential solutions to seabird bycatch. Three different net modifications were trailed: small black and white striped panels; green LED lights, and; flashing white LED lights. None of these three modifications resulted in reduced seabird bycatch which is contrary to evidence from a similar trial in Peru where green lights on the top of nets reduced the numbers of Guanay cormorants caught. In the Lithuanian/Polish fisheries, the main species being bycaught are ducks. More worryingly, using white flashing lights or black and white panels increased the numbers of Long-tailed ducks being accidentally caught. We think this attraction response may be something to do with the importance of black and white contrast to this species which has striking black and white plumage. The problem, therefore remains an intractable one. Various other approaches could be tried, including preventing the conflict between fishers and birds in either time or space by closing areas to fishing at certain times. However, this seems unlikely to be acceptable to fishers or the economies they support. Other options, such as preventing seabirds diving in the vicinity of nets using deterrents, or using different types of lights, net materials, or even acoustic methods could be tried, but until we know more of the effects of these on the fish catch, or the birds' behaviours, trials will have to continue. This study also highlights the need to be able to publish negative results (not always an easy task) to enable rapid refocussing of effort and resources away from unfruitful avenues of research.

Cortés and González-Solís (2018) investigated four mitigation measures in the artisanal demersal longline fishery for European hake in the Western Mediterranean. The measures tested were night setting, tori lines, weighted hooks and artificial bait. Night setting reduced bycatch risk without affecting the target and non-commercial fish catches, while the other methods did not reduce the bycatch risk and/or had a negative effect on catch/fishing operation. The authors conclude that night setting stands out as the best mitigation measure for reducing the bycatch levels without compromising target catches.

In another study on longline fisheries, Jiménez et al. (2018) looked at the effect of branch line weighting on bycatch rates of seabirds in Uruguay. The author found that using a 65 g weight on 1 m leader lines reduced the number of bird attacks on the lines, in addition to lower the

seabird bycatch rate by 42.5%. The authors conclude that this measure would work best in combination with other bycatch mitigation measures, such as night setting, and doing so could result in zero seabird bycatch in that South American pelagic fishery.

The effectiveness of the "hookpod", a mitigation device for pelagic longline fisheries, was tested in a study by Sullivan *et al.* (2018). The hookpod is a plastic capsule that covers the point and barb of longline hooks while setting the gear, and that way preventing bird bycatch. Using this gear resulted in a bycatch rate of 0.04 birds/1000 hooks, compared to a rate of 0.8 birds/1000 hooks in the control. No significant difference in catch of target species was detected, although the catch was highly variable between trips.

In a study using penguins in captivity, Hanamseth *et al.* (2018) looked at the effect of gillnet filament colour (green, orange, clear) on collision rates of the penguins. Orange coloured monofilament lines resulted in lower collision rates (5.5%) while clear and green lines resulted in higher rates of collision (31-36%) suggesting that orange nets might be more visible to diving birds. In another study on gillnets, Mangel *et al*. (2018) investigated using LED lights to illuminate gillnets to reduce seabird bycatch. Illuminating the nets resulted in 85% reduction of guanay cormorant bycatch, as 39 birds were caught in control nets, while 6 were caught in the illuminated nets.

In a study on seabird mitigation measures in the Australian trawl fishery, Koopman *et al.* (2018) tested the effectiveness of two industry designed mitigation devices, a baffler and a water sprayer. Both the experimental devices showed 84% and 59% reduction in interaction rate (bird interactions per shot) compared to the control. The author conclude that the new mitigation devices can greatly contribute to the reduction of incidental fishing mortality in this Australian trawl fishery, and potentially in other trawl fisheries.

2.1.3.1.3 4.1.3.1.3 Elasmobranchs

In an effort to reduce rates of bycatch of sharks and rays in the Australian trap fishery for red snapper, traps with permanent magnets added to the traps were tested against a control with no magnets (Richards *et al.* 2018). The addition of the magnets reduced incidences of elasmobranch bycatch (mainly *Brachelurus waddi*) by over a third, while increasing the catch of the target species. The authors conclude that magnets can be used as a bycatch reduction device in that fishery, without harming the profitability of the fishery.

2.2 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 pinger use is fully implemented and there is active enforcement.
- With respect to bycatch mitigation, development of effective mitigation measures are in general hampered by a lack of understanding of the aetiology of bycatch, and more research is needed on this to guide the development.
- For marine mammals, little progress in mitigating bycatch has happened and results have been inconsistent and ambiguous. Effectiveness of pingers to reduce bycatch of small cetaceans varies with species, area and fishing métier with no apparent reasons to why this is; results from experiments testing the PAL, as an example, highlight this point.[12]
- For seabirds, research has suggested a number of bycatch mitigation techniques that could be used to reduce bycatch of some species in particular fisheries, but more research is needed on the general applicability of these techniques.
- 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 on identification of bycatch hot-spots, on why pingers are effective in some fisheries and not in others and on the possible effects of habituation and habitat exclusion in relation to pinger deployment.

[12] Sentence "results from experiments testing the PAL, as an example, highlight this point" added based on reviewers' comments.

3 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)

Bycatch Risk Assessments (BRA), as described in WKREV812 (ICES, 2011) were undertaken by a subgroup using data held in the WGBYC database. The subgroup focused during the 2019 meeting on an assessment for grey seals (*Halichoerus grypus*) and harbour porpoise (*Phocoena phocoena).* Bycatch of harbour porpoise has recently been the focus of a joint workshop organised by the North Atlantic Marine Mammal Commission and the Norwegian Institute for Marine Research (NAMMCO_NIMR 2019) to assess the status of this species in the North Atlantic. However, WGBYC uses the most recent data available (2017). WGBYC has been using the BRA approach since 2012, but its application to understand population impacts can be challenging given that monitoring effort is patchy and many metiers have not been sampled. Few countries have undertaken dedicated monitoring programmes or pilot projects to assess bycatch rates, and consequently, there has been some attention to developing alternative approaches to derive mortality estimates of cetaceans due to bycatch. France has led in this area of work (Peltier et al. 2012, 2014, 2016) using strandings and drift models to quantify the amount and sources of bycatch. We provide an update on the most recent work undertaken in this regard.

3.1 Evaluating the impacts of bycatch on protected species populations using WGBYC at-sea monitoring data

3.1.1 Marine Mammals: Bycatch Risk Assessment

The BRA approach relies on the use of the ICES WGBYC database, which holds data submitted by MS that are subject to Reg. 812/2004 (Table 1). MS data are submitted to the WGBYC database in an aggregated form. Data are aggregated by MS, year, métier and ICES Division (see ICES, 2019). Bycatch event level data (i.e. haul or tow level data) are not available. Days at sea (DaS) is the only aggregated unit of effort that is consistently reported among MS. Consequently, monitored and total fishing effort, and estimated bycatch rates are reported in units associated with DaS.

Total bycatch $\hat{Y}$ of species (i) by region (r) was estimated as the product of the ratio of the sum of observed specimens (y_i) to observed DaS (x), times total fishing DaS (X) summed over ICES areas (a) of interest:

$$\hat{Y}_{ir} = \frac{\sum y_{iar}}{\sum x_{ar}} \cdot \sum X_{ar}$$

Due to the aggregated nature of data submissions to the WGBYC database, more traditional approaches to estimating uncertainty around a point estimate (e.g. bootstrapping) could not be applied. Alternatively, a binomial or Poisson probability density function (Source excel code:

John Pezzullo–Kissimmee Florida USA, suggested reference: CJ Clopper and ES Pearson, 1934) was used to calculate the range (lower and upper) of bycatch estimates from an expected 95% confidence interval (CI). Bycatch events of harbour porpoise and grey seals were both treated as binomial for the purposes of calculating 95% confidence intervals around a bycatch rate. Observed DaS are either porpoise/seal positive or porpoise negative with a maximum of one animal observed in any one day (it is unusual to observe more than one animal bycaught in a single day). The estimate of the 95% confidence intervals around harbour porpoise and grey seal bycatch rates were then used to generate maximum and minimum bycatch totals based on the fishing effort data. The results were set in the context of regional abundance estimates of the protected species of interest .

Estimates are derived for two ecoregions; the Celtic Sea (Divisions 6a, 6.b.2, 7.c.2, f, g , h, 7.j.2, 7.j.1 and 7.k.2.) and Greater North Sea (Divisions 4 a b, c, 7d 7e and 3a20 and 21). It was not possible to derive bycatch rate estimates throughout the whole of the Celtic Sea Ecoregion for several reasons: for example in Division 2.a. a large part of the area is covering parts of the Norwegian Sea and areas north of the Faroes where WGBYC do not hold information on bycatch rates or fishing effort. Bycatch mortality was also assessed in the east Biscay shelf (Divisions 8a and b). This is an area where there are many bycatch records for the species of interest; this area has also recently been redefined as a "Celtic Sea" assessment unit for harbour porpoise (NAMMCO_NIMR 2019) and the implications of this were considered.

The gear types assessed in the BRA were netting (GNS, GTR, GND), bottom trawling (OTB, OTT, PTB) and pelagic trawling (OTM, PTM). The data on bycatch used in the BRA spanned 2015-2017. The decision to use these data rather than earlier data the WGBYC hold (from 2005) was based on an assessment of the compatibility of the different annual datasets (see ToR C, section 5.1.2). Submission of data to WGBYC prior to that collected in 2015, was less controlled than it has been in recent years through formal data calls and the use of a data template with mandatory fields and fixed vocabularies (see ToR F, section 6.5).

Pooling data from 2015 until 2017 gives a reasonable high observer coverage in certain areas and métiers (Table 5.). The maximum observer coverage is in the Celtic Sea in midwater trawls (14.1 %). It is also the area with the highest coverage in set net fisheries (6.9 %). When data from 2015 and 2017 were pooled, the highest bycatch rate for harbour porpoise was observed in set gillnets in the Celtic and North Sea. Pooling data over years and Divisions, the harbour porpoise bycatch rate ranged from 0.0002–0.0492 porpoise per DaS (95% CI) depending on area and métier. Using the reported fishing effort, the total bycatch in nets in 2017 for the Celtic Sea Ecoregion ranged from 230–471 harbour porpoises. No porpoises were observed bycaught in midwater trawls and a maximum of 182 porpoises were caught in bottom trawls in the Celtic Sea Ecoregion. In the Greater North Sea (which also includes 3a), the estimated bycatch could range from 1,175 – 2,126 harbour porpoises per annum in nets. With regards to grey seals, the highest bycatch rate was observed in bottom trawls in the Celtic Sea. These reported incidents were mainly reported by France and were reported as incidents and not the number of individuals. Therefore, we have assumed that one incident equals one individual grey seal. With the exception of these reports bycatch of grey seals were highest in set nets. Pooling data over years and Divisions, the grey seal bycatch rate ranged from 0.0003 to 0.0381 (95% CI) depending on area and metier with the highest bycatch rate in bottom trawls in the Celtic Sea. Using the reported fishing effort, extrapolating the total bycatch in nets in 2017 for the Celtic Sea Ecoregion ranged from 101-282 grey seals. The maximum of 2,149 grey seals were found in bottom trawls in the Celtic Sea. This high number of bycatch derives from a single country reporting high bycatches of seals during 2016 and 2017. These singular events, when scaled across the fleet, likely cause an upward bias. The confidence intervals around the bycatch rate are very wide (figure 2) and the numbers presented are most likely not representative. No bycatch of grey seals were observed in bottom or midwater trawls in the North Sea.

In 2016, the SCANS-III project (Hammond *et al*., 2017) surveyed the north western European shelf and offshore waters to generate precise abundance estimates for the more common cetacean species. Unlike previous SCANS surveys, Irish waters were not surveyed as part of this project but through an independent programme ObSERVE (Rogan *et al*., 2018). The abundance estimates from these two projects were used to generate abundance estimates for harbour porpoise Celtic Sea Ecoregion and SCANS-III used for the Greater North Sea, so that bycatch estimates could be put into context of "population" sizes.

ASCOBANS defines a total anthropogenic removal above 1.7% of the best available estimate of abundance to be considered unacceptable in the case of the harbour porpoise. It further proposes an intermediate precautionary aim to reduce bycatch to less than 1% of the best available population estimate ("a precautionary environmental limit") (ASCOBANS 2016). Table 7 shows that bycatch of harbour porpoise in the Celtic Sea Ecoregion as we have defined it is likely below the 1% precautionary environmental limit (95% CI 0.29-0.80%). The greatest proportion of mortality is due to nets. It should be noted that there is considerable netting and documented bycatch in 7e, some of which is within the Celtic Sea Ecoregion but has not been included here because there is no way to apportion fishing or monitoring effort within the subarea to this ecoregion. This will give rise to an underestimate of bycatch in the ecoregion. This result contrasts with the findings from last year's BRA (ICES 2018a) which suggested that bycatch in part of the Celtic Seas Ecoregion (Subarea 7) was potentially exceeding the 1% environmental limit (1.08-2.42%) for the corresponding portion of harbour porpoise population. This probably reflects the fact that bycatch of harbour porpoise in the Celtic Seas Ecoregion is focused in the southern part (predominantly Subarea 7 where much of the netting effort is). The discrepancy in the results highlights the issues surrounding assessing bycatch within "artificially" defined ecoregions that have no real bearing on biological populations; so population impacts are not truly reflected.

A NAMMCO_NIMR (2019) workshop reviewed the stock structure of harbour porpoise in the Northeast Atlantic. The assessment unit (AU) they defined as "Celtic Seas" based on a range of evidence to support stock structure for this species, is approximated by ICES Divisions 7 f, g, h, e and 8 a and b. The WGBYC data show that much of the observed bycatch of harbour porpoise in Subarea 7 occurs in these Divisions and also the eastern Biscay Shelf. For this reason, the range of mortality in the eastern Biscay Shelf was also assessed and in nets amounted to 205- 740 animals per annum. This estimate when considered together with the relevant Divisions within Subarea 7 (as per Celtic Seas AU), could amount to a range of bycatch in the AU of 536-1409 harbour porpoise per year (Table 8). The abundance of harbour porpoise in this AU is approximately 25,281[13] and the bycatch range represents 2.12-5.57 % of the best available abundance estimate (from Hammond et al. 2017) for this area.

In the Greater North Sea Ecoregion, the BRA suggests that bycatch mortality of harbour porpoise is below the 1% threshold (95% CI 0.33-0.59) (Table 7).

The abundance of grey seals in the Greater North Sea and Celtic Seas was assessed for the OSPAR Intermediate Assessment (OSPAR_IA 2017) and the combined areas approximate those of the relevant ICES ecoregions when combined. Abundance of grey seals in this area was estimated to be 111,504 animals. WGBYC estimates of potential low and high (95% CI) bycatch estimates for the Celtic Seas and Greater North Sea Ecoregions combined were 1.689-3.173 animals which represents 1.51-2.85% of the best available abundance estimate for this region (Table 7). A further 207- 918 grey seals are estimated to be taken in the eastern Biscay Shelf, primarily in nets (Table 7). There are no "environmental limits", such as ASCOBANS definition of total anthropogenic removal, for seals; however, under the Marine Strategy Framework Directive, indicators for seals

[13] Approximated as SCANS-III blocks B and D (Hammond et al 2017) and ObSERVE strata 4 and 8 (Rogan et al. 2018)

look at trends in population abundance. The population of grey seals in these areas is steadily increasing (OSPAR_IA 2017).

WGBYC again caveats the results of the BRA given that the bycatch estimates are subject to unquantifiable biases. In particular, the fishing effort used to scale-up bycatch rates is likely to be underestimated as effort from smaller vessels is not fully represented. In this respect, the bycatch range may be underestimated. Bycatch monitoring is also largely carried out through DCF fisheries observers; only a few countries have dedicated at-sea observers in a protected species bycatch monitoring programme. WGBYC have reported previously on the downward bias in bycatch rates from data collected in non-dedicated vs. dedicated observer schemes. Depending on the observer protocol and procedures, bycaught animals falling out of the net during hauling (e.g. Kindt-Larsen *et al*., 2012) may be overlooked which might also produce additional downward bias. Conversely, monitoring has focused on larger vessels, which are assumed to have higher bycatch due to larger numbers of nets set and this would cause a positive bias in the assessments. The magnitude of potential bias in fishing effort and bycatch numbers is unknown.

3.1.2 Marine Mammals: Summary and comparison of minimum and maximum bycatch rates 2005-2017

Bycatch events for marine mammals are relatively rare and a summary of the data in the WGBYC database for 2005–2017 was compiled (Table 9). The marine mammals that were included in the summary were: Common dolphin (*Delphinus delphis*), grey seal, harbor porpoise, white beaked dolphin (*Lagenorhynchus albirostris*), Atlantic white-sided dolphin (*Lagenorhynchus acutus)*, striped dolphin (*Stenella coeruleoalba*), "seals" (*Phocidae*), harbor seal (*Phoca vitulina*), bottlenose dolphin (*Tursiops truncatus*) and Long-finned pilot whale (*Globicephala melas*). BRAs can only be carried out for those species that are better represented in the dataset. However, metier specific minimum and maximum bycatch rates of the other species can be estimated in the same way as described in 5.1.1. These rates have not been scaled up (even though in some cases the sample size is fairly large) due to the fact that the numbers bycaught differ significantly over the years in certain areas and/or metiers. This can be due to the fact that fishing effort and methods might have changed over time along with species distribution and abundance. However, they can be used to show relative levels of risk across metiers and ecoregions. When calculating 95% confidence intervals all species except for common dolphins have been treated as binomial events. Bycatch rates for common dolphins were estimated using a poisson distribution.

The highest bycatch rate was found in midwater trawls for common dolphins in the eastern Biscay shelf (8a and 8b), where the rate ranged from 0.285 to 0.372 dolphins per DaS (95% CI). These high bycatch rates are most likely highly influenced by the fact that only a certain métier with known high bycatch rates has been observed and in this analysis we have pooled several métiers. However, for all other species and in all areas the highest bycatch rates are found in set net fisheries. For harbour porpoise the highest bycatch rates were in set net fisheries in the Celtic and North Sea (0.0594 to 0.0801 and 0.0297 to 0.040, 95% CI). Grey seals have the highest bycatch rates in set nets in the Celtic Sea (0.0411 to 0.0589, 95% CI).

Extrapolations of high and low numbers of bycaught porpoises and grey seals, in different metiers and areas, using pooled data from 2005 until 2017 were compared to extrapolation of high and low numbers of bycaught porpoises and grey seals based on data from the same area and metier but pooled only from 2015 to 2017 (grey seals, Figure 2 and harbour porpoise, Figure 3. Marine mammal data are summarised for 2015-2017 period is in Table 6) . The comparison showed large differences in the number of bycaught individuals in some areas and metiers depending on the time period of the dataset used. For example, there is a large difference in grey seal bycatch in the Celtic Sea depending on which data are pooled. There are higher bycatch

numbers in set net fisheries if data from the early period (2005-2017) are pooled than the later period (2015-2017). In the eastern Biscay shelf and the Greater North Sea in set net fisheries, the high and low bycatch estimates are greater and have larger uncertainty when data are pooled during the more recent period (2015-2017) compared to those based on the earlier data. This is most likely due to limited sample size of the shorter recent time period. Another explanation can be that there are different bycatch rates depending on metiers. Pooling metiers in level 4 might give biases both with regards to bycatch rates as well as when these are extrapolated to total bycatch estimates.

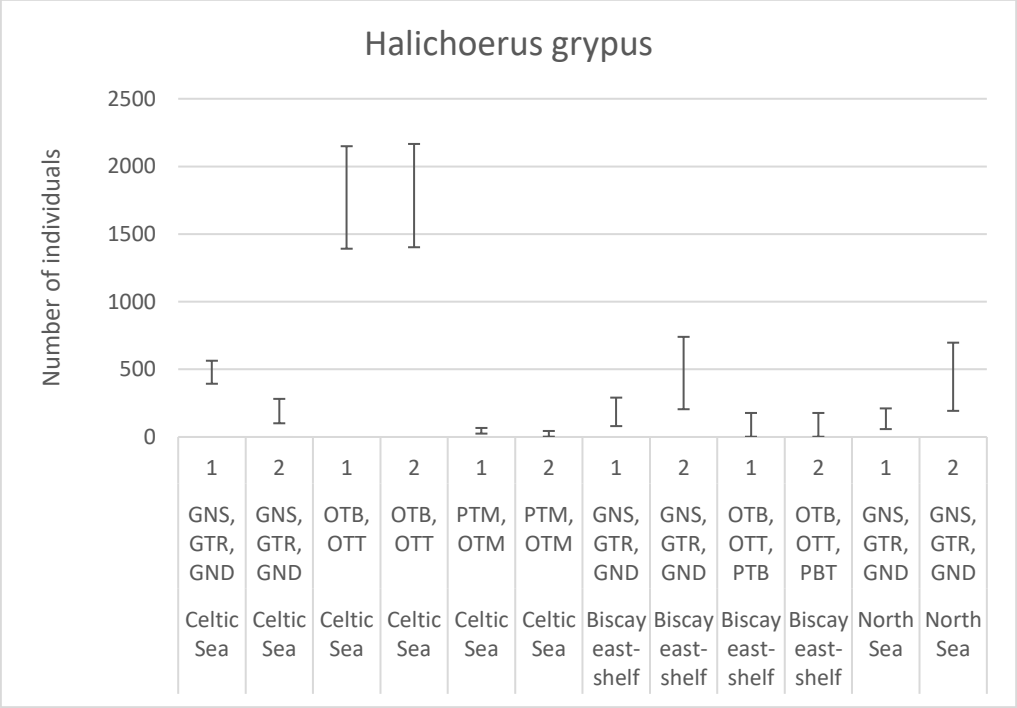

Figure 2. Estimation of high and low bycatch extimates for grey seals using two periods of data. Period 1 uses data pooled over the years 2005 until 2017. Period two uses data pooled over 2015 to 2017. Fishing effort used to extrapolate the numbers is from 2017.

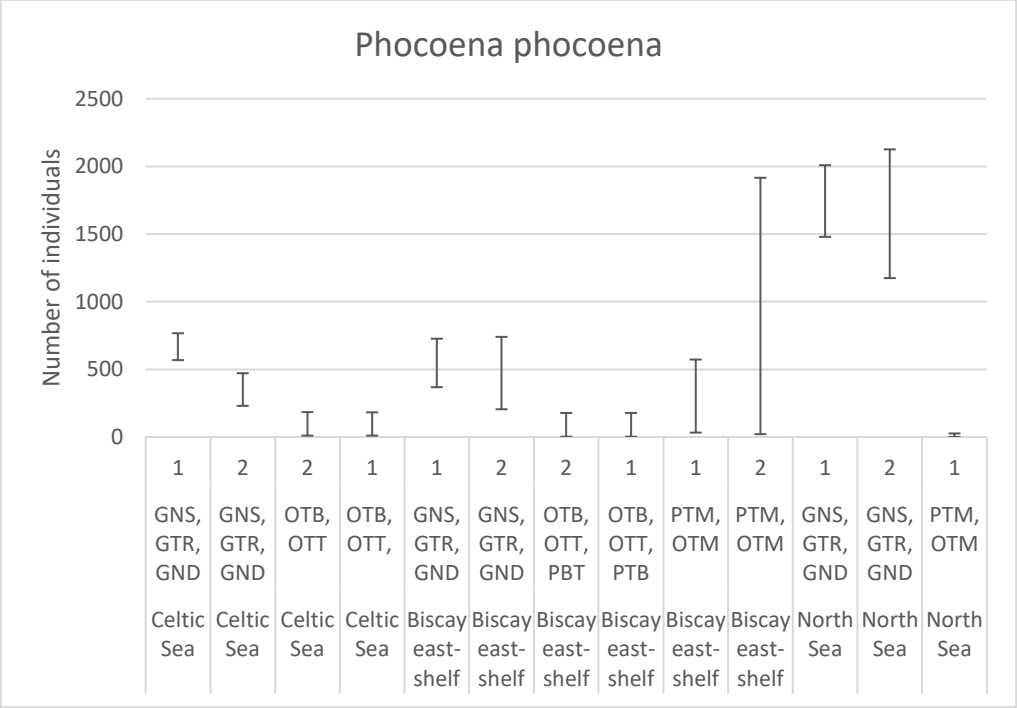

Figure 3. Estimation of high and low bycatch extimates for harbour porpoise using two periods of data. Period 1 uses data pooled over the years 2005 until 2017. Period two uses data pooled over 2015 to 2017. Fishing effort used to extrapolate the numbers is from 2017.

Estimates of high and low harbour porpoise bycatch estimates were also compared (Figure 3). With regards to harbour porpoise, there is a difference in bycatch estimates in set net fisheries in the Celtic sea; higher bycatch estimates when data from the earlier period is pooled. We also see higher estimates in the eastern Biscay shelf set net fisheries pooling data from the later period compared to the earlier period. The range between high and low estimates is also largely indicative of the smaller sample size in shorter time periods.

The results from the comparison analysis, as well as the summary of bycatch rates do indicate that there is a need to analyse data using a higher metier level as well as taking into regards changes in fisheries and abundance of the concerned species over the time period.

3.1.3 Seabirds: Summary of minimum and maximum bycatch rates for 2017

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 are static and drift nets, hooks and lines/longlines, seines/surrounding nets, midwater and demersal trawls, traps and dredges, based on information collated by JWGBIRD (ICES 2018). Table 10 lists those species susceptible to bycatch within OSPAR, HELCOM and GFCM areas. Moreover, Redlist status (OSPAR, HELCOM, BirdLife and IUCN) is given and whether the species is listed in Annex I of the Birds Directive or as a migratory species. A similar table was provided by Volker Dierschke, Chair of JWGBIRD, and discussed in the WGBYC subgroup. It can be seen that many of those species are classed as endangered either regionally or globally. Bycatch risk is generally considered to be closely linked to species specific foraging behaviour. For example, surface-feeding seabirds are more inclined to suffer 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 (EU Commission 2012). WGBYC issued a data call in late 2018 requesting fishing effort, monitoring effort and bycatch records from MS national databases for 2017. For many species the data indicate that often more than one individual is bycaught in those hauls when bycatch occurs, making statistical analysis less straightforward due to the clumped distribution of the data. Severe bycatch events, where multiple birds are caught in the same fishing trip, are even more challenging when overall data quantities are relatively low and the full distribution is not well understood.

Table 11 provides bycatch rates for selected species, areas and gears. The records presented in this table were chosen based upon two basic criteria: 1) Is the species generally considered to be of high conservation concern, in which case we included that species to at least highlight the occurrence of bycatch or 2) if the species was not considered to be of high conservation concern, was there a reasonable level of monitoring data in the WGBYC database on which to base the calculation of a bycatch rate? The term "reasonable" in this context was not fully defined by subgroup members but could be formalised in future, potentially based on some metric relating to monitored effort vs fishing effort. The resulting selection included 367 bycaught individuals . In the data call, bycatch numbers and incidences were reported on a monthly basis but these were subsequently pooled by species within areas due to low monitored effort in individual months. Reporting of monthly fishing effort in the WGBYC data call is not a mandatory field (it is for monitored effort) because it was considered that this level of resolution is not available

from all national fisheries databases. Consequently, monthly (or pooled) bycatch rates were not extrapolated to the total effort to produce bycatch estimates. Given the strong seasonal influence on behaviour of seabirds, the ability to generate stratified total bycatch estimates at finer temporal resolutions is more meaningful than what would be possible to achieve with WGBYC existing data.

We present monthly (or pooled) bycatch rates with 95% confidence intervals (calculated by bootstrapping) to provide a measure of the uncertainty around the estimated rate (Table 11). In cases where the monitored fishing effort is low and the bycatch data are widely dispersed, the confidence intervals are wide and thus are not particularly useful for extrapolating using total fishing effort. It was discussed by the subgroup that a possible approach to address this situation might be to generate multi-annual bycatch rates (which should have tighter confidence intervals due to increased monitoring levels and improved insight into the statistical distribution of the data) as more data are obtained. As bycatch rates gradually become more robust the subgroup may be in a position to begin applying rates to total fishing effort, as is done for marine mammals, to produce bycatch estimates for particular species and metiers.

For **Icelandic waters** (27.5.a.2) (Table 11), bycatch rates were calculated for black and common guillemot, long tailed duck, northern fulmar, gannet and common eider in gillnets and given as 95% confidence intervals. Cormorant and shag cannot always be well distinguished and thus a bycatch rate for the family Phalacrocoracidae is given. Further, bycatch rates of northern fulmars and gannets in longlines were calculated.

In the **Western Mediterranean** (GFCM areas 1, 5 and 6) (Table 11), Audouin's gull bycatch rates were calculated. Although based on a low monitored fishing effort, bycatch of Balearic shearwaters in gillnets and longlines is given due to the high conservation value of this species. Also some bycatch of this species has been observed in longlines in Celtic/Irish Sea (27.7) but only with a low observed effort which did not allow for calculating rates.

Bycatch rates are also given for gannets in otter and pair trawls in the southern **North Sea** (27.4.a), cormorants in gillnets in the **Baltic Sea** (27.3.d.29-30 and 32) and common guillemots in gillnets in the **Bay of Biscay** (27.8.a-b) and the **Celtic/Irish Sea** (27.7.e-f-j) (Table 10).

3.1.4 Elasmobranchs: summary of minimum and maximum bycatch rates for 2017

Elasmobranchs are not protected under the Habitats Directive, but species listed by the OSPAR List of Threatened and/or Declining Species and Habitats are factually protected according to the OSPAR Biological Diversity and Ecosystems Strategy and also the Marine Strategy Framework Directive (MSFD). A number of species are 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, 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 second time that elasmobranch data have been accessed formally by WGBYC. Due largely to the quantity of elasmobranch bycatch data received for 2017 (as obtained through the WGBYC 2019 data call) we consider this more recent years data to be more representative of potentially available data residing in national databases, than data obtained for 2016 through the previous data call. WGBYC has collated all bycatch data for protected elasmobranchs from 2017 to provide an over-view of the degree of bycatch by gear and geographic region for various species, from records for the countries which submitted data. These are provided in section 3, Table 2.

The data have been screened to some extent, mainly correcting species names ac-cording to the World Register of Marine Species (WoRMS). Thus data submitted as *Dipturus flossada* were re-assigned as *Dipturus batis*. Some errors relating to spatial areas were corrected, based on the known or expected species composition in these areas. For instance, data submitted simply as areas 1, 2, 5, 6 and 7 were re-assigned from ICES Subareas to the Mediterranean GFCM Subareas 1, 2, 5, 6 and 7.

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" or "critically endangered" were considered to be of high conservation concern. Those classified as "vulnerable" are classified as of medium concern; those classified as "near threatened", or "data deficient" were considered for now to be of low conservation concern; whilst those classified as "least concern" are considered to be of no conservation concern. The least concern species are often characterised by large numbers of observations (e.g. *Etmopterus spinax*) 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 metier were calculated for all species of high and medium conservation concern and presented in Table 12. These estimates include confidence intervals, calculated using poisson distributions.

In the North and Celtic Seas, the most frequently observed species was *Dipturus batis* the blue skate, followed by *Squalus acanthias*, the spiny dogfish (North and Celtic Seas). In Biscay/Iberia, *Leucoraja circularis*, the sandy ray was more frequent than *D. batis* or *S. acanthias*. Bottom trawls accounted for most of the observations in all regions. *Dipturus batis* and *Squalus acanthias* bycatches were most frequently observed in ICES Divisions 4a (Northern North Sea), 6a (West of Scotland) and 7e, f, g, j (Western Channel and Celtic Sea). For the more severely depleted species in the ICES area, *Squatina squatina*, the angel shark, and *Rostroraja alba*, the white skate, low numbers of observed bycatches were recorded in gill nets in ICES Divisions 7f (Bristol Channel), 7j (SW Ireland) and 9a (Portugal).

Dalatias licha, the kitefin shark and *Centrophorus granulosus*, the gulper shark, were the most frequently observed deepwater species, with most records of both species from Portuguese (Azorean) waters. *Lamna nasus*, the porbeagle dominated observed pelagic bycatches, mostly from gill nets in 7g (Celtic Sea).

In the Mediterranean the dominant species in observations were *Dalatias licha* and *Squalus acanthias*, mainly caught by bottom trawls. The main areas for these species were GFCM areas 7 and 22 (Western Mediterranean) respectively.

For species of medium conservation concern, in the Atlantic, tope shark, *Galeorhinus galeus* is the most observed, in both trawls and gillnets. In the Mediterranean Mustelus sharks were the most observed, mostly in trawls.

Abundant aggregating species such as *S. acanthias*, were recorded in large numbers in some bycatch events. On the other hand, the low frequency of species such as *S. squatina* illustrates their extremely low abundance, depleted state and restricted spatial distribution. Some of the large bodied skates were recorded in large numbers in the Atlantic, though less so in the Mediterranean. Noteworthy is the paucity of observations of some formerly abundant species such as *Centroscymnus coelolepis*, the Portuguese dogfish, and *Centrophorus squamosus*, the leafscale gulper shark. Further work is required to understand the underlying issues with these data.

This analysis can be used to plan further research into bycatch, especially of the rarer species. More work may be required to raise to population scale estimates. It should be noted that in some cases the presented number of observations has already been raised from a sample of the total catch at haul level. This is standard procedure in catch sampling for abundant species and/or large hauls. Where a haul consists of a large catch of a particular species, it is impossible to sample the entire haul. So a sample is taken, consisting of a known proportion of the total catch. This sample is fully evaluated for number of specimens per species. The number of specimens per species is then "raised" to the total catch by multiplying it by a "raising factor" which is the ratio of the total catch to the sampled catch. This procedure may be repeated in several hierarchical steps, such that there may be sub-samples of the sampled catch , if this is required to handle very large catches.

Bycatch rates are illustrated in **Figure 9**, for two example species taken in bottom trawls. One species, *Dipturus batis* species complex, is of high conservation concern (Critically Endangered in the Redlist). The other, *Dipturus oxyrinchus*, is a data poor species ranked as "Near Threatened" in the Redlist. Figure 4 implies that the latter species is less abundant than the Critically Endangered *D. batis*, and hence it may warrant further attention by ICES WGEF, and in the Fish Biodiversity assessment context. However it should be noted that although this species is data poor it is endemic to European waters, and hence warrants further attention.

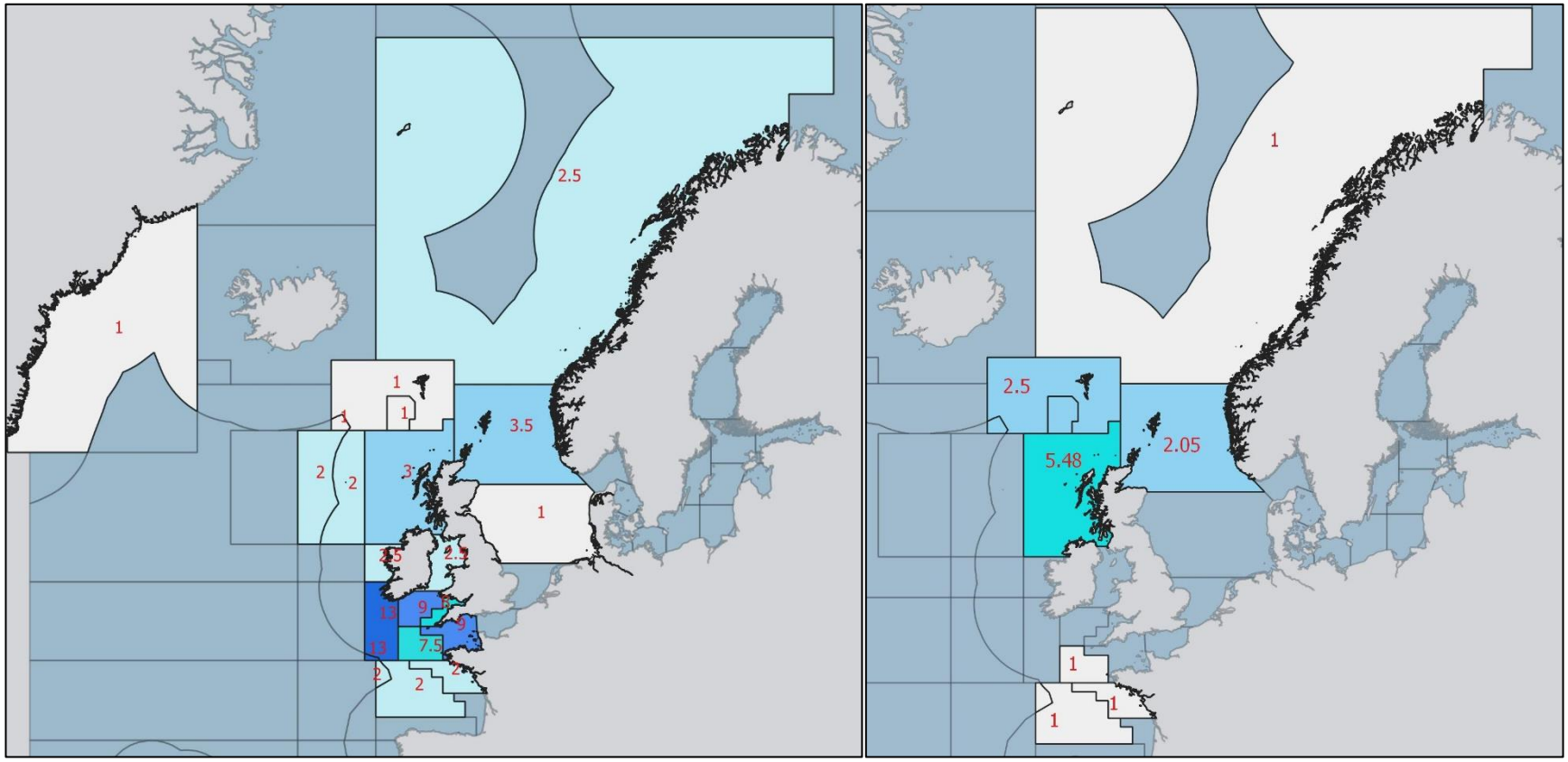

Figure 4. Illustration of bycatch rates (individuals per observed day at sea) for two species, *Dipturus batis* from trawl, a species of high conservation concern (left); and *Dipturus oxyrinchus* from trawls, a species of low conservation concern, but for which data are largely lacking in ICES to conduct any assessment (right). White to dark blue represents lowest to highest bycatch rates. The values of the bycatch rates are shown on the maps.[14]

[14] Last sentence of the Figure caption added base don reviewers' comments.

Overall, the 2019 data call has been a success, and the inclusion of elasmobranchs in the WGBYC data call is considered to have increased scientific understanding of the extent of bycatch of these species across metiers and areas. This represents a considerable development in scientific knowledge. The analyses presented by the working group are preliminary in nature, and serve as a scoping exercise, to allow for more detailed investigation and refined analyses in future years.

3.2 Evaluating the impacts of bycatch using strandings data: harbour porpoise and common dolphins

In previous years, WGBYC has reported on the development of modelling methods to quantify bycatch using data from strandings (Peltier *et al*. 2012; 2014, 2016). This year, Peltier presented new analyses to the group on bycatch of harbor porpoise in the North Sea and harbor porpoise and common dolphin in the Channel and Bay of Biscay.

Harbour porpoise stranding time series were gathered from North Sea coastlines of Denmark, Germany, the Netherlands, Belgium, the United Kingdom and France from 1990 to 2014. A total of 16,517 stranded harbour porpoises were reported from 1990-2014 across the study area. Additionally, a total of 895 animals showing evidence of being bycaught were recovered from 1990-2015 along the coasts of the English Channel (n=533) and the Bay of Biscay (n=362). This approach is geographically explicit and is based on drift back-calculations (thereafter named 'reverse drift modelling') in order to reconstruct the trajectory of every stranded harbour porpoise from its stranding location to its likely area of death at sea (Peltier *et al*., 2016). Since 1990, the highest density of dead harbour porpoises at sea were predicted in the North Sea. Their distribution was widely extended in the eastern part of the North Sea, whereas mortality areas of porpoises along the western North Sea coasts remained very coastal. Over the years, predicted densities of bycaught harbour porpoise increased, and slowly moved down to the southeast North Sea.

Mortality areas were identified in the English Channel since the late 90's and in the Bay of Biscay from the early 2000's onwards. In the Bay of Biscay, the distribution of dead porpoises was located almost entirely on the continental shelf. From 1997 to 2004, the distribution of bycaught harbour porpoises inferred from strandings was mostly located in the western Channel and the Celtic Sea. Then, since 2009 the eastern Channel became an area of high densities of bycaught harbour porpoises, and later the south of the Bay of Biscay close to the Spanish border. In the whole area (Bay of Biscay, English Channel and Celtic Sea) the average annual number of bycaught porpoises was estimated at 530 [330 – 1,030] individuals from the available data for 1990 to 2015. From 2012 – 2015 an increase was observed[15]: the yearly average estimate reached 1,300 [810-2,520] bycaught porpoises, that could exceed the commonly used threshold of 1.7% of the best population estimations (provided by SCANS-III survey and French dedicated aerial surveys in summer 2011 in the same area), as sustainable anthropogenic removal. A slight decrease in the estimated number of bycaught porpoises occurred in 2015[16].

In the Bay of Biscay, harbour porpoise and common dolphin strandings revealed different bycatch processes. The phenomenon seems chronic, as stranded harbour porpoises with evidence of having been bycaught are collected all year round. Maxima are reached in winter. Common dolphin strandings suggested a trophic interaction with sea bass and hake fisheries (midwater

[15] Based on reviewers comments it has been clarified in the text that the selected time period was motivated by data availability; 1990 – 2015 & 2012

[16] Last sentence eof the paragraph added after the reviewers' report was received.

trawlers and gill nets): common dolphins and predator fishes concentrate on feeding areas targeting small pelagic fish. The bycatch process appears to be localized rather than widely dispersed, and therefore easy to miss by on-board observers.

The last available extrapolation of harbour porpoise bycatch by the French dedicated observer program in 2009 (n=300) is consistent with the estimate inferred from strandings (200 to 620 ind.) in sub area 27.8. Estimates provided for common dolphins are diverging following both monitoring tools (in 2009: 1,000 ind. following national report vs 2010 to 6,210 ind. inferred from strandings). But estimates from standings are very close to those provided by WGBYC BRA based on 2016 data (BRA : 1,607 to 4,355 ind. vs 1,400 to 4,800 ind. inferred from strandings in 2016) (ICES, 2018a).

3.3 Prioritising areas where additional monitoring is needed: Regional Coordination Group request for input to risk assessment of North Atlantic Fishing Grounds.

The group was asked by the RCG to review part of the WKBYC/FishPi "risk assessment" (ICES, 2013). WKBYC developed a methodology to estimate the bycatch risk of different groups of species, based on the métier, fishing effort and abundance in each different fishing region. The group combined this risk with the DCF sampling effort, to provide an index of which areas and fishing gears are most in need of sampling (ICES 2013). The FishPi project used this method and applied to the North Atlantic and North Sea. WGBYC applied the method to the Baltic Sea at last year's meeting (ICES 2018). A review of the method and updating of results (using most recent effort data) is a task to be addressed in the current coordinated fishPi 2 project but most Member States in this project are also represented in WGBYC. The RCG require the outputs to inform the design of sampling under the EU-MAP, and therefore, RCG asked WGBYC to assist with this task. The assessment method is summarised in Figure 5.

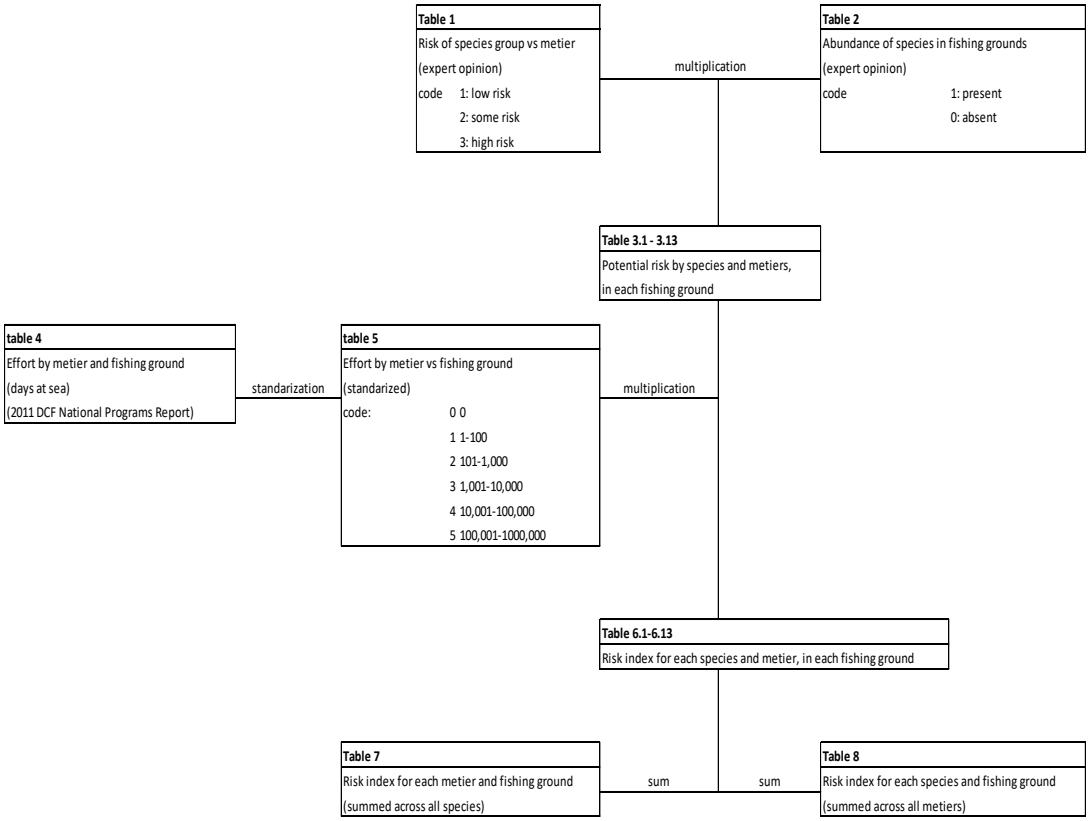

Figure 5. WKBYC/FishPi Risk Assessment methodology.

The specific tasks for a subgroup established in WGBYC were:

- To review the taxonomic grouping used in the WKBYK/FishPi method (Table 1, Figure 5)
- To review the assignment of risk categories in the table that indicates susceptibility of different taxa to bycatch by metier (Table 1 in Figure 5 above);
- To review presence/absence in the abundance table (Table 2 in Figure 5 above); and
- Compare and comment on the at-sea observer effort carried out under the DCF versus observer effort in observer programs that target (groups of) protected species.

3.3.1 Review of taxonomic grouping in the risk assessment and the assignment to risk categories

A subgroup was established to review how the range of taxa susceptible to bycatch had been classified for the purposes of the risk assessment (Table 1, Figure 5). The subgroup observed that the divisions into "taxonomic groups" was not consistent, as a group may contain only one species ("harbour porpoise", "lamprey") or may cover several classes ("round fish"). In addition, the groups do not differentiate small fish from megafauna and pelagics from demersal organisms even though the risk of bycatch to different gears likely varies. The group discussed these inconsistencies and considered the current grouping arbitrary; they questioned whether it was fit-for-purpose. The different groups originate from the WKBYK (ICES, 2013) for the purposes of assessing the distribution of at-sea observer effort under the (pre 2017) DCF. Sampling under the DCF, is targeted mainly to fisheries where most commercial species are caught. From a PETS sampling point of view the observer effort should be targeted to fisheries with a high bycatch of protected species of different groups. The method should be able to determine to what extent the at sea-observer programs do cover these fisheries. The results of the assessment WKBYC and FishPi very clearly show the discrepancies between the distribution of the observer effort and the high risk metiers in the different Fishing Grounds. The subgroup therefore concluded that the taxonomic grouping fits it original purpose. However, the group noticed the use of the name "risk assessment" (in WKBYC) may create false expectation about the way these tables can be interpreted.

There were also discussions on the definitions of each of the groups; so what are the differences between "dolphins" and "large whales"; between "surface feeding" birds and "diving birds" but it was concluded that this is not directly relevant for the assessment of observer effort distribution.

As the categorization of risk (to being bycaught) is on a scale of 1-3 (lowest-highest risk) and is based on expert opinion, the risk-assignment by metier for each taxonomic group can lead to large discussions. In general, the group agreed on assignment of the risk categories but in some cases another code has been suggested (Table 13). The upgrading from 1 to 2 for several metiers under "Round Fish" is based on the consideration that the number of species in this group is large and diverse, making it likely that at least some species are susceptible to being bycaught.

Risk categories were also upgraded for some metiers for harbour porpoise and "large whales". Beach seines are one of the gears to which harbour porpoises are more vulnerable (Read, 2015; Sequeira *et al*, 1996; Vingada *et al*, 2011) and risk assignment was consequently upgraded.

The risk category for large whales in "Pots and Traps" was been upgraded from 1 to 2 based on recent publications on entanglements of minke whales (*Balaenoptera acutorostrata*) and humpback whales (*Megaptera novaeangliae*) in pots and traps (Northridge *et al*, 2010; Ryan *et al*, 2016).

3.3.2 Review the presence/absence of taxonomic groups by area

Given the coarse approach for the purpose of the assessment (as described above) differences in the calculated risk index by species-group, metier and area should be limited. The subgroup agreed completely with the assignment of presence/absence (1 or 0) as previously assigned by WKBYK and FishPi.

3.3.3 Comparison observer effort distribution in DCF- and dedicated surveys

The request from the RCG was to also give an indication of the amount of observer effort in dedicated PETS survey compared to the distribution of DCF observer effort. The observer effort was extracted from the WGBYC database as observer days at sea. For each North Atlantic Fishing Ground the number of DCF observer days ("DCF SAMP DAYS") and the number of dedicated observer days ("DED SAMP DAYS") were extracted by metier and made available on the SharePoint for RCG intersessional work. An example for the North Sea is given in Table 14; there were just 22 days of dedicated PETS monitoring compared to 1829 days under the DCF over all metiers.

3.4 Other approaches to risk assessment: Mapping by-catch risk in relation to seabird & cetacean distributions in NW European Seas

Peter Evans gave a short presentation on the risk assessments undertaken as part of a five-year UK research initiative called the Marine Ecosystem Research Programme funded by the Natural Environment Research Council and Department of the Environment, Food and Rural Affairs. The project looked at the overlap in space and time between fishing effort using different gear types and the density distributions of different cetacean and seabird species. For fishing effort, the aim was to draw upon both AIS and VMS data to map fishing effort, using the EU vessel register for further information on vessel length, country of origin, gear types carried, and catches. Using algorithms developed largely by Global Fishing Watch, to attempt to better discriminate periods when vessels are actively fishing, maps are produced for each of the years 2012-17 split by country, by gear type, by month and by year. These are then compared with monthly maps of modelled predicted densities and abundance for the twelve most common cetacean and twelve seabird species, and areas of overlap identified. Examples of areas of greatest overlap for high risk fisheries and species are presented for common guillemot and harbour porpoise for static gillnets, and common dolphin from pelagic trawls. The main areas of overlap in common guillemot with static gillnets were northern North Sea, West Norway, Skagerrak and English Channel. For harbour porpoise and static gillnets, it was west of Norway and Denmark, the eastern English Channel, Celtic Sea and South-west Approaches to the English Channel (the Baltic Sea was included in the analysis). For common dolphin and pelagic trawls, it was the western English Channel, northern Bay of Biscay, and north-west Spain. Assessments of risk will be developed taking into account observed relative bycatch rates, species vulnerabilities according to population status and life history features, and other information such as overlap between dietary preferences and target fish catches. These can then be used to inform when and where to focus monitoring and mitigation actions.

3.5 Conclusions

- Bycatch Risk Assessments (BRA) were conducted for grey seal (*Halichoerus grypus*) and harbour porpoise *(Phocoena phocoena*) in the Celtic Seas and Greater North Sea ecoregions.
- In 2017, bycatch rates of harbour porpoise were highest in nets (GNS, GTR, GND) in both ecoregions; in the Celtic Seas, harbour porpoise total bycatch in nets was estimated to be 230-471; in the Greater North Sea the estimated bycatch in nets ranged from 1,175 – 2,126 porpoise per annum.
- These harbour porpoise bycatch estimates were below the ASCOBANS 1.7% threshold of unacceptable interaction. They are also below the 1% precautionary environmental limit defined by ASCOBANS for bycatch.
- However, the harbour porpoise BRA was also carried out for a biologically defined Celtic Seas Assessment Unit for this species; total bycatch in nets in 2017 was estimated to be 536-1,409 animals (>2% of the population abundance) which exceeds both ASCOBANS thresholds.
- Grey seal bycatch was purportedly highest in bottom trawls in the Celtic Sea ecoregion; however, this was driven by an entry in French data of an incident with multiple individuals which could not be verified. This aside, bycatch rates were highest in nets (GNS, GTR, GND) in the Celtic Seas ecoregion.
- In 2017, the percentage mortality of grey seals due to bycatch in the Celtic and Greater North Sea ecoregions combined was estimated to be 1.5 - 2.8% of the best estimate of abundance.
- High and low bycatch rates were also estimated for all marine mammals in the entire WGBYC database (2005-2017) for the Greater North Sea and Celtic Seas Ecoregions and the eastern Bay of Biscay shelf (8a & b); the bycaught species recorded over this period are Common dolphin (*Delphinus delphis*), grey seal, harbour porpoise, white beaked dolphin (*Lagenorhynchus albirostris*), Atlantic white-sided dolphin (*Lagenorhynchus acutus)*, striped dolphin (*Stenella coeruleoalba*),harbour seal (*Phoca vitulina*), bottlenose dolphin (*Tursiops truncatus*) and long-finned pilot whale (*Globicephala melas)*
- The highest bycatch rates when WGBYC database (2005-2017) was analysed were reported for common dolphin from observations of mid-water trawls in the eastern Bay of Biscay. Observed bycatch rates were 0.285 – 0.372 dolphins per day at sea observed. These rates were lower than those using just recent data 2015-2017 of 0.424-0.676 dolphins per day at sea observed.
- Results were presented from modelling time-series data from stranded harbour porpoise that had been identified as being bycaught along the coasts of the North Sea, English Channel and Bay of Biscay. Between 1990-2014, in the North Sea, predicted densities of harbour porpoise bycatch mortality increased and distribution of mortality areas moved to the south eastern North Sea. In the Bay of Biscay (1990-2015), predicted harbour porpoise bycatch was almost entirely restricted to the continental shelf. Predicted bycatch density increased in the western Channel and Celtic Sea between 1997-2004. In the Bay of Biscay, English Channel and Celtic Sea the average annual number of bycaught porpoises was estimated at 530 (330 – 1,030).
- Confidence intervals around bycatch rates for seabirds were generally wide due to limited monitoring effort in particular metiers; seasonal or monthly bycatch estimates are preferable for seabirds given the patterns of distribution/abundance with time of year. In 2017, highest bycatch rates were calculated for gannet (*Morus bassanus*) in set longlines,

the great cormorant (*Phalacrocorax carbo*) in set gillnets, common eider (*Somateria mollissima)* in set gillnets and Balearic sharewater (*Puffinus mauretanicus*) in set gillnets and trammelnets.[17]

- Elasmobranch bycatch was very common in all ecoregions. Notably high bycatch rates were recorded in the Azores in hooks and lines of *Deania calcea*; in the Bay of Biscay/Iberiain nets of *Leucoraja circularis*; in Celtic Seas in nets of *Dipturus flossada*; in the Greater North Sea in pelagic trawls of *Squalas acanthias*; and in the Mediterranean in bottom trawls of *Dalatias licha*.
- All of the bycatch estimates from WGBYC are biased by the distribution and "quality" of monitoring effort and need to be interpreted with caution. Sampling is not representative, and bias is introduced from various sources. For example, monitoring of larger vessels and data collection using fisheries observers (i.e. as part of the DCF) dominate the dataset. An exercise comparing dedicated versus DCF monitoring effort in North Atlantic fishing grounds, highlighted the trivial number of dedicated PETS monitoring days in 2017. In the North Sea, there were just 22 days of dedicated monitoring compared to 1829 under the DCF.
- However, the BRAs and summary bycatch rates do serve to flag metiers and areas where further monitoring may be justified; where mitigation should be considered; and highlights those species that may be at risk.

[17] Paragraph updated after the Advice Drafting Group (ADGBYC) 2019 when a new extraction from the data base was carried out.

Table 5. Fishing and monitoring effort (DaS = Days at Sea) by metier and are of interest, together with observed bycatch of grey seals (Hg) and harbour porpoise (Pp) for 2015-2017.

Ecoregional	Metier	Total DaS	Observed DaS (2015-2017)	Observer coverage %	Observed number of Hg (2015-2017)	Observed number of Pp (2015-2017)
Celtic Seas	GNS, GTR	9572	657	6.9	12	23
	OTM, PTM	4691	663	14.1	2	0
	OTT, OTB, PTB	56438	1931	3.4	60	2
Greater North sea	GNS, GTR, GND	49853	1029	2.1	8	33
	OTM, PTM	9819	516	5.3	0	0
	OTT, OTB, PTB	114757	1665	1.5	0	0
Biscay East-Shelf (8a and b)	GNS, GTR, GND*	51648	1004	1.9	8	8
	OTM, PTM	60949	149	0.2	0	1
	OTT, OTB, PTB	7485	198	2.6	1	1

***No observer effort in metier GND, only fishing effort in GND.**

Table 6. Total and observed effort in days at sea (DaS) and number of observed number of specimen pooled per métiers described in column Metier L4, area and during the years 2015 to 2017. The marine mammals included in the table are: *Delphinus delphis, Halichoerus grypus, Phocoena phocoena , Lagenorhynchus albirostris, Lagenorhynchus acutus, Stenella coeruleoalba, Phocidae, Phoca vitulina, Tursiops truncatus and Globicephala melas*. If the species is not seen in the table it means there are no bycatch incidents of that species. Total DaS from WGBYC database for 2017. Bycatch rate = Specimens/DaS observed

Ecoregion	Metier L4	Years pooled	Total fishing effort 2017	DaysAtSea Observed	Observer coverage %	Species	Specimens	Low by-catch rate (95% CI)	High by-catch rate (95% CI)
North Sea	GNS. GTR	2015-2017	49853	1029	2.1	*Delphinus delphis*	5	0.0016	0.0113
						Halichoerus grypus	8	0.0039	0.0140
						Phocoena phocoena	33	0.0236	0.0426
	PTM, OTM	2015-2017	9819	516	5.3	*Phoca vitulina*	3	0.0016	0.0150
	OTT, OTB, PBT	2015-2017	114757	1665	1.5	*Phocidae*	1	0.0000	0.0028
Celtic Sea	GNS, GTR, GND	2015-2017	9572	657	6.9	*Delphinus delphis*	9	0.0063	0.0260
						Halichoerus grypus	12	0.0106	0.0294
						Phocoena phocoena	23	0.0240	0.0492
						Globicephala melas	2	0.0005	0.0096
						phocidae	2	0.0005	0.0096
	PTM, OTM	2015-2017	4691	663	14.1	*Delphinus delphis*	20	0.0184	0.0466
						Halichoerus grypus	2	0.0005	0.0095
						Lagenorhynchus albirostris	1	0.0001	0.0071
	OTB, OTT	2015-2017	56438	1931	3.4	*Delphinus delphis*	5	0.0008	0.0060

Ecoregion	Metier L4	Years pooled	Total fishing effort 2017	DaysAtSea Observed	Observer coverage %	Species	Specimens	Low by-catch rate (95% CI)	High by-catch rate (95% CI)
						Halichoerus grypus	60	0.0249	0.0384
						Phocoena phocoena	2	0.0002	0.0033
						Stenella coeruleoalba	1	0.0000	0.0025
						Phocidae	1	0.0000	0.0025
Biscay East-Shelf (8a and b)	GNS, GTR, GND*	2015-2017	51648	1004	1.9	*Delphinus delphis*	22	0.0137	0.0332
						Halichoerus grypus	8	0.0040	0.0143
						Phoca vitulina	1	0.0001	0.0047
						Phocoena phocoena	8	0.0040	0.0143
	PTM/OTM	2015-2017	60949	149	0.2	*Delphinus delphis*	80	0.4246	0.6664
						Phocoena phocoena	1	0.0002	0.0373
	OTB, OTT, PBT	2017	7485	198	2.6	*Halichoerus grypus*	1	0.0003	0.0237
						Phocoena phocoena	1	0.0003	0.0237

***No observer effort in metier GND, only fishing effort in GND.**

Table 7. Estimates of lower and upper 95% bycatch mortality for grey seals and harbour porpoise in the context of harbour porpoise and grey seal abundance estimated in the Celtic sea and Greater Sea ecoregions. Estimates for the eastern Bay of Biscay shelf are aer also provide for grey seal. Estimates were derived from bycatch data submitted to the WGBYC database and the French Reg. 812/2004 report for 2015 until 2017 and fishing effort data submitted to WGBYC for 2017.

Species	Area	Metier	Fishing effort (2017)	Estimate of bycatch rate (Specimens /observed days at sea)		Estimate of bycatch		Best estimate of abundance	% Mortality using lower bycatch estimate	% Mortality using higher bycatch estimate
				Lower 95% CI	Upper 95% CI	Lowe 95% CI	Upper 95% CI			
Halichoerus grypus	Celtic Ecoregion (5.b.2. 6.a, 6.b.2, 7.c.2, f, g , h, 7.j.2, 7.j.1 and 7.k.2)	Nets (GNS, GTR)	9572	0.0106	0.0294	101	282	111 504	0.09	0.25
		Midwater trawls (PTM, OTM)	4691	0.0005	0.0094	2	44		0.00	0.04
		Bottom trawl (OTB, OTT, PTB)	56438	0.0247	0.0381	1392	2149		1.25	1.93
	North Sea (4 a b, c, 7d 7e and 3a)	Nets (GNS, GTR, GND)	49853	0.0039	0.0140	193	697		0.17	0.63
	TOTAL					*1689*	*3173*		1.51	2.85
	Biscay East-Shelf (8a and b)	Nets (GNS, GTR, GND*)	51648	0.0040	0.0143	205	740	-	-	-

Species	Area	Metier	Fishing effort (2017)	Estimate of bycatch rate (Specimens /observed days at sea)		Estimate of bycatch		Best estimate of abundance	% Mortality using lower bycatch estimate	% Mortality using higher bycatch estimate
				Lower 95% CI	Upper 95% CI	Lowe 95% CI	Upper 95% CI			
		Bottom trawl (OTB, OTT, PTB)	7485	0.0003	0.0237	2	178		-	-
	TOTAL					*207*	*918*			
Phocoena phocoena	Celtic Ecoregion (6.a, 6.b.2, 7.c.2, f, g , h, 7.j.2, 7.j.1 and 7.k.2)	Nets (GNS, GTR)	9572	0.0240	0.0492	230	471	81860	0.28	0.58
		Bottom trawl (OTB, OTT, PTB)	56438	0.0002	0.0032	10	182		0.01	0.22
	TOTAL								0.29	0.80
	North Sea (4 a b, c, 7d 7e and 3a)	Nets (GNS, GTR, GND*)	49853	0.0236	0.0426	1175	2126	359428	0.33	0.59
	TOTAL								*0.33*	*0.59*

***No observer effort in metier GND, only fishing effort in GND.**

Table 8. Estimates of lower and upper 95% bycatch mortality for harbour porpoise in the context of harbour porpoise abundance estimates in the Celtic Sea Assessment Unit (NAMMCO_NIMR 2019). Estimates were derived from bycatch data submitted to the WGBYC database and the French Reg. 812/2004 report for 2015 until 2017 and fishing effort data submitted to WGBYC for 2017.

Species	Area	Metier	Fishing effort (2017)	Estimate of bycatch rate (Specimens/observed days at sea)	Estimate of bycatch	Best estimate of abundance (SCANS-III)	% Mortality using lower bycatch estimate		% Mortality using higher bycatch estimate	
				Lower 95% CI	Upper 95% CI	Lower 95% CI	Upper 95% CI			
Phocoena phocoena	Celtic Ecoregion (7e, f, g, h))	Nets (GNS, GTR, GND*)	16216	0.0204	0.0413	331	669	25,281	1.31	2.65
	Biscay East-Shelf (8a and b)		51648	0.0040	0.0143	205	740		0.81	2.93
	Total					536	1409		2.12	5.57

Table 9. Observed DaS, number of individuals and bycatch rates (individuals per day at sea) for marine mammal species, pooled by metier described and by area using data pooled over different time periods between 2005 until 2017 and held within the WGBYC database. Bycatch rate = specimens/DaS observed

Ecoregion	Metier L4	Years pooled	DaysAtSea Observed	Marine mammal Species	Specimens	Low bycatch rate (95% CI)	High bycatch rate (95% CI)
North Sea	GNS, GTR, GND	2008-2017	3402.15	*Delphinus delphis*	14	0.0022	0.0069
				Halichoerus grypus	8	0.0012	0.0042
				Phoca vitulina	2	0.0001	0.0018
				Phocoena phocoena	118	0.0297	0.0403
				Stenella coeruleoalba	2	0.0001	0.0018
				Tursiops truncatos	2	0.0001	0.0018
				Lagenorhynchus acutus	1	1.5077E-05	0.0014
				Lagenorhynchus albirostris	1	1.5077E-05	0.0014
	PTM. OTM	2008-2017	1783.77	*Delphinus delphis*	59	0.0252	0.0427
				Phoca vitulina	5	0.0011	0.0059
				Phocoena phocoena	1	2.8751E-05	0.0027
				Tursiops truncatos	5	0.0011	0.0059
	OTB. OTT. PBT	2010-2017	2883	*Delphinus delphis*	3	0.0002	0.0030
				Phocidae	1	1.7791E-05	0.0016
Celtic Sea	GNS. GTR	2005-2017	1720.37	*Delphinus delphis*	27	0.0103	0.0228
				Halichoerus grypus	85	0.0411	0.0589

Ecoregion	Metier L4	Years pooled	DaysAtSea Observed	Marine mammal Species	Specimens	Low bycatch rate (95% CI)	High bycatch rate (95% CI)
				Phoca vitulina	12	0.0040	0.0113
				Phocoena phocoena	119	0.0594	0.0801
				Globicephala melas	2	0.0002	0.0036
				Phocidae	2	0.0002	0.0036
	PTM. OTM	2007-2017	1449	*Delphinus delphis*	41	0.0203	0.0384
				Halichoerus grypus	13	0.0053	0.0142
				Globicephala melas	6	0.0018	0.0082
				Lagenorhynchus albirostris	1	0.00003	0.0033
	OTB. OTT.	2016-2017	1945.58	*Delphinus delphis*	5	0.0008	0.006
				Halichoerus grypus	60	0.0247	0.0381
				Phocoena phocoena	2	0.0002	0.0032
				Stenella coeruleoalba	1	2.6358E-05	0.0024
				Phocidae	1	2.6358E-05	0.0024
Eastern Biscay Shelf (8a and b)	GNS. GTR. GND*	2008-2017	2558.82	*Delphinus delphis*	48	0.0138	0.0249
				Halichoerus grypus	8	0.0015	0.0056
				Phoca vitulina	1	2.0044E-05	0.0018
				Phocoena phocoena	26	0.0071	0.0141

Ecoregion	Metier L4	Years pooled	DaysAtSea Observed	Marine mammal Species	Specimens	Low bycatch rate (95% CI)	High bycatch rate (95% CI)
				Stenella coeruleoalba	4	0.0005	0.0036
	PTM. OTM	2008-2017	686.42	*Delphinus delphis*	224	0.285	0.372
				Phocoena phocoena	2	0.0005	0.0094
	OTB. OTT. PTB	2017	198.18	*Halichoerus grypus*	1	0.0003	0.0237
				Phocoena phocoena	1	0.0003	0.0237

***No observer effort in metier GND, only fishing effort in GND.**

Table 10. List of seabird species of the NE Atlantic, the Mediterranean Sea and the Baltic Sea with relevant fishing métiers concerning bycatch, regions of sea with occurrence and status of various Red Lists IUCN criteria given below; note that UK and Ireland use a slightly different system). For sources, see marked (*) references

	species	Purse seine (PS)	Pelagic trawls OTM, PTM)	Bottom trawls (TBB, OTB, OTT, PTB)	Nets (GNS, GTR, GND)	Hooks and longlines (LLS, LLD)	Pots and traps (FPO)	NE Atl.: Arctic Waters (OSPAR I)	NE Atl.: Greater North Ses (OSPAR II)	NE Atl.: Celtic Seas (OSPAR III)	NE-Atl.: Bay of Biscay, Iberian Coats (OSPAR IV)	NE Atl.: Wider Atlantic (OSPAR V)	Mediterranean Sea	Baltic Sea	Red List World (IUCN 2018)	Red List Europe (BirdLife International 2015)	Red List EU27 (BirdLife International 2015)	Red List Baltic Sea (HELCOM 2013)	OSPAR List of Threatened and/or Declining Species and Habi-	Bird Directive Annex I	Bird Directive migratory species	scientific name
withbenthic feeding ducks	Common Pochard				x				x	x	x		x	x	VU	VU	VU				x	*Aythya ferina*
	Tufted Duck				x			x	x	x	x		x	x				NT			x	*Aythya fuligula*
	Greater Scaup				x			x	x	x	x		x	x		VU	VU	VU			x	*Aythya marila*
	Steller's Eider				x			x						x	VU		EN	EN	x	x	x	*Polysticta stelleri*
	King Eider				x			x						x							x	*Somateria spectabilis*
	Common Eider				x			x	x	x	x		x	x	NT	VU	EN	EN			x	*Somateria mollissima*
	Velvet Scoter				x			x	x	x	x		x	x	VU	VU	VU	EN			x	*Melanitta fusca*
	Common Scoter				x			x	x	x	x		x	x				EN			x	*Melanitta nigra*
	Long-tailed Duck				x	x		x	x	x				x	VU	VU	VU	EN			x	*Clangula hyemalis*

	Common Goldeneye				x			x	x	x	x		x	x							x	*Bucephala clangula*
mergan-sers	Smew				x	x			x				x	x						x	x	*Mergellus albellus*
	Goosander				x	x		x	x	x				x							x	*Mergus merganser*
	Red-breasted Merganser				x	x		x	x	x	x		x	x		NT	VU	VU			x	*Mergus serrator*
divers	Red-throated Diver				x	x		x	x	x	x		x	x				CR		x	x	*Gavia stellata*
	Black-throated Diver				x	x		x	x	x	x		x	x				CR		x	x	*Gavia arctica*
	Great Northern Diver				x	x		x	x	x	x					VU	VU			x	x	*Gavia immer*
	White-billed Diver				x	x		x	x					x	NT	VU					x	*Gavia adamsii*
petrels and storm petrels	European Storm Petrel		x		x	x		x	x	x	x	x	x							x	x	*Hydrobates pelagicus*
	Band-rumped Storm Petrel		x		x	x					x	x									x	*Hydrobates castro*
	Monteiro's Storm Petrel		x		x	x						x			VU	VU	VU				x	*Hydrobates monteiroi*
	Leach's Storm Petrel		x		x	x		x	x	x	x	x			VU		VU			x	x	*Hydrobates leucorhoa*
	White-faced Storm Petrel		x		x	x						x				EN	EN			x	x	*Pelagodroma marina*
	Desertas Petrel		x		x	x						x			VU	VU	VU			x	x	*Pterodroma deserta*
	Zino's Petrel		x		x	x						x			EN	EN	EN			x	x	*Pterodroma madeira*
	Bulwer's Petrel		x		x	x						x								x	x	*Bulweria bulwerii*
Fulmar and shearwaters	Northern Fulmar		x		x	x		x	x	x						EN	VU				x	*Fulmarus glacialis*
	Scopoli's Shearwater	x	x		x	x					x	x	x							x	x	*Calonectris diomedea*
	Cory's Shearwater	x	x		x	x					x	x	x							x	x	*Calonectris borealis*

	Sooty Shearwater	x	x		x	x		x	x	x	x	x			NT						x	*Ardenna grisea*
	Great Shearwater	x	x		x	x		x	x	x	x	x									x	*Ardenna gravis*
	Manx Shearwater	x	x		x	x		x	x	x	x	x							x		x	*Puffinus puffinus*
	Balearic Shearwater	x	x		x	x			x	x	x		x		CR	CR	CR			x	x	*Puffinus mauretanicus*
	Yelkouan Shearwater		x		x	x							x		VU					x	x	*Puffinus yelkouan*
	Barolo Shearwater		x		x	x					x	x				NT	NT		x	x	x	*Puffinus baroli*
grebes	Red-necked Grebe				x	x			x		x		x	x				EN			x	*Podiceps grisegena*
	Great Crested Grebe				x	x			x	x	x		x	x							x	*Podiceps cristatus*
	Horned Grebe				x	x		x	x	x	x		x	x	VU	NT	VU	VU		x	x	*Podiceps auritus*
gan-nets	Northern Gannet	x	x	x	x	x		x	x	x	x	x	x	x							x	*Morus bassanus*
cormo-rants	European Shag*	x		x	x	x	x	x	x	x	x		x				NT			x	x	*Phalacrocorax aristo-telis*
	Great Cormorant	x		x	x	x	x	x	x	x	x		x	x							x	*Phalacrocorax carbo*
rails	Eurasian Coot				x			x	x	x	x		x	x		NT					x	*Fulica atra*
gulls	Black-legged Kittiwake	x		x	x	x		x	x	x	x	x		x	VU	VU	EN	EN	x		x	*Rissa tridactyla*
	Sabine's Gull	x		x	x	x		x	x	x	x	x									x	*Xema sabini*
	Slender-billed Gull	x		x	x	x							x							x	x	*Chroicocephalus genei*
	Black-headed Gull	x		x	x	x		x	x	x	x	x	x	x							x	*Chroicocephalus ridi-bundus*
	Little Gull					x			x	x	x		x	x		NT		NT		x	x	*Hydrocoloeus minutus*
	Audouin's Gull	x		x	x	x					x		x							x	x	*Ichthyaetus audouinii*

	Mediterranean Gull	x		x	x	x			x	x	x		x	x				EN		x	x	*Ichthyaetus melano-cephalus*
	Common Gull	x		x	x	x		x	x	x	x		x	x							x	*Larus canus*
	Great Black-backed Gull	x		x	x	x		x	x	x	x			x							x	*Larus marinus*
	Glaucous Gull	x		x	x	x		x	x	x	x			x							x	*Larus hyperboreus*
	Iceland Gull	x		x	x	x		x	x	x											x	*Larus glaucoides*
	Herring Gull	x		x	x	x		x	x	x	x			x		NT	VU				x	*Larus argentatus*
	Yellow-legged Gull	x		x	x	x			x		x		x	x							x	*Larus michahellis*
	Lesser Black-backed Gull*	x		x	x	x		x	x	x	x		x	x				VU	x		x	*Larus fuscus*
terns	Caspian Tern					x							x	x			NT	VU		x	x	*Hydroprogne caspia*
	Sandwich Tern					x			x	x	x		x	x						x	x	*Thalasseus sandvicensis*
	Little Tern					x			x	x	x		x	x						x	x	*Sternula albifrons*
	Roseate Tern					x			x	x	x	x							x	x	x	*Sterna dougallii*
	Common Tern					x		x	x	x	x	x	x	x						x	x	*Sterna hirundo*
	Arctic Tern					x		x	x	x	x	x		x						x	x	*Sterna paradisaea*
	Black Tern								x		x		x	x						x	x	*Chlidonias niger*
skuas	Great Skua					x		x	x	x	x	x									x	*Stercorarius skua*
	Pomarine Skua					x		x	x	x	x	x	x								x	*Stercorarius pomarinus*
	Arctic Skua					x		x	x	x	x	x	x	x			EN				x	*Stercorarius parasiticus*
	Long-tailed Skua					x		x	x	x	x	x									x	*Stercorarius longicau-dus*

auks	Little Auk	x	x	x	x	x		x	x	x										x	*Alle alle*
	Brünnich's Guillemot	x	x	x	x	x		x											x		x	*Uria lomvia*
	Common Guillemot*	x	x	x	x	x		x	x	x	x			x		NT			x	x	x	*Uria aalge*
	Razorbill	x	x	x	x	x		x	x	x	x		x	x	NT	NT					x	*Alca torda*
	Black Guillemot*	x	x	x	x	x		x	x	x				x			VU	VU			x	*Cepphus grylle*
	Atlantic Puffin	x	x	x	x	x		x	x	x	x		x		VU	EN	NT				x	*Fratercula arctica*

*** Part of information refers to a subspecies only.**

RE	IUCN: regionally extinct
CR	IUCN: critically endangered
EN	IUCN: endangered
VU	IUCN: vulnerable
NT	IUCN: near threatened
R	UK/IE: red list
A	UK/IE: amber list

Table 11. Bycatch rates (individuals per day at sea) for selected seabird species, areas and gears. In order to obtain reasonable observed effort, a number of months or areas were combined. One country uploaded decimals for observed days at sea.

Month	AreaCode	MetierL4	DaysAtSea Observed	Species	Specimens	Incidents	Low bycatch rate (95% CI)	High bycatch rate (95% CI)
3,4,6,7	27.5.a.2	GNS	126	*Cepphus grylle*	20	6	0.10	0.25
3	27.5.a.2	GNS	43	*Clangula hyemalis*	2	2	0.01	0.17
4	27.5.a.2	GNS	74	*Fulmarus glacialis*	3	2	0.01	0.12
1,2,3,5,7,10	27.5.a.2	LLS	89	*Fulmarus glacialis*	69	9	0.60	0.98
4,5,6	GFCM 1~5~6	LLD	39	*Larus audouinii*	5	3	0.04	0.30
4	27.5.a.2	GNS	74	*Morus bassanus*	3	3	0.01	0.12
5	27.5.a.2	LLS	23	*Morus bassanus*	24	3	0.67	1.55
6	27.4.a	OTB,PTB	151	*Morus bassanus*	16	6	0.06	0.17
3,6,7	27.5.a.2	GNS	52	*Phalacrocoracidae*	10	6	0.09	0.35
4 to 11	27.3.d.29,30,32	GNS	36	*Phalacrocorax carbo*	49	21	1.01	1.80
7,8	27.8.b	GNS,GTR	8	*Puffinus mauretanicus*	4	2	0.14	1.27
5,8	GFCM 1~5~6	LLD	107	*Puffinus mauretanicus*	3	3	0.01	0.08
4,5,10	27.3.d.29,30	GNS	14	*Somateria mollissima*	19	5	0.82	2.12
3 to 7	27.5.a.2	GNS	131	*Somateria mollissima*	62	13	0.36	0.61
1,2,3,5,10,11,12	27.7e,f,j	GNS	57	*Uria aalge*	14	11	0.14	0.42
11	27.8a,b	GNS	14	*Uria aalge*	6	4	0.15	0.90
3 to 5	27.5.a.2	GNS	122	*Uria aalge*	55	13	0.34	0.59

Table 12: Bycatch of protected elasmobranchs of high and medium conservation concern expressed in numbers and rate (no. specimens) presented by Ecoregion, and ICES/GFCM area

Ecoregion	Area	Gear	Species	Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Total Ob-served	Total no. Speci-mens	Low CI	High CI	By-catch rate (mean event rate)	Low rate (speci-mens/DaS)	High rate (specimens/DaS)	Red List Cri-te-rion	Type
Azores	27.10.a.2	Longlines	*Alopias superciliosus*	1226	10392	2	2.0	0.24	7.22	1	0.1	3.6	EN	Pelagic
Azores	27.10.a.2	Longlines	*Alopias vulpinus*	1226	10392	2	2.0	0.24	7.22	1	0.1	3.6	EN	Pelagic
Azores	27.10.a.2	Longlines	*Centrophorus granulosus*	1226	10392	16	70.0	54.57	88.44	4	3.4	5.5	CR	Deep-water
Azores	27.10.a.2	Longlines	*Centrophorus squamosus*	1226	10392	1	1.0	0.03	5.57	1	0.0	5.6	EN	Deep-water
Azores	27.10.a.2	Longlines	*Dalatias licha*	1226	10392	52	178.0	152.81	206.16	3	2.9	4.0	EN	Deep-water
Azores	27.10.a.2	Rods and lines	*Dalatias licha*	1576	26457	2	2.0	0.24	7.22	1	0.1	3.6	EN	Deep-water
Azores	27.10.a.2	Longlines	*Deania calcea*	1226	10392	4	58.0	44.04	74.98	15	11.0	18.7	EN	Deep-water
Azores	27.10.a.2	Rods and lines	*Deania calcea*	1576	26457	2	87.0	69.68	107.31	44	34.8	53.7	EN	Deep-water
Azores	27.10.a.2	Longlines	*Raja batis*	1226	10392	45	113.0	93.13	135.86	3	2.1	3.0	CR	Demersal
Azores	27.10.a.2	Rods and lines	*Raja batis*	1576	26457	1	4.0	1.09	10.24	4	1.1	10.2	CR	Demersal
Biscay/Iberia	27.9.a~27.8.c	Bottom trawls	*Centrophorus squamosus*	126	NULL	2	9.0	4.12	17.08	5	2.1	8.5	EN	Deep-water

Ecoregion	Area	Gear	Species	Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Total Observed	Total no. Specimens	Low CI	High CI	Bycatch rate (mean event rate)	Low rate (specimens/DaS)	High rate (specimens/DaS)	Red List Criterion	Type
Biscay/Iberia	27.9.a~27.8.c	Nets	*Centrophorus squamosus*	30	NULL	1	1.0	0.03	5.57	1	0.0	5.6	EN	Deep-water
Biscay/Iberia	27.8.a	Pelagic trawls	*Cetorhinus maximus*	45	5737	1	1.0	0.03	5.57	1	0.0	5.6	EN	Pelagic
Biscay/Iberia	27.8.a	Nets	*Dalatias licha*	169	30750	1	1.0	0.03	5.57	1	0.0	5.6	EN	Deep-water
Biscay/Iberia	27.9.a~27.8.c	Bottom trawls	*Deania calcea*	126	NULL	6	21.0	13.00	32.10	4	2.2	5.4	EN	Deep-water
Biscay/Iberia	27.9.a~27.8.c	Nets	*Deania calcea*	30	NULL	3	5.0	1.62	11.67	2	0.5	3.9	EN	Deep-water
Biscay/Iberia	27.8.a	Bottom trawls	*Dipturus batis*	123	48000	3	3.0	0.62	8.77	1	0.2	2.9	CR	Demersal
Biscay/Iberia	27.9.a	Bottom trawls	*Galeorhinus galeus*	126	54797	2	10.0	4.80	18.39	5	2.4	9.2	VU	Demersal
Biscay/Iberia	27.9.a~27.8.c	Bottom trawls	*Galeorhinus galeus*	126	NULL	3	16.0	9.15	25.98	5	3.0	8.7	VU	Demersal
Biscay/Iberia	27.8.c	Pelagic trawls	*Gymnura altavela*	86	3400	1	1.0	0.03	5.57	1	0.0	5.6	CR	Demersal
Biscay/Iberia	27.8.a	Nets	*Leucoraja circularis*	169	30750	3	60.0	45.79	77.23	20	15.3	25.7	EN	Demersal
Biscay/Iberia	27.9.a~27.8.c	Nets	*Mustelus mustelus*	30	NULL	3	3.0	0.62	8.77	1	0.2	2.9	VU	Demersal

Ecoregion	Area	Gear	Species	Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Total Observed	Total no. Specimens	Low CI	High CI	Bycatch rate (mean event rate)	Low rate (specimens/DaS)	High rate (specimens/DaS)	Red List Criterion	Type
Biscay/Iberia	27.9.a	Nets	*Rostroraja alba*	21	165095	2	12.0	6.20	20.96	6	3.1	10.5	CR	Demersal
Biscay/Iberia	27.8.a	Bottom trawls	*Squalus acanthias*	123	48000	4	16.0	9.15	25.98	4	2.3	6.5	EN	Demersal
Biscay/Iberia	27.8.a	Pelagic trawls	*Squalus acanthias*	45	5737	1	1.0	0.03	5.57	1	0.0	5.6	EN	Demersal
Biscay/Iberia	27.9.a	Bottom trawls	*Squalus acanthias*	126	54797	1	3.0	0.62	8.77	3	0.6	8.8	EN	Demersal
Celtic Seas	27.6.a	Bottom trawls	*Centroscymnus coelolepis*	540	2914	1	1.0	0.03	5.57	1	0.0	5.6	EN	Deep-water
Celtic Seas	27.6.a	Bottom trawls	*Dalatias licha*	540	2914	2	10.0	4.80	18.39	5	2.4	9.2	EN	Deep-water
Celtic Seas	27.7.j	Bottom trawls	*Dalatias licha*	91	7299	1	13.0	6.92	22.23	13	6.9	22.2	EN	Deep-water
Celtic Seas	27.7	Bottom trawls	*Dipturus batis*	117	NULL	94	1064.0	1001.02	1129.90	11	10.6	12.0	CR	Demersal
Celtic Seas	27.6.a	Bottom trawls	*Dipturus batis*	540	2914	64	216.0	188.15	246.81	3	2.9	3.9	CR	Demersal
Celtic Seas	27.6.b	Bottom trawls	*Dipturus batis*	48	1577	5	9.0	4.12	17.08	2	0.8	3.4	CR	Demersal
Celtic Seas	27.7.a	Bottom trawls	*Dipturus batis*	306	4567	4	10.0	4.80	18.39	3	1.2	4.6	CR	Demersal

Ecoregion	Area	Gear	Species	Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Total Observed	Total no. Specimens	Low CI	High CI	Bycatch rate (mean event rate)	Low rate (specimens/DaS)	High rate (specimens/DaS)	Red List Criterion	Type
Celtic Seas	27.7.b	Bottom trawls	*Dipturus batis*	51	3501	11	27.0	17.79	39.28	2	1.6	3.6	CR	Demersal
Celtic Seas	27.7.f	Nets	*Dipturus batis*	62	NULL	1	1.0	0.03	5.57	1	0.0	5.6	CR	Demersal
Celtic Seas	27.7.f	Bottom trawls	*Dipturus batis*	69	7458	4	30.0	20.24	42.83	8	5.1	10.7	CR	Demersal
Celtic Seas	27.7.g	Nets	*Dipturus batis*	32	1535	2	2.0	0.24	7.22	1	0.1	3.6	CR	Demersal
Celtic Seas	27.7.g	Seines	*Dipturus batis*	17	1125	5	13.0	6.92	22.23	3	1.4	4.4	CR	Demersal
Celtic Seas	27.7.g	Bottom trawls	*Dipturus batis*	384	28236	245	1721.0	1640.64	1804.28	7	6.7	7.4	CR	Demersal
Celtic Seas	27.7.h	Bottom trawls	*Dipturus batis*	252	12857	152	895.0	837.32	955.61	6	5.5	6.3	CR	Demersal
Celtic Seas	27.7.j	Seines	*Dipturus batis*	5	627	3	16.0	9.15	25.98	5	3.0	8.7	CR	Demersal
Celtic Seas	27.7.j	Nets	*Dipturus batis*	191	1606	39	95.0	76.86	116.13	2	2.0	3.0	CR	Demersal
Celtic Seas	27.7.j	Bottom trawls	*Dipturus batis*	91	7299	12	109.0	89.50	131.49	9	7.5	11.0	CR	Demersal
Celtic Seas	27.7.g	Nets	*Dipturus flossada*	32	1535	1	1.0	0.03	5.57	1	0.0	5.6	CR	Demersal
Celtic Seas	27.7.h	Nets	*Dipturus flossada*	42	2118	3	551.0	505.95	598.99	184	168.6	199.7	CR	Demersal
Celtic Seas	27.7.j	Nets	*Dipturus flossada*	191	1606	5	806.0	751.31	863.62	161	150.3	172.7	CR	Demersal

Ecoregion	Area	Gear	Species	Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Total Observed	Total no. Specimens	Low CI	High CI	Bycatch rate (mean event rate)	Low rate (specimens/DaS)	High rate (specimens/DaS)	Red List Criterion	Type
Celtic Seas	27.6.a	Bottom trawls	*Dipturus intermedius*	540	2914	12	19.0	11.44	29.67	2	1.0	2.5	CR	Demersal
Celtic Seas	27.7.g	Seines	*Dipturus intermedius*	17	1125	1	2.0	0.24	7.22	2	0.2	7.2	CR	Demersal
Celtic Seas	27.7.g	Bottom trawls	*Dipturus intermedius*	384	28236	2	3.0	0.62	8.77	2	0.3	4.4	CR	Demersal
Celtic Seas	27.7	Bottom trawls	*Galeorhinus galeus*	117	NULL	1	4.0	1.09	10.24	4	1.1	10.2	VU	Demersal
Celtic Seas	27.7.f	Nets	*Galeorhinus galeus*	62	NULL	11	16.0	9.15	25.98	1	0.8	2.4	VU	Demersal
Celtic Seas	27.7.g	Nets	*Galeorhinus galeus*	32	1535	1	2.0	0.24	7.22	2	0.2	7.2	VU	Demersal
Celtic Seas	27.7.h	Bottom trawls	*Galeorhinus galeus*	252	12857	1	1.0	0.03	5.57	1	0.0	5.6	VU	Demersal
Celtic Seas	27.7.h	Nets	*Galeorhinus galeus*	42	2118	7	9.0	4.12	17.08	1	0.6	2.4	VU	Demersal
Celtic Seas	27.7.j	Nets	*Galeorhinus galeus*	191	1606	3	5.0	1.62	11.67	2	0.5	3.9	VU	Demersal
Celtic Seas	27.6.a	Pelagic trawls	*Lamna nasus*	97	2139	2	2.0	0.24	7.22	1	0.1	3.6	CR	Pelagic
Celtic Seas	27.7.f	Nets	*Lamna nasus*	62	NULL	4	4.0	1.09	10.24	1	0.3	2.6	CR	Pelagic

Ecoregion	Area	Gear	Species	Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Total Observed	Total no. Specimens	Low CI	High CI	Bycatch rate (mean event rate)	Low rate (specimens/DaS)	High rate (specimens/DaS)	Red List Criterion	Type
Celtic Seas	27.7.g	Nets	*Lamna nasus*	32	1535	17	32.0	21.89	45.17	2	1.3	2.7	CR	Pelagic
Celtic Seas	27.7.h	Nets	*Lamna nasus*	42	2118	9	18.0	10.67	28.45	2	1.2	3.2	CR	Pelagic
Celtic Seas	27.7.j	Pelagic trawls	*Lamna nasus*	1	184	1	1.0	0.03	5.57	1	0.0	5.6	CR	Pelagic
Celtic Seas	27.7.j	Nets	*Lamna nasus*	191	1606	2	2.0	0.24	7.22	1	0.1	3.6	CR	Pelagic
Celtic Seas	27.7	Bottom trawls	*Leucoraja circularis*	117	NULL	2	4.0	1.09	10.24	2	0.5	5.1	EN	Demersal
Celtic Seas	27.7	Bottom trawls	*Squalus acanthias*	117	NULL	1	1.0	0.03	5.57	1	0.0	5.6	EN	Demersal
Celtic Seas	27.6.a	Longlines	*Squalus acanthias*	51	1830	1	1.0	0.03	5.57	1	0.0	5.6	EN	Demersal
Celtic Seas	27.6.a	Pelagic trawls	*Squalus acanthias*	97	2139	2	4.0	1.09	10.24	2	0.5	5.1	EN	Demersal
Celtic Seas	27.6.a	Bottom trawls	*Squalus acanthias*	540	2914	10	208.0	180.69	238.27	21	18.1	23.8	EN	Demersal
Celtic Seas	27.7.f	Bottom trawls	*Squalus acanthias*	69	7458	3	24.0	15.38	35.71	8	5.1	11.9	EN	Demersal
Celtic Seas	27.7.f	Nets	*Squalus acanthias*	62	NULL	23	89.0	71.47	109.52	4	3.1	4.8	EN	Demersal
Celtic Seas	27.7.g	Seines	*Squalus acanthias*	17	1125	3	17.0	9.90	27.22	6	3.3	9.1	EN	Demersal
Celtic Seas	27.7.g	Nets	*Squalus acanthias*	32	1535	33	272.0	240.63	306.32	8	7.3	9.3	EN	Demersal

Ecoregion	Area	Gear	Species	Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Total Observed	Total no. Specimens	Low CI	High CI	Bycatch rate (mean event rate)	Low rate (specimens/DaS)	High rate (specimens/DaS)	Red List Criterion	Type
Celtic Seas	27.7.g	Bottom trawls	*Squalus acanthias*	384	28236	22	620.0	572.15	670.78	28	26.0	30.5	EN	Demersal
Celtic Seas	27.7.h	Bottom trawls	*Squalus acanthias*	252	12857	30	238.0	208.72	270.24	8	7.0	9.0	EN	Demersal
Celtic Seas	27.7.h	Nets	*Squalus acanthias*	42	2118	12	247.0	217.15	279.80	21	18.1	23.3	EN	Demersal
Celtic Seas	27.7.j	Nets	*Squalus acanthias*	191	1606	5	10.0	4.80	18.39	2	1.0	3.7	EN	Demersal
Celtic Seas	27.7.f	Nets	*Squatina squatina*	62	NULL	1	1.0	0.03	5.57	1	0.0	5.6	CR	Demersal
Celtic Seas	27.7.j	Nets	*Squatina squatina*	191	1606	2	3.0	0.62	8.77	2	0.3	4.4	CR	Demersal
Greater North Sea	27.7.e	Pelagic trawls	*Alopias vulpinus*	19	642	2	4.0	1.09	10.24	2	0.5	5.1	EN	Pelagic
Greater North Sea	27.4.a	Bottom trawls	*Cetorhinus maximus*	536	9288	2	2.0	0.24	7.22	1	0.1	3.6	EN	Pelagic
Greater North Sea	27.7.e	Bottom trawls	*Cetorhinus maximus*	277	20606	2	2.0	0.24	7.22	1	0.1	3.6	EN	Pelagic
Greater North Sea	27.4.a	Bottom trawls	*Dalatias licha*	536	9288	1	1.0	0.03	5.57	1	0.0	5.6	EN	Deep-water
Greater North Sea	27.7.d	Nets	*Dasyatis pastinaca*	122	10624	1	1.0	0.03	5.57	1	0.0	5.6	VU	Demersal
Greater North Sea	27.7.e	Nets	*Dasyatis pastinaca*	199	12563	2	2.0	0.24	7.22	1	0.1	3.6	VU	Demersal

Ecoregion	Area	Gear	Species	Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Total Observed	Total no. Specimens	Low CI	High CI	Bycatch rate (mean event rate)	Low rate (specimens/DaS)	High rate (specimens/DaS)	Red List Criterion	Type
Greater North Sea	27.4.a	Bottom trawls	*Dipturus batis*	536	9288	15	81.0	64.33	100.68	5	4.3	6.7	CR	Demersal
Greater North Sea	27.4.b	Bottom trawls	*Dipturus batis*	393	77471	1	1.0	0.03	5.57	1	0.0	5.6	CR	Demersal
Greater North Sea	27.7.d	Nets	*Dipturus batis*	122	10624	4	4.0	1.09	10.24	1	0.3	2.6	CR	Demersal
Greater North Sea	27.7.e	Bottom trawls	*Dipturus batis*	277	20606	45	356.0	319.98	394.97	8	7.1	8.8	CR	Demersal
Greater North Sea	27.7.e	Seines	*Dipturus batis*	2	95	2	9.0	4.12	17.08	5	2.1	8.5	CR	Demersal
Greater North Sea	27.7.e	Nets	*Dipturus flossada*	199	12563	2	2.0	0.24	7.22	1	0.1	3.6	CR	Demersal
Greater North Sea	27.4.a	Bottom trawls	*Dipturus intermedius*	536	9288	7	30.0	20.24	42.83	4	2.9	6.1	CR	Demersal
Greater North Sea	27.3.a.20	Bottom trawls	*Dipturus linteus*	149	29095	7	29.0	19.42	41.65	4	2.8	5.9	CR	Demersal
Greater North Sea	27.4.a	Bottom trawls	*Dipturus linteus*	536	9288	5	14.0	7.65	23.49	3	1.5	4.7	CR	Demersal
Greater North Sea	27.4.c	Nets	*Galeorhinus galeus*	23	5457	4	4.0	1.09	10.24	1	0.3	2.6	VU	Demersal
Greater North Sea	27.7.d	Nets	*Galeorhinus galeus*	122	10624	4	4.0	1.09	10.24	1	0.3	2.6	VU	Demersal

Ecoregion	Area	Gear	Species	Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Total Observed	Total no. Specimens	Low CI	High CI	By-catch rate (mean event rate)	Low rate (specimens/DaS)	High rate (specimens/DaS)	Red List Criterion	Type
Greater North Sea	27.7.e	Bottom trawls	*Galeorhinus galeus*	277	20606	4	6.0	2.20	13.06	2	0.6	3.3	VU	Demersal
Greater North Sea	27.7.e	Nets	*Galeorhinus galeus*	199	12563	9	9.0	4.12	17.08	1	0.5	1.9	VU	Demersal
Greater North Sea	27.7.d	Pelagic trawls	*Lamna nasus*	75	3384	2	2.0	0.24	7.22	1	0.1	3.6	CR	Pelagic
Greater North Sea	27.7.e	Bottom trawls	*Lamna nasus*	277	20606	1	1.0	0.03	5.57	1	0.0	5.6	CR	Pelagic
Greater North Sea	27.7.e	Pelagic trawls	*Lamna nasus*	19	642	1	2.0	0.24	7.22	2	0.2	7.2	CR	Pelagic
Greater North Sea	27.4.a	Bottom trawls	*Leucoraja circularis*	536	9288	3	19.0	11.44	29.67	6	3.8	9.9	EN	Demersal
Greater North Sea	27.4.b	Bottom trawls	*Mustelus mustelus*	393	77471	1	24.5	15.38	35.71	25	15.4	35.7	VU	Demersal
Greater North Sea	27.4.a	Bottom trawls	*Raja batis*	536	9288	6	7.0	2.81	14.42	1	0.5	2.4	CR	Demersal
Greater North Sea	27.3.a.20	Bottom trawls	*Squalus acanthias*	149	29095	14	476.0	434.19	520.75	34	31.0	37.2	EN	Demersal
Greater North Sea	27.3.a.21	Bottom trawls	*Squalus acanthias*	88	13096	3	14.0	7.65	23.49	5	2.6	7.8	EN	Demersal
Greater North Sea	27.4.a	Bottom trawls	*Squalus acanthias*	536	9288	6	44.0	31.97	59.07	7	5.3	9.8	EN	Demersal

Ecoregion	Area	Gear	Species	Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Total Ob-served	Total no. Speci-mens	Low CI	High CI	By-catch rate (mean event rate)	Low rate (speci-mens/DaS)	High rate (specimens/DaS)	Red List Cri-te-rion	Type
Greater North Sea	27.4.a	Pelagic trawls	*Squalus acanthias*	77	1933	25	57392.3	56923.41	57863.49	2296	2276.9	2314.5	EN	Demersal
Greater North Sea	27.4.b	Bottom trawls	*Squalus acanthias*	393	77471	2	12.4	6.20	20.96	6	3.1	10.5	EN	Demersal
Greater North Sea	27.7.d	Bottom trawls	*Squalus acanthias*	280	39012	1	1.0	0.03	5.57	1	0.0	5.6	EN	Demersal
Greater North Sea	27.7.e	Bottom trawls	*Squalus acanthias*	277	20606	14	378.0	340.85	418.09	27	24.3	29.9	EN	Demersal
Greater North Sea	27.7.e	Nets	*Squalus acanthias*	199	12563	3	19.0	11.44	29.67	6	3.8	9.9	EN	Demersal
Greater North Sea	27.7.e	Seines	*Squalus acanthias*	2	95	1	9.0	4.12	17.08	9	4.1	17.1	EN	Demersal
Mediterranean Sea	1~5~6	Longlines	*Alopias vulpinus*	570	7789	3	3.0	0.62	8.77	1	0.2	2.9	EN	Pelagic
Mediterranean Sea	1	Bottom trawls	*Centrophorus granulosus*	118	22537	4	5.0	1.62	11.67	1	0.4	2.9	CR	Deep-water
Mediterranean Sea	2	Bottom trawls	*Centrophorus granulosus*	50	952	1	5.0	1.62	11.67	5	1.6	11.7	CR	Deep-water
Mediterranean Sea	22	Nets	*Centrophorus granulosus*	426	401221	2	13.0	6.92	22.23	7	3.5	11.1	CR	Deep-water
Mediterranean Sea	1	Bottom trawls	*Dalatias licha*	118	22537	1	9.0	4.12	17.08	9	4.1	17.1	EN	Deep-water

Ecoregion	Area	Gear	Species	Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Total Observed	Total no. Specimens	Low CI	High CI	By-catch rate (mean event rate)	Low rate (specimens/DaS)	High rate (specimens/DaS)	Red List Criterion	Type
Mediterranean Sea	2	Bottom trawls	*Dalatias licha*	50	952	25	48.0	35.39	63.64	2	1.4	2.5	EN	Deep-water
Mediterranean Sea	6	Bottom trawls	*Dalatias licha*	253	78740	1	1.0	0.03	5.57	1	0.0	5.6	EN	Deep-water
Mediterranean Sea	7	Bottom trawls	*Dalatias licha*	277	15178	2	60.0	45.79	77.23	30	22.9	38.6	EN	Deep-water
Mediterranean Sea	22	Bottom trawls	*Dipturus batis*	88	26928	1	2.0	0.24	7.22	2	0.2	7.2	CR	Demersal
Mediterranean Sea	22	Nets	*Gymnura altavela*	426	401221	1	1.0	0.03	5.57	1	0.0	5.6	CR	Demersal
Mediterranean Sea	1	Bottom trawls	*Leucoraja circularis*	118	22537	4	4.0	1.09	10.24	1	0.3	2.6	EN	Demersal
Mediterranean Sea	5	Bottom trawls	*Leucoraja circularis*	98	9177	1	1.0	0.03	5.57	1	0.0	5.6	EN	Demersal
Mediterranean Sea	6	Bottom trawls	*Leucoraja circularis*	253	78740	1	2.0	0.24	7.22	2	0.2	7.2	EN	Demersal
Mediterranean Sea	1~5~6	Longlines	*Mobula mobular*	570	7789	6	7.0	2.81	14.42	1	0.5	2.4	EN	Pelagic
Mediterranean Sea	5	Bottom trawls	*Mustelus mustelus*	98	9177	8	18.0	10.67	28.45	2	1.3	3.6	VU	Demersal
Mediterranean Sea	6	Bottom trawls	*Mustelus mustelus*	253	78740	4	11.0	5.49	19.68	3	1.4	4.9	VU	Demersal

Ecoregion	Area	Gear	Species	Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Total Observed	Total no. Specimens	Low CI	High CI	Bycatch rate (mean event rate)	Low rate (specimens/DaS)	High rate (specimens/DaS)	Red List Criterion	Type
Mediterranean Sea	17	Pelagic trawls	*Mustelus mustelus*	173	12556	5	10.0	4.80	18.39	2	1.0	3.7	VU	Demersal
Mediterranean Sea	22	Bottom trawls	*Mustelus mustelus*	88	26928	3	3.0	0.62	8.77	1	0.2	2.9	VU	Demersal
Mediterranean Sea	22	Longlines	*Mustelus mustelus*	91	84082	4	5.0	1.62	11.67	1	0.4	2.9	VU	Demersal
Mediterranean Sea	22	Nets	*Mustelus mustelus*	426	401221	1	1.0	0.03	5.57	1	0.0	5.6	VU	Demersal
Mediterranean Sea	17	Pelagic trawls	*Mustelus punctulatus*	173	12556	20	35.0	24.38	48.68	2	1.2	2.4	VU	Demersal
Mediterranean Sea	16	Pelagic trawls	*Myliobatis aquila*	23	2620	4	11.0	5.49	19.68	3	1.4	4.9	VU	Demersal
Mediterranean Sea	17	Pelagic trawls	*Myliobatis aquila*	173	12556	9	13.0	6.92	22.23	1	0.8	2.5	VU	Demersal
Mediterranean Sea	22	Bottom trawls	*Oxynotus centrina*	88	26928	2	2.0	0.24	7.22	1	0.1	3.6	VU	Demersal
Mediterranean Sea	2	Bottom trawls	*Rostroraja alba*	50	952	3	3.0	0.62	8.77	1	0.2	2.9	CR	Demersal
Mediterranean Sea	6	Bottom trawls	*Squalus acanthias*	253	78740	1	1.0	0.03	5.57	1	0.0	5.6	EN	Demersal
Mediterranean Sea	7	Bottom trawls	*Squalus acanthias*	277	15178	4	42.0	30.27	56.77	11	7.6	14.2	EN	Demersal

Ecoregion	Area	Gear	Species	Observed Effort (Days at sea)	Fishing Effort (Days at sea)	Total Ob-served	Total no. Speci-mens	Low CI	High CI	By-catch rate (mean event rate)	Low rate (speci-mens/DaS)	High rate (specimens/DaS)	Red List Cri-te-rion	Type
Mediterranean Sea	17	Pelagic trawls	*Squalus acanthias*	173	12556	14	18.0	10.67	28.45	1	0.8	2.0	EN	Demersal
Mediterranean Sea	22	Bottom trawls	*Squalus acanthias*	88	26928	5	8.0	3.45	15.76	2	0.7	3.2	EN	Demersal
Mediterranean Sea	22	Longlines	*Squalus acanthias*	91	84082	3	45.0	32.82	60.21	15	10.9	20.1	EN	Demersal
Mediterranean Sea	22	Nets	*Squalus acanthias*	426	401221	2	40.0	28.58	54.47	20	14.3	27.2	EN	Demersal

Table 13. Classification of bycatch risk for different taxanomic groupings and gear based on expert opinion of WGBYC participants[18]: 1 = low risk; 2= medium risk; 3 = high risk. WGBYC revied the entries and upgraded some risk scores, shown in brackets.

Gear	Lampreys	Roundfish	Turtles	Diving birds	Surface birds	Seals	Dolphins	Harbour porpoise	Large Whales
Boat dredge [DRB]	1	1	1	1	1	1	1	1	1
Bottom otter trawl [OTB]	2	2	3	1	2	2(1)	1	1	1
Multi-rig otter trawl [OTT]	2	2	3	1	1	1	1	1	1
Bottom pair trawl [PTB]	2	2	3	1	1	1	1	1	1
Beam trawl [TBB]	2	1	3	1	1	1	1	1	1
Midwater otter trawl [OTM]	1	3	2	2	2	2	2	1	2(1)
Pelagic pair trawl [PTM]	1	3	2	2	2	2	2	1	2(1)
Hand and Pole lines [LHP] [LHM]	1	1(2)	1	1	1	1	1	1	1
Trolling lines [LTL]	1	1(2)	1	2	3	1	1	1	1
Drifting longlines [LLD]	1	1(2)	3	2	3	1	1	1	2
Set longlines [LLS]	1	1(2)	3	2	3	1	1	1	2
Pots and Traps [FPO]	2	1	1	1	1	1	1	1	2(3)
Fykenets [FYK]	3	2	1	2	1	3	1	1	1
Stationary uncovered poundnets [FPN]	1	1	1	1	1	2	1	1	1
Trammelnet [GTR]	1	3	3	3	1	3	2	3	2
Set gillnet [GNS]	1	3	3	3	1	3	2	3	2

[18] Based on reviewers' comments it was specified that this classification was based on expert opinion of WGBYC participants

Gear	Lampreys	Roundfish	Turtles	Diving birds	Surface birds	Seals	Dolphins	Harbour porpoise	Large Whales
Driftnet [GND]	1	3	3	3	3	3	3	3	3
Purse-seine [PS]	1	1(2)	1	1	1	1	2	1	1
Lampara nets [LA]	1	1(2)	1	1	1	1	1	1	1
Fly shooting seine [SSC]	2	2	1	1	1	1	1	1	1
Anchored seine [SDN]	2	2	1	1	1	1	1	1	1
Pair seine [SPR]	2	2	1	1	1	1	1	1	1
Beach and boat seine [SB] [SV]	2	2	1	1	1	1	1(2)	1(2)	1
Glass eel fishing	2	1	1	1	1	1	1	1	1

Table 14. Example (North Sea) of the output created for the request of the RCG to compare observer effort distribution in DCF- and dedicated surveys. The table also summarise the risk categories from the FishPi appraoch* The information on these columns has not been updated by WGBYC 2019. Extracted from the FishPi report WP3 (FishPi project, MARE/2014/19, "Strengthening regional cooperation in the area of fisheries data collection in the north sea and eastern arctic", table 12).

	Summed Risk*	Risk Category*	DCF Monitoring (Days at Sea)	Dedicated Monitoring (Days at Sea)
Boat dredge [DRB]	32	2		
Bottom otter trawl [OTB]	60	3	588	
Multi-rig otter trawl [OTT]	40	2	347	
Bottom pair trawl [PTB]	30	2	181	
Beam trawl [TBB]	36	2	280	
Midwater otter trawl [OTM]	45	2	154	
Pelagic pair trawl [PTM]	45	2	17	
Hand and Pole lines [LHP] [LHM]	24	1	5	
Trolling lines [LTL]	0	0		
Drifting longlines [LLD]	0	0		
Set longlines [LLS]	36	2	11	
Pots and Traps [FPO]	50	2	2	
Fykenets [FYK]	14	1	1	
Stationary uncovered poundnets [FPN]	0	0		
Trammelnet [GTR]	72	3	108	13
Set gillnet [GNS]	72	3	60	8

	Summed Risk*	Risk Category*	DCF Monitoring (Days at Sea)	Dedicated Monitoring (Days at Sea)
Driftnet [GND]	66	3	5	1
Purse-seine [PS]	18	1		
Lampara nets [LA]	0	0		
Fly shooting seine [SSC]	30	2	49	
Anchored seine [SDN]	30	2	21	
Pair seine [SPR]	NA	NA		
Beach and boat seine [SB] [SV]	0	0		
Glass eel fishing	NA	NA		

4 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)

4.1 Coordination with WGCATCH

ICES WGCATCH met 5-9th November 2018. WGCATCH considers the design of sampling of commercial catches and given that PETS data will be collected through DC-MAP, then cooperation with this expert group is of importance to WGBYC. This cooperation was initiated in 2018, when the joint workshop WKPETSAMP was organised with a view to focus on data collection protocols and survey design. However, two tasks have not been fully addressed through PETSAMP, and WGCATCH have asked WGBYC to assist them with. These are:

1. Prepare definitions of fields in the RDBES relevant to the at-sea sampling of PETS. Explore the necessity for additional fields from other sampling schemes and define any proposed fields.
2. Prepare guidelines for at-sea sampling programs, listing best practices and relevant parameters for PETS sampling for specific fisheries (this was formerly a WKPETSAMP ToR)

The request was received by WGBYC Chairs just a couple of days in advance of the meeting and therefore the group agreed that we would continue to work intersessionally with WGCATCH, through a meeting in the first instance. With regards (1), WGBYC (2018) reviewed proposed fields relevant to PETS sampling for the RDBES, but WGCATCH consider that these and additional fields need to be more clearly defined as their meanings may be different depending on the fishery being sampled. For example, we want observers to make a visual sample of the activity (rather than recording the sample as weight, as is done for fish), but the length of time this should be for needs to be determined. Also, use of terms means different things depending on the gear; "slipping" in purse seines has different meaning to slipping in a gillnet. Currently the RDB is not designed to store PETS sampling data but the RDBES needs to be; alignment of national databases to RDBES PETS fields would greatly facilitate data storage and submission to ICES.

WGBYC considered that (2) would be best tackled through a workshop. Existing best practice PETS sampling procedures would need to be collated (e.g. from the US) and relevant experts would need to attend. The workshop should take into account work already progressed through the FishPi project. The proposal for a workshop will be discussed with WGCATCH and if deemed necessary, Terms of Reference drafted intersessionally.

4.2 WGBYC coordination with Expert Groups/Workshops working on elasmobranchs

4.2.1 Working Group on Elasmobranch Fishes (WGEF)

In 2019, WGBYC further built on the relationship established with the WGEF in 2018. WGBYC are mainly concerned with avoiding duplication of tasks between the groups but also better understanding the data collated by WGEF and its use, with a view to complimenting where appropriate. WGBYC is responsible for bycatch data pertaining to PET species i.e. Protected, Endangered and Threatened. All of the elasmobranch species requested identified through the WGBYC data call qualify as protected, either under the CFP prohibition list, or the deep-sea fisheries regulation. However, not all species on the list are endangered or threatened (Nieto et al. 2015). If we take the critically endangered "CE", endangered "EN" and vulnerable "VU" species as qualifying as endangered and threatened, then WGBYC's responsibility is solely for these species (Table 15). Those classified as near threatened "NT" or least concern "LC" in the red list are not the responsibility of WGBYC. Data deficient "DD" species that are listed as protected, and some others which are not, should be included in the data call to improve the information available.

WGEF's main responsibility is to assess and draft advice for commercial elasmobranchs. However some of these also partly or wholly qualify as PET species, e.g. *Squalus acanthias*, the spiny dogfish. For commercial species, the main responsibility is with WGEF, across all categories of assessments. For Category 1 and 2 (full assessments giving F and stock size estimates), bycatch estimation is not an issue, provided that dead discards are included in the assessment. Of course a species may cease to be PET, either locally or globally, if ICES advice suggests this is appropriate, e.g. *Raja undulata* the undulate ray.

There is overlap between WGEF and WGBYC for especially category 3 and 4 (trends only) assessments (Table 16). These assessments usually give a stock trend but not a fishing mortality trend. Thus, WGBYC could have a role in estimating bycatch trends. Category 5/6 (bycatch species with no information on trends) are usually stocks which WGEF cannot provide more information on. WGBYC can have a role here, as is the case for Category 3 and 4 stocks.

The D1 (non-commercial fish, MSFD descriptor 1) group, which has yet to be formally established, will concern itself only with non-commercial species, whether they are PET or not. ICCAT has responsibility for commercial pelagic sharks, and for pelagic sharks as bycatch in tuna and bill fish fisheries. The D1 group would draw upon assessments from WGEF, ICCAT or WGBYC, rather than reinventing the wheel. However, there may be instances where this group is best placed to produce estimates of bycatch mortality.

The 2019 data call shows that there are considerable data on discarded bycatch e.g. for *Squalus acanthias*. These data could be accessed by WGEF to improve the assessment of the stock, by including discard mortality. This would remove the need for WGBYC to consider bycatch of that species, because the advised catch (if any) would include bycatch and discards.

It will be important to establish synergies between the groups, to avoid duplication, to assist one another and in preparing data calls. Table 3 shows some obvious synergies. WGEF, ICCAT-sharks and WGBYC have much commonality. If discards are included in the assessments and advice for category 1 and 2 PET stocks, then WGBYC need not have a role (bycatch F already estimated). However this would require new data calls and more work for WGEF/ICCAT.

WGBYC's responsibility is PET species for which estimates of bycatch are not forthcoming already. This means that it is mostly concerned with Categories 3-6 assessments. For category 3 and 4, WGBYC could assist with estimation of bycatch levels. For categories 5 and 6, WGBYC

could take the lead because WGEF probably cannot make any progress with existing data. WGEF would benefit from raised bycatch data provided by WGBYC.

ICCAT's remit is pelagic sharks and sharks by-caught in tuna or billfish fisheries. For such species straddling the ICES area there needs to be some discussion on how to collaborate. This also relates to non-elasmobranch fish by-caught in these fisheries e.g. *Mola mola*, the ocean sunfish.

The D1 group would only work on species that have not been handled by the ICES or ICCAT groups already. This would mainly confine the D1 group's activities to non-commercial, non-PET species Category 3-6 stocks. D1 assessments should draw on work already done by ICES or ICCAT e.g. for *Squalus acanthias, Isurus oxyrinchus* etc.

Table 17 summarises the potential synergies between the groups.

4.2.2 WKSHARK5

The Workshop on incorporating discards into the assessments and advice of elasmobranch stocks (WKSHARK5) met in Leeuwarden, Netherlands from 25 February – 1 March 2019 to:

a) Investigate and propose a raising method for elasmobranch fishes when a species is mostly discarded, as standard raising procedures are not applicable;
b) Evaluate and define the data quality and onboard coverage; discard retention patterns between fleets and countries; discard survival, as well as the definition of acceptable types/sources of data required for advice;
c) propose how to include discard information into the advisory process for elasmobranch fishes;
d) Propose a method to provide fishing opportunities that ensure that exploitation is sustainable when a species has been under moratorium, as is the case with the undulate ray

A presentation on the work of WGBYC was given during WKSHARK5. The workshop is an initiative of WGEF and is mostly attended by the members of this group. The goal of the presentation was to present the work of WGBYC and discuss possible overlap and areas for coordination with regards to elasmobranch assessments. WGEF carries out analyses on the basis of survey data Bycatch information may be a useful addition to the work of this group as they do not collate information from the wider commercial fisheries sampling. It was agreed that the Chairs keep in contact intersessionally (if needed) to inform each other of relevant developments within the group.

Of current interest is an upcoming data call to address questions from NEAFC/OSPAR to ICES. The purpose is to collate scientific knowledge on a list of deep sea elasmobranchs to be used by both organisations when respectively considering possible future measures and to ensure healthy populations of deep-sea elasmobranchs. WGBYC has provided bycatch numbers of these species on the list by metier and ecoregion (table 12.

4.3 ICES Working Group on Marine Mammal Ecology (WGMME)

WGMME has a ToR C to: 'Review additional aspects of marine mammal fishery interactions not covered by WGBYC. Details of this ToR to be agreed with WGBYC.' Ahead of the 2018 meeting, WGBYC suggested that topics not directly related to bycatch, such as depredation on catches or competition with fisheries, could fall within the WGMME remit. In 2019, WGBYC also proposed that it would be valuable for WGMME to critically evaluate methods for assessing thresholds and/or update thresholds for cetacean bycatch; WGBYC utilises established thresholds against which to compare its estimates of bycatch mortality to understand population level impacts.

However, in 2019, WGMME undertook the following assessments as part of its TOR C:

i. Seal interactions with fisheries (e.g. in which fisheries and by whom is it reported; how many seals are bycaught in fisheries);
ii. Other sources of cetacean bycatch data, i.e. those not being used in current bycatch assessments: the nature and utility of information available on cetacean bycatch, by area/country, gear, species).
iii. Identify potential risk areas (i.e. species-area-fishery combinations associated with a high risk of negative impacts on marine mammal populations due to fishery bycatch mortality).
iv. Revise existing thresholds for bycatch: WGMME reviewed this topic in 2013 and 2014, describing various approaches used to set safe limits for bycatch mortality in marine mammal populations.

WGBYC note that there is considerable overlap between the EGs with regards to the aims i-iii) identified by WGMME. With regards to i) seal bycatch/interaction has been addressed previously by WGBYC, specifically in 2011 and the group has, since 2012, collated information on the bycatch of species "other than cetaceans" (see ToRs and data calls). However, WGMME collated information (strandings, at-sea monitoring projects, interviews) to document seal bycatch at their meeting to fill their perception of a "gap" in the bycatch work undertaken by WGBYC. To complement the information that WGMME has pulled together, WGBYC agreed at its meeting to evaluate the seal data within its WGBYC database through the use of the BRA framework (see 3.1.1). WGBYC holds data from dedicated and non-dedicated monitoring programmes since 2005 and have been used in this report to look at the risk posed to grey seals by metier and ecoregion.

Under ii), WGMME (2019) reports that "WGBYC compiles data from National Reports from the MS related to EC Regulation 812/2014 and that in the last two years ICES has issued data calls for information on fishing effort, monitoring/sampling effort and bycatch numbers obtained from other monitoring programs, including the fisheries data collection framework (DCF, now EU-MAP). However, at present, WGBYC does not routinely make use of information from strandings, voluntary recording schemes, interview surveys etc." WGBYC has, in fact, issued datacalls annually since its inception, although they have been formalised the last two years through the ICES formal process; this greatly improved the response. WGBYC has also collated data from sources other than Reg812/DCF monitoring, including pilot projects and those using Remote Electronic Monitoring into its database. Additionally, WGBYC has, since 2012, reported on bycatch from other sources of information, including strandings (e.g. USA, Portugal and France) and interviews. WGBYC concluded that the work on strandings estimating bycatch numbers was important and should stay within WGBYC. At this year's meeting, the French delegate proposed to undertake a more complete summary of bycatch information from all north-east Atlantic strandings networks where possible for future WGBYC reports. WGBYC already provides some summaries where the information has been included in Reg812/2004 reports and given that these data are now being more widely used in WGBYC analyses to assess total mortality, the group agreed to the suggestion. This will provide a better understanding of the datasets that underpin these analyses and WGBYC agreed that it is important to compare the bycatch estimates derived from strandings to estimates based on on-board observer/electronic data.

In relation to WGMME ToR C (iii), WGBYC has been conducting risk assessments since 2012. WGBYC, however, has focussed on using the data collected from at-sea monitoring rather than other sources for this purpose.

Ongoing discussions with WGMME are clearly needed to avoid ongoing duplication and clarify next years' work.

Table 15. Roles and responsibilities between WGEF, WGBYC and fish biodiversity group (MSFD "D1" Descriptor) for elasmobranchs by quality of the assessment possible. Note the fish biodiversity group has yet to be established, and may be under OSPAR.

Red list	CE	EN	VU	NT	LC	DD
ICES Cat 1/2	EF	EF	EF	EF	EF	n.a.
ICES Cat 3/4	EF/BYC/D1	EF/BYC/D1	EF/BYC/D1	EF/D1	EF/D1	n.a.
ICES Cat 5/6	BYC/D1	BYC/D1	BYC/D1	D1	D1	BYC, D1, EF

Table 16. Roles and responsibilities of groups working on elasmobranchs.

Red list	CE	EN	VU	NT	LC	DD
WGEF	Yes if assessment (incl. discards) possible			Yes if commercial		
WGBYC	Yes if bycatch is an issue			No		Yes
ICCAT-Sharks	Yes if commercial + pelagic			Yes if commercial + pelagic		
ICCAT-Ecosystem	Yes if pelagic + bycatch is an issue			Yes if pelagic + bycatch is an issue		
D1 (non-commercial)	Yes, but only for species not dealt with above			Yes		

Table 17. Potential synergies between the groups.

	WGEF	WGBYC	ICCAT-Sharks	ICCAT-Ecosystem	D1
WGEF	Discards needed				
WGBYC	Cat 3/4: bycatch F estimation Cat 5/6 BYC lead	-			
ICCAT-Sharks	For discussion between ICES and ICCAT	For discussion on stocks straddling ICES area	-		
ICCAT-Ecosystem	-	For discussion on stocks straddling ICES area	Yes	-	
D1	Collaboration on discards (cat 3-6)	Cat 3-6 PET species	Non-commercial pelagic species	-	-

5 Continue to develop collaborative research proposals among WGBYC members to pursue research projects and funding opportunities in support of researching protected and target species behaviour in relation to fishing gear (ToR E)

The annual WGBYC meeting continues to be an important opportunity for participants to discuss and consider existing collaborative research and potential future work. At this year's meeting, WGBYC considered future potential collaboration projects, key research areas and knowledge gaps. There was insufficient time to develop proposals but participants were tasked to continue discussions intersessionally, especially if funding opportunities arise[19].

The group discussed the potential need to explore Electronic Monitoring (EM) as a tool for monitoring bycatch of protected species within EU-MAP monitoring. The Regulation 812/2004 will be repealed and monitoring bycatch of protected species will be included in the monitoring within EU-MAP. WGBYC has highlighted the issues around use of non-dedicated PETS observers to collect bycatch data; essentially, bycatch rates tend to be biased low when PETS bycatch data are recorded through fisheries observers rather than dedicated PETS observers. The use of EM could be an effective means of collecting reliable data under the new sampling requirements of the EU-MAP. Sample design including how to monitor, what métiers to monitor and to a certain extent how much to monitor has been evaluated in WGBYC reports (2018, and current) as well as in the FishPi report (fishPi 2019). In the fishPi report several EM proposals to be used within EU-MAP monitoring are listed and together with basic cost analysis for the different EM proposals.

The technique is readily available and can be cheap and there are many manufacturers all over the world providing solutions for monitoring both large and small scale fisheries. EM monitoring is in use in some fisheries today and there are approximately a thousand EM monitoring systems installed on fishing vessels all over the world (Michelin et al., 2019). An overview of the current state of EM use, the benefits of the technology, and the main barriers to broader adoption is described in Michelin et al., (2019). However, EM monitoring is not adopted in EU fisheries and to enhance implementation a collaborative project between Member States could be initiated trying out and evaluating different EM monitoring methods in a future EU-MAP. A project proposal would not only include one type of monitoring for example using only Remote Electronic Monitoring (REM) which has been tried out already by many Member States including Sweden, Denmark and the Netherlands, but also looking at combining many monitoring approaches such as onboard observers, REM, portable cameras and monitoring landings.

With regard to finding effective mitigation methods for reducing the bycatch of harbour porpoises, one question that remains unanswered is why harbour porpoise are actually bycaught? How they might detect a net and if possible avoid it. By using several underwater sound recorders (soundtraps), harbour porpoises movement can be followed within a distance of 200 meters. The SMRU, UK are studying the movement of harbour porpoises in the vicinity of a gillnet equipped with pingers to track harbour porpoise deterrent behaviour. Using sound traps (e.g. Macaulay et al. 2017) to study harbour porpoise behaviour near different types of gillnets will

[19] The last sentence of the paragraph was added based on reviewers' comments.

provide valuable insights into the behaviour of porpoises around the nets and could provide insights to novel mitigation.

Another area of great concern regarding carrying out reliable bycatch risk assessments is getting accurate data on fishing effort. WGBYCs´ analysis of data submitted through the ICES WGBYC datacall as well to ICES RBD show inconclusive reporting on fishing effort for many fisheries (small-scale for example) and by many Member States. Projects have been carried out trying to estimate relative fishing effort in different areas by using AIS data (see 3.4). This is a step forward, however there are disadvantages in using AIS data in that not all fishing vessels are currently required to use AIS and AIS does not show the type of gear in the water. However, a comparative analysis of the outcome of estimated fishing effort from AIS compared to actual fishing effort in an area would be a valuable exercise to inform on the use of AIS data to estimate fishing effort. Data on fishing effort could also be collected by Member States by expanding reporting for small scale fisheries to the EU logbook or getting this information by other means such as mobile phone apps. Another method of collecting data on fishing effort could be by using remote satellite analysis, but this approach has the same disadvantages as AIS with not knowing which gears are actually set in the water.

A new program funded by measure 39 of the EMFF will start in 2019 for three years in France, conducted by the French Institute for marine research and exploitation (*Institut Français de Recherche et d'Exploitation de la Mer* - IFREMER,), representatives of the industry from the Committee for marine fisheries and fish farming (*Comité National des Pêches Maritimes et des Elevages Marins* - CNPMEM,), regional grouping of professional fishermen (*Pêcheurs de Bretagne*), *Aglia* and *Observatoire Pélagis* (University of La Rochelle and CNRS).

The aim of this project is to develop or adapt mitigation strategies for common dolphin bycatch in the Bay of Biscay. One of the listed actions is the development of a new interactive and unidirectional pinger adapted for midwater pair trawlers. Different net adaptations will be tested for gillnets, including the development and test of acoustic reflectors. Analyses on by catch circumstances and fishermen interviews will generate reflections around best practices and bycatch avoidance strategies.

6 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 European waters. (Intersessional (ToR F)

6.1 Needs of WGBYC for the new RDBES

As Regulation 812/2004 will be repealed, monitored data on bycatch of PETS in commercial fisheries will be included in ICES RDBES (ICES Regional database and estimation system). To be able to submit data on PETS into the RDBES, the database needs to be modified. The recording of bycatch handling by fishers can be diverse depending on, for example, the fisheries monitored; it can take place in different parts of the vessel or during different stages of the fishing operation. Studies have shown that depending on whether the observer is a dedicated marine mammal observer compared to a discard observer you get higher bycatch rates using the former, suggesting that discard observation might be incomplete when monitoring PETS. For the calculation of catches and bycatch, WGBYC and other ICES EGs need the RDBES to provide a "picture" of the fishing operation associated to each data record that has been effectively screened *and* the species likely to have been detected at each stage. On the 18th of October 2018, Bram Couperus (Co-chair WKPETSAMP, member WGBYC), Sara Königson (Co-chair WGBYC) and Nuno Prista (Core-Group of RDBES) had an intersessional meeting to review the version of the current datamodel v.1.15. The fishing process was characterized by three separate defined processes:

1. Slipping- In fishing operations such as purse-seiners, the net may be opened and part of the catch released without ever coming onboard. In those cases, marine mammals but also some fish species (e.g., sardines) are released and these are frequently quantified in number or weight. In gillnet fisheries slipping is characterized by species falling out from the net while on the outside of the boat.
2. Hauling- This is when the nets are taken onboard and for example the cod-end of the trawl is opened and catch is emptied or when the gillnet comes into the vessel.
3. Sorting- This is when observers generally take a sample of a from the large catch and screen. This can in some fisheries be carried out below deck. These observation can be representative for most fish and crustaceans however not for rare protective species or mega-fauna.

One of the main requirements from WGBYC for the new RDBES is that it will be possible to distinguish between non-observation (missing values) and observation (true 0s, positive values). Until now in the WGBYC database and in RDBES it is not possible to distinguish the situations above which makes a difference for bycatch monitoring of for example large mammals.

6.2 ICES WGBYC Data call

On 14th December 2018, WGBYC issued an official data call for the second time (Annex 7 to the report to include data call). The call aims to collect data describing total fishing effort, monitoring/sampling effort and protected species bycatch incidents from 2017. The data supports ICES annual advice on the impact of bycatch on small cetaceans and other marine animals to answer

a standing request from the European Commission for advice on the impacts of fisheries on the marine environment.

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

The majority of the contacted countries submitted data through the call (20 out of 24 countries; Cyprus, Malta, Russia and Norway did not submit) but the quality and quantity of the data provided varied widely among nations. Further, about a third of the countries submitted data after the deadline outlined in the data call.

WGBYC reiterates that to facilitate data submission and processing it is recommended that each nation nominates a single organization to coordinate and provide bycatch data in future ICES data calls.

In the latest data call, WGBYC referred to Table D1 in the EU-MAP for a list of bony fish to be reported. However, following requests from some countries as to regards which species the group are interested in, the group reviewed the Table to develop a WGBYC priority species list (see section 6.3 below).

The database template includes fixed/mandatory vocabularies for several data fields, which facilitates 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 2018, updates were made to the data submission format and several fields have been changed from "optional" to "mandatory" in the latest database template. For example "observer days at sea", "number of incidents (with and without pingers)" and "number of specimens (with and without pingers)" are now mandatory. Importantly, it is also now mandatory that any bycatch record should be linked to a bycatch monitored effort record. This year, however, the fact that "days at sea" is not the mandatory metric for fishing effort presented problems and the group will make it so in next year's data call. WGBYC would also recommend that "days at sea" is a mandatory field for the RDB(ES) to ensure continuity of WGBYCs time series of bycatch data and assessments. Developments of the database template are ongoing and will, in particular, be mindful of data collection under the EU-MAP and the fact that 2018 data (to be assessed at WGBYC 2020) will be the last time data collected under Reg812/2004 will be submitted.

Over the course of the WGBYC meeting, it also became apparent that the spatial scale at which fisheries data were to be submitted is not fixed within the template; consequently some data were received at ICES subareas (preferred), others by division and yet others aggregated over multiple divisions. For example, the allowed entries could be "1~5~6" or "27.2.b.2" where the former is not useable for generating metier specific bycatch rates and consequently cannot be used in the bycatch risk assessments carried out by the group. This causes problems for assessments of bycatch rates.

6.3 Fish species of interest to WGBYC

In Table 1D 'Species to be monitored under protection programmes in the Union or under international obligations' of the Commission Implementing Decision (EU) 2016/1251 adopting a multiannual 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. The list contains 121 entries of bony fish, 7 of which are multiple entries and 63 entries for the area of the Baltic Sea alone. The list was critically reviewed during this year's meeting to determine which of these

bony fish species are relevant for the work of WGBYC and should therefore be queried in the annual Data Calls.

An initial decision was taken by the group to remove commercial species for which other scientific entities, e.g. ICES expert groups, carry out assessments. Additionally, it was noted that many bony fish species are listed for the Baltic Sea area, based on HELCOM. Our review shows that this is likely due to the EU Table 1D list being based on a list from HELCOM that listed almost all species occurring in the Baltic Sea as a preparatory stage for the classification of species on the current HELCOM Red List. The group reviewed the remainder of species, taking into account their conservation status; as a consequence, some were classified as 'not applicable' (NA) or 'least concern' (LC), so they were not included on the WGBYC Species List. Species, listed in the EU Habitats Directive were included in the WGBYC species list. The final list is given in Table 18.

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

WGBYC has historically used fishing effort data for static nets and midwater trawls obtained through MS annual Reg. 812 reports for contextualising reported bycatch rates and to form the basis of bycatch risk assessments for those gear types. WGBYC was informed in 2017 that Reg. 812 was in the process of being repealed, so when that process is complete annual reports will no longer be submitted to the EC meaning this source of fishing effort data will not be available to the working group. To identify possible alternative sources of fishing effort data a comparison of four different effort datasets (WGBYC data call, RDB, VMS, Logbooks) was conducted during the 2018 WGBYC meeting, the results of which are described in the working group report from that year (ICES 2018a). Based on this comparison the WGBYC data call and RDB datasets were considered to be the most complete of the four but some broad discrepancies between them were evident but there was insufficient time at the meeting to investigate this more fully. Consequently it was agreed that at the 2019 WGBYC meeting a more thorough comparison of these two datasets should be conducted to understand any possible biases in reported effort levels if WGBYC transitioned to using the RDB as the primary source of fishing effort data.

In late 2018 WGBYC issued a formal data call to MS requesting fishing effort, monitoring effort and bycatch data for 2017 from national databases. A request was also sent to the ICES secretariat in early 2019 to request fishing effort data from 2017 from the RDB. This section describes the results and conclusions from this comparative analysis of the effort data available in each dataset. Effort data from some countries (e.g. UK, Portugal) are not included because comparable effort metrics were not submitted to both databases.

Two broad gear types, static nets and midwater trawls were separated into under 10m and over 10m fleets by MS, as this was the only size category consistent between the two datasets. There was almost no midwater trawl effort in either dataset for under 10m vessels so we have not presented those data here. Figures 6 - 8 show the differences in recorded effort (days at Sea) by MS between the two datasets for each gear type / vessels size category.

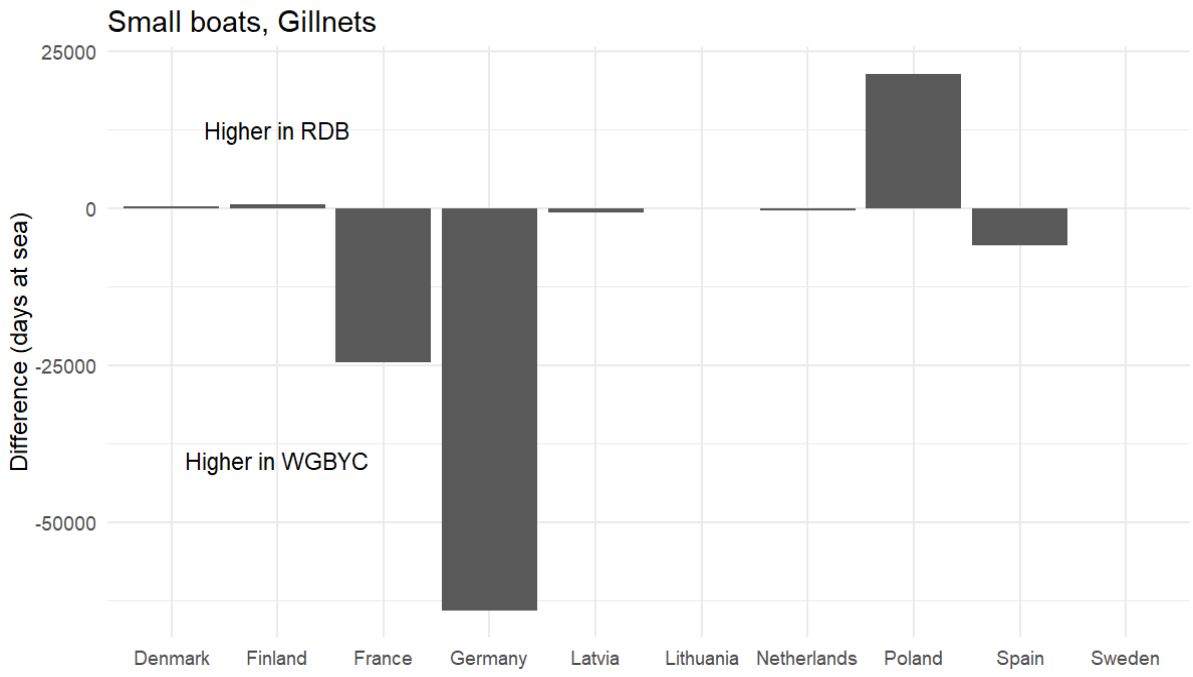

Figure 6. Differences between RDB and WGBYC datasets for under 10m netters.

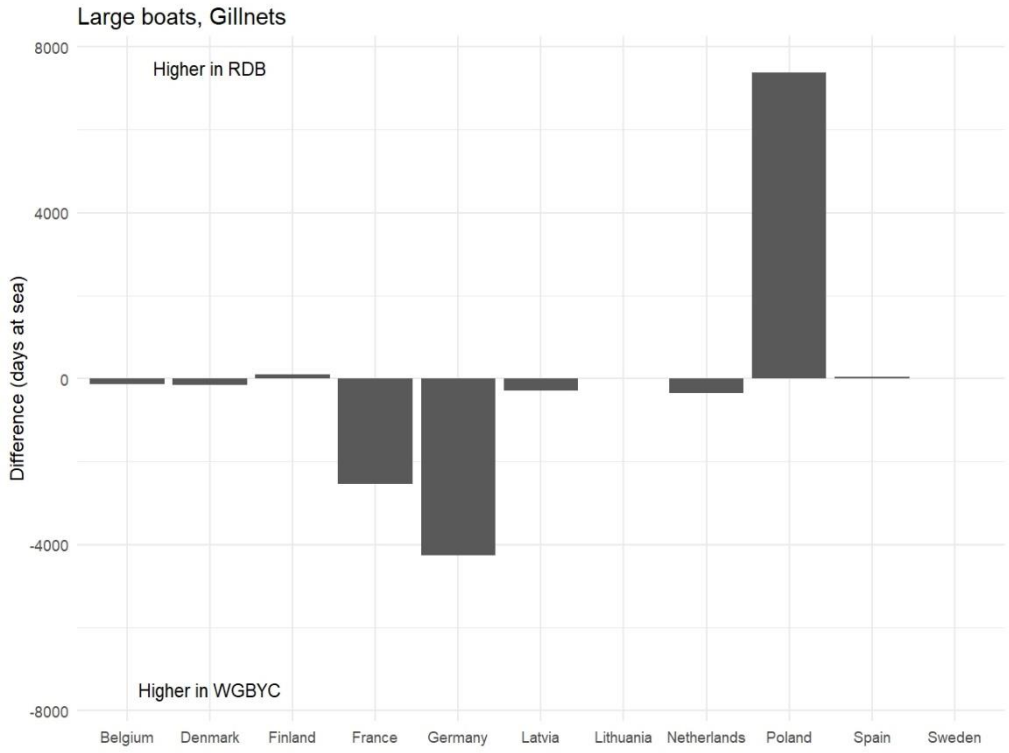

Figure 7 Differences between RDB and WGBYC datasets for over 10m netters.

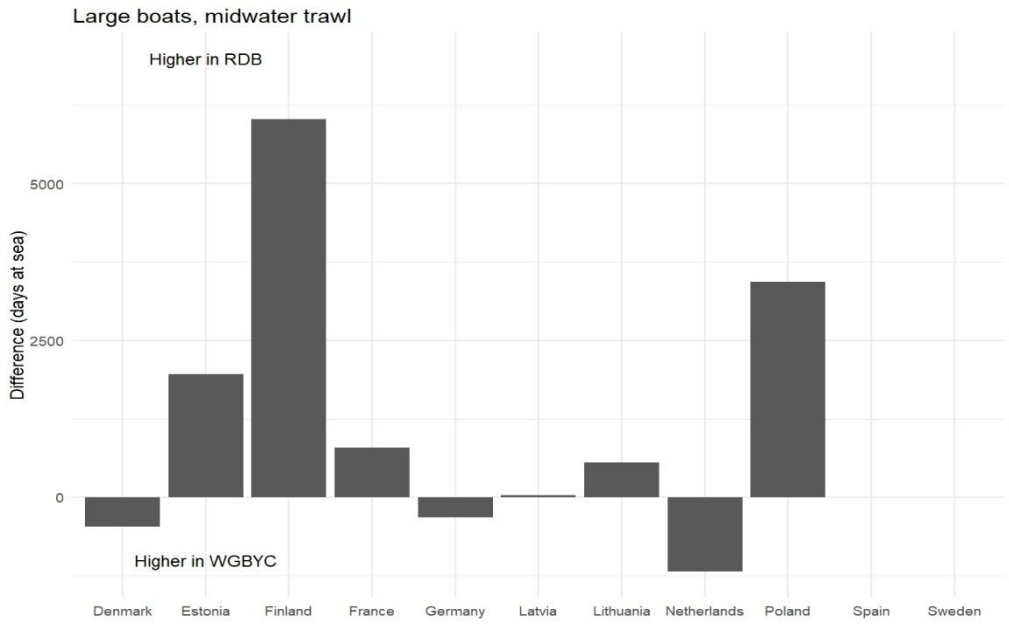

Figure 8 Differences between RDB and WGBYC datasets for over 10m midwater trawls.

Significant country specific differences were found between the two datasets in each gear / vessel size combination. In the under 10m gill netting datasets (Figure 6) Germany and France had much higher reported effort in the WGBYC database compared to the RDB. According to the German WGBYC members present at the meeting this discrepancy was due to significant over-estimation of effort for small German vessels due to a peculiar artefact of the effort recording system in place which means that if a small boat registers even a single day at sea in a particular calendar month, that boat is registered as fishing for the entire month (i.e. circa 30 days). The difference in the French effort data in this category could not be determined at the meeting and so needs further investigation. The lower reported effort for Poland in the WGBYC database is thought to be because monitored effort rather than total effort for 2017 was submitted in error to the WGBYC database.

For over 10m gill netting vessels (Figure 7) Germany, France and Poland show much the same general pattern as the under 10m gill netting category with Germany and France reporting higher effort to the WGBYC database and Poland higher to the RDB.

The discrepancies between the two datasets are smaller for midwater trawls (Figure 8) with Finland, Poland, Estonia and the Netherlands showing the greatest differences. Further investigation is needed to determine the reasons for this. The reporting of midwater trawl effort by most other MS appears to be relatively consistent.

The scale of some of the identified differences between these datasets raises important questions about the suitability of any single existing fishing effort dataset for use in assessments of protected species bycatch that utilize effort data in calculations of total mortality or risk. Additionally the fact that days at sea is not mandatory in the current RDB also means that the utility of that particular effort data source is further reduced as significant gaps may arise from MS simply not reporting data in that format. For now the judgement of the members of WGBYC that worked on this effort data comparison is that the group should continue requesting data from MS through an annual formal ICES/WGBYC data call in the standard format, but also obtain equivalent data for the same years from the RDB. This will allow a synthesis of both datasets to be undertaken prior to the WGYC meeting each year. With sufficient scrutiny and understanding of the issues contained within each dataset it should be possible to produce a single "most complete" dataset utilising the most accurate data originating from either the ICES/WGBYC data call or via the RDB.

A new version of the RDB, the RDBES, is currently in development and WGBYC recommend that days at sea is incorporated as a mandatory field for future data submissions to that database so that all countries submit equivalent and comparable formats to both databases.

6.5 Collating data from 2005 until 2017 into a single table

WGBYC has, since 2005, collected data on bycatch in fisheries along with fishing effort according to Regulation 812/2004. WGBYC has a database for this data however data has been summarized and submitted differently by member states over the years from 2005-2017. To carry out trend analysis on bycatch rates over time, areas and in different métiers , it would be helpful to have all the observed effort and bycatch data collated and submitted into a single table to facilitate assessment of bycatch rates over time or development of a temporal mean which can be applied to recent fishing effort data. This structure has arisen as a result of the evolution of the way in which WGBYC requests and stores the bycatch data. It has also been driven by policy drivers, particularly Reg. 812/2004 to date, but going forward EU-MAP data collection will be the priority.

Member states received a WGBYC data template on which to base data submissions to the group; however, the early template allowed flexibility in how the data were entered. For example, bycatch estimates could have been pooled over multiple divisions where a member state had conducted monitoring which makes it impossible to drill down to métier-specific bycatch rates/estimates. Some member states only submit the number of bycatch incidents and not the number of individuals bycaught. To alleviate these issues, the template has become more structured overtime and fixed vocabularies have been introduced. Data submission guidance has developed and more formal data calls (WGBYC 2016) and ICES\WGBYC (2017 and 2018) are now used to improve the standard of data submissions.

The entire dataset is not suitable for analysis of all taxa. The data submitted was initially required only by Reg. 812/2004 and therefore only data held by WGBYC on cetacean bycatch can be used from 2005 until 2014 this is because bycatch on other bycaught PETS was not asked for even though some member states did report such bycatch. It is for this reason that the summary table of bycatch records for the period 2005-2017 presented in ToR C was only applicable to marine mammals (see 0).

Data submitted for 2015-2017 is relatively compatible due to the structured datacall. However, during WGBYC 2019 efforts were made to pool data from 2005 until 2014 submitted to the WGBYC database for further analysis. However, with regards to different member states submitting data differently, many assumptions had to be made while pooling data.

In order to pool the data, a common metric of fishing and monitored effort is needed. WGBYC has always worked with, and now requests, both effort types in Days at Sea (DaS) and observed days at sea (obDaS). However fishing effort can be reported both in DaS and trips. Therefore, when only trips have been reported in certain métiers we have converted the number of observed trips into Observed DaS. WGBYC used the information provided by WGCATCH (2019) for this conversion which concluded that for set gillnets for small boats, one trip equals one DaS. In other métiers, such as OTM or OTT, the mean number of DaS per trip has been calculated for the métier of concern. Thereafter, the mean DaS has been included when only trips were reported.

Over the time period, cases of duplicated data submissions were identified. Only the latest submitted data has been retained.

If only the number of incidents was reported and not the number of individuals, Member States' Reg. 812/2004 report was referred to try and fill information gaps. However this was only possible to do for cetaceans, in the case of grey seals, for example, we have assumed that one incident equals one caught individual. This information has then been added to the summarized data. The outputs from this collation exercise is a summarized data table for the entire period 2005-2017 which is held within the WGBYC database.

Despite the efforts to create the summarized table, WGBYC decided that only the more recent data 2015-2017 would be used in the BRAs. Earlier data were only used to summarise bycatch rates of marine mammals and not scaled up using fishing effort data. There are a number of reasons for this relating to the pre-2015 data which:

- were not collected through formal datacall
- were not standardized sufficiently, resulting in assumptions being made on how to use available data
- assumptions around fishing effort and monitored effort in particular, could give rise to large bias in bycatch estimates

WGBYC have considered these issues and the value of the collated data. The group considers that the best way to resolve this issue and ensure there is a consistent time-series of data, is to request resubmission of all data using the new data template. However, the effort involved for countries may be prohibitive.

Table 18. WGBYC proposed priority bony fish list.

Scientific name	Common name
Acipenser spp.	Sturgeon sp.
Alosa alosa	Allis shad
Alosa fallax	Twait shad
Coregonus lavaretus (previously Coregonus balticus) (migratory)	European white-fish
Coregonus lavaretus (previously Coregonus maraena) (stationary)	European white-fish
Hippocampus guttulatus (previously Hippocampus ramulosus)	Long-snouted seahorse
Hippocampus hippocampus	Short-snouted seahorse
Hippoglossus hippoglossus	Atlantic halibut
Lampetra fluviatilis	European River lamprey
Petromyzon marinus	Sea lamprey

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Annex 1: List of participants

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Annex 2: Resolutions

Terms of Reference for 2019 meeting

The Working Group on Bycatch of Protected Species, chaired by Kelly Macleod, UK and Sara Königson, Sweden, will meet in Faro, Portugal 5–8th March 2019. The Terms of Reference proposed:

a) Review and summarize annual national reports submitted to the European Commission under Regulation 812/2004 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, furthering the bycatch risk approach to assess likely conservation level threats and prioritize areas where additional monitoring is needed;

d) 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) (intersessional);

e) Continue to coordinate and support among WGBYC members research proposals/projects and funding opportunities in support of researching protected species bycatch 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 European waters. (Intersessional).

WGBYC will report by 8th April 2019 to the attention of the Advisory Committee.

Agenda

Tuesday 5st March		
Time	Type	Item
08:30	Plenary	Laptop/network setup
08:45		Welcome & Introductions House keeping Ways of working
09:00	Plenary – deciding tasks	TOR A) Summary of reports (bycatch estimates): status review - 812 report summaries by MS - summaries from ancillary data (e.g. strandings) - summaries bycatch rates from literature/metadatabase in N Atlantic (spreadsheet) - outputs: tables (previous + advice)
		TOR B) Summary of reports (mitigation): status review - 812 report summaries by MS - summaries from new literature in N Atlantic: mitigation trials & compile results
09:45	Presentations	TOR C) Evaluation of population level impacts Methods of calculating and modelling seabird by-catch based on effort data and on-boat observations Evaluation of harbour porpoise bycatch using European strandings data
10:30	Plenary	TOR C) Evaluation of population level impacts : Seabirds: WGBYC data; JWGBIRD; EU PoA Elasmobranchs: WGBYC data; WGEF *Marine mammals*
11:30	Plenary	TOR C) prioritise areas for more monitoring How do we provide clarity on metiers to sample? RCG_NA_PETS subgroup work: North Atlantic risk assessment update (FishPi method) Update monitoring metadatabase
13:30	Presentation/plenary	TOR F) Report from the database subgroup Data call Response
		Agree additional Tasks

		Repeat effort comparison: unpick the problems and bias. How can it be improved? Other sources effort? Review WGCATCH approach for SSF MERP approach –present to the subgroup *Combining older and new WGBYC data*
14:30	Plenary	ToR D) 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) *WGCATCH ;JWGBIRD ;WGEF ; WKSHARKS; WGMME*
15:00	Plenary	TOR E) Continue to coordinate and support among WGBYC members research proposals/projects and funding opportunities in support of researching protected species bycatch mitigation Identify key research questions/priorities Can we work up to a collaborative research proposal? UK soundtrap work - opportunities for collaborating? (present to subgroup)
16:00		Sub-group work – organising group & planning for day 2. Start tasks as time allows
18:00		*Close*
Wednesday		
08:30	Presentation	Welcome from CCMAR represented by Jorge Gonçalves with a brief presentation on the work of the Coastal Fisheries and Research Group
8:45	Work session	All ToRs
11:30	Presentations	Tor B) Bycatch mitigation PAL trials in the Icelandic cod gillnet fishery – preliminary results Testing pingers to reduce interactions between dolphins and trammel nets: preliminary results of a pilot study off the Algarve coast (southern Portugal)
12:45 lunch		
13:30	Work session	All ToRs
13:30-15:30		Elasmo subgroup: Remote join to WGEF Chairs
17:15	Plenary	Review of progress
18:00	Close	
Thursday		
08:30	Plenary	Tasks
	Work session	All TORs

12:30 Lunch		
13:30	Plenary	ToRs: Status review – Subgroup lead to update, present key results and draft conclusions, 2 slides for review by group
15:30	Close : Excursion & social	
Friday		
08:30	Work session	Finishing up – all TORs
11:00	Plenary	Reviewing ToR conclusions Draft recommendations
12:30 Lunch		
13:30	Plenary	Writing and reviewing texts Finalise Recommendations
15:45		2020 ToRs
16:15		Wrap up Next meeting – timing; venues
16:30		CLOSE

WGBYC terms of reference for the 2020 meeting

The Working Group on Bycatch of Protected Species, chaired by Kelly Macleod, UK and Sara Königson, Sweden, will meet in [near Amsterdam] on XXXX 2020. The Terms of Reference proposed:

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).

Supporting Information

Priority	The current activities of this Group will lead ICES into issues related to the ecosystem affects of fisheries, especially with regard to the application of the Precautionary Approach. Consequently, these activities are considered to have a very high priority.
Scientific justification	a–b) This is essential to use in answering part of the European Commission MoU request to "provide any new information regarding the impact of fisher-ies on marine mammals, seabirds..."; c) ICES Member Countries are required to reduce levels of bycatch under several pieces of legislation; the response to this ToR will help meet that aim; d) Bycatch monitoring and assessment is fundamental to the work of the group; in light of significant changes in legislation that will impact monitoring programs for PETS any improvements in coordination and methods will help the group and other workers in this field; e) Improving scientific understanding how target and non-target catches interact with commercial fishing gear is fundamental to developing effective mitigation measures to reduce bycatch on vulnerable species; f) An operating database allows for more efficient response to future advice requests and an audit trail for information used in the Group's reports; remaining intersessional ToR's all aim to increase effeciency of WGBYC's tasks in providing advice to various groups; g) The European Commission has decided not to amend Res. 812/2004 and to integrate monitoring of protected and endangered species into the new DCF (DC-MAP). It is essential to cooperate with the scientists who design observer schemes and protocols for the monitoring of catch and discards;
Resource requirements	None beyond usual Secretariat facilities
Participants	15–25
Secretariat facilities	Secretariat support with meeting organization and final editing of report
Financial	No financial implications.

Linkages to advisory committees	ACOM
Linkages to other committees or groups	JWGBIRD, WGFTFB, WGMME, WGSE, WGEF, WGCATCH, WGMIXFISH, WGSFD, WGNSSK, SCICOM
Linkages to other organizations	NAMMCO, ASCOBANS, ACCOBAMS, GFCM, EC, IWC

Annex 3: Recommendations 2019

Recommendation	Addressed to
Best practice sampling procedures for PETS need to be further developed and presented to the RCGs and/or national contacts leading sampling programmes under the EU-MAP. This would include further definition of sampling fields as asked for by WGCATCH. WGBYC consider this would be best achieved through a workshop.	WGCATCH/WKPETSAMP
WGBYC recommends that WGCATCH work with us to deliver estimates of fishing effort for the small-scale netting fisheries for 2018 prior to WGBYC 2020 meeting.	WGCATCH
WGBYC concluded that the 2017 fishing effort data from the RDB could not be used for their PETS bycatch estimates WGBYC recommends that RDB discusses with the data needs of WGBYC to fulfil its advisory role to the European Commission.	SCRDB(ES)
WGBYC recommend that WGMME could request WGBYC to estimate/assess bycatch of specific species of their interest to reduce duplication between groups and enhance outputs of both.	WGMME
In 2018, WGBYC recommended the RDB Steering Group include additional fields to accommodate the new format of protected species data collection. New data fields were recommended by PETSAMP and reviewed by WGBYC. In 2019, WGBYC recommend that the RDB continue to work with WGBYC to ensure RDB(ES) can store PETS data from 2020.	RDB(ES)

Annex 4: ICES WGBYC Data Call for ICES advisory work of the Working Group on Bycatch of Protected Species (WGBYC)

Data call: Data submission for ICES advisory work of the Working Group on Bycatch of Protected Species (WGBYC)

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 2017. 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.

Currently, 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) 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 2018[20]). Reg 812/2004 is due to be repealed, and consequently ICES is now 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 future, data provision will be through the ICES regional database (RDB) because of Commission Implementing Decision (EU) 2016/1251[21] (EU MAP). This data call aims to improve consistency and completeness in the reporting of bycatch data at a regional scale. ICES acquisition of fisheries sampling and protected species bycatch data will aid the transition from Reg 812/2004 to EU MAP, and improve the ability of ICES to advise on the effect of fisheries on protected species.

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

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[20] ICES 2018. Bycatch of small cetaceans and other marine animals – review of national reports under Council Regulation (EC) No. 812/2004 and other information. *In* Report of the ICES Advisory Committee, 2018. ICES Advice 2018, 8 pp. http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2018/2018/byc.eu.pdf

[21] 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).

The data will also be used to undertake a comparative assessment of fishing effort data acquired from different sources. Any inconsistencies will, therefore, be understood as WGBYC transitioning from Reg 812/2004 reports to the RDB as their main source of effort data that underpins advice.

3. Legal framework

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 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, 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 15th of February 2019, to provide enough time for additional quality assurance and data handling procedures before the upcoming WGBYC meeting in March 2019. **Data submitted after this date cannot be processed and will not be taken into account at the WGBYC 2019 meeting**.

5. Data to report

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 from **2017**. However, historical data (i.e. 2009-2016) that have not been submitted previously to ICES (by EU and non-EU countries) should also be submitted in the same format. Please refer to Section 6 – Annex 1 and 2 for specific guidance on the data submission process, format, data fields, and definitions.

5.2 Data types

Data covered by this data call include:

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;** and*
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), to include all other marine mammals (phocids etc.), all seabird species, all sea turtle species, and any protected, prohibited (see pages 26 and 27 of the WGEF 2018 report for a list of EU-prohibited elasmobranchs) or zero TAC elasmobranchs and protected fish species, from the same gear types as listed in point 1.*
3. *Data describing monitoring effort and incidental bycatch of **all protected species (as defined in points 1 and 2 above**) recorded from any **other** monitored gear types (demersal trawls, lines etc.) under national data collection programmes (e.g. DCF etc.) or other monitoring 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.*

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/bycatchReporting_template.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.dk for 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 please contact the ICES Secretariat advice@ices.dk_or the WG chairs Sara Königson (sara.konigson@slu.se) and Kelly Macleod (Kelly.Macleod@jncc.gov.uk).

8. Electronic outputs

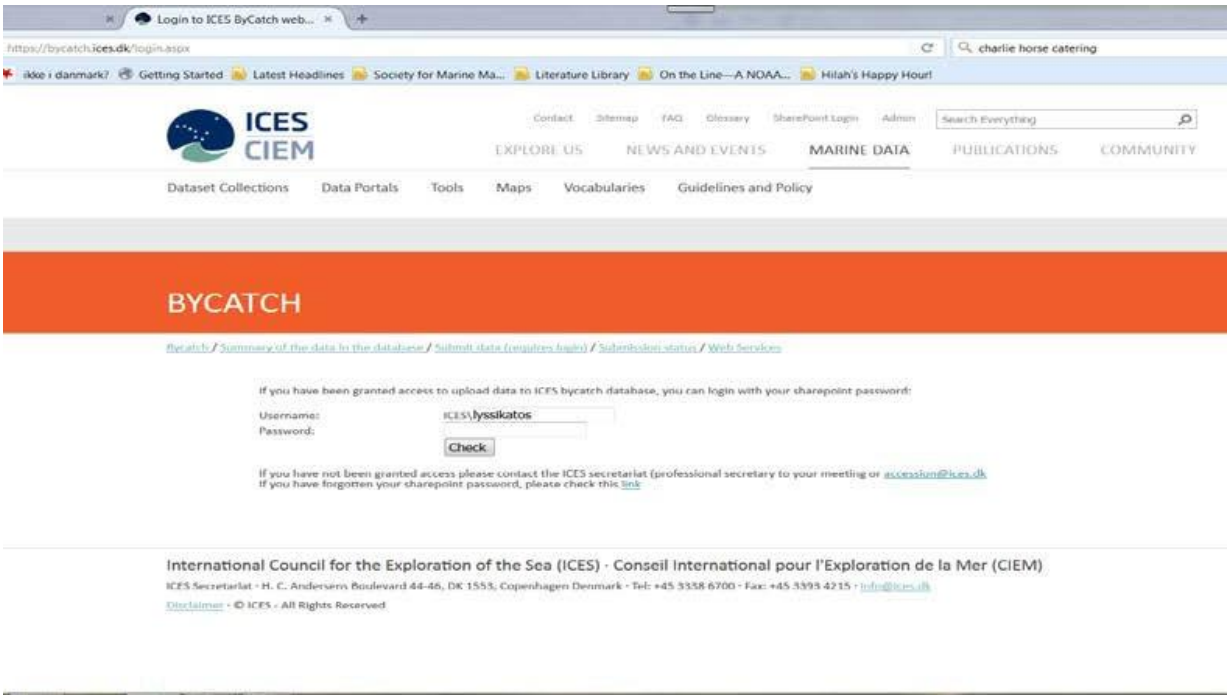
Data on fishing effort, monitored effort, and bycatch of protected species will be aggregated by ICES Areas and ecoregion, as well as by GSA area in the Mediterranean. This data will be shown in maps and tables within ICES Bycatch reports and in ICES Advice[22]. Aggregated data will also be visible and accessible on the ICES Publications Library.

[22] ICES 2018. Bycatch of small cetaceans and other marine animals – review of national reports under Council Regulation (EC) No. 812/2004 and other information. *In* Report of the ICES Advisory Committee, 2018. ICES Advice 2018, 8 pp. http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2018/2018/byc.eu.pdf

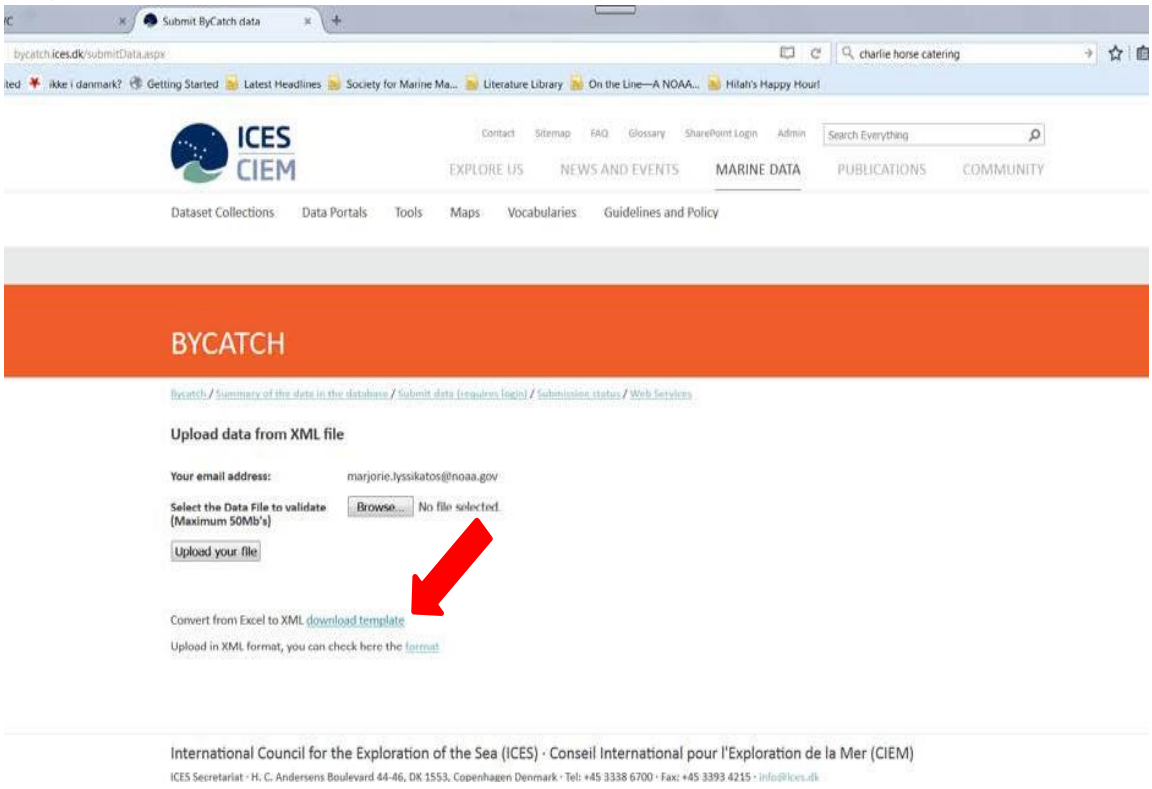
Annex 1. Data submission procedure

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 Monitoring Effort, and Table 4 - Bycatch Events) 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 when 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.

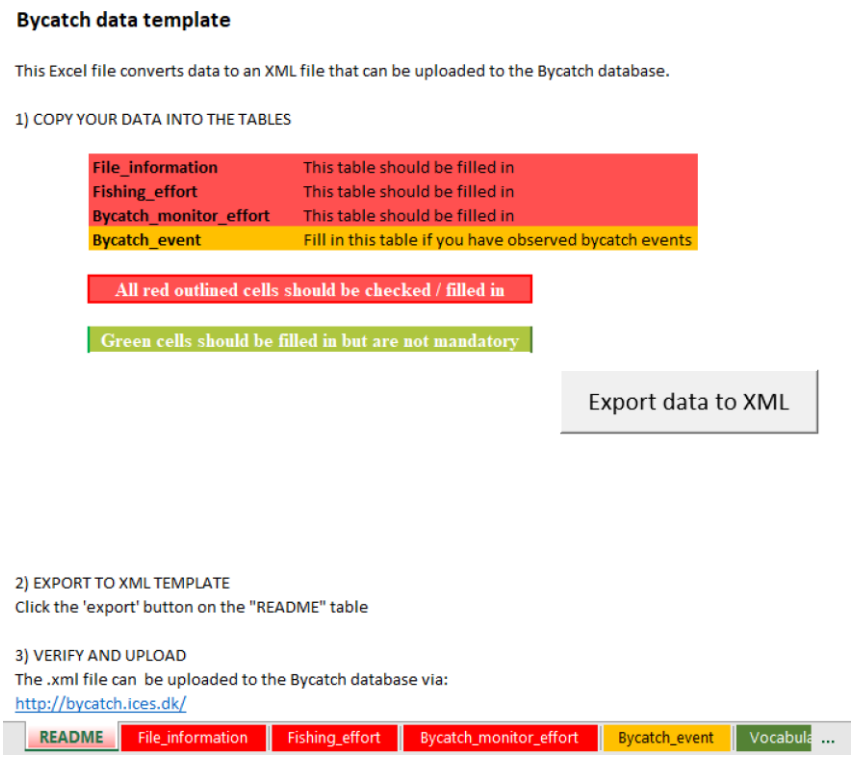
The **first step** is to click on the link provided here: http://bycatch.ices.dk/login.aspx to access the data entry and upload template from the data submission site. ICES sharepoint login credentials are required to login and can be requested at data.call@ices.dk.



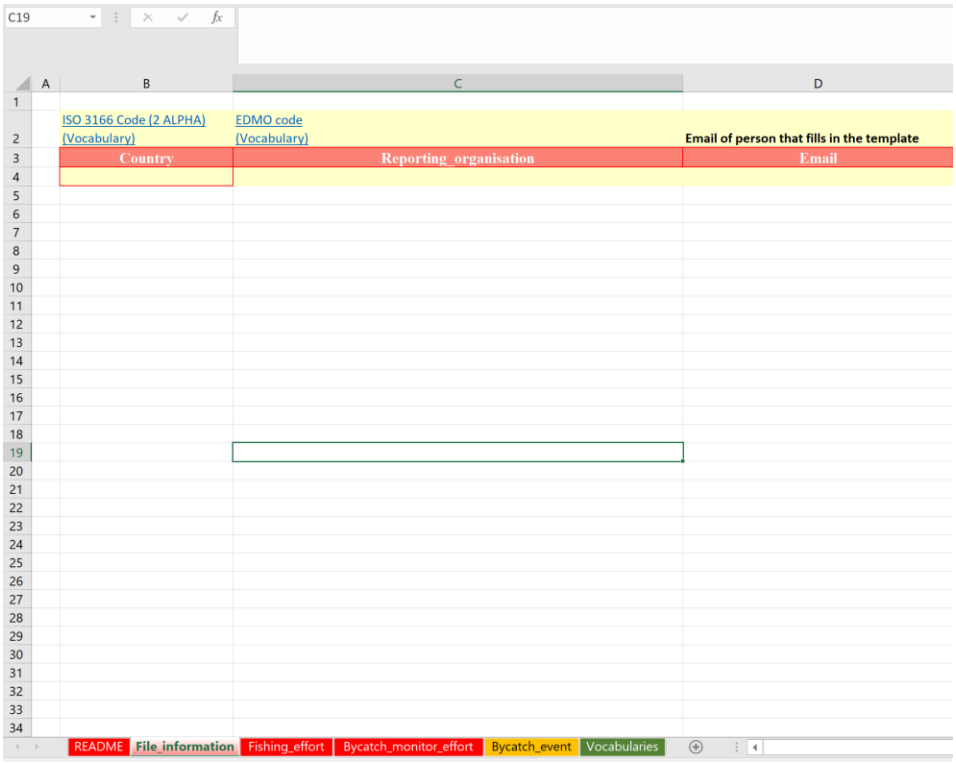
After entering your username and password, the **second step** is to download the template (see below).



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



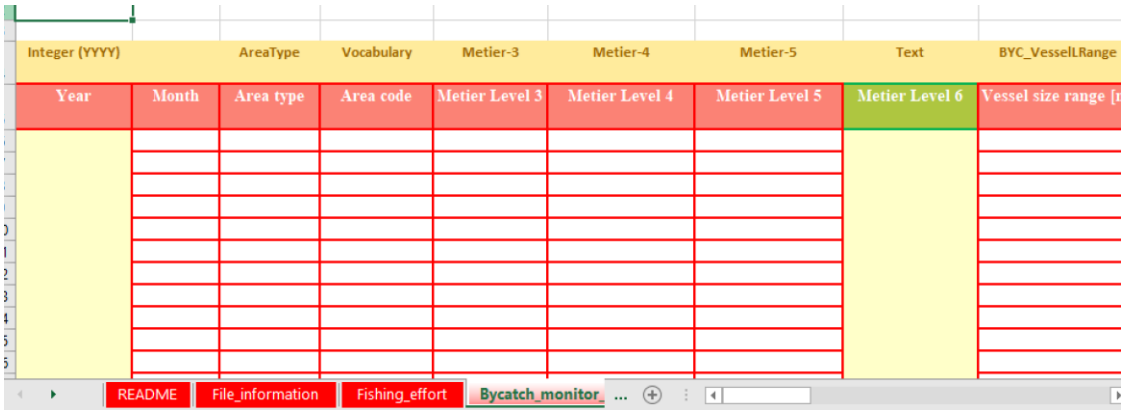
Step 4. Begin entering your data starting with the 'File_Information' tab (Annex 2 – Table 1). **NOTE: you may choose to manually enter the data or cut and paste data from an electronic file. However, if you cut and paste, the values must match the values provided in the vocabularies/drop down lists.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



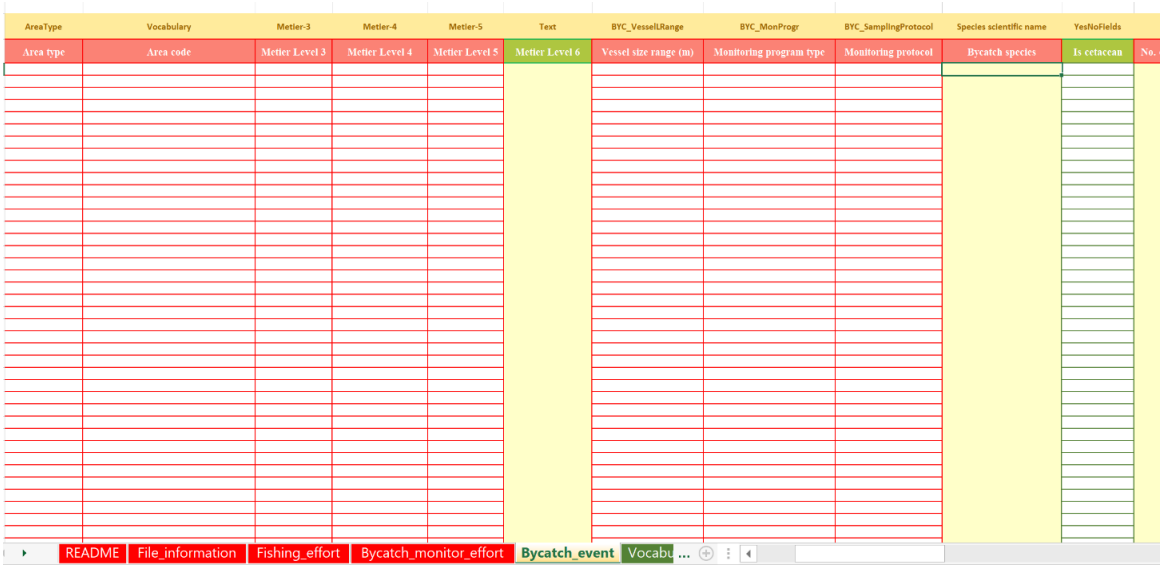
Step 5. Move on to the 'Fishing Effort' table. Then begin to populate the remaining columns and rows given the data.

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

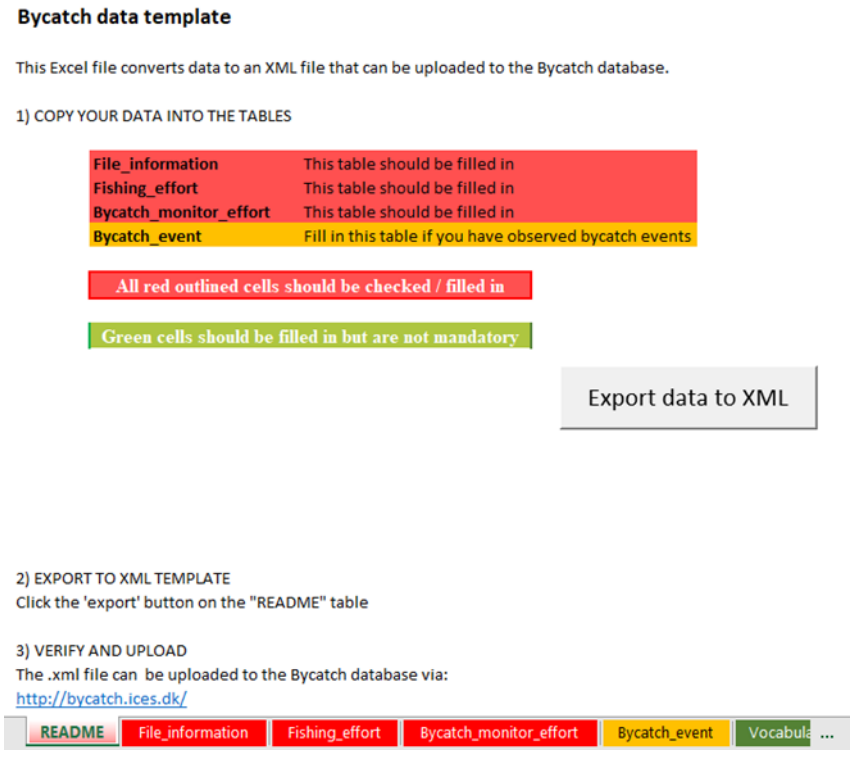
Step 6. After completing the Fishing effort table, move on to the next tab 'Bycatch_monitor_effort' (Annex 2 – Table 3).



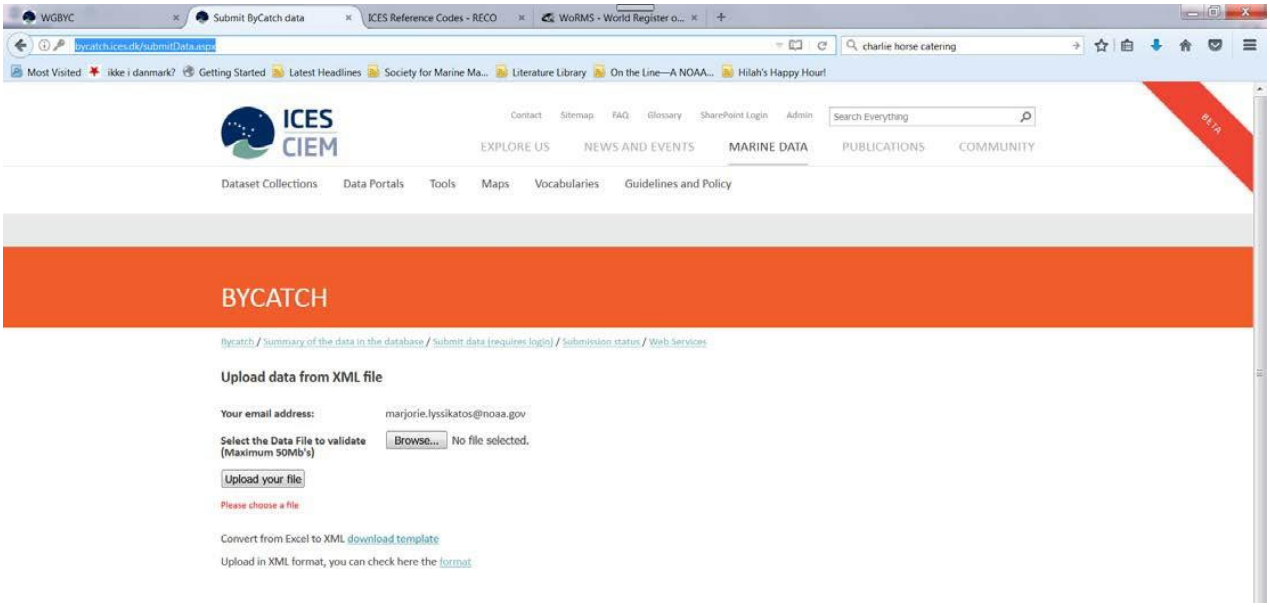
Step 7. After completing the Monitoring Fishing effort table, move on to the next tab 'By-catch_event' (Annex 2 – Table 3). This tab is where observed bycatch events, bycatch rates, and estimates for different species are entered and linked with the Bycatch monitored effort and the Fishing effort. Any 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.



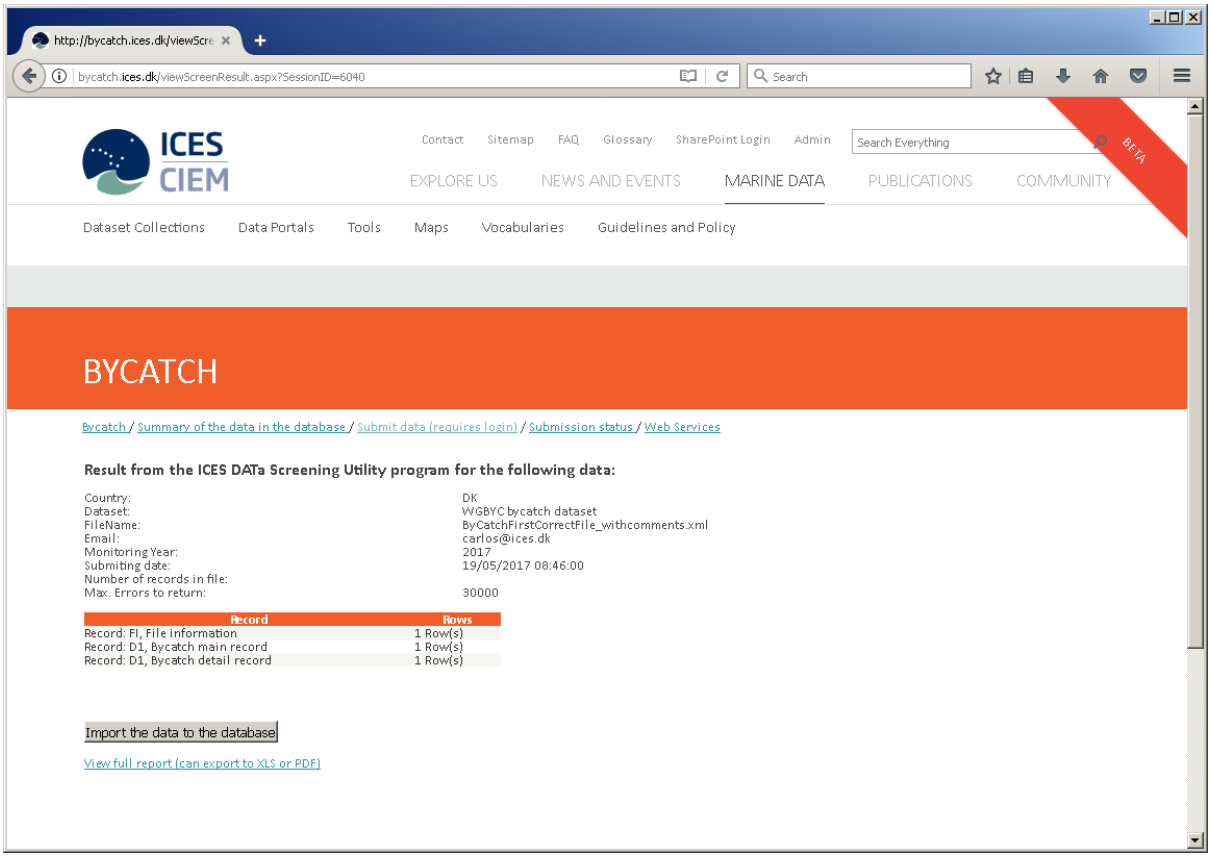
Step 8. Go back to the readme tab, export your data to XML file, and save the file locally in your computer.



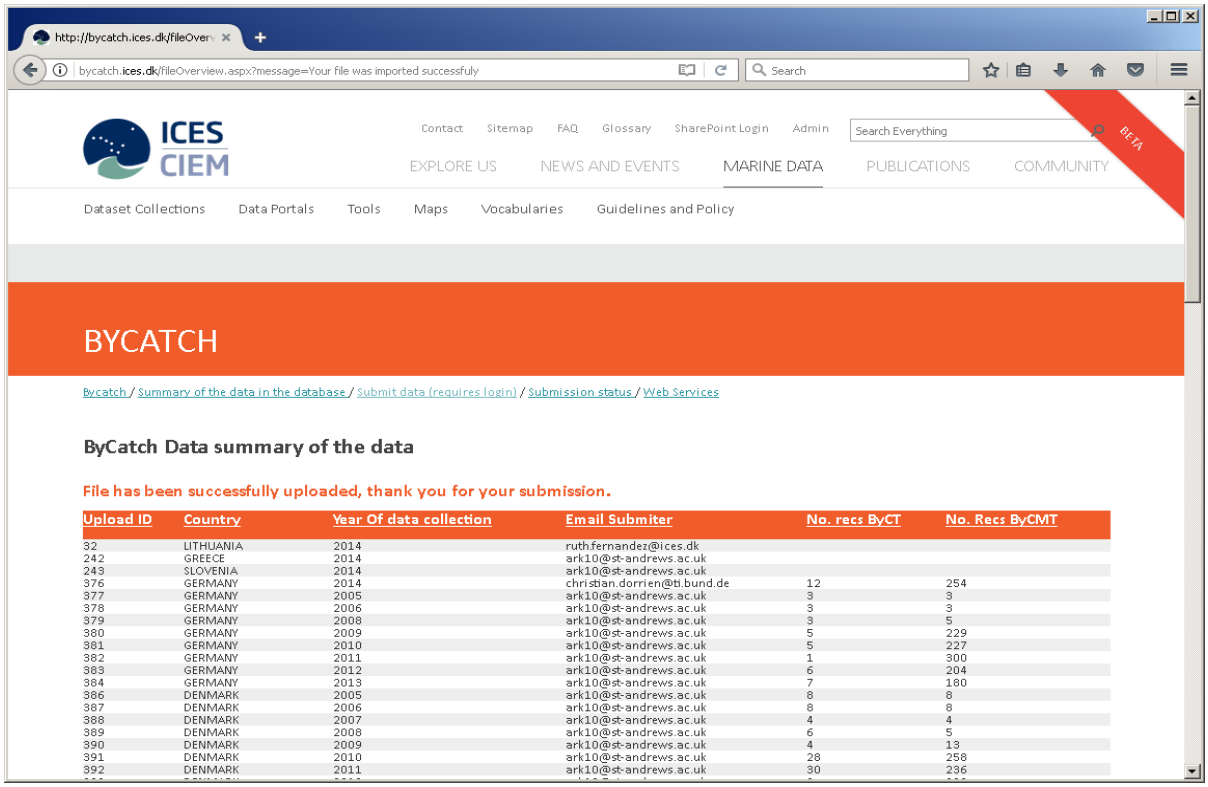
Step 9. Go back to the http://bycatch.ices.dk/submitData.aspx_ link, and **browse** to your directory where you saved your XML file and then click 'Upload your File' to upload your data to the database.



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 button, you will receive a message that the data have been successfully uploaded.



Upload ID	Country	Year Of data collection	Email Submiter	No. recs ByCT	No. Recs ByCMT
32	LITHUANIA	2014	ruth.fernandez@ices.dk		
242	GREECE	2014	ark10@st-andrews.ac.uk		
243	SLOVENIA	2014	ark10@st-andrews.ac.uk		
376	GERMANY	2014	christian.dorrien@ti.bund.de	12	254
377	GERMANY	2005	ark10@st-andrews.ac.uk	3	3
378	GERMANY	2006	ark10@st-andrews.ac.uk	3	3
379	GERMANY	2008	ark10@st-andrews.ac.uk	3	5
380	GERMANY	2009	ark10@st-andrews.ac.uk	5	229
381	GERMANY	2010	ark10@st-andrews.ac.uk	5	227
382	GERMANY	2011	ark10@st-andrews.ac.uk	1	300
383	GERMANY	2012	ark10@st-andrews.ac.uk	6	204
384	GERMANY	2013	ark10@st-andrews.ac.uk	7	180
386	DENMARK	2005	ark10@st-andrews.ac.uk	8	8
387	DENMARK	2006	ark10@st-andrews.ac.uk	8	8
388	DENMARK	2007	ark10@st-andrews.ac.uk	4	4
389	DENMARK	2008	ark10@st-andrews.ac.uk	6	5
390	DENMARK	2009	ark10@st-andrews.ac.uk	4	13
391	DENMARK	2010	ark10@st-andrews.ac.uk	28	258
392	DENMARK	2011	ark10@st-andrews.ac.uk	30	236

If errors are found in your file, you can re-upload and overwrite previously entered data. If you have no success with your data upload, please contact ICES Data Centre (data.call@ices.dk). You can check the summary of records entered by clicking on the Summary of the data in database or Submission Status. **Please note that data uploaded after the deadline (15th[t] February 2019) will not be considered in the provision of advice on the bycatch of protected species in 2019.**

In case of questions about the template, reporting format, vocabulary codes, etc., please contact data.call@ices.dk.

Annex 2. Data submission format in detail

There are four tables (worksheets) in the Excel file 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.

Table 19. File Information Table

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

Table 20. Fishing_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.
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 trips were observed	Use code options from the look-up lists for each area type; multiple areas must be separated by '~'
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.
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 V according to Appendix IV of the Commission Decision 2008/949/E

FIELD NAME	FIELD TYPE	OBLIGATION	DESCRIPTION	GUIDANCE
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	O	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 5 according to Appendix IV of the Commission Decision 2008/949/E
Total km hours F	Numeric	O	Total soak time of nets in kilometre hours (kmh) (this information is intended for fixed gears).	Indicate total soak time (kmh) fished at Métier level 5 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 5
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 21. Bycatch Monitoring Effort Table

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	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 the majority of trips were observed	Use code options from the look-up lists for each area type; multiple areas must be separated by '~'
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

FIELD NAME	FIELD TYPE	OBLIGATION	DESCRIPTION	GUIDANCE
Fishery target species	Char	O	Name of the main target species. Minimum specification – taxonomic group or common name; Maximum specification – scientific name of the species.	If more than one species, separate scientific names by '~' e.g. Sprattus sprattus~Clupea harengus
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; Type 1 or Type 2 (http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32004R0812, DDD=Dolphin Dissuasive Device; MIX = a mixture of acoustic deterrents used; other=devices other than Type 1, Type 2, DDD, or a mixture of these 3 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	O	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 (e.g. tows or sets) at the Métier level reported.

FIELD NAME	FIELD TYPE	OBLIGATION	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 Reg. 812	Indicate type of monitoring program conducted in agreement with Article 4 and Annex III of Council Regulation (EC) 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 22. Bycatch Event Table

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	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 the majority of trips were observed	Use code options from the look-up lists for each area type; multiple areas must be separated by '~'
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 4 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
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 5: Tables, Figures, Acronyms

Tables

Figures

Acronyms

ADD	Acoustic Deterrent Device
ASCOBANS	Agreement on the Conservation of Small Cetaceans of the Baltic, Northeast Atlantic, Irish and North Seas
BRA	Bycatch Risk Assessment
BRD	Bycatch Reduction Device
DCF	Data Collection Framework
DC-MAP/EU-MAP	Data Collection Multi-Annual programme
DDD	Dolphin Dissuasive Device
EEZ	Exclusive Economic Zone
FPO	Pots and traps
GND	Drift gillnet
GNS	Set gillnet
GSA	Geographical subareas http://www.fao.org/gfcm/data/map-geographical-subareas/en/
GTR	Trammel nets
HELCOM	Baltic Marine Environment Protection Commission
LLD	Drifting longline
MS	Member State
NAFO	North Atlantic Fisheries Organisation
NAMMCO	North Atlantic Marine Mammal Commission
OTM	Midwater Otter trawl
PETS	Protected, Endangered and Threatened Species
PTB	Paired bottom trawl
PTM	Midwater pair trawl
RDB	ICES Regional Database
RDBES	ICES Regional Database and Estimation System
SMRU	Sea Mammal Research Unit
TAC	Total Allowable Catch
VMS	Vessel Monitoring System
WGBYC	Working Group on Bycatch of Protected Species (ICES)
WGCATCH	Working Group on Commercial Catches (ICES)
WKPETSAMP	Joint WGBYC/WGCATCH Workshop on sampling of bycatch and PET species (ICES)
WKREV812	Workshop to Evaluate the Implementation of Council Regulation (EC) 812/2004

Annex 6: Reviewers Reports

Title: Review of ICES Working Group on Bycatch of Protected Species (WGBYC) Meeting Report

Reviewer: Chris Orphanides, NOAA

Date: June 2019

Summary: Overall I thought that the working group did a very good job assembling the report it reflects well on all the work and analysis they have done. So, I have relatively few comments. As someone not terribly familiar with the European bycatch setting, I appreciated the overview sections describing the regulations, upcoming changes, and the definitions of acronyms in the beginning of the report. In general, it seemed that there was a lot of care was taken to get the details of the document right. It made things much more clear than when I reviewed last year's document. The group appears to have nicely fulfilled most of the terms of reference. However, for ToR E, it wasn't clear whether proposals came out of the fruitful discussions that were had on potential research. But, all in all, it is a very solid document.

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)

The report does a good job reviewing and summarizing national reports and other data summarizing available protected species interactions. The summaries are hampered somewhat by inconsistent reporting on the part of the member states, but that is out of the hands of the authors of this WGBYC report.

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)

This section provides a good and intereseting summary of bycatch mitigation efforts underway or completed in the EU, plus a helpful summary of recent bycatch mitigation efforts elsewhere. It is unclear whether the WGBYC has met the portion of the ToR that deals with coordinating future work on protected species bycatch. The report summarizes work that has been done, but does not discuss its role coordinating future work.

In the third bullet of the conclusions, I think the conclusion is a bit broad. I would suggest adding that pinger effectiveness varies by species in addition to area and fishing métier. My understanding is that they are fairly effective with harbour porpoise, but less so with other species. The report mentions the effectiveness of the banana pinger in Sweden, and ADDs in Ireland and England. The PAL had mixed results, but that is experimental still at this point and takes a different approach than most pingers.

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)

This section did a very good job assessming the potential bycatch ranges of numerous species and more detailed analysis on harbor porpoise and gray seals, which is appropriate. Below are a handful of small comments about the text

- Is there some text or a figure missing on page 64 (section 5.1)? Maybe that is just a formatting issue. The same things occurs several times in that chapter
- There is a typo in Table 8 "Lowe".
- In Figure 4, it is hard to see some of those numbers on the map.
- In the third paragraph of section 5.2, are the numbers in the brackets confidence intervals "1,300 [810;2520]"? Would a dash between them be better?
- In the second to last paragraph in section 5.2, I don't understand why the process being "localized" would result in it being easy to miss by observers.

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)

This section was well organized and clear and it appears well worth the effort given all the overlap between different groups.

Continue to develop collaborative research proposals among WGBYC members to pursue research projects and funding opportunities in support of researching protected and target species behaviour in relation to fishing gear (ToR E)

This section discusses a number of useful ideas for research projects, however it is unclear if any of them became actual research proposals. Some EM proposals may have come out of these discussions, though it is unclear if those came about before the time period discussed in this report. This is the one area where it seems that the WGBYC may not met the terms of reference. It may be that these discussions did, or will shortly, result in proposals, but that is not clear from the text.

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 European waters. (Intersessional (ToR F)

The working group appears to have met this term of refernce with all their work on the bycatch and fishing effort databases.

The reviewer concludes that the work is at a sufficient scientific standard for ICES to base its advice on bycatch of protected species.

Reviewer: Daniel Oesterwind, Thunen Institute

Date: June 2019

Note: The comments had been inserted by the reviewer in the draft report text and were later collated by the ICES Secretariat

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Detailed comments

Section 3.2. Monitoring under (EC) Regulation 812/2004-Overview

The text says "*Six of the 23 EU MS were not affected by any part of Reg. 812/2004 (hereafter in this section termed "the Regulation"*)". However, this are only the relevant MS, otherwise there are 28 EU-MS

Section 3.3. Monitoring reported under (EC) Regulation 812/2004 by Member States (including non-cetacean bycatch events when provided)

The following and the next section is a bit confusing. E.g. for Spain, no report was provided and the mentioned data are based of the data call, which will be dealt with in the next section.

Section 3.5. Other monitoring programmes and associated bycatch estimates

Greece:

The text says "… *A total of 822 days at sea were monitored. No cetacean or birds bycatch incidents were recorded*…". Any Idea about the observed coverage of the total fishing effort?

Section 3.5.2. Non-EU Member States

The text says "*Monitoring in* ***Icelandic waters*** *during 2017 included 71 trips/days on lumpsucker gillnet vessels, 60 trips/days on cod gillnet vessels, 72 trips/377 days on demersal trawl vessels, 143 trips/192 days on long line vessels fishing within the Icelandic EEZ.* " Any idea about the coverage of the total fishing effort?

Section 3.6. Auxiliary data (strandings, entanglement and interviews) indicative of the impact of bycatch

The text says "*In the absence of at-sea observer monitoring programmes or when monitoring effort is low, data from other sources such as cetacean strandings or video monitoring can be assessed to highlight the occurrence of bycatch. Belgium, Denmark, France, Netherlands and Portugal have reported on assessments of auxiliary data in their Reg. 812/2004 reports or directly to WGBYC*. " This is already mentioned for Denmark in the section before.

Section 3.7. Conclusions

The text says "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 nets in the Celtic Sea. *A notably high bycatch rate for some vulnerable species on the IUCN red list of threatened species was observed in the Greater North Sea ecoregion for trawl gears*. " Is the IUCN status listed in he Table?

The text says "*In conclusion, information provided through the Member States' Reg. 812/2004 reports and other additional and relevant sources of information is limited. For many areas and métiers, there is insufficient monitored effort to enable any assessment of the over-all impact of fisheries on cetaceans or other protected species*. " This is already the conclusion section

Table 2.

The IUCN status of the different species within the region would be very interesting

I would suggest to round the effort to full days and use a comma as thousands separator

Bycatch rates: I guess three decimal places would be enough

Table 3.

Column: Bycatch rate (Number of specimens/day at sea observed: zero values might be confusing if bycatch is listed

Section 4.2. Conclusions

The text says "*In conclusion, 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 on identification of bycatch hot-spots, on why pingers are effective in some fisheries and not in others and on the possible effects of habituation and habitat exclusion in relation to pinger deployment*." This is already the conclusion section

Section 5.1. Evaluating the impacts of bycatch on protected species populations using WGBYC at-sea monitoring data

The text says "**…** *The results were set in the context of regional abundance estimates of the protected species of interest* .". How were those estimates performed?

The text says "The discrepancy in the results highlights the issues surrounding assessing bycatch within "artificially" defined ecoregions that have no real bearing on biological populations; so population impacts are not truly reflected. " In future, the group should try to estimate the rates and BRA on population level instead on the basis of ecoregions.

Section 5.1.2. Marine Mammals: Summary and comparison of minimum and maximum bycatch rates 2005–2017

The text says "The results from the comparison analysis, as well as the summary of bycatch rates do indicate that there is a need to analyse data using a higher metier level as well as taking into regards changes in fisheries and abundance of the concerned species over the time period. " Are there any statistically significant differences?

Section 5.1.4. Elasmobranchs: summary of minimum and maximum bycatch rates for 2017

Typo:

However it should be noted that although this species is data poor it is ~~is~~ endemic to European waters, and hence warrants further attention.

Figure 9. The explanation of the colour code and numbers in the field are missing

Section 5.2. Evaluating the impacts of bycatch using strandings data: harbour porpoise and common dolphins

The text says "*In the whole area (Bay of Biscay, English Channel and Celtic Sea) the average annual number of bycaught porpoises was estimated at 530 [330 – 1,030] individuals from 1990 to 2015. A decrease was highlighted in 2015. Since 2012 the yearly average estimate reached 1,300 [810; 2,520] bycaught porpoises, …"* Is there any explanation? What is the reason for the selected time period (1990–2015 & 2012–)?

Section 5.5. Conclusions

The text says "High and low bycatch rates were also estimated for all marine mammals in the entire WGBYC database (2005-2017) for the Greater North Sea and Celtic Seas Ecoregions and the eastern Bay of Biscay shelf (8a & b);…" Change "high and low" to "minimum and maximum"?

Table 13. In the caption it should be mentioned that this is based on an expert opinion

Section 7. Continue to develop collaborative research proposals among WGBYC members to pursue research projects and funding opportunities in support of researching protected and target species behaviour in relation to fishing gear (ToR E)

The text says *"The group discussed the potential need to explore Electronic Monitoring (EM) as a tool for monitoring bycatch of protected species within EU-MAP monitoring."* maybe WGTIFD might be an interesting WG as well.

The reviewer concludes that the work is at a sufficient scientific standard for ICES to base its advice on bycatch of protected species.