

OSPAR request to estimate bycatch mortality of marine mammals (harbour porpoise *Phocoena phocoena*, common dolphin *Delphinus delphis*, grey seal *Halichoerus grypus*) within the OSPAR maritime area

Advice summary

The estimated total number of common dolphins taken as bycatch was 7315 in 2019 and 6406 in 2020 (OSPAR regions II, III, IV, and V); for harbour porpoise it was 10 096 in 2019 and 9299 in 2020 (OSPAR regions I, II, III and IV); and for grey seals it was 3587 in 2019 and 3,096 in 2020 (OSPAR regions I, II and III).

Data quality and quantity issues contribute high levels of unquantified uncertainty and potential bias in bycatch estimates of marine mammals. Fishing effort data used were limited to 2019 and 2020, the only years for which days at sea were available for all countries who submitted data.

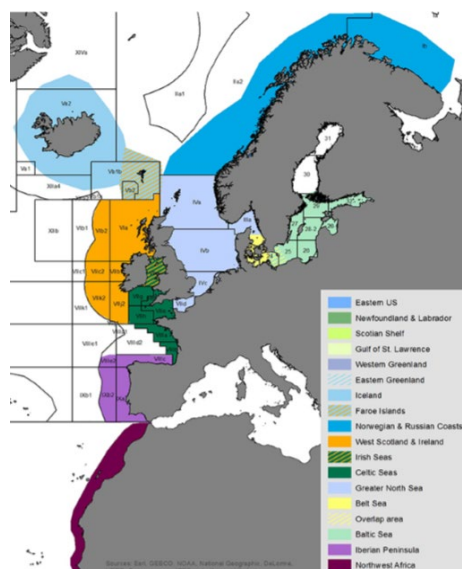
ICES has not evaluated the proposed thresholds and therefore cannot provide advice according to them.

Request

OSPAR Special request to ICES :

OSPAR requests ICES to provide advice on the estimated numbers of bycaught marine mammals with respect to OSPAR bycatch mortality thresholds. ICES is requested to consider the following when preparing the advice delivery:

- data collated in the WGBYC and/or RDBES database to generate bycatch rates (e.g. specimens per day at sea) and associated confidence intervals for static and towed gears (at least Metier Level 4), relevant species and assessment units. Historical bycatch monitoring data (2005 onwards) held within the database may need to be utilised to ensure robust estimation.
- Using the best available (source and most recent) fishing effort data (WGBYC/RDBES), generate assessment unit and metier specific bycatch mortality estimates for each species and their associated confidence intervals.
- The mortality estimates generated will be used to make assessments against agreed thresholds for the relevant species/areas. The thresholds will be provided from OMMEG for each of the species and assessment units.
- For harbour porpoise the assessment units will correspond to those defined in NAMMCO_NIMR (2019) report (see supplementary information and map below). The units to be assessed are the Greater North Sea and West Scotland Ireland and Celtic Seas which broadly correspond to OSPAR Regions II and III:



- For common dolphin and grey seal the assessment units are OSPAR Regions III and IV.
- The availability of marine mammal bycatch monitoring data will be evaluated to determine whether bycatch rates can be estimated for other regions an species also (e.g. harbour porpoise in Region IV).

Elaboration on the advice

Common dolphin

The estimated total number of common dolphins taken as bycatch (in the single OSPAR assessment unit) was 7315 (95% CI 3485–10 739) in 2019 and 6406 (95% CI 3052–9414) in 2020.

Table 1 Estimated bycatch of common dolphin by OSPAR assessment unit and métier level 4 in 2019 and 2020. Numbers of individuals taken as bycatch are obtained by multiplying the average bycatch rates (animals caught per day-at-sea) by the annual fishing effort. Lower and upper values represent 95% confidence intervals.

OSPAR assessment unit	Métier level 4*	Estimated bycatch rate 2015–2020 (95% CI)	Number of individuals taken as bycatch 2019 (95% CI)	Number of individuals taken as bycatch 2020 (95% CI)
Region II, III, IV and V	GNS/GND	0.014 (0.006–0.050)	1315 (703–2034)	1152 (616–1780)
Region II, III, IV and V	GTR	0.020 (0.010–0.041)	1058 (623–1241)	925 (549–1080)
Region II, III, IV and V	OTB	0.003 (0.001–0.005)	896 (481–1012)	771 (414–871)
Region II, III, IV and V	OTM	0.524 (0.240–1.126)	944 (434–1476)	978 (449–1530)
Region II, III, IV and V	OTT	0.008 (0.004–0.014)	93 (50–105)	69 (37–77)
Region II, III, IV and V	PS	0.012 (0.002–0.057)	390 (79–720)	368 (75–680)
Region II, III, IV and V	PTB	0.188 (0.064–0.546)	726 (246–1191)	599 (203–982)
Region II, III, IV and V	PTM	0.524 (0.241–1.126)	1893 (869–2960)	1544 (709–2414)
Region II, III, IV and V	All		7315 (3485–10739)	6406 (3052–9414)

Harbour porpoise

The bycatch for harbour porpoise was estimated for all requested assessment units except eastern Greenland, the Faroe Islands, the Iberian Peninsula, and the Norwegian and Russian coasts. The estimated total number of harbour porpoise taken as bycatch (summed across all OSPAR assessment units for which an estimate was possible) was 10 096 (95% CI 5799–18 198) in 2019 and 9299 (95% CI 5374–16 677) in 2020.

Table 2 Estimated bycatch of harbour porpoise by OSPAR assessment unit and métier level 4 in 2019 and 2020. Except for the Belt Sea assessment unit, numbers of individuals taken as bycatch are obtained by multiplying the average bycatch rates (animals caught per day-at-sea) by the annual fishing effort. Lower and upper values represent 95% confidence intervals.

OSPAR assessment unit	Métier level 4*	Estimated bycatch rate 2015–2020 (95% CI)	Number of individuals taken as bycatch 2019 (95% CI)	Number of individuals taken as bycatch 2020 (95% CI)
Belt Sea*	GNS/GTR	n/a*	601 (500–710)*	601 (500–710)*
Iceland	GNS	0.251 (0.177–0.340)	1863 (1374–2490)	1713 (1274–2276)
Celtic Seas	GNS/GND	0.007 (0.003–0.019)	407 (167–1159)	374 (152–1079)
Celtic Seas	GTR	0.011 (0.004–0.031)	287 (95–1021)	257 (85–917)
Celtic Seas	OTB/OTT	0.001 (0.0005–0.003)	125 (55–284)	108 (47–244)
Irish Seas	GNS/GND	0.021 (0.010–0.044)	2 (1–3)	2 (1–3)
Irish Seas	OTB/OTT	0.001 (0.0005–0.003)	14 (6–32)	10 (5–24)
West Scotland & Ireland	GNS	0.011 (0.004–0.031)	214 (94–481)	255 (112–572)
West Scotland & Ireland	OTB/OTT	0.001 (0.0005–0.003)	52 (23–118)	50 (22–113)

* <https://vocab.ices.dk/?ref=1498>.

OSPAR assessment unit	Métier level 4*	Estimated bycatch rate 2015–2020 (95% CI)	Number of individuals taken as bycatch 2019 (95% CI)	Number of individuals taken as bycatch 2020 (95% CI)
Greater North Sea**	GNS/GND	0.240 (0.137–0.409)	5696 (3021–10391)	5327 (2845–9637)
Greter North Sea**	GTR	0.247 (0.142–0.418)	690 (399–1178)	479 (277–821)
Greater North Sea	OTB/OTT	0.001 (0.0005–0.003)	145 (64–331)	123 (54–281)
Total	All		10096 (5799–18198)	9299 (5374–16677)

* From Helcom Action 2021. Estimated bycatch rates are not available.

** Evidence of non-random sampling

Grey seal

Bycatch of grey seal was estimated for all requested assessment areas except Stad-Vesterålen and Troms and Finnmark. The estimated total number of grey seals taken as bycatch (summed across all OSPAR assessment units for which an estimate was possible) was 3587 (95% CI 2309–5913) in 2019 and 3096 (95% CI 2019–5042) in 2020.

Table 3 Estimated bycatch of grey seals by OSPAR assessment unit and métier level 4 in 2019 and 2020. Numbers of individuals taken as bycatch are obtained by multiplying the average bycatch rates (animals caught per day-at-sea) by the annual fishing effort. Lower and upper values represent 95% confidence intervals.

OSPAR assessment unit	Métier level 4†	Estimated bycatch rate 2015–2020 (95% CI)	Number of individuals taken as bycatch 2019 (95% CI)	Number of individuals taken as bycatch 2020 (95% CI)
Hvaler-Stad	GNS	0.070 (0.053–0.094)	n/a*	n/a*
Ireland	GNS	0.041 (0.034–0.049)	82 (67–97)	108 (89–129)
Ireland	GTR	0.005 (0.002–0.009)	2 (1–4)	0
Iceland	GNS	0.086 (0.038–0.194)	971 (425–2187)	760 (333–1715)
UK and Greater North Sea	GNS/GND	0.070 (0.053–0.094)	2171 (1632–2903)	1922 (1444–2570)
UK and Greater North Sea	GTR	0.019 (0.009–0.036)	342 (179–650)	282 (147–536)
UK and Greater North Sea	OTM	0.005 (0.001–0.018)	19 (5–72)	24 (6–92)
Total			3587 (2309–5913)	3096 (2019–5042)

* Fishing effort data were incomplete for this OSPAR assessment unit and for this reason it was not possible to calculate the number of individuals taken as bycatch.

† <https://vocab.ices.dk/?ref=1498>

Basis of the advice

OSPAR assessment units

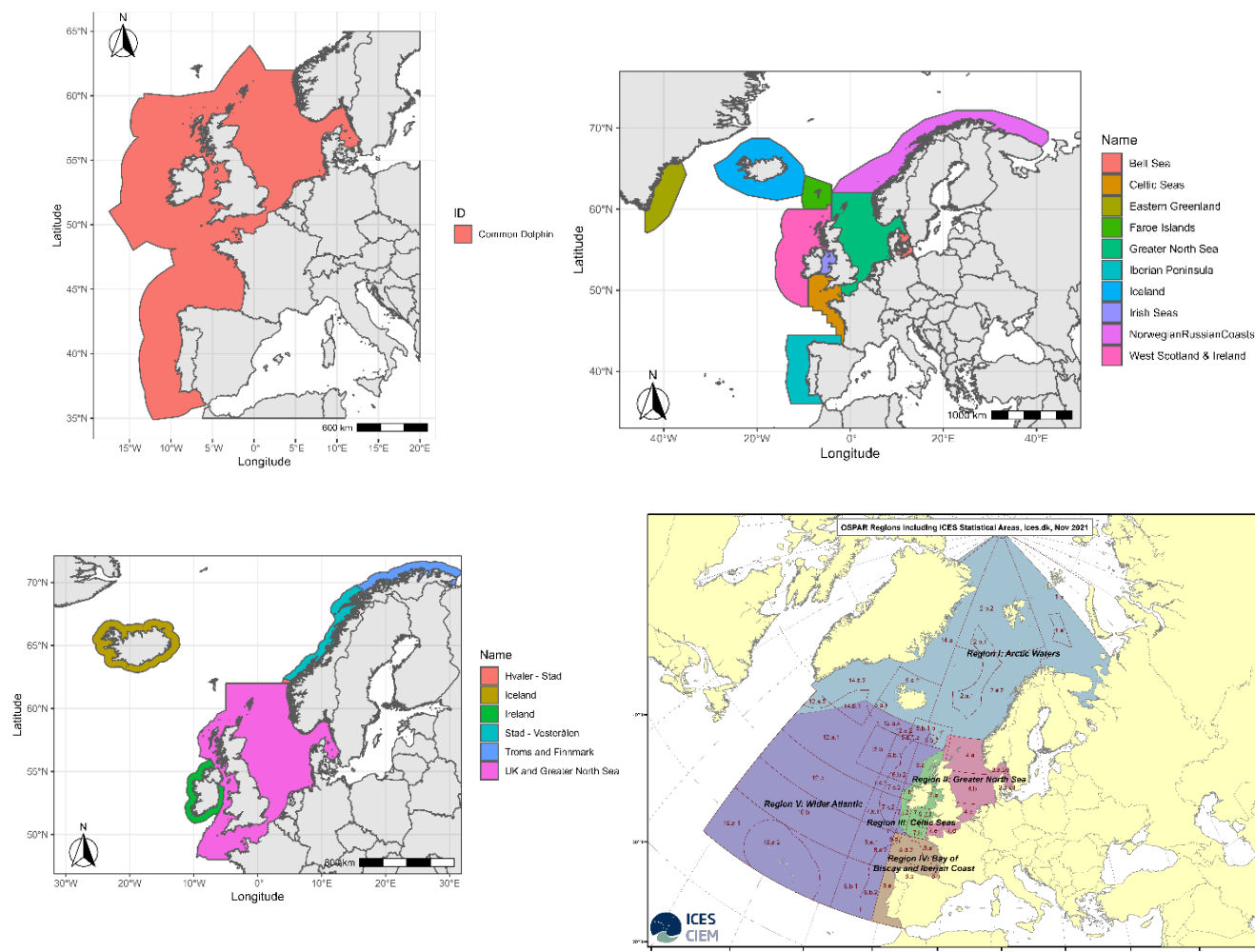


Figure 1 The assessment units (AUs) for common dolphin within OSPAR regions II, III, IV and V (top-left), harbour porpoise within OSPAR regions I, II, III, and IV (top-right) and grey seal within OSPAR regions I, II, and III (bottom-left), and OSPAR regions overlaid by ICES statistical areas (bottom-right). Note that the common dolphin NE Atlantic AU and grey seal Greater North Sea AU include ICES subdivisions 3.a.20 and 3.a.21 and that harbour porpoise Greater North Sea AU includes ICES subdivision 3.a.20. Harbour porpoise Belt Sea AU includes ICES subdivisions 3.a.21, 3.b.23m and 3.c.22.

Data

ICES gathered information describing fishing effort, monitoring effort, and bycatch of the species of interest from fisheries operating in the OSPAR Region[‡] pertaining to:

- Fishing effort by: country; year; quarter; month; ICES division; ICES rectangle; RCG area; Métier levels 4, 5, 6; vessel length; trip; haul and soak time (where available); kilowatt-days; gross tonnage days and; days at sea (DaS).

[‡] https://www.ices.dk/sites/pub/Publication%20Reports/Data%20calls/WKMOMA_Data%20Call%202021.pdf.

- At-sea monitoring/sampling effort regardless of incidental bycatch.
- Recorded incidental bycatch of species of interest based on at-sea monitoring.

Adjustments were necessary to align data:

- Effort (DaS) was not consistently available, and standardizations were required to address potential estimations bias.
- Data for the most complete years, 2015 to 2020 (monitoring effort and bycatch incidents) and 2019–2020 (fishing effort), were used.
- Certain data were not used in the analyses owing to potential estimation bias.
- ICES rectangles and OSPAR assessment units do not always align in the case of grey seal. In the rare instances of partial overlap, bycatch data from the full rectangle was assigned to the associated assessment unit.

Data analysis

All bycatch events are considered to result in mortality. To cope with zero inflated data, a Gamma-Hurdle model was used to estimate bycatch rates (number of animals taken as bycatch per day-at-sea). This two-step process first estimates the probability of a bycatch occurring (binomial Generalized Additive Model [GAM] and logit-link function), and second, the number of animals being caught (gamma GAM model and log-link function; Hilborn and Mangel, 1997). This approach was validated and found to be appropriate to estimate bycatch using available data (ICES, 2020).

Statistical tests, using a GAM with Poisson distribution and log-link function, were first performed to explore the effects of various factors (year, month, vessel size, ICES subarea, and métier level 4) on the bycatch rates. For all three species, the year, area and métier effects were significant. Vessel size (small vs. large, with the cut-off set at 12 m, except in the Iceland assessment unit where the cut-off of is 15 m) was significant for harbour porpoise and grey seal. Métier level 4, ICES subarea and vessel size were used to inform model stratification, while year could not be accounted for owing to small sample sizes. Bycatch observations from the years 2015 to 2020 were more complete relative to earlier years, therefore only those years were pooled to enable estimation. In some cases it was necessary to merge métiers of a similar nature in order to achieve a suitable sample size. For example, GND were commonly joined with GNS, and OTT with OTB within an ICES subarea.

Estimated bycatch rates were multiplied by annual fishing effort to obtain the annual number of animals taken as bycatch.

Issues relevant to the advice

Data submissions were incomplete (some countries providing no data), imbalanced (some countries providing small vessel data while others did not), did not consider implementation of mitigation measures to reduce the bycatch, and data quality and quantity varied substantially among years and countries.

Fishing effort data used was limited to 2019 and 2020, the only years for which DaS was available for all countries that submitted data. Owing to potential bias in 2020 bycatch estimates arising from the COVID-19 pandemic, the 2019 estimates are provided along with 2020.

Bycatch monitoring per métier and vessel size was highly variable within each assessment unit, with some countries reporting only for larger vessel sizes and gear types identified as “general monitoring requirements” following EU Regulation 812/2004 (> 15 m for set-nets and pelagic trawls). The need for scientific data collection on bycatch in the < 15 m fleet was largely overlooked; there was limited sampling on smaller vessels, which make up the majority of the European fleet and likely account for a significant proportion of marine mammal bycatch.

Bias associated with sampling design is related to sampling coverage and methods used for selecting the primary sampling units (e.g. trips, vessels). While emphasis is usually placed on achieving proportional monitoring across métiers and temporal and spatial ranges, it is also crucial to know whether the vessels monitored were selected randomly and what the proportion of unique vessels monitored was. In practice high risk métiers and areas for bycatch may be selected for monitoring, which can

result in positively biased bycatch estimates. For example in the Greater North Sea, data from several targeted large vessels with high bycatch rates of porpoises, submitted by one member country, increased bycatch rates by a factor of up to 5 in GNS/GND, and 3.5 in GTR. Bias can also arise from failure to meet an intended survey design (i.e. implementation constraints such as safety concerns, space availability or other reasons affecting onboard access for observers and monitoring), leading to non-representative sampling.

No data were available on several additional factors that can affect bycatch estimates. These include fine-scale effort data (such as soak time and net length), fishing depth, time of day, distance from shore, and other gear configuration factors such as mesh size, net height, twine type, and diameter and hanging ratio.

Métiers and areas with limited or no bycatch were excluded from analyses, and the resulting bycatch estimates are representative of métiers and areas where bycatch of the species of interest occurred on more than one occasion.

Sources and references

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