

Bycatch of protected and potentially vulnerable marine vertebrates – review of national reports under Council Regulation (EC) No. 812/2004 and other information

Advice summary

ICES summarizes bycatch information and provides advice on the likely impacts of fishery bycatch to marine mammals, seabirds and marine turtles in 2018, based on bycatch data reported by EU Member States under Council Regulation (EC) No. 812/2004 and other information. However, ICES notes that the current state of knowledge, together with data collection schemes and reporting formats, does not allow for robust assessment of Protected, Endangered, and Threatened Species (PETS) bycatch and evaluation of fishing effects.

The available data are used to highlight species, areas, ecoregions, and métiers where bycatch may be of particular concern. Bycatch rates of cetaceans and seabirds were higher, across ecoregions, for métiers using nets; however, not all métiers or areas were equally monitored. Bycatch rates of seals were higher in pelagic trawls.

ICES evaluated bycatch mortality across métiers for the common dolphin in the Celtic Seas, in the Bay of Biscay and the Iberian Coast, and in the western English Channel. Sustainable anthropogenic removals were defined using a potential biological removal (PBR) threshold of 4927 common dolphins per year in the Northeast Atlantic, based on the abundance estimates of 634 286 animals. Based on limited information, the at-sea monitoring point estimate of bycatch mortality is just below the potential biological removal (PBR) while the point estimate from strandings data exceeded it. The abundance of the Baltic Proper harbour porpoise was estimated at 497 (CV = 0.42) individuals (ICES, 2020a). Since the highest bycatch rates calculated for porpoises were found in métiers using nets and net effort is high in the Baltic Sea, it follows that net fisheries pose one of the greatest threats to the Baltic harbour porpoise. ICES has advised on other areas and species in previous years.

ICES highlights the need to re-evaluate fishery monitoring objectives to ensure adequate coverage of static gears where the risk of PETS bycatch is high.

Request

Work Package I, section 1.1.3. of the Specific Grant Agreement between the EU and ICES requests ICES to:

- 1) *Provide information regarding the impact of fisheries on the ecosystem including marine mammals, seabirds and habitats impacts (including incidental catches). This should include information on the location of habitats sensitive to particular fishing activities. "Review and summarise annual national reports submitted to the EC under Regulation 812/2004 and other published documents and collated bycatch rates and estimates in EU waters";*
- 2) *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;*

This advice section covers only aspects of impacts on marine mammals, seabirds and marine turtles. Information relating to habitats will be advised separately. ICES Advice in recent years (ICES, 2017, 2018, 2019, 2020a) has analysed bycatch in further areas and for other species than those described here.

Elaboration on the advice

ICES currently provides advice on the likely impacts of fisheries on marine mammals, seabirds and marine turtles, based on reported bycatch data received through the ICES data call. Bycatch incidence is monitored as an indication of species/taxa interacting with fisheries, enabling bycatch rates to be estimated and used as an indicator of potential impact from fishing activities. ICES reiterates that the present monitoring and data reporting for many areas and métiers is, in most cases, insufficient and inconsistent for ICES to provide reliable bycatch estimates.

Based on very limited observations, the 185 bycatch incidents (monitored days-at-sea with bycatch) for marine mammals in 2018 involved 259 specimens (177 seals and 82 cetaceans) from nine species (4 seals and 5 cetaceans) across eight

ecoregions (Table 1). The net métiers (level 3) accounted for more than 75% of marine mammal bycatch incidents across ecoregions, including 78% of bycaught cetaceans and 85% of bycaught seals. Average bycatch rates (specimens per monitored days-at-sea) across taxa and ecoregions were higher in nets for cetaceans and in pelagic trawls for seals, relative to other monitored métiers. The highest reported bycatch rates in nets were observed for harbour seal *Phoca vitulina* in Icelandic Waters (0.27), for harbour porpoise *Phocoena phocoena* in Icelandic Waters and in the Sound (ICES Subdivision 23; 0.20 and 0.154, respectively), and for grey seal *Halichoerus grypus* in the Celtic Seas (0.25). Pelagic trawls in the Greater North Sea and in the Bay of Biscay and Iberian Coast ecoregions had a higher bycatch rate of grey seal (0.36) and common dolphin *Delphinus delphis* (0.091) relative to other monitored métiers/ecoregions.

For seabirds, a total of 217 bycatch incidents were reported in 2018, involving 696 specimens from at least 22 species. Seabird bycatch rates were calculated based on a subset of the reported data. This included 109 bycatch incidents (of which 107 are from nets and 2 are from trawls), for a total of 399 bycaught seabirds from twelve species across four ecoregions (Table 2). Across taxa and ecoregions, the average bycatch rate of seabirds was higher in nets than in trawls. In Icelandic Waters in the second quarter, the net métiers (level 3) accounted for 76% of bycatch incidents and 88% of bycaught seabirds in the data subset. Bycatch rates in nets greater than one bird per monitored days-at-sea involved the common murre *Uria aalge*, in the first quarter in the Celtic Seas (1.50) and in the second quarter in Icelandic Waters (1.16). Relatively high bycatch rates in nets also involved the common eider *Somateria mollissima* in the second quarter in Icelandic Waters (0.75) and the Great cormorant *Phalacrocorax carbo* in the third quarter in the East of Gotland and Gulf of Riga (ICES Subdivision 28; 0.71). In other quarters/ecoregions, bycatch rates in nets were less than 0.4. Métiers for which seabird bycatch was reported, but bycatch rates could not be calculated because of data limitations, include longlines, rods and lines, seines, surrounding nets, and traps.

For marine turtles in 2018, 94 bycatch incidents involving 134 specimens from two families (Cheloniidae [*Caretta caretta* and another unidentified species] and Dermochelyidae [*Dermochelys coriacea*]) were reported across four métiers and five ecoregions (Table 5). Bottom-trawl effort accounted for the majority (70%) of reported bycatch events and 75% of bycaught marine turtles. Bottom-trawl interactions all involved the loggerhead turtle *Caretta caretta*, with the highest bycatch rate in the Adriatic Sea (0.116 specimens per monitored days-at-sea) and with bycatch rates ranging from 0.005 to 0.007 turtles per monitored days-at-sea in other ecoregions. A bycatch rate of 0.075 was also recorded for loggerhead turtle in pelagic trawls in the Adriatic Sea. While trawls were predominantly responsible for bycatch in the Mediterranean Sea, bycatch of marine turtles occurred in longlines in the Azores, with bycatch rates ranging from 0.003 specimens per monitored days-at-sea for loggerhead turtle, to 0.006 specimens per monitored days-at-sea for the leatherback marine turtle *Dermochelys coriacea*.

More detailed assessments of the impacts and risks from fisheries to selected populations and species are undertaken as data allow and/or where the available information indicates potentially serious threats from fishing activities. In 2020, based on 2016–2018 data, quantitative bycatch mortality estimation across métiers was performed for the common dolphin in the Celtic Seas, in the Bay of Biscay and Iberian Coast, and in the western English Channel. An in-depth evaluation of Baltic Proper harbour porpoise bycatch was performed under a separate request on emergency bycatch mitigation measures (ICES, 2020a).

For common dolphin in the Celtic Seas, the mean annual bycatch in 2016–2018 across all métiers amounted to 720 (95% CI 278–1345) individuals, with bottom otter trawls and gillnets accounting for the largest bycatch. In the Bay of Biscay and the Iberian Coast, the mean annual bycatch estimated from at sea observations for 2016–2018 across all métiers amounted to 3973 (95% CI 1998–6599) dolphins, with trammelnets accounting for the largest bycatch. Common dolphin bycatch mortality estimated from stranded animals along the French coastlines of the Bay of Biscay and the western English Channel was 5800–17 900 individuals in 2017 and 3400–10 500 individuals in 2018. In the absence of policy decisions at a European level, ICES has previously evaluated bycatch rates of small cetaceans against the ASCOBANS level, defining “unacceptable interaction” (e.g. ICES, 2018, 2019). The origins of the ASCOBANS limit were for assessments of the levels of anthropogenic mortality on harbour porpoise and not for small cetaceans in general. Rather than assume the ASCOBANS limit for common dolphin, it was more robust to use a PBR approach (Wade, 1998) to set a species-specific limit. Sustainable anthropogenic removals were defined using a PBR threshold of 4927 common dolphins per year in the Northeast Atlantic, based on the abundance estimates of 634 286 animals. Based on limited information, the at-sea monitoring point estimate of bycatch mortality is just below the PBR, while the point estimate from strandings data

exceeded it. Both fisheries bycatch and anthropogenic pollution are major threats to the common dolphin in the Northeast Atlantic and defining potential impacts from resource/prey depletion on the population requires further assessment.

Gillnets and trammelnets have the highest bycatch rates of harbour porpoise in the Baltic Sea, Greater North Sea, Celtic Seas, and Icelandic Waters ecoregions, and for the Bay of Biscay and Iberian Coast ecoregion high bycatch rates were recorded also in pelagic trawls (ICES, 2020b).

In the absence of adequate data to conduct robust assessments of the impact of fisheries on PETS, ICES has used assessments of bycatch risk to highlight where threats from fishing activities are likely to occur. The tabulation of fishing effort and monitoring effort data from the WGBYC database for 2018, together with risk indices from FishPi[†], provided an overview of the state of monitoring in relation to risks for PETS bycatch by ICES division (Table 5). The majority of métiers with more than 5% observer coverage were trawls, which generally had lower bycatch risk index scores, whereas net fisheries, particularly in the Bay of Biscay, had the highest risk indices but relatively low levels of observer coverage. Trawls also had a higher proportion of non-dedicated bycatch monitoring compared to net fisheries.

Suggestions

Information available from monitoring and reported to ICES through the EU Member States' Council Regulation (EC) No. 812/2004 (EU, 2004) reports, ICES data call, and other additional and relevant sources remains limited and mainly targets certain areas, métiers, and vessel types that are not necessarily associated with high bycatch risk (ICES, 2020c; Table 6). Considering that EU Member States are obliged to monitor bycatch of protected species, ICES suggests that the Regional Coordination Groups consider focusing the relative observer sampling effort to static gears as these gears likely account for a significant proportion of the bycatch.

ICES also noted that the proportion of fishing effort without bycatch events represented 0.8% of the monitored effort and 2% of the total effort submitted through the data call. In order to reduce bias in the estimation of bycatch rates, ICES suggests that all monitoring effort in all métiers should be reported, regardless of whether there is a bycatch or not. To improve the precision of bycatch estimates, which is particularly important for birds, each bycatch event should be reported separately so the error can be estimated directly rather than based on assumed error distributions around the estimated bycatch rates.

Basis of the advice

Background

All data submissions were received via a formal ICES data call issued to EU Member States and ICES Member Countries. The data call requested data on fishing effort, monitoring effort, and incidents of bycatch of protected, endangered and threatened species (PETS; marine mammals, seabirds, and marine turtles) in 2018. Of the 24 countries contacted (18 ICES Member Countries and 6 Mediterranean non-ICES countries), 19 responded.

The quality and scope of EU Member State reports on the implementation of Council Regulation (EC) No. 812/2004 (EU, 2004 – cetacean bycatch) during 2018 remain varied. Most countries have relied on monitoring through their EU Data Collection Framework (DCF) sampling programmes, targeting commercial fish species, rather than implementing dedicated observer programmes for cetaceans or other PETS. This means that métiers with the greatest potential for PETS bycatch are generally undersampled and bycatch may thus be underestimated. Regulation 812/2004 was repealed in June 2019 by the Technical Conservation Measures Regulation (Regulation (EU) 2019/1241; EU, 2019) and PETS bycatch monitoring is further required through the EU-MAP (Regulation (EU) 2017/1004; EU, 2017).

Methods

All reported bycatch data for marine mammals and marine turtles were used to calculate bycatch rates.

[†] https://www.masts.ac.uk/media/36862/fishpi2-final_v4_summaryreport.pdf.

Estimates of métier-specific minimum and maximum bycatch rates: common dolphin

Bycatch of common dolphins was evaluated in two ecoregions: Celtic Seas (divisions and subdivisions 6.a, 6.b.2, 7.c.2, 7.f, 7.g, 7.h, 7.j.2, 7.j.1, 7.k.2, 7.e, and 7.d) and Bay of Biscay (divisions 8.a, 8.b, 8.d and 8.e) and Iberian Coast (divisions 8.c and 9.a). The evaluation was based on two data sources: the WGBYC database and the results of modelling stranded dolphins (ICES, 2020b). Using data in the WGBYC database, as provided through ICES bycatch data calls and the monitored effort (days-at-sea), the number of common dolphins (specimens) bycaught was summarized for métier level 4 (gear) and métier level 5 (target assemblage) within the ecoregions for 2016–2018, and bycatch rates were estimated (Table 4). To estimate the 95% confidence intervals around the bycatch rates, the Poisson distribution was assumed, and the confidence intervals were estimated with bootstrapping, given the mean and the sample sizes. The bycatch rates were raised to fleet level using the average annual fishing effort 2016–2018 within the métier (métier level 5) from the Regional DataBase (RDB).

Estimates of métier-specific bycatch rates: seabirds

A subset of the reported seabird bycatch data was selected to calculate bycatch rates based upon the following criteria: (1) the observer coverage within the métier (métier level 3) was above an arbitrarily set limit of 1% of the total fishing effort; (2) only bycatch data that represented full coverage of observer trips were included; (3) data based on self-reporting instead of at-sea observations were excluded; and (4) obvious inconsistencies in reported data were excluded. ICES was unable to produce any reliable confidence intervals for the bycatch rates, as the data available mostly had only one or very few data points per species, métier, and area. Additionally, reported bycatch events available for analysis are often aggregated, which makes estimates of uncertainty highly difficult as the variation in such data is hidden.

Summary of métier-specific bycatch risks

Using data collected during 2018 and collated through the bycatch data call, ICES summarized the total reported fishing effort and dedicated and non-dedicated bycatch monitoring across ICES divisions and métiers (métier level 4) and assigned a PETS bycatch risk score (FishPi project[†]). The total observer coverage for each métier and division was calculated as the sum of dedicated and non-dedicated monitoring effort as a percentage of total fishing effort. This enabled a comparison of the bycatch risk across divisions and métiers.

Additional information

ICES notes that effort metrics other than the currently used one “days-at-sea” may provide more accurate information on bycatch rates of PETS. Therefore, ICES suggests to investigate the possibility to obtain fishing effort in different metrics to perform comparative analysis on the effect of different fishing effort metrics on bycatch mortality estimates.

To continue to provide information on incidental bycatch of PETS in the Mediterranean Sea also in the future, accessibility of data to ICES should be ensured. There is a concern that moving to the new format (Regional Database Estimation System, RDBES) as a data source would prevent ICES to access data from the Mediterranean Sea, where RDBES is not yet used.

In order to raise bycatch rates to fleet level, an accurate record of fishing effort is needed. In 2017 and 2018 there were discrepancies in total fishing effort between the WGBYC database and the ICES Regional DataBase (RDB). When RDBES is operational (2022), ICES should carry out comparisons of fishing effort, monitoring effort, and bycatch data before any decisions on full transition to RDBES as the sole data source.

ICES notes that in general, there has been little progress on the mitigation of cetacean bycatch. ICES continues to have insufficient data to examine bycatch rates according to pinger use within their database. A recent study carried out in the Bay of Biscay on three midwater pair trawls in winter 2018 indicate a reduction of 65% of bycaught common dolphins with the use of pingers DDD-03 (ICES, 2020b).

[†] https://www.masts.ac.uk/media/36862/fishpi2-final_v4_summaryreport.pdf.

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Annex

Table 1 Total number of marine mammals and observed bycatch rates ($[\text{number of specimens}] \times [\text{monitored days-at-sea}]^{-1}$) in 2018, reported by EU Member States in their Council Regulation (EC) No. 812/2004 (EU, 2004) reports and obtained through the ICES data call. Bycatch numbers and rates are grouped by gear type and fishing area. The number of incidents is defined as monitored days-at-sea with bycatch. Fishing effort monitored corresponds to $([\text{Monitored days-at-sea}] \times [\text{Fishing effort}]^{-1}) \times 100$.

| Ecoregion | Species | ICES statistical area | Level 3 métier | Reported | | | Database | | | | |
|-------------------------------------|---------------------------|-----------------------|----------------|-----------------------|---------------------------|---------------------------|------------------------------|-----------------------|---------------------------|---------------------------|--|
| | | | | Monitored days-at-sea | Total number of incidents | Total number of specimens | Fishing effort (days-at-sea) | Monitored days-at-sea | Total number of incidents | Total number of specimens | Bycatch rate ($[\text{number of specimens}] \times [\text{days-at-sea}]^{-1}$) |
| Baltic Sea | <i>Halichoerus grypus</i> | 27.3.d.28.1 | Traps | | | | 5086 | 22 | 2 | 2 | 0.091 |
| | | 27.3.d.31 | Traps | | | | 16757 | 41 | 1 | 1 | 0.024 |
| | | 27.3.d.30 | Nets | | | | 26486 | 44 | 1 | 1 | 0.023 |
| | | 27.3.d.32 | Traps | | | | 6911 | 72 | 4 | 5 | 0.069 |
| | | 27.3.d.30 | Traps | | | | 10972 | 93 | 1 | 1 | 0.011 |
| | <i>Phoca hispida</i> | 27.3.d.28.1 | Traps | | | | 5086 | 22 | 2 | 2 | 0.091 |
| | <i>Phocoena phocoena</i> | 27.3.b.23 | Nets | 32 | 2 | 2 | 4977 | 13 | 2 | 2 | 0.154 |
| Bay of Biscay and the Iberian Coast | <i>Delphinus delphis</i> | 27.8.c | Pelagic trawls | 9 | 1 | 1 | 188 | 11 | 1 | 1 | 0.091 |
| | | 27.8.a | Pelagic trawls | 3 | 1 | 1 | 1562 | 50 | 1 | 1 | 0.020 |
| | | 27.8.a | Nets | 138 | 1 | 1 | 10421 | 146 | 1 | 1 | 0.007 |
| | | 27.8.b | Nets | 156 | 5 | 7 | 7280 | 172 | 5 | 7 | 0.041 |
| | <i>Halichoerus grypus</i> | 27.8.a | Nets | 138 | | | 10421 | 146 | 2 | 2 | 0.014 |
| | <i>Phocoena phocoena</i> | 27.8.b | Nets | 37 | 1 | 1 | 7280 | 172 | 1 | 1 | 0.006 |
| | <i>Tursiops truncatus</i> | 27.9.a | Nets | 18 | 1 | 1 | 109869 | 21 | 1 | 1 | 0.048 |

| Ecoregion | Species | ICES statistical area | Level 3 métier | Reported | | | Database | | | | |
|---------------------------|---------------------------|-----------------------|----------------|-----------------------|---------------------------|---------------------------|------------------------------|-----------------------|---------------------------|---------------------------|---|
| | | | | Monitored days-at-sea | Total number of incidents | Total number of specimens | Fishing effort (days-at-sea) | Monitored days-at-sea | Total number of incidents | Total number of specimens | Bycatch rate ([number of specimens] × [days-at-sea] ⁻¹) |
| Celtic Seas | <i>Delphinus delphis</i> | 27.7.g | Nets | 18 | 2 | 2 | 2302 | 63 | 2 | 2 | 0.032 |
| | | 27.7.f | Bottom trawls | | 1 | 1 | 11138 | 121 | 1 | 1 | 0.008 |
| | | 27.7.j | Bottom trawls | | 1 | 1 | 11512 | 313 | 1 | 1 | 0.003 |
| | | 27.7.g | Bottom trawls | | 5 | 5 | 24147 | 477 | 5 | 5 | 0.010 |
| | <i>Halichoerus grypus</i> | 27.7.h | Nets | 11 | | | 1169 | 30 | 1 | 1 | 0.033 |
| | | 27.7.f | Nets | 66 | 2 | 2 | 2695 | 66 | 1 | 1 | 0.015 |
| | | 27.6.a | Pelagic trawls | 73 | 1 | 1 | 2301 | 124 | 1 | 1 | 0.008 |
| | | 27.7.j | Nets | 127 | 37 | 43 | 3201 | 175 | 37 | 43 | 0.25 |
| | <i>Phoca vitulina</i> | 27.6.a | Bottom trawls | 1 | | 1 | 23118 | 259 | 1 | 1 | 0.004 |
| | <i>Phocoena phocoena</i> | 27.7.g | Nets | 18 | 1 | 1 | 2302 | 63 | 1 | 1 | 0.016 |
| | | 27.7.j | Bottom trawls | | 1 | 1 | 11512 | 313 | 1 | 1 | 0.003 |
| | | 27.7.h | Bottom trawls | | 1 | 1 | 11591 | 861 | 1 | 1 | 0.001 |
| Greater North Sea | <i>Delphinus delphis</i> | 27.7.e | Bottom trawls | | 2 | 3 | 31665 | 439 | 2 | 3 | 0.007 |
| | <i>Halichoerus grypus</i> | 27.4.b | Pelagic trawls | 30 | 9 | 11 | 666 | 31 | 9 | 11 | 0.36 |
| | | 27.7.e | Nets | 113 | 2 | 2 | 11442 | 165 | 3 | 3 | 0.018 |
| | | 27.7.e | Bottom trawls | | | | 31665 | 439 | 1 | 1 | 0.002 |
| | <i>Phocoena phocoena</i> | 27.4.c | Nets | 1 | 1 | 1 | 3683 | 18 | 1 | 1 | 0.056 |
| Western Mediterranean Sea | <i>Grampus griseus</i> | 1 | Longlines | | | | 5590 | 459 | 1 | 1 | 0.002 |

| Ecoregion | Species | ICES statistical area | Level 3 métier | Reported | | | Database | | | | |
|--|-----------------------------------|-----------------------|----------------|-----------------------|---------------------------|---------------------------|------------------------------|-----------------------|---------------------------|---------------------------|---|
| | | | | Monitored days-at-sea | Total number of incidents | Total number of specimens | Fishing effort (days-at-sea) | Monitored days-at-sea | Total number of incidents | Total number of specimens | Bycatch rate ([number of specimens] × [days-at-sea] ⁻¹) |
| Adriatic Sea | Pinnipeds | 17 | Bottom trawls | | | | 76635 | 272 | 2 | 2 | 0.007 |
| | <i>Tursiops truncatus</i> | 17 | Pelagic trawls | 418 | 2 | 2 | 11242 | 386 | 2 | 2 | 0.005 |
| Ionian Sea and the Central Mediterranean Sea | <i>Tursiops truncatus</i> | 16 | Bottom trawls | | | | 55516 | 1000 | 1 | 1 | 0.001 |
| Icelandic Waters | <i>Halichoerus grypus</i> | 27.5.a.2* | Nets | | | | 7634 | 229 | 10 | 21 | 0.092 |
| | <i>Lagenorhynchus albirostris</i> | 27.5.a.2* | Nets | | | | 7634 | 229 | 2 | 2 | 0.009 |
| | <i>Pagophilus groenlandicus</i> | 27.5.a.2* | Nets | | | | 7634 | 229 | 8 | 15 | 0.066 |
| | <i>Phoca hispida</i> | 27.5.a.2* | Nets | | | | 7634 | 229 | 2 | 2 | 0.009 |
| | <i>Phoca vitulina</i> | 27.5.a.2* | Nets | 229 | | 61 | 7634 | 229 | 27 | 61 | 0.27 |
| | <i>Phocoena phocoena</i> | 27.5.a.2* | Nets | | | | 7634 | 229 | 36 | 46 | 0.20 |
| TOTAL | | | | | 80 | 153 | | | 185 | 259 | |

* Iceland is not an EU Member State; no Council Regulation (EC) No. 812/2004 report submitted, but data added to the database.

Table 2 Bycatch rates ($[\text{number of specimens}] \times [\text{monitored days-at-sea}]^{-1}$) for selected seabird species for which the reported data met specific criteria, by areas and gears. The monitored fishing effort corresponds to $([\text{Monitored days-at-sea}] \times [\text{Fishing effort}]^{-1}) \times 100$.

| Ecoregion | ICES statistical area | Quarter | Level 3 métier | Species | Monitored days-at-sea | Fishing effort (days-at-sea) | Fishing effort monitored (%) | Total number of incidents | Total number of specimens | Bycatch rate ($[\text{number of specimens}] \times [\text{monitored days-at-sea}]^{-1}$) |
|-------------------|-----------------------|---------|----------------|----------------------------|-----------------------|------------------------------|------------------------------|---------------------------|---------------------------|--|
| Baltic Sea | 27.3.d.28 | 3 | Nets | <i>Phalacrocorax carbo</i> | 7 | 256 | 2.7 | 3 | 5 | 0.71 |
| | 27.3.d.28 | 3 | Nets | <i>Aythya marila</i> | 7 | 256 | 2.7 | 1 | 1 | 0.143 |
| | 27.3.d.28 | 3 | Nets | <i>Aythya fuligula</i> | 7 | 256 | 2.7 | 1 | 1 | 0.143 |
| | 27.3.d.28 | 4 | Nets | <i>Uria aalge</i> | 3 | 88 | 3.4 | 1 | 1 | 0.33 |
| | 27.3.d.28 | 4 | Nets | <i>Phalacrocorax carbo</i> | 3 | 88 | 3.4 | 1 | 1 | 0.33 |
| | 27.3.d.28 | 4 | Nets | <i>Aythya fuligula</i> | 3 | 88 | 3.4 | 1 | 1 | 0.33 |
| Celtic Seas | 27.7.g | 1 | Nets | <i>Uria aalge</i> | 8 | 405 | 1.98 | 2 | 12 | 1.50 |
| | 27.7.b | 1 | Pelagic trawls | <i>Morus bassanus</i> | 8 | 390 | 2.1 | 1 | 1 | 0.125 |
| | 27.7.f | 2 | Nets | <i>Uria aalge</i> | 22 | 957 | 2.3 | 3 | 4 | 0.182 |
| | 27.7.g | 3 | Bottom trawls | <i>Morus bassanus</i> | 166 | 6061 | 2.7 | 1 | 1 | 0.0060 |
| | 27.7.f | 4 | Nets | <i>Uria aalge</i> | 16 | 520 | 3.1 | 1 | 1 | 0.061 |
| | 27.7.f | 4 | Nets | <i>Phalacrocorax carbo</i> | 16 | 520 | 3.1 | 2 | 2 | 0.125 |
| Greater North Sea | 27.7.d | 1 | Nets | <i>Uria aalge</i> | 19 | 1864 | 1.02 | 1 | 1 | 0.053 |
| | 27.7.e | 1 | Nets | <i>Uria aalge</i> | 33 | 1919 | 1.72 | 1 | 2 | 0.061 |
| | 27.7.e | 4 | Nets | <i>Phalacrocorax carbo</i> | 34 | 2570 | 1.32 | 1 | 1 | 0.030 |

| Ecoregion | ICES statistical area | Quarter | Level 3 métier | Species | Monitored days-at-sea | Fishing effort (days-at-sea) | Fishing effort monitored (%) | Total number of incidents | Total number of specimens | Bycatch rate ([number of specimens] × [monitored days-at-sea] ⁻¹) |
|------------------|-----------------------|---------|----------------|-----------------------------|-----------------------|------------------------------|------------------------------|---------------------------|---------------------------|---|
| Icelandic Waters | 27.5.a.2 | 1 | Nets | <i>Cephus grylle</i> | 57 | 1917 | 3.0 | 1 | 1 | 0.0175 |
| | 27.5.a.2 | 1 | Nets | <i>Somateria mollissima</i> | 57 | 1917 | 3.0 | 5 | 12 | 0.21 |
| | 27.5.a.2 | 1 | Nets | <i>Clangula hyemalis</i> | 57 | 1917 | 3.0 | 1 | 1 | 0.0175 |
| | 27.5.a.2 | 2 | Nets | <i>Uria aalge</i> | 134 | 4071 | 3.3 | 12 | 156 | 1.16 |
| | 27.5.a.2 | 2 | Nets | <i>Fratercula arctica</i> | 134 | 4071 | 3.3 | 2 | 2 | 0.0149 |
| | 27.5.a.2 | 2 | Nets | <i>Cephus grylle</i> | 134 | 4071 | 3.3 | 23 | 52 | 0.39 |
| | 27.5.a.2 | 2 | Nets | <i>Uria lomvia</i> | 134 | 4071 | 3.3 | 3 | 3 | 0.022 |
| | 27.5.a.2 | 2 | Nets | <i>Somateria mollissima</i> | 134 | 4071 | 3.3 | 20 | 100 | 0.75 |
| | 27.5.a.2 | 2 | Nets | <i>Phalacrocoracidae</i> | 134 | 4071 | 3.3 | 15 | 31 | 0.23 |
| | 27.5.a.2 | 2 | Nets | <i>Fulmarus glacialis</i> | 134 | 4071 | 3.3 | 2 | 2 | 0.0149 |
| | 27.5.a.2 | 2 | Nets | <i>Morus bassanus</i> | 134 | 4071 | 3.3 | 1 | 1 | 0.0075 |
| | 27.5.a.2 | 2 | Nets | <i>Clangula hyemalis</i> | 134 | 4071 | 3.3 | 1 | 1 | 0.0075 |
| | 27.5.a.2 | 2 | Nets | <i>Alca torda</i> | 134 | 4071 | 3.3 | 1 | 1 | 0.0075 |
| | 27.5.a.2 | 4 | Nets | <i>Uria aalge</i> | 30 | 660 | 4.6 | 1 | 1 | 0.033 |

Table 3 Bycatch information for marine turtle bycatch numbers, including the number of bycatch incidents and observed bycatch rates in 2018 obtained through the ICES data call. Bycatch information is grouped by ecoregion and gear type. The number of incidents is defined as monitored days-at-sea with bycatch. Fishing effort monitored corresponds to $[(\text{Monitored days-at-sea}) \times (\text{Fishing effort})^{-1}] \times 100$.

| Ecoregion | GSA*/ ICES statistical area | Level 3 métier | Species | Monitored days- at-sea | Fishing effort (days-at- sea) | Fishing effort monitored (%) | Total number of incidents | Total number of specimens | Bycatch rate ((number of specimens) × [monitored days-at- sea] ⁻¹) |
|---|--------------------------------------|------------------|-----------------------------|---------------------------|--|---------------------------------|------------------------------|------------------------------|--|
| Adriatic Sea | 17–18 | Bottom trawls | <i>Caretta caretta</i> | 664 | 137071 | 0.48 | 42 | 77 | 0.116 |
| | 17 | Pelagic trawls | <i>Caretta caretta</i> | 386 | 11242 | 3.4 | 24 | 29 | 0.075 |
| Aegean–Levantine Sea | 22 | Bottom trawls | <i>Caretta caretta</i> | 198 | 38161 | 0.52 | 1 | 1 | 0.005 |
| | 25 | Nets | Cheloniidae | 503 | 61933 | 0.81 | 1 | 1 | 0.002 |
| Azores | 27.10.a.2 | Longlines | <i>Caretta caretta</i> | 363 | 6981 | 5.2 | 1 | 1 | 0.003 |
| | 27.10.a.2 | Longlines | <i>Dermochelys coriacea</i> | 363 | 6981 | 5.2 | 2 | 2 | 0.006 |
| Ionian Sea and the Central Mediterranean Sea | 16, 19 | Bottom trawls | <i>Caretta caretta</i> | 1225 | 89655 | 1.37 | 8 | 8 | 0.007 |
| Western Mediterranean Sea | 6, 9, 11.2 | Bottom trawls | <i>Caretta caretta</i> | 2830 | 140381 | 2.0 | 15 | 15 | 0.005 |

* GSA = FAO geographical subarea.

Table 4 Summary of common dolphin bycatch information in the Bay of Biscay and Celtic Seas by métier (Level 5) for 2016–2018. DaS = days-at-sea; CI = confidence interval; bycatch rate is number of individuals per monitored days-at-sea.

| Ecoregion | Level 4 métier | Level 5 métier | Monitored effort (DaS), 2016–2018 | Total number of bycaught individuals, 2016–2018 | Bycatch rate | Lower 95% CI | Upper 95% CI | Annual fishing effort (Das) | Estimated annual total number of bycaught individuals | Lower 95% CI | Upper 95% CI | Mean annual observer coverage (%) |
|-----------------------------------|----------------|----------------|---|--|-----------------|-----------------|-----------------|-----------------------------------|--|-----------------|-----------------|--|
| Celtic Seas (subareas 6 and 7) | OTB | DEF | 1779 | 11 | 0.006 | 0.003 | 0.009 | 44691 | 276 | 151 | 427 | 1.33 |
| | GNS | DEF | 852 | 9 | 0.011 | 0.005 | 0.016 | 18207 | 192 | 85 | 299 | 1.56 |
| | OTB | CRU | 273 | 1 | 0.004 | 0.000 | 0.011 | 26597 | 97 | 0 | 292 | 0.34 |
| | GTR | DEF | 324 | 4 | 0.012 | 0.003 | 0.025 | 7117 | 88 | 22 | 176 | 1.52 |
| | OTM | SPF | 482 | 16 | 0.033 | 0.021 | 0.048 | 943 | 31 | 20 | 45 | 17.0 |
| | OTT | CRU | 350 | 1 | 0.003 | 0 | 0.009 | 7026 | 20 | 0 | 60 | 1.66 |
| | GNS | CRU | 356 | 1 | 0.003 | 0 | 0.008 | 4621 | 13 | 0 | 39 | 2.6 |
| | OTB | DWS | 520 | 1 | 0.002 | 0 | 0.006 | 1040 | 2 | 0 | 6 | 16.7 |

| Ecoregion | Level 4 métier | Level 5 métier | Monitored effort (DaS), 2016–2018 | Total number of bycaught individuals, 2016–2018 | Bycatch rate | Lower 95% CI | Upper 95% CI | Annual fishing effort (Das) | Estimated annual total number of bycaught individuals | Lower 95% CI | Upper 95% CI | Mean annual observer coverage (%) |
|--|----------------|----------------|-----------------------------------|---|--------------|--------------|--------------|-----------------------------|---|--------------|--------------|-----------------------------------|
| Bay of Biscay and Iberian Coast (subareas 8 and 9) | GTR | DEF | 340 | 12 | 0.035 | 0.021 | 0.053 | 58365 | 2062 | 1203 | 3092 | 0.19 |
| | PTB | MPD | 67 | 10 | 0.149 | 0.075 | 0.22 | 5195 | 775 | 388 | 1163 | 0.43 |
| | PTM | DEF | 167 | 118 | 0.71 | 0.60 | 0.81 | 682 | 481 | 408 | 555 | 8.2 |
| | OTM | DEF | 0.82 | 1 | 1.22 | 0 | 3.7 | 243 | 297 | 0 | 891 | 0.11 |
| | PS | SPF | 335 | 2 | 0.006 | 0 | 0.015 | 35564 | 213 | 0 | 532 | 0.32 |
| | GNS | DEF | 537 | 2 | 0.004 | 0 | 0.009 | 36839 | 137 | 0 | 343 | 0.49 |
| | PTM | LPF | 65 | 1 | 0.015 | 0 | 0.046 | 510 | 8 | 0 | 23 | 4.3 |

Table 5 Information on gear-specific observer coverage, including dedicated and non-dedicated PETS bycatch monitoring, in different areas in 2018. Gears (level 4 métier) are ordered based on the risk factor for PETS bycatch derived from the FishPi project.

| Level 4 métier* | Division | Subarea | Risk factor | Fishing effort (days-at-sea) | Dedicated bycatch monitoring (days-at-sea) | Non-dedicated bycatch monitoring (days-at-sea) | Total observer effort (days-at-sea) | Observer coverage (% days-at-sea) |
|-----------------|----------|---------|-------------|------------------------------|--|--|-------------------------------------|-----------------------------------|
| GTR | 27.8.c | 8 | 105 | 16914 | 0 | 1 | 1 | 0.01 |
| GNS | 27.7.e | 7 | 84 | 9087 | 73 | 48 | 121 | 1.33 |
| GNS | 27.8.a | 8 | 84 | 5081 | 0 | 76 | 76 | 1.50 |
| GNS | 27.8.b | 8 | 84 | 2111 | 0 | 85 | 85 | 4.0 |
| GNS | 27.8.c | 8 | 84 | 16101 | 0 | 28 | 28 | 0.17 |
| GNS | 27.8.d | 8 | 84 | 262 | 0 | 10 | 10 | 3.8 |
| GNS | 27.9.a | 9 | 84 | 71536 | 3 | 18 | 21 | 0.03 |
| GTR | 27.8.a | 8 | 84 | 5165 | 0 | 70 | 70 | 1.35 |
| GTR | 27.8.b | 8 | 84 | 4643 | 0 | 86 | 86 | 1.86 |
| GND | 27.8.b | 8 | 75 | 459 | 0 | 1 | 1 | 0.15 |
| LLS | 27.8.a | 8 | 64 | 5531 | 0 | 18 | 18 | 0.32 |
| LLS | 27.8.b | 8 | 64 | 2698 | 0 | 12 | 12 | 0.43 |
| GNS | 27.7.b | 7 | 63 | 496 | 0 | 3 | 3 | 0.60 |
| GNS | 27.7.f | 7 | 63 | 2539 | 52 | 9 | 61 | 2.4 |
| GNS | 27.7.g | 7 | 63 | 2274 | 21 | 37 | 58 | 2.6 |
| GNS | 27.7.h | 7 | 63 | 530 | 0 | 16 | 16 | 3.00 |
| GNS | 27.7.j | 7 | 63 | 3139 | 5 | 170 | 175 | 5.6 |
| GTR | 27.7.e | 7 | 63 | 2037 | 8 | 35 | 43 | 2.1 |
| GTR | 27.7.f | 7 | 63 | 96 | 2 | 3 | 5 | 5.2 |
| GTR | 27.7.g | 7 | 63 | 28 | 5 | 0 | 5 | 18 |
| GTR | 27.7.h | 7 | 63 | 639 | 0 | 14 | 14 | 2.1 |
| OTB | 27.6.a | 6 | 56 | 17485 | 4 | 257 | 261 | 1.49 |
| OTB | 27.6.b | 6 | 56 | 2033 | 0 | 46 | 46 | 2.3 |
| OTB | 27.7.a | 7 | 56 | 12706 | 0 | 198 | 198 | 1.56 |
| OTB | 27.7.b | 7 | 56 | 3090 | 0 | 33 | 33 | 1.06 |
| OTB | 27.7.c | 7 | 56 | 3593 | 0 | 8 | 8 | 0.22 |
| OTB | 27.7.e | 7 | 56 | 17305 | 0 | 305 | 305 | 1.8 |
| OTB | 27.7.f | 7 | 56 | 2189 | 0 | 25 | 25 | 1.16 |
| OTB | 27.7.g | 7 | 56 | 12034 | 0 | 253 | 253 | 2.1 |
| OTB | 27.7.h | 7 | 56 | 4970 | 0 | 288 | 288 | 5.8 |
| OTB | 27.7.j | 7 | 56 | 10000 | 0 | 105 | 105 | 1.05 |
| OTB | 27.7.k | 7 | 56 | 3742 | 0 | 21 | 21 | 0.56 |
| OTB | 27.8.a | 8 | 56 | 8083 | 0 | 42 | 42 | 0.52 |
| OTB | 27.8.b | 8 | 56 | 5842 | 0 | 25 | 25 | 0.42 |
| OTB | 27.8.c | 8 | 56 | 6270 | 0 | 76 | 76 | 1.21 |
| OTB | 27.8.d | 8 | 56 | 143 | 0 | 0 | 0 | 0.14 |
| OTB | 27.9.a | 9 | 56 | 39094 | 0 | 147 | 147 | 0.38 |

| Level 4 métier* | Division | Subarea | Risk factor | Fishing effort (days-at-sea) | Dedicated bycatch monitoring (days-at-sea) | Non-dedicated bycatch monitoring (days-at-sea) | Total observer effort (days-at-sea) | Observer coverage (% days-at-sea) |
|-----------------|----------|---------|-------------|------------------------------|--|--|-------------------------------------|-----------------------------------|
| OTT | 27.8.a | 8 | 52 | 13587 | 0 | 539 | 539 | 4.0 |
| OTT | 27.8.b | 8 | 52 | 454 | 0 | 2 | 2 | 0.50 |
| OTT | 27.8.d | 8 | 52 | 247 | 0 | 46 | 46 | 19 |
| PTB | 27.8.c | 8 | 52 | 4537 | 0 | 18 | 18 | 0.40 |
| PTB | 27.9.a | 9 | 52 | 963 | 0 | 2 | 2 | 0.21 |
| FPO | 27.7.e | 7 | 48 | 20546 | 0 | 4 | 4 | 0.02 |
| FPO | 27.8.a | 8 | 48 | 4021 | 0 | 7 | 7 | 0.17 |
| FPO | 27.8.b | 8 | 48 | 269 | 0 | 1 | 1 | 0.21 |
| LLS | 27.7.e | 7 | 48 | 498 | 0 | 2 | 2 | 0.40 |
| OTM | 27.7.e | 7 | 48 | 485 | 5 | 7 | 12 | 2.5 |
| PTM | 27.8.a | 8 | 48 | 1419 | 0 | 49 | 49 | 3.4 |
| PTM | 27.8.b | 8 | 48 | 632 | 0 | 11 | 11 | 1.74 |
| PTM | 27.8.d | 8 | 48 | 1097 | 0 | 40 | 40 | 3.7 |
| TBB | 27.9.a | 9 | 48 | 10804 | 0 | 0 | 0 | 0.00 |
| PS | 27.9.a | 9 | 44 | 28358 | 33 | 63 | 96 | 0.34 |
| GNS | 27.7.a | 7 | 42 | 341 | 3 | 1 | 4 | 1.17 |
| LHM | 27.7.e | 7 | 40 | 1 | 0 | 39 | 39 | NA |
| OTT | 27.7.b | 7 | 39 | 4 | 0 | 1 | 1 | 32 |
| OTT | 27.7.c | 7 | 39 | 77 | 0 | 10 | 10 | 13 |
| OTT | 27.7.e | 7 | 39 | 1368 | 0 | 16 | 16 | 1.18 |
| OTT | 27.7.f | 7 | 39 | 76 | 0 | 8 | 8 | 11 |
| OTT | 27.7.g | 7 | 39 | 1509 | 0 | 141 | 141 | 9.4 |
| OTT | 27.7.h | 7 | 39 | 4080 | 0 | 525 | 525 | 13 |
| OTT | 27.7.j | 7 | 39 | 1425 | 0 | 208 | 208 | 15 |
| OTT | 27.7.k | 7 | 39 | 58 | 0 | 5 | 5 | 9.3 |
| DRB | 27.7.a | 7 | 36 | 12298 | 0 | 25 | 25 | 0.20 |
| DRB | 27.7.e | 7 | 36 | 10038 | 0 | 16 | 16 | 0.16 |
| TBB | 27.7.e | 7 | 36 | 12939 | 0 | 118 | 118 | 0.91 |
| TBB | 27.7.f | 7 | 36 | 8862 | 0 | 87 | 87 | 0.99 |
| TBB | 27.7.g | 7 | 36 | 10604 | 0 | 83 | 83 | 0.78 |
| TBB | 27.7.h | 7 | 36 | 2541 | 0 | 47 | 47 | 1.86 |
| PS | 27.7.e | 7 | 33 | 594 | 0 | 1 | 1 | 0.17 |
| PS | 27.8.a | 8 | 33 | 257 | 0 | 5 | 5 | 1.95 |
| PS | 27.8.b | 8 | 33 | 2109 | 0 | 5 | 5 | 0.24 |
| LLS | 27.6.a | 6 | 32 | 1843 | 0 | 49 | 49 | 2.7 |
| OTM | 27.6.a | 6 | 32 | 1224 | 22 | 85 | 107 | 8.7 |
| OTM | 27.6.b | 6 | 32 | 72 | 0 | 1 | 1 | 1.39 |
| OTM | 27.7.a | 7 | 32 | 386 | 0 | 87 | 87 | 22.6 |
| OTM | 27.7.b | 7 | 32 | 66 | 0 | 1 | 1 | 1.52 |

| Level 4 métier* | Division | Subarea | Risk factor | Fishing effort (days-at-sea) | Dedicated bycatch monitoring (days-at-sea) | Non-dedicated bycatch monitoring (days-at-sea) | Total observer effort (days-at-sea) | Observer coverage (% days-at-sea) |
|-----------------|----------|---------|-------------|------------------------------|--|--|-------------------------------------|-----------------------------------|
| OTM | 27.7.c | 7 | 32 | 196 | 0 | 9 | 9 | 4.6 |
| OTM | 27.7.g | 7 | 32 | 26 | 0 | 1 | 1 | 3.8 |
| OTM | 27.7.h | 7 | 32 | 154 | 0 | 11 | 11 | 7.1 |
| OTM | 27.7.j | 7 | 32 | 85 | 0 | 11 | 11 | 13 |
| OTM | 27.7.k | 7 | 32 | 39 | 0 | 9 | 9 | 23 |
| PTM | 27.6.a | 6 | 32 | 1076 | 0 | 18 | 18 | 1.67 |
| PTM | 27.7.a | 7 | 32 | 352 | 0 | 6 | 6 | 1.70 |
| PTM | 27.7.b | 7 | 32 | 392 | 0 | 11 | 11 | 2.8 |
| PTM | 27.7.c | 7 | 32 | 186 | 0 | 3 | 3 | 1.61 |
| PTM | 27.7.g | 7 | 32 | 159 | 0 | 8 | 8 | 5.0 |
| PTM | 27.7.j | 7 | 32 | 390 | 0 | 3 | 3 | 0.77 |
| PTM | 27.8.c | 8 | 32 | 188 | 0 | 11 | 11 | 5.6 |
| LHM | 27.8.b | 8 | 30 | 108 | 0 | 0 | 0 | 0.23 |
| OTB | 27.5.b | 5 | 28 | 179 | 0 | 6 | 6 | 3.3 |
| OTT | 27.7.a | 7 | 26 | 235 | 0 | 42 | 42 | 18 |
| TBB | 27.7.a | 7 | 24 | 2082 | 0 | 8 | 8 | 0.40 |
| TBB | 27.8.b | 8 | 24 | 3933 | 0 | 15 | 15 | 0.38 |
| SDN | 27.8.a | 8 | 22 | 703 | 0 | 17 | 17 | 2.5 |
| SDN | 27.8.b | 8 | 22 | 283 | 0 | 8 | 8 | 2.7 |
| SSC | 27.7.g | 7 | 22 | 993 | 0 | 6 | 6 | 0.60 |
| SSC | 27.7.j | 7 | 22 | 760 | 0 | 2 | 2 | 0.26 |
| GTR | 27.7.a | 7 | 21 | 4 | 1 | 0 | 1 | 25 |
| DRB | 27.7.g | 7 | 18 | 697 | 0 | 7 | 7 | 1.00 |
| OTM | 27.5.b | 5 | 16 | 87 | 0 | 1 | 1 | 1.15 |
| OTM | 27.8.a | 8 | 16 | 143 | 0 | 3 | 3 | 1.98 |
| PTB | 27.6.a | 6 | 13 | 183 | 0 | 1 | 1 | 0.50 |
| PS | 27.7.f | 7 | 11 | 100 | 13 | 0 | 13 | 13 |

* A description of métiers can be found at <https://vocab.ices.dk/?ref=1498>.

ICES Ecoregions including ICES Statistical Areas, ices.dk, Dec 2017

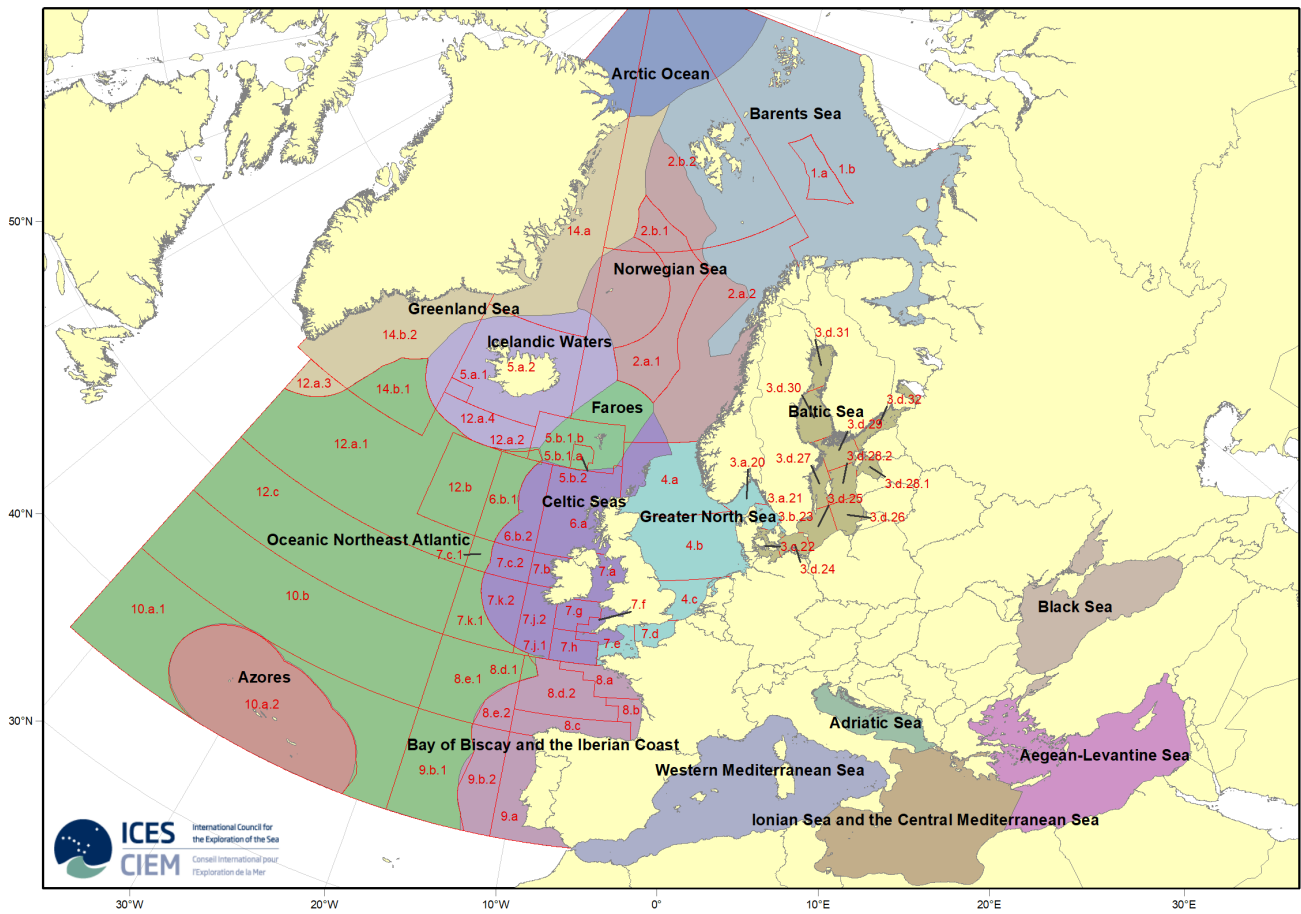


Figure 1 ICES ecoregions, including statistical areas.

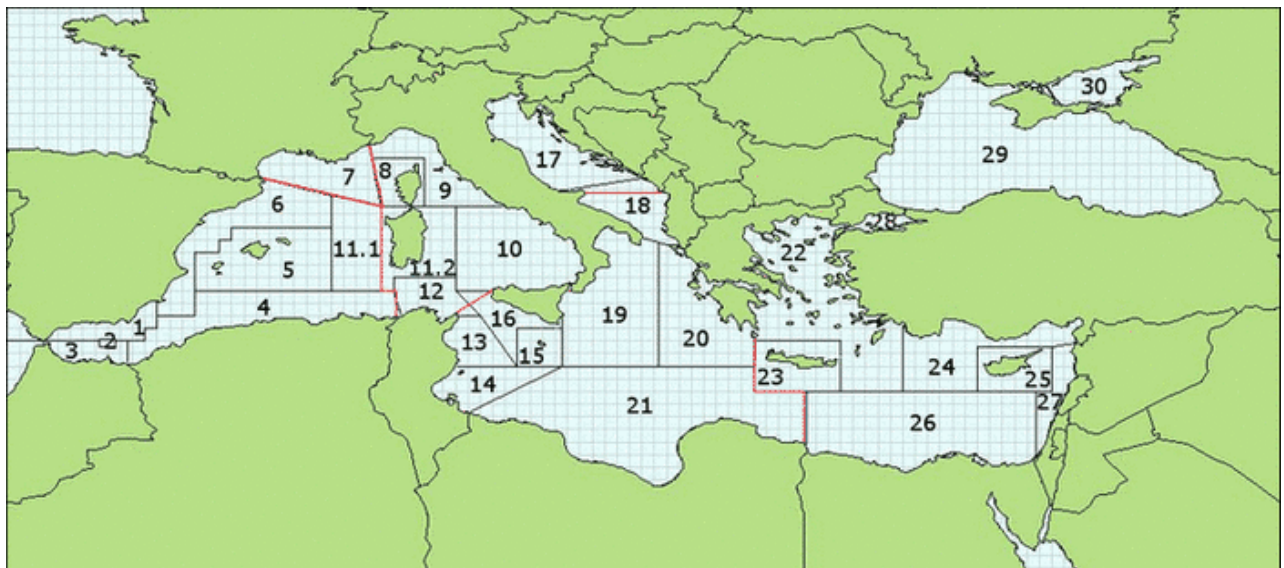


Figure 2 FAO Major Fishing Area 37, Mediterranean and Black Sea, including FAO geographical subareas (GSAs). Source: <http://www.fao.org/gfcm/data/maps/gsas>.