OSPAR
COMMISSION

Marine Mammal By-catch

Common Indicator Assessment

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Marine Mammal By-catch

OSPAR Convention

The Convention for the Protection of the Marine Environment of the North-East Atlantic (the "OSPAR Convention") was opened for signature at the Ministerial Meeting of the former Oslo and Paris Commissions in Paris on 22 September 1992. The Convention entered into force on 25 March 1998. The Contracting Parties are Belgium, Denmark, the European Union, Finland, France, Germany, Iceland, Ireland, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Convention OSPAR

La Convention pour la protection du milieu marin de l´Atlantique du Nord-Est, dite Convention OSPAR, a été ouverte à la signature à la réunion ministérielle des anciennes Commissions d´Oslo et de Paris, à Paris le 22 septembre 1992. La Convention est entrée en vigueur le 25 mars 1998. Les Parties contractantes sont l´Allemagne, la Belgique, le Danemark, l´Espagne, la Finlande, la France, l´Irlande, l´Islande, le Luxembourg, la Norvège, les Pays-Bas, le Portugal, le Royaume- Uni de Grande Bretagne et d´Irlande du Nord, la Suède, la Suisse et l´Union européenne

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Key Message

This assessment concluded by-catch is a significant pressure affecting marine mammal (Harbour Porpoise; Common Dolphin; Grey Seal) populations in the North-East Atlantic (Greater North Sea (Region II), Celtic Seas (Region III), Bay of Biscay and Iberian Coast (Region IV)), with harbour porpoise and common dolphin exceeding the thresholds. Grey seal did not exceed the thresholds.

The assessment is underpinned by a conservation objective attempting to capture European ambition for by-catch levels, subject to adjustment for future assessments to accommodate new evidence.

Background (brief)

The primary human-induced cause of mortality of marine mammals in the OSPAR Maritime Area is incidental capture and entanglement in fishing gears, commonly known as by-catch. Assessing the impact of this pressure in relation to population abundance is paramount.

This indicator assessment has been further developed since the Intermediate Assessment 2017 (IA2017) which assessed harbour porpoise, to now include common dolphin and grey seal. A candidate indicator has also been piloted, extending the assessment into Region I for harbour porpoise and grey seal (https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/marine-mammal-bycatch-region-i-cand/). This set of species comprises some of the most abundant marine mammal species in the OSPAR Maritime Area. The assessment capitalises on the latest advice provided by the International Council for the Exploration of the Sea (ICES). By-catch estimates are derived from annual fishing effort (days at sea) and by-caught animals made by observers and/or remote electronic monitoring on commercial fishing vessels (> 12m).

The assessment units (AUs) applied in the IA 2017 for harbour porpoise have been updated, taking account of the current best ecological evidence. AUs have also been defined for common dolphin and grey seal. Since the IA2017, OSPAR has also agreed on the methodologies to be used for setting thresholds, which has resulted in capacity to complete a robust assessment of by-catch impact on these three species.

Background (extended)

The primary human-induced cause of mortality of marine mammals in the OSPAR Maritime Area is incidental capture and entanglement in fishing gears, widely known as by-catch (**Figure a**; Bjørge *et al.,* 2013; Peltier *et al.,* 2016, Peltier *et al.,* 2021). There are existing legal requirements to monitor by-catch of marine mammals and to apply relevant measures to ensure it does not have a significant negative impact on marine mammal populations (ICES 2021c).

Species

This indicator assesses by-catch of harbour porpoise *Phocoena phocoena* (including the Iberian harbour porpoise *P. p. meridionalis* found in the MSFD subregion Bay of Biscay and Iberian Coast which displays sub-species level genetic divergence but is not yet recognised as a sub-species), short-beaked common dolphin *Delphinus delphis*, and grey seal *Halichoerus grypus*. Of the marine mammal species reported as by-caught in the OSPAR Maritime Area, these three species are the most commonly observed (e.g., ICES, 2020a; ICES 2020b). These species are also amongst the most abundant marine mammals in the OSPAR area and consequently, are potentially prone to more interactions with fishing gear compared to other species.

Harbour porpoise is included in the OSPAR List of Threatened and / or Declining Species and Habitats for the Greater North Sea and Celtic Seas MSFD subregions owing to evidence of a decline in populations, their sensitivity and the threat of incidental capture and drowning in fishing nets (ICES 2022).

Assessment Units

In order to define a spatial scale within which to conduct an assessment, appropriate Assessment Units (AU) within the range of each species have been agreed.

The AUs for harbour porpoise have been updated since IA2017 taking into account the recommendation from a joint OSPAR-HELCOM workshop (OSPAR-HELCOM, 2019) that the revised NAMMCO-NIMR AUs (NAMMCO/IRM 2019) be used for harbour porpoise by-catch assessments, as the most biologically accurate units (Figure b).

One AU is currently recognised for common dolphins: Murphy et al., (2021) proposed to join OSPAR Regions II, III and IV for this species. The AU used in the assessment encompasses this proposal and extends it to the boundaries of the MSFD subregions Greater North Sea, Celtic Seas, and Bay of Biscay and the Iberian Coast (Figure c) given the wide-ranging nature and lack of evidence of finer-scale population structure within the North-East Atlantic.

Grey seals are also highly mobile and range over large distances in open water and between haul-out sites (Russell et al., 2013; Brasseur et al., 2015): their abundance is therefore assessed at a large scale with two units broadly aligning with OSPAR Region II: the Greater North Sea and OSPAR Region III: West of Scotland and Celtic Seas (Figure d). The Iceland AU has also been assessed as part of the candidate indicator in OSPAR Region I (https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/marine-mammal-bycatch-region-i-cand/). Questions remain as to how to partition grey seal distribution in OSPAR Regions II, III and IV to best represent the possibly different units. Further research and interpretation of existing evidence is required to resolve this. For the QSR 2023, although OSPAR Region III is assessed as a single AU for this species within the current indicator assessment, this scale may provide an underestimate of regionalised by-catch levels.

Data

At OSPAR's request, the ICES workshop (WKMOMA) issued a data call in addition to the annual WGBYC data call requesting further information on which to base the estimates (ICES 2021a). The data call requested finer scale data which comprised observer records per haul and fishing effort data at ICES rectangle level (https://www.ices.dk/data/maps/Pages/ICES-statistical-rectangles.aspx) , for a suite of relevant fishing métiers (https://vocab.ices.dk/?ref=1498; Figure e). These fine scale data allowed for a better quantification of by-catch in each identified assessment unit (**Figure b, Figure c, Figure d** and **Figure e**).

Thresholds

Identifying a threshold enables a comparison of the actual values against the estimated limit at which a species would be significantly impacted. In the case of this assessment, the aim is to compare estimated actual by-catch levels against the calculated threshold, which, if exceeded, means a demographically significant impact. Threshold setting methods were agreed enabling threshold values to be derived against which to compare estimated by-catch levels for these assessments. No threshold value was agreed for this indicator in the IA2017, which resulted in the assessment outputs based solely on estimated by-catch compared to estimated abundance of harbour porpoise. Since then, experts have undergone a process via multiple workshops to further develop threshold setting following current and innovative methods (see Palialexis et al., 2021 for an overview). OSPAR's Biodiversity Committee (BDC) agreed on the methodologies to be used for setting thresholds in 2021 (see Assessment Method). The resulting consensus allows use of the precautionary approach to assess impact against a calculated threshold using the best available evidence.

Background (figures & tables)

Figure a: By-caught harbour porpoise in a fishing net.

Marine Mammal By-catch (Harbour Porpoise; Common Dolphin; Grey Seal) Region II, III and IV

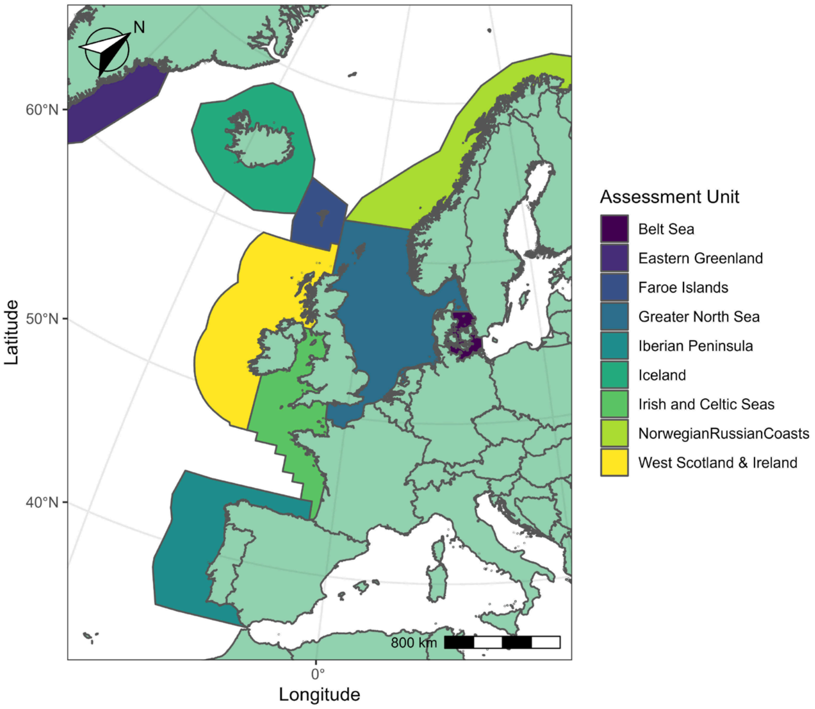

Figure b: Assessment Units for harbour porpoises. Only AUs that are partially or completely within the OSPAR Maritime Area are shown. (filename: Figure_b_M6_AU_HP.jpg)

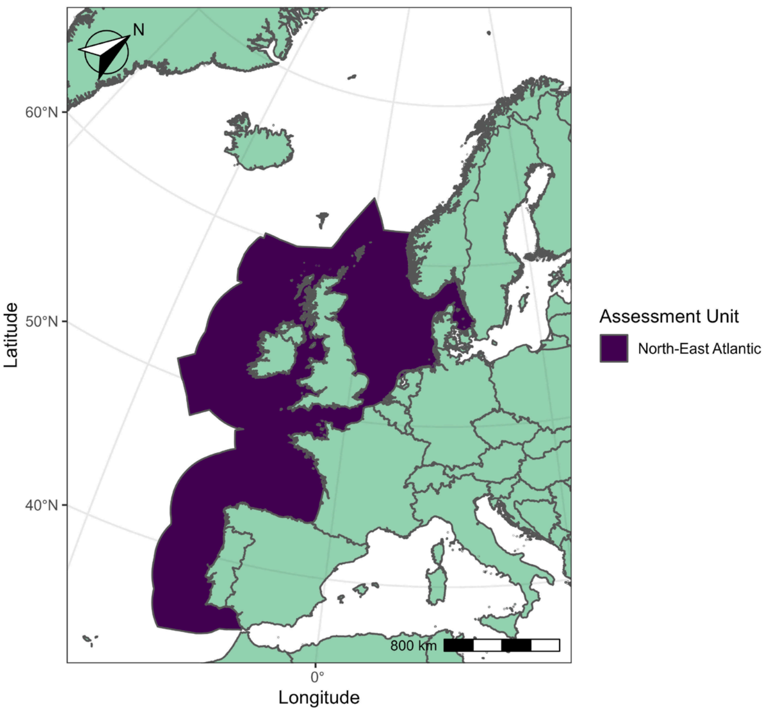

Figure c: Assessment Units for common dolphin. (filename: Figure_c_M6_AU_CD.jpg)

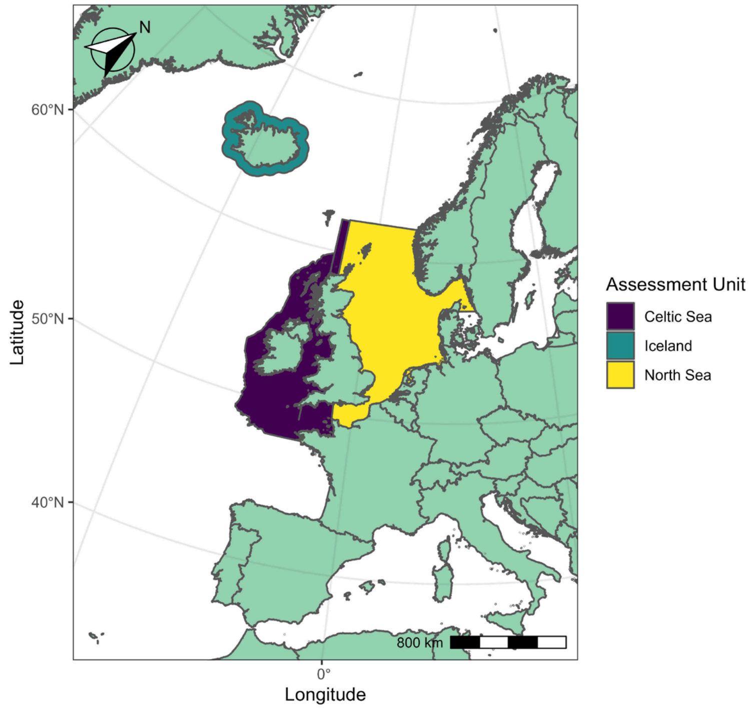

Figure d: Assessment Units for grey seals.

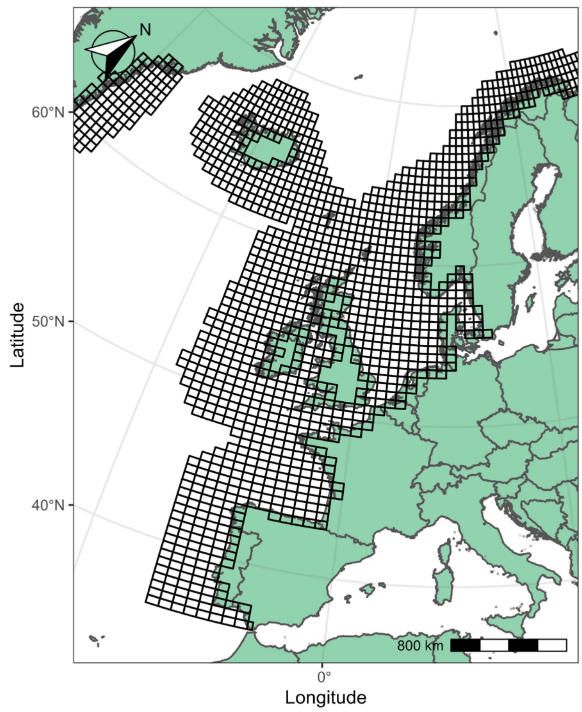

Figure e: ICES statistical rectangles.

Assessment Method

Introduction

Observations of by-caught animals for this indicator assessment were collated over several years to ensure sufficient geographical coverage. The observed number of by-caught animals was modelled in order to produce a 'by-catch rate'. The by-catch rate was then multiplied by the number of days at sea by vessels in a specific area during the entire year, in order to produce an estimate of total annual by-catch for that section of the fleet (ICES 2021a; Moore et al., 2021). This by-catch rate was then assessed against the calculated thresholds (see below; Wade et al., 2021). Thesholds were set using state-of-the-art methods (Palialexis et al., 2021) and robust estimates of absolute abundance (Hammond et al., 2021b).

Policy context

This indicator assesses anthropogenic removals, of which by-catch is a leading contributor (Wade et al., 2021). However, other anthropogenic activities such as offshore construction, shipping, tourism, noise, whaling etc. can also cause mortality directly, indirectly or both which is decribed in the QSR 2023 thematic assessment on marine mammals. All these activities contribute to anthropogenic removals which is the sum of the additional sources of mortality (beyond natural mortality).

There is currently no policy guidance on how to take into account allocation of removals limits across the contributing human activities. Given by-catch is the dominant cause of human-caused mortality, this pressure is key in assessing impact of anthropogenic removals within a population. Thresholds in the context of by-catch of protected species such as marine mammals are currently understood to represent an upper limit to total anthropogenic removals; that is, a limit beyond which the risk of failing to achieve the conservation objectives set by policy makers is unacceptable.

Threshold setting methods rely on a management strategy evaluation (MSE) framework that uses computer simulations to compare and assess the robustness of different thresholds to yield consistent outcomes compared to a target under different monitoring conditions. Of primary importance are (i) the conservation objectives that the management framework should achieve; and (ii) the inputs used in the computer simulations. The inputs used in a MSE should reflect the best available evidence on populations for which a threshold is developed. In particular, these inputs may also indirectly reflect other human-related pressures outwith the assessment focus (by-catch). For example, pollutants or noise in the current environment may reduce the fecundity or survival of individuals of a population compared to a population in an unimpacted environment.

In 2017, the OSPAR By-catch Intermediate Assessment stressed the need for conservation objectives in order to set thresholds. An existing conservation objective is therefore integrated for the present assessment. The OSPAR Marine Mammal Expert Group (OMMEG) undertook a process to further the development of management procedures tuned to relevant EU legislation for defining thresholds, including an interpretation of the conservation objective using best available evidence.

Development of thresholds

In 2009, ICES advised the European Commission that a Catch Limit Algorithm approach is the most appropriate method to set limits on the by-catch of harbour porpoises or common dolphins. In order to use this (or any other) approach, specific conservation objectives must first be specified (ICES, 2009b). Without these conservation objectives, ICES was unable to properly consider the impacts of these interactions in its management advice (ICES, 2010) and the ICES Working Group on Marine Mammal Ecology (WGMME) suggested that ASCOBANS be asked to consider the policy decisions required for the setting of appropriate bycatch limits (ICES, 2013). This was then picked up by ASCOBANS in a series of workshops to identify the way forward (Hammond et al., 2018).

In 2019, a joint HELCOM/OSPAR workshop to examine possibilities for developing indicators for incidental by-catch of birds and marine mammals discussed methodologies for indicator assessment, including threshold setting. The workshop also proposed as an interim management objective: “The mortality rate from incidental catches should be below levels which threaten any protected species, such that their long-term viability is ensured.” Based upon the recommendations from this workshop, the following operational objective was included in OSPAR’s North-East Atlantic Environment strategy 2030 (NEAES 2030): OSPAR will work with relevant competent authorities and other stakeholders to minimise, and where possible eliminate, incidental by-catch of marine mammals, birds, turtles and fish so that it does not represent a threat to the protection and conservation of these species and will work towards strengthening the evidence base concerning incidental by-catch by 2025 (operational objective S7.O6). The current parameterisation of this objective was decided to provide a conservation objective against which future projections of populations could be compared when exposed to different levels of by-catch, in order to define thresholds. A set of more detailed measures to be implemented both nationally and jointly have been adopted by HELCOM in the update of the Baltic Sea Action Plan.

To ensure long-term viability in the face of anthropogenic impacts, PBR was developed in the U.S. for the purposes of implementing the 1994 Marine Mammal Protection Act (MMPA) (Wade 1998; Moore et al., 2013). The PBR is an upper limit to the level of anthropogenic mortality that would allow a population to achieve abundance equal to or greater than the Maximum Net Productivity Level (MNPL). A population that is at/above the MNPL is referred to as being at “optimum sustainable population”. The conservation objective of the MMPA is: a population will remain at, or recover to, its maximum net productivity level MNPL (typically 50% of the population’s carrying capacity), with 0,95 probability, within a 100-year period. The computation of PBR requires only information on species abundance (including uncertainty in that estimate) and does not incorporate estimates of by-catch (thereby differing from Removals Limit Algorithms (RLA), see below). PBR is calculated as:

$$\mathrm{PBR} = \frac{\mathrm{R_{max}}}{2} \times \mathrm{N_{min}} \times \mathrm{F_r}$$

Formula a: Calculation of PBR. (filename: Formula_a_PBR.jpg)

where Nmin is the minimum estimate of population size (defined as the 20th percentile of the log-normal distribution; Wade 1998), Rmax is the maximum theoretical or estimated productivity rate of the population and Fr is a recovery factor between 0,1 and 1,0. Following robustness simulations, it was found that Fr should most often be chosen below 1 (Taylor et al. 2003; Punt et al., 2018) to (i) account for the current depletion level of the population (the more depleted, the lower), and (ii) allow for some protection against bias and uncertainties in these data. The use of Fr < 1 buffers against uncertainties that might prevent population recovery, such as biases in the estimation of Nmin, Rmax and bycatch rates. Wade (1998) determined in a MSE designed for the US MMPA the more robust value Fr = 0,5 for populations that are depleted, threatened, or of unknown status. The Fr value can be increased up to 1 when populations are well studied and biases in estimation of Nmin and other parameters are thought to be negligible (Punt et al., 2020). Fr is set at 0,1 for endangered species (Taylor et al. 2003).

OSPAR 2021 agreed a conservation objective was needed for both mPBR and RLA. A definition emerged: "a population should be able to recover to or be maintained at 80% of carrying capacity, with probability 0,8, within a 100-year period". OSPAR applies a time horizon of 100 years as recommended by ICES (2013) and a probability level of 0,8[1]. This conservation objective is a quantitative interpretation of the ASCOBANS interim objective "to restore and/or maintain [cetacean] stocks/populations to 80% or more of the carrying capacity".

The OSPAR conservation objective was used in an MSE (available at https://gitlab.univ-lr.fr/pelaverse/rla_paper; Genu et al., 2021), emulating the process described for PBR above, which is a process whereby the robustness of threshod values is tested against potential biases in estimates (Punt 2006; Hilborn 2012; Moore et al., 2013; Kaplan et al., 2021). The goal of MSE is to identify the threshold more likely to yield the conservation objective under different monitoring, management, and assessment regimes given potential uncertainties in the process (e.g., abundance and by-catch rate estimates). The RLA is thus one (so-called harvest control) rule to set limits to anthropogenic removals when data on abundance and removals are available. There are, however, other rules that are less data-hungry (Moore et al., 2013), and OMMEG modified the PBR approach of the United States to the aforementioned conservation objective (Genu et al., 2021).

A modified PBR (mPBR) was developed by tuning simulation trials used to appraise the robustness of PBR to the conservation objective “a cetacean population should be able to recover to or be maintained at [80]% of carrying capacity, with [0,8] probability, within a [100]-year period” (Genu et al., 2021). In order to do so, new default values for Fr were evaluated in a MSE framework, using the same assumptions about biases as was used in the original PBR robustness simulations, and it was proposed that the more robust value of Fr = 0,1 could be used for cetacean populations that are depleted, threatened, or of unknown status. It was proposed that the Fr value can be increased up to 0,35 when populations are well studied and biases in estimation of Nmin and other parameters are thought to be negligible. For marine mammals, mPBR is set to 0 for small populations in an AU (Nmin is less than **2 500 mature individuals**) as agreed at BDC given the likely impact by-catch could have on a population of that size, as well as accounting for a level of precaution given biases in the data and potential for underestimation of by-catch.

RLA aims to set limits to anthropogenic mortality of small cetacean populations that allow specified conservation objectives to be met. The RLA comprises a population model to simulate population dynamics and a control rule to estimate the mortality limit given a series of estimates of absolute abundance and anthropogenic mortality, including by-catch. RLA incorporates information on their uncertainties. Hammond et al., (2019) developed an RLA to set limits to anthropogenic mortality of harbour porpoise in the Greater North Sea AU. This population of harbour porpoises in the North Sea AU was the only one that met the data requirements of the RLA. This work came with a considerable number of assumptions and caveats and called for further developments. OMMEG undertook further developments of the procedure in 2021 with a view to improving the approach and deriving an anthropogenic mortality limit (or threshold) for harbour porpoise in the Greater North Sea AU (Genu et al., 2021).

The conservation objective used by OMMEG for the RLA was that “the Greater North Sea harbour porpoise Assessment Unit should be able to recover to or be maintained at 80% of carrying capacity, with 0,8 probability, within a 100-year period”. This objective is one possible quantitative interpretation of the ASCOBANS “short-term practical sub-objective” “to restore and/or maintain stocks/populations to 80% or more of the carrying capacity”. The RLA estimates two parameters: population growth rate (r) and depletion. The latter parameter corresponds to the depletion level at the time of the best available survey estimate. For the population of harbour porpoises in the Greater North Sea AU, there are three survey estimates available (SCANS surveys 1994, 2005, 2016; Hammond et al., 2002; 2013; 2021) to estimate these

[1] lower than the level of 0,95 used in the U.S. MMPA yet corresponding to a reasonably high probability as suggested in ASCOBANS (2015, page 10). Hammond et al., (2019) used a level of 0,50 which corresponds to an expectation of meeting the conservation objective half of the time. OMMEG decided to use the level of 0.8 after preliminary analyses showed that a 0,95 level would result in extremely stringent thresholds (i.e., very close to zero).

parameters. Once these two parameters have been estimated, the anthropogenic mortality limit is computed as:

$$\text{removals limit} = \mathrm{N_{best}} \times r \times \max\left(0,\ \text{depletion} - IPL\right)$$

Formula b: Calculation of the RLA control rule. max(a, b) denotes the maximum between a and b.

where Nbest is the best available abundance estimate and IPL is the internal protection level assumed to be 0,54 (i.e., 54% of the carrying capacity K, Boyce 2000). If the estimated depletion level of the population is below the IPL, then the removals limit is automatically set to 0. Tuning the RLA to the conservation objective was achieved in a MSE framework by considering different quantiles of the posterior distribution of the removals limit as suggested in Hammond et al., (2019, page 7) or as done in Wade (1998). Tuning by choosing a quantile allowed to better take account of estimation uncertainty in parameters r and depletion. For the RLA to be robust against several uncertainties, the 30% quantile was selected (Genu et al., 2021). This is a conservative choice, made to obtain a threshold robust against possible underestimation of anthropogenic mortality estimates (including by-catch).

Harbour porpoise removals limit

The methods to be used to set removals limit for harbour porpoise were agreed at OSPAR BDC 2021. These vary by AU (**Table a**), reflecting in part data availability.

Common dolphin removals limit

The method to set removals limit for common dolphin by-catch is the modified Potential Biological Removal (**Table a**).

Grey seal removals limit

The method to set removals limit for grey seal by-catch is the Potential Biological Removal (**Table a**).

OSPAR Region	AU	Threshold setting approach	Threshold values (anthropogenic removal)	Conservation Objective
		Harbour porpoise		
II	Greater North Sea	RLA	1622	80% of K after 100 years with probability 0,8
III (IV)	Irish and Celtic Seas	mPBR	82	
III	West Scotland and Ireland	mPBR	78	
IV	Iberian Peninsula	mPBR	0	
		Common dolphin		80% of K after 100 years with probability 0,8
II, III, IV	NE Atlantic	mPBR	985	
		Grey seal		50% of K after 100 years with probability 0,95
II	North Sea	PBR	7171	
III	Celtic Sea	PBR	3647	

Table a: Thresholds for anthropogenic removals (including by-catch) for the common indicator assessment. Note that the conservation objectives can differ between species. (Filename: Table_a_M6_thresholds.xlsx)

Abundance estimates

Estimates of cetacean abundance in the OSPAR Maritime Area are available from the large-scale multinational surveys such as the Small Cetaceans in European Atlantic Waters and the North Sea (SCANS) surveys (https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/abundance-distribution-cetaceans/). This was initiated in 1994 with SCANS-I (SCANS 1995; Hammond et al., 2002) and then followed by SCANS-II and CODA surveys in summer 2005 and 2007 (Hammond et al., 2013, CODA 2009), and the SCANS-III and ObSERVE surveys in summer 2016 (Hammond et al., 2021a, Rogan et al., 2018). The geographic coverage of the SCANS surveys is displayed in Abundance and Distribution of Cetaceans (https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/abundance-distribution-cetaceans/).

Harbour porpoise abundance estimation

The harbour porpoise is the most abundant cetacean species in the North-East Atlantic shelf waters. As a result of the widescale surveys, there are now three estimates of abundance for harbour porpoise in the Greater North Sea AU from SCANS (1994), SCANS-II (2005) and SCANS-III (2016; **Figure f, Table b**).

Assessment Unit	Year	Abundance	CV	Confidence interval (95%) lower bound*	Confidence interval (95%) upper bound*
Greater North Sea	1994	289 000	0,14	218 000	376 000
Greater North Sea	2005	355 000	0,22	226 000	531 000
Greater North Sea	2016	345 000	0,18	239 000	482 000

* approximate confidence interval obtained from quantile of a lognormal distribution
Note that numbers are rounded to the nearest thousands

Table b: Abundance estimates (rounded to the nearest thousand; Hammond et al., 2021) of harbour porpoises in the Greater North Sea AU.

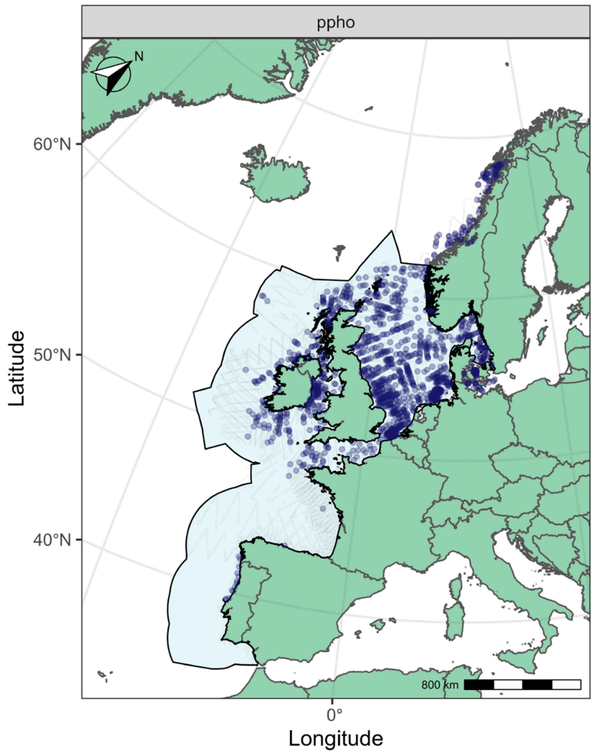

Figure f: Results from the OSPAR data call for harbour porpoise sightings in 2016 from line-transect surveys in the North-East Atlantic

Irish waters were surveyed in 2015 and 2016 through the ObSERVE Programme. Results from 2016 were analysed alongside SCANS III data (https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/abundance-distribution-cetaceans/) to estimate populations for the Irish and Celtic Seas AU (46 797; CV = 0,14) and the West of Scotland and Ireland AU (44 261; CV = 0,14).

In the Iberian Peninsula AU (**Figure b**) the majority of harbour porpoise are concentrated in the relatively shallower coastal waters and there is evidence to suggest they form a distinct population within the OSPAR Maritime Area. The abundance estimate from SCANS-III (2016) is 2 898 (CV = 0,32) individuals (Hammond et al., 2021ª), a relatively small population compared to the other AUs for this species. In terms of setting the threshold, the IUCN guidance sets among one of its criteria for endangered species, a population size of 2 500 mature individuals (Butchart et al., 2005). This criterion was discussed by OMMEG and adopted in order to warrant a by-catch threshold of 0. With an abundance of 2 898 animals, the assumption is that the proportion of mature versus juvenile animals would result in the number of mature harbour porpoises falling below 2 500.

Common dolphin abundance estimation

As with harbour porpoise, estimates of abundance of common dolphins in European Atlantic waters are available from the large-scale multinational SCANS-II and CODA surveys in summer 2005 and 2007 (Hammond et al., 2013, CODA 2009) and the SCANS-III and ObSERVE surveys in summer 2016 (Hammond et al. 2021a, Rogan et al., 2018; Figure g). These surveys cover the majority of Economic Exclusive Zone (EEZ) waters in the European Atlantic but exclude offshore waters in the Portuguese EEZ. Estimates of abundance have been made for common dolphins, striped dolphins, and also for common and striped dolphins combined; the latter because there are a substantial number of sightings of 'unidentified common or striped dolphins'. These species are often sighted in mixed groups and have similar characteristics which can make identification challenging, particularly from above. Using data from SCANS-III ship-based, SCANS-

III aerial and ObSERVE aerial surveys, the combined common dolphin and unidentified (probably common) dolphin abundance is 634 286 (CV = 0,31; ICES 2020a).

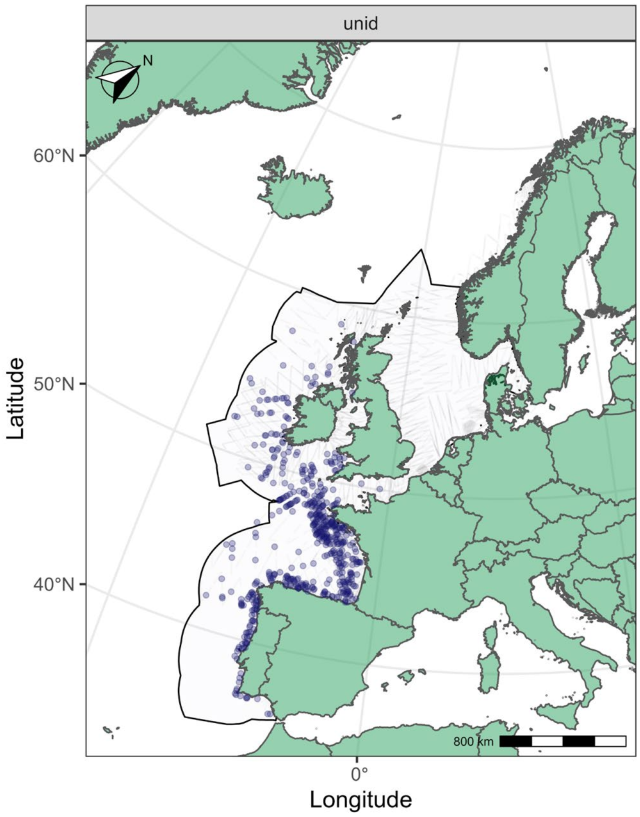

Figure g: Results from the OSPAR data call for common dolphin sightings (including unidentified common or striped dolphins; ICES 2021a) in 2016 from line-transect surveys in the North-East Atlantic.

Grey seal abundance estimation

Data for grey seal estimates were completed from the data call for the M3 / M5 seal indicators using data from 2015-2020 in line with the ICES data call for by-catch data. Seal Abundance and Distribution: https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/seal-abundance-and-distribution/ and Grey Seal Pup Production: https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/grey-seal-pup-production/. Estimates were derived from grey seal counts conducted during surveys of harbour seals in their summer moult period (August), counts of grey seal pups made at breeding colonies in the autumn / winter, and counts during the grey seal moult period which follows the breeding season in early spring.

The summer counts of grey seals can be variable and are not, on their own, a reliable estimate of the size of the grey seal breeding population. This is due to the proportion of animals not hauled out and thus counted resulting in widely varied counts; animals counted in a particular location during the summer are not necessarily those that breed in the same area, because grey seals may travel extensively between breeding and foraging sites (Russell et al., 2013; Brasseur et al., 2015); and in summer more grey seals are in mixed haul outs with harbour seals, potentially leading to error in identification and biased counts. By addressing bias in all three counts and combining the outputs, a more representative picture of grey seal abundance was obtained. August breeding counts were converted into Nmins given the low proportion of animals hauled out during counts, Seal Abundance and Distribution: https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/seal-abundance-and-distribution/.

Estimates were produced for the two AUs with adequate by-catch data on which to complete a full assessment: North Sea (OSPAR Region II) and Celtic Seas (OSPAR Region III) (**Table d**).

North Sea AU (Region II) - 119 519 (Nmin)

Celtic Seas AU (Region III) - 60 780 (Nmin)

A pilot assessment was also carried out in Region I for the Iceland AU (https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/marine-mammal-bycatch-pilot).

Although the Celtic Seas AU is considered a single area for assessment, further work is required to consider evidence on movements within this area to determine if there is a more appropriate way to subdivide this AU to better capture the distribution and movements of this species.

Evidence suggests by-catch is of greater significance in the south of the Celtic Seas AU, but the population size is greater in the north. By assessing at this scale, there is opportunity for misrepresentation of the localised issue. Two values for Nmin were therefore calculated for this region based on the AUs applied in the M3 / M5 assessments, with OSPAR Region IIIa (South-West Scotland; West Scotland; and Western Isles) resulting in an Nmin of 38 766, and OSPAR Region IIIb (southwest England; Wales; northwest England; Northern Ireland and Ireland) resulting in an Nmin of 22 014. With the significantly greater numbers in the north, but higher by-catch levels in the south, the impact on the southern groups may be masked by the wider assessment at OSPAR Celtic Seas (Region III) scale.

By-catch and mortality estimates

ICES issued an official data call in 2021 to 18 of the 20 ICES countries with fisheries operating in the OSPAR Maritime Area to collect data describing total by-catch monitoring/sampling effort and grey seal, harbour porpoise and common dolphin by-catch events from the years 2005 until 2020 (ICES 2021a). Observations of by-caught animals are collated over several years primarily via by-catch observer schemes but also via Remote Electronic Monitoring (REM). The number of observed dead animals is modelled, taking into account the number of days that fishing activity was observed, in order to produce a ‘by-catch rate’ (Moore *et al.,* 2021). The by-catch rate is then multiplied by the number of days at sea (DaS) by vessels in a specific area during the entire year, in order to produce an estimate of the total number of by-catch events (by-catch estimate) for that section of the fleet. This number is further multiplied by the number of animals involved in a by-catch event (‘by-catch intensity’, see below) to obtain mortality estimates, that is the total number of by-caught animals (ICES 2021a).

Through its Working Group on By-catch of Protected Species (WGBYC), the International Council for the Exploration of the Sea (ICES) collates and reviews data reported by Member States to the European Commission (formerly under EC Regulation 812/2004 and now under Regulation EU 2019/1241), annually. 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). While the collection of protected species by-catch 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 by-catch observers usually leads to downward bias in the number of recorded events (see ICES 2015, STECF 2021).

All data are requested by WGBYC through an issued data call in a standard format and collated in a by-catch database. Further to this, ICES were requested via OSPAR to convene a Workshop on Estimation of Mortality of Marine Mammals (WKMOMA) with the following Terms of Reference:

- Generate by-catch rates for static and towed gears
- Generate assessment unit and métier specific by-catch mortality estimates
- Compare the by-catch mortality estimates against thresholds
- Data available within OSPAR Region I will be evaluated and, if feasible, processed to generate by-catch rate and mortality estimates for harbour porpoise and grey seal using the relevant country / NAMMCO advised assessment units.

The ICES WKMOMA convened in autumn 2021 to address the special advice request from OSPAR on mortality of marine mammals due to by-catch within the OSPAR Maritime Area. ICES Member Countries with fisheries operating in the OSPAR Maritime Area were requested to provide total fishing effort data (in Days at Sea, DaS), by-catch monitoring effort data and by-catch incidents for the harbour porpoise, common dolphin and grey seal. A DaS is any continuous period of 24 h (or part thereof) during which a vessel is present within an area and absent from port (Anon. 2019). The data for each by-catch event (i.e., per fishing haul), including the number of hauls where no by-catch was observed, were requested to generate assessment unit and métier specific by-catch mortality estimates for each species and their associated confidence intervals. The result of the data call for several fisheries across 15 countries are provided in Table c (Métier level 4).

Code	**Description**	**Harbour porpoise**	**Common dolphin**	**Grey seal**
GND	Driftnet	v	v	v
GNS	Set gillnet	v	v	v
GTR	Trammel nets	v	v	v
OTB	Bottom otter trawl	v	v	
OTM	Midwater otter trawl		v	v
OTT	Multi-rig otter trawl	v	v	
PS	Purse seine		v	
PTB	Bottom pair trawl		v	
PTM	Pelagic pair trawl		v	

Table c: List of fishing métier (level 4) considered by WKMOMA for estimating mortality due to by-catch.

A generalised additive hurdle model was fitted to the monitoring data to estimate by-catch risk (binomial likelihood with a logit link function) and intensity (gamma likelihood with a log link function). The modelling approach estimates the total annual mortality due to by-catch of a species in an assessment unit:

$$\begin{aligned}\text{Mortality (total number of animals)} = \textstyle\sum[DaS] \times\ & \text{Average number of Hauls per DaS} \times \\ & \text{bycatch risk} \times \\ & \text{bycatch intensity}\end{aligned}$$

Formula c: Calculation of mortality

where:

By-catch intensity (number of animals involved in a by-catch event) = generalised additive model (with a Gamma likelihood and a log link function);

By-catch risk (by-catch event probability per haul) = generalised additive model (with a Bernoulli likelihood and a logit link function);

Average number of Hauls per DaS = the mean number of hauls per day at sea in the monitoring data; and,

Sum [DaS] = total number of days at sea.

ICES WKMOMA (ICES 2021a) pooled data on by-catch across 2015-2020 due to the patchiness and low coverage of relevant fisheries in any one year: observer coverage is well below 1% of the total effort in most fisheries (STECF 2021). Due to low monitoring coverage and summarising data over a large area and time period, the estimated by-catch rates by ICES come with important caveats (ICES 2021a). Monitoring coverage per métier and vessel size was highly variable within each AU. In particular, the ICES advice stressed how the requirements for scientific data collection on by-catch in the < 15m fleet was largely over looked. Smaller vessels, which make up the majority of the European fleet and likely account for a significant proportion of marine mammal by-catch, have not been adequately sampled. As a result, a by-catch estimate was not possible for the Iberian Peninsula AU as there were no observed records of by-catch within the timeframe, despite evidence that by-catch is an ongoing pressure in this region (STECF 2021, ICES 2022).

Summary of WKMOMA outputs (ICES 2021a)

ICES issued an official data call requesting 18 of the 20 ICES countries with fisheries operating in the OSPAR area (excluding USA and Canada) to provide data between 2005 and 2020. Norway, the Faroes, and Russia did not submit by-catch monitoring and effort in response to the data call, and it was therefore not possible to estimate by-catch in these waters.

All submitted monitoring effort data was summarised and resulted in a total of 884 common dolphins, 1 221 harbour porpoises and 574 grey seals observed by-caught between 2015 and 2020. These rates were then raised from sample to population by multiplication with fishing effort to estimate total by-catch per AU (Formula c). The effects of the COVID-19 pandemic have been far-reaching in the marine monitoring sector. Between 2019 and 2020 there was a notable decrease in the amount of at-sea observer data reported to WGBYC (ICES 2021b). The most recent complete year of data is 2020 and is therefore the timeframe used for the by-catch estimates. WKMOMA also provided 2019 estimates given the potential impact of COVID-19 on fishing and recording effort, leading to a potential underestimate in the 2020 values. Both estimates are evidenced in the ICES (ICES 2021a) report. Although 2019 estimates are generally higher across the board, the difference is relatively small therefore the assessment is based on the newest available data, which is 2020. The assessment does not change for any species / AU whether 2019 or 2020 estimates are used.

WKMOMA by-catch estimates (data from 2020):

Harbour porpoise:

West Scotland and Ireland AU

The overall by-catch estimate for harbour porpoises in the West Scotland and Ireland AU was 305 individuals (95% CI 134 - 686).

Irish and Celtic Seas AU

The overall by-catch estimate for harbour porpoises in the Irish and Celtic Seas AU was 751 (95% CI 290 - 2 267).

Greater North Sea AU

Two by-catch estimates for harbour porpoises in the Greater North Sea AU were presented (ICES 2021a):

- one higher estimate including submitted data from all countries, but includes heavily skewed data from one contributing country due to very frequent by-catch observations from preferential sampling in targeted vessels – 5 974 (95% CI 3 176 - 10 739); and
- one estimate where the monitoring effort data from this country has been taken out – 1 627 (95% CI 922 - 3 325).

The precautionary approach promotes the use of the higher figure when assessing harbour porpoise by-catch against the threshold to reduce the chance of underestimation of the impact of by-catch for this species. In addition, estimates came with several caveats including low observer coverage, and lack of sampling of small vessels. The higher figure has been taken forward in the results of this assessment. It should be noted that both estimates result in the threshold being exceeded therefore the assessment outcome is the same applying either estimate.

Iberian Peninsula AU

No assessment – there were no record of by-catch in this AU from observer data within the time period (between 2015 and 2020) therefore WKMOMA could not estimate by-catch from observer data for the AU. However, given the majority of by-catch originates from small, inshore vessels which are not covered by adequate observer effort, it is unlikely assessment will be possible in future using this method. STECF (2021) also concluded that observer data in this AU was scant and that the population of Iberian harbour porpoise is at a level that is cause for a high level of concern. Consideration of using other data sources such as strandings data may be integrated in future in combination with observer data, in an effort to fill some of the data gaps and enable a clearer picture where observer effort is not adequate.

Common dolphin:

North-East Atlantic AU

The overall by-catch estimate for common dolphin in the North-East Atlantic AU was 6 406 individuals (95% CI 3 052 - 9 414).

Grey seal:

The overall by-catch estimates for grey seals were 3 096 individuals (95% CI 2 019 – 5 042; ICES 2021a). Telemetry and photo ID data show significant seal movements (Figure h; Kierly at al., 2000; Sayer et al., 2019; Carter et al., 2020; Langley et al., 2020). The AUs used for grey seals in this indicator assessment align broadly with OSPAR Regions II and III (Figure d). The ICES (2021a) by-catch estimates have been aggregated to fit the AUs of Grey Seals (with respect to abundance) for the QSR 2023.

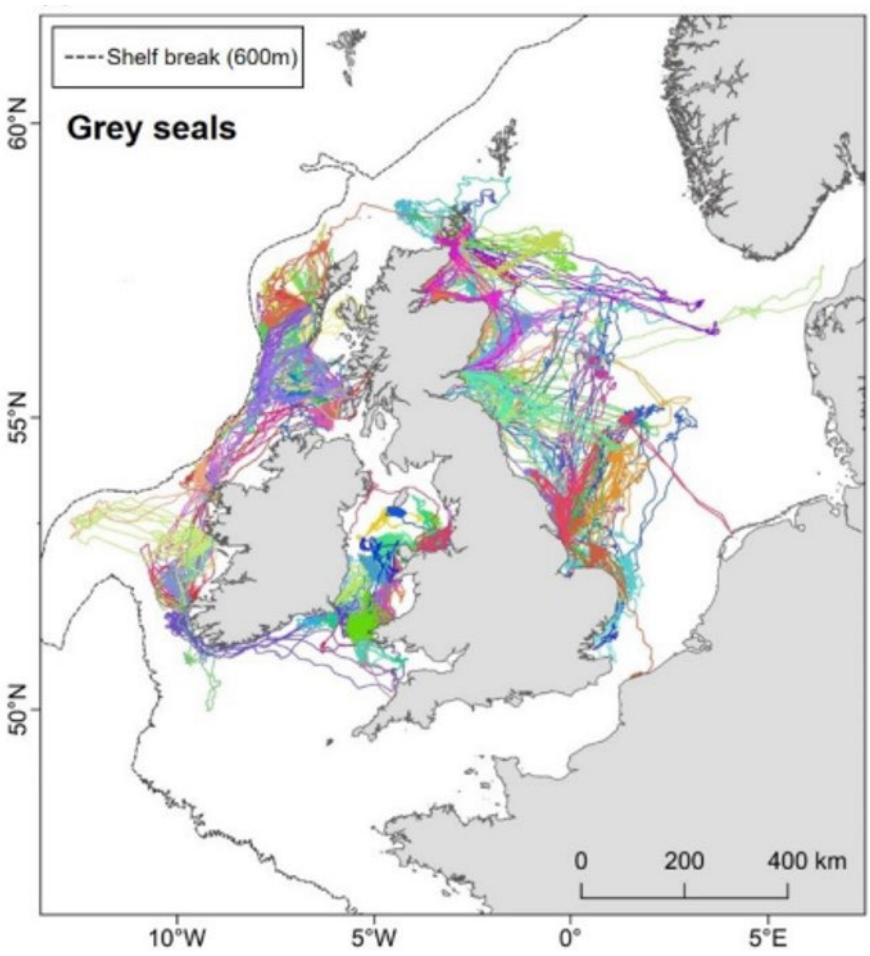

Figure h: GPS tracking data for grey seals. Data were combined from SMRU, University of Aberdeen and University College Cork. Tracks are shown before cleaning, coloured by individual (number of tracks = 114).

North Sea AU (Region II)

The overall by-catch estimate for grey seals in the North Sea AU was 704 individuals (95% CI 501 - 1 009).

Celtic Seas AU (Region III)

The overall by-catch estimate for grey seals in the Celtic Seas AU was 1 632 individuals (95% CI 1 186 - 2 320).

The by-catch estimate outputs from ICES (ICES 2021a) have been assessed against the calculated by-catch thresholds for each species by AU for evaluation.

The Coordinated Environmental Monitoring Programme (CEMP) guideline for this indicator provides further details of the assessment method.

Results (brief)

The combination of the agreed threshold setting methods and ICES advice on estimates of by-catch mortality (ICES 2021a) has resulted in tangible values on which to base this assessment. Full assessments of the three species have been possible for seven of the identified AUs in OSPAR Regions Greater North Sea, Celtic Seas and Bay of Biscay and Iberian coast (Region II-IV). A qualitative assessment of by-catch against the threshold has been possible for one additional AU (Iberian Peninsula AU). Results for the candidate indicator for harbour porpoise and grey seal in Arctic Waters (Region I) are provided here.

Four identified AUs for by-catch of harbour porpoise have been assessed against a threshold setting method: thresholds were exceeded in all four AUs (see candidate assessment for OSPAR Region I: https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/marine-mammal-bycatch-pilot). By-catch levels in the Greater North Sea; Irish and Celtic Seas and West of Scotland and Ireland AU exceeded the threshold. The Iberian Peninsula AU was not assessed by ICES as there was no by-catch registered through observer data during the timeframe assessed (between 2015 and 2020). However, data from other means such as fisher interviews and strandings data provide evidence of a significant by-catch risk in the Iberian Peninsula AU in relation to the estimated population size. Although it is not possible to quantify this issue using the methods applied to all other AUs given the lack of records through the observer scheme, the evidence suggests a number greater than 200 harbour porpoises are by-caught annually (Vingada and Eira, 2018), which, when taken into context with the by-catch threshold of zero, indicates that by-catch in this AU is critically exceeding the agreed threshold.

By-catch of common dolphin has been assessed for a single AU for the North-East Atlantic given the far-ranging nature of the species and limited evidence of distinct populations within that range. In this AU, estimated by-catch significantly exceeded mPBR, and therefore the threshold is exceeded.

By-catch of grey seal was assessed using PBR given the availability of data and subsequent confidence in a growing population trend. By-catch estimates in Region II (North Sea AU) and III (Celtic Seas AU) were below the threshold value. However, this does not account for potential regional impacts of by-catch on for this species, particularly in the southern portion of Region III where population numbers are lower than the northern portion, but by-catch levels are estimated to be higher. As a result, the greater risk in the south of the AU could be attenuated or masked by the wider assessment outcome.

Results (extended)

Harbour porpoise

Four identified AUs for harbour porpoise have been assessed against a threshold setting method of either RLA or mPBR as noted in **Table d**. The ICES advice (ICES 2021a) provided an estimate of harbour porpoise by-catch for three AUs where the Indicator is common: Greater North Sea, West Scotland and Ireland, and Irish and Celtic Seas. In the first AU, the threshold setting method is the RLA, while it is mPBR in the two last AUs. In all AUs, estimated by-catch exceeded the threshold. The Indicator Assessment did not change whether the by-catch estimates for 2019 or 2020 were used.

Harbour porpoise - Iberian Peninsula AU

The ICES (ICES 2021a) outputs were unable to provide an estimate of harbour porpoise by-catch for the Iberian Peninsula AU due to zero reported cases of by-catch through observer programmes during the assessment period between 2015 and 2020. The ICES WKMOMA 2021 data call requested data between 2005 and 2020, and the dataset submitted by Portugal included data from several on board observer programmes in the Portuguese Iberian coast for the requested period, ranging from the annual DCF programme for fisheries monitoring, to data from observation programmes dedicated to marine mammals / birds / reptiles from several other projects. Overall, from this period (between 2005 and 2020), only one by-catch event of harbour porpoise was observed, which was in 2012. The dataset included data reported for several métiers monitored in each year.

However, the submitted dataset included only one part of the data from a large research programme (LIFE project MarPro) dedicated to by-catch in Portuguese fisheries' monitoring several métiers through different methods in the Bay of Biscay and Iberian coast MSFD subregion. Results from this project include the confirmation that by-catch of harbour porpoise occurred on a regular basis during the period between 2010 and 2012 (ICES 2021a; Vingada and Eira 2018; Vingada et al., 2012). On the Iberian coast (ICES Division 9.a), harbour porpoises are reported by-caught mainly in polyvalent boats operating bottom-set nets (gill or trammel nets) and beach seine. Overall, average/numbers per year from the Portuguese fleet exceed 200 individuals which is of concern due to the low population estimates for the area and the additional pressure from the Spanish fleet in the region (Vingada and Eira, 2018). The low population density of porpoises in the Iberian Peninsula AU, coupled with a high level of gillnet fishing activity and frequent stranding records with signs of by-catch, suggests that this population is severely affected as a result of by-catch (Carlén et al., 2021; ICES 2021a).

It can be further added that project MarPro collected data in 2010, 2011, 2012 either from strandings (Table e) and from onboard observers, fishers' logbooks and fishers' questionnaires, with each of these methods applied to several fleets (purse seine, multi-gear, bottom trawl, set longlines for deep water species and beach seine nets). The results are summarised in Table f and this information demonstrates the occurrence of by-catch events of harbour porpoise by several fishing fleets / métiers in the period between 2010 and 2012 in Portuguese waters of the Iberian coast.

Within the MarPro project, the data were then analysed to obtain an estimate of the number of individuals that may become by-caught in one year taking into consideration the monitoring effort deployed and the fishing effort of each fishing fleet / métier. Results from MarPro were used when reporting under the MSFD second cycle in order to assess the harbour porpoise population occurring in the Portuguese continental shelf associated to the Iberian coast, which was considered not to be in good status due to by-catch (MM, 2020). Nevertheless, these estimates of by-catch rates and of total number of individuals by-caught as determined in the MarPro project need to be used with caution, since the analysis was based on several assumptions and there are data limitations which need to be taken in account, especially concerning the métier level, the fishing depth of gear in the water column, the soak time of the passive gears and the geographical area considered.

Therefore, although it was not possible to assess this AU in the same way as the other AUs for harbour porpoise, there is evidence that by-catch occurs in practice and is heavily impacting the population within this AU.

There are also data from Spanish waters of by-catch through strandings analysis which may further increase the approximate figure of > 200 animals per annum, resulting in an unquantified number of harbour porpoise by-caught annually in the Iberian Peninsula AU (Vingada and Eira, 2018). Vinaga and Eira (2018) predicts that approx 12% of by-caught harbour porpoise make landfall and are therefore recorded through the strandings programme which further throws into question the actual number of animals impacted annually.

The low population abundance of porpoises in the Iberian Peninsula AU (estimated 2 898), coupled with a high level of gillnet fishing activity and frequent stranding records with signs of by-catch, suggests that the population is severely affected as a result of by-catch (Carlén et al., 2021). Therefore, although there is no by-catch assessment for this AU, driven by the lack of observer records, it is very likely that the threshold of zero is exceeded (STECF 2021).

Common dolphin

Common dolphin is assessed at a single AU level given the far-ranging nature of the species, and the lack of evidence of finer scale population structure (Murphy et al., 2021). This AU was assessed against the mPBR threshold, calibrated to the ASCOBANS conservation objective of restoring or maintaining the population to at least 80% of carrying capacity with probability 0,8 over 100 years. This threshold set by mPBR is lower than the PBR threshold calculated by WKEMBYC (ICES 2020a) because the ASCOBANS conservation objective is aiming for 80% of carrying capacity whereas the US MMPA conservation objective is 50% of carrying capacity. Irrespective of whether the mPBR or PBR is used, estimated by-catch is exceeding the threshold for common dolphins in the North-East Atlantic in both 2019 and 2020.

Grey seal - Celtic Seas AU (Region III)

Given the potential for masking of regional impact for this species due to the large AUs, two population values were calculated for the Celtic Seas AU (OSPAR Region III). These values support a disparity in distribution within the AU, with a Nmin of 38 766 for OSPAR Region IIIa in the north, encompassing South-West Scotland, western Scotland and the Western Isles; and a Nmin of 22 014 in OSPAR Region IIIb in the south, encompassing South-West England, Wales, North-West England, Northern Ireland and Ireland. The higher by-catch risk in the south is therefore acting on a smaller local population size than is evident at the wider AU level (Luck et al., 2020; Kingston et al., 2021). Further evidence and discussion are required to appropriately partition the OSPAR Region III Celtic Seas AU in relation to grey seal movements and genetic analysis.

Results (figures & tables)

OSPAR Region	**AU**	**Threshold setting approach**	**Abundance estimates**	**Threshold values (anthropogenic removal via by-catch)**	**By-catch estimates (2020) Red = threshold exceeded**
Harbour porpoise					
II	Greater North Sea	RLA	Nbest = 345 000 CV = 0,18 (239 000 - 483 000)	1 622	5 974
III / IV	Irish and Celtic Seas	mPBR	Nbest = 47 000 CV = 0,14 (35 300 - 60 800)	82	751
III	West Scotland and Ireland	mPBR	Nbest = 44 300 CV = 0,14 (33 400 - 57 700)	78	305

IV	Iberian Peninsula	mPBR	Nbest = 2 900 CV = 0,32 (1 500 - 5 100)	0	No estimate from observer data*
Common dolphin					
II, III, IV	North-East Atlantic	mPBR	Nbest = 634 000 CV = 0,31 (336 000 - 1 092 000) Common dolphin and unidentified (common or striped) combined total	985	6 406
Grey seal					
II	North Sea	PBR	Nmin = 119 519	7 171	704
III	Celtic Seas	PBR	Nmin = 60 780	3 647	1 632

*see Results and Results Extended text

Table d: Overview of threshold values and estimated by-catch per AU. Abundance estimates are rounded. Approximate 95% Confidence intervals were computed assuming a log-normal distribution. (https://en.wikipedia.org/wiki/Log-normal_distribution

Fishing fleet/métier	**Monitoring method**	**N individuals**	**2010**	**2011**	**2012**
Undefined	Strandings network	Stranded porpoises	14+5=19	33+3=36	15+4=19
		Subset of stranded porpoises that were analysed	11+3=14	20+3=23	12+4=16
		Subset of stranded porpoises that were analysed and diagnosed with bycatch as the cause of death	8+1=**9**	11+0=**11**	6+1=**7**

Table e: Numbers of stranded individuals of harbour porpoise recorded in Portuguese waters of the Iberian coast according to reports from the LIFE project MarPro. Data is provided for three consecutive years (2010 to 2012) and separates two stranding network units (“north-west coast” and “south coast

Fishing fleet/métier	**Monitoring method**	**2010**	**2011**	**2012**
Purse seine	On board observers	0	0+1=**1**	0

	Fishers logbooks	0	0	0+**1=1**
	Questionnaires to fishers	0+1=**1**	-	0
Multi-gear	On board observers	0	0	1+0=**1**
	Fishers logbooks	-	0	0
	Questionnaires to fishers	4+2=**6**	-	5+0=**5**
Bottom trawl	On board observers	0	0	0
	Fishers logbooks	-	-	-
	Questionnaires to fishers	0	0	0
Set longline for deep water species	On board observers	0	0	0
	Fishers logbooks	-	-	-
	Questionnaires to fishers	0	0	0
Beach seine nets	On board observers	5+0=**5**	-	-
	Fishers' logbooks	5+1=**6**	-	-
	Questionnaires to fishers	-	-	-

Table f: Numbers of by-caught individuals of harbour porpoise recorded in Portuguese waters of the Iberian coast according to the LIFE project MarPro. Data is provided separately per fishing fleet/method, monitoring method and year. The table includes all animals reported ("dead" + "alive").

Conclusion (brief)

Harbour porpoise, common dolphin and grey seal are the most commonly by-caught marine mammal species in the OSPAR Maritime Area according to records from observer monitoring. By-catch levels are exceeding the calculated thresholds for cetaceans but not seals in the AUs assessed in the QSR 2023. Harbour porpoise is exceeding the threshold in the four assessed AUs. Common dolphin is exceeding the threshold in the single AU assessed. Grey seal is below the threshold in the two assessed AUs, and this species is thought to be increasing in abundance across its North-East Atlantic range.

Data availability was poor due to large gaps in coverage of observer data. There was low to moderate consensus in methodology / maturity of methodology. Despite these caveats, it is clear that by-catch is occurring at high levels that do not align with the OSPAR Strategy of tackling biodiversity loss and of minimising, and where possible eliminating, incidental by-catch.

Conclusion (extended)

In 2020, it was estimated that more than 7 000 harbour porpoises died as a result of by-catch in the areas assessed. Thresholds were estimated to have been exceeded in all AUs (Greater North Sea, Western Scotland and Ireland, Irish and Celtic Seas, Iberian Peninsula) where the indicator is common (candidate indicator: https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/marine-mammal-bycatch-pilot). In the same year, an estimated 6 400 common dolphins were by-caught in the North-East Atlantic, exceeding the threshold for this single AU. Approximatively 2 300 greys seals were by-caught in 2020, but thresholds were not exceeded in the Celtic Seas or North Sea Aus (candidate indicator: https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/marine-mammal-bycatch-pilot).

Results with respect to threshold exceedance differ between seals and cetaceans, but remain congruent on the overall conclusion that by-catch of marine mammals is a widespread and significant pressure in the OSPAR Maritime Area. This must be addressed to meet the aims of the OSPAR Strategy to minimise, and where possible eliminate, incidental by-catch of marine mammals so that it does not represent a threat to the protection and conservation of these species by 2025.

Confidence Statements

The assessment is undertaken using data on marine mammal abundance with a spatial coverage and temporal extent that is mostly sufficient for the area assessed. With respect to by-catch data however, despite an unprecedented effort as testified by WKMOMA (ICES 2021a), there remain substantial gaps in coverage resulting in a low data availability, mainly owing to the absence of a dedicated monitoring of marine mammal by-catch by onboard observers across the OSPAR Maritime Area.

There is moderate / low confidence in the methodology used in this assessment. There is consensus within the scientific community regarding this methodology. However, as the method has been developed specifically for this assessment and has not been more widely used it is considered moderate / low.

Knowledge Gaps (brief)

Marine mammal by-catch monitoring

A robust assessment of by-catch crucially hinges on an appropriate collection of effort data as well as targeting of observer effort in relevant fisheries across all range states (e.g., coverage of relevant vessels). Moreover, standardisation of by-catch data recording is also required to enable the comprehensive analysis at the AU / OSPAR scale.

Abundance and distribution information

All threshold setting methods require accurate and recent abundance estimates. In the case of seals, improved distribution data are needed to delineate AUs, especially in OSPAR Region III. For cetaceans, dedicated surveys (e.g., SCANS) at regular intervals must take place to produce confidence in abundance estimates.

Knowledge Gaps (extended)

Overlap of harbour porpoise populations in the Kattegat

Although overlapping partially with the OSPAR Maritime Area, the Kattegat and Belt Seas AU for harbour porpoises was not assessed. The northern part of the Kattegat and Belt Seas AU is occupied by harbour porpoises from two genetically distinct populations – the North Sea population and the Kattegat / Belt Seas population (Sveegaard et al., 2015). Animals from both populations are at risk of being by-caught in each other's AUs. Reported by-catch numbers in the northern Kattegat cannot be reliably assigned to one population or the other. An assessment of Kattegat and Belt Seas AU for harbour porpoises will be provided by HELCOM.

By-catch data

By-catch estimates provided by a dedicated workshop from the International Council for the Exploration of the Sea (ICES 2021a) represent the best available estimates given the underlying data. There are still many data gaps regarding the information and reporting of by-catch events, which cannot be addressed with the EU data collection framework (EU MAP) alone but require accurate declarations obligations and dedicated monitoring programmes (STECF 2021). Additional sources of by-catch data include strandings (ICES 2021b) or fishers' logbooks. While the former can be used to estimate by-catch - although with caveats - Peltier et al., 2016), the latter has been shown to underestimate by-catch quite severely (Basran and Sigurðsson, 2021). Remote Electronic Monitoring (REM) is a realistic, feasible and cost-effective venue for improved by-catch monitoring (van Helmond et al., 2019; Course et al., 2020; Basran and Sigurðsson, 2021). The pros of REM include cost savings, a better coverage (because REM can be extended to small-scale fisheries), less observer bias, and improved accuracy of self-reporting (van Helmond et al., 2019; Course et al., 2020).

Despite likely under-reporting of by-catch events due to non-dedicated monitoring, estimated by-catch numbers for common dolphins and harbour porpoises exceeded thresholds in their respective AUs. The assessment is thus likely a conservative one, which is cause for concern.

By-catch data on cetaceans is, overall, of low quality to allow a robust estimation of by-catch levels (ICES 2020b, STECF 2021). The situation is even more challenging for seals which are less systematically monitored by stranding networks across the OSPAR Maritime Area (ICES 2021c), resulting in larger data gaps on by-catch for these species. Further consideration of other data types to assess by-catch levels e.g., strandings data and fisher interviews of by-catch and entanglement events could contribute to future assessments in order to make best use of available data on which to base the assessment outcomes. However, further work is required to be able to integrate these data types with confidence and greater gain in confidence would result from improved and dedicated by-catch data collection onboard fishing vessels.

Fishing effort data

By-catch estimates were obtained from raising rates estimated from samples collected by onboard observers to whole fleet using DaS (ICES 2021ª). DaS was considered the most appropriate metrics for measuring effort, because it is a metric that is comparable across countries. Nevertheless, ICES (2021ª) noted that some data gap in DaS and that the allocation of effort to months, areas and métiers is currently country-specific, with no silver-bullet solution to ensure data commensurability between data providers. Improved, and equally importantly, shared procedures should be sought to unify fishing effort data so that assessment at the scale of the OSPAR Maritime Area may be routinely carried out. Other metrics than DaS (e.g., fishing days) may also be more appropriate.

Abundance data

Abundance data are crucial for a robust assessment of marine mammal by-catch as all threshold setting methods requires that one recent abundance estimate (along with a measure of its uncertainty) is available. For cetaceans, the vast majority of abundance estimates come from the latest SCANS surveys, SCANS-III which took place in 2016 (Hammond et al., 2021a). Robust, design-based estimates were used (Hammond et al., 2021b). A fourth SCANS survey is being prepared for the summer of 2022 but it will not deliver results in time for the QSR 2023. Relatively low frequency of widescale survey results in limitations in capacity to identify trends in populations (Abundance and Distribution of Cetaceans: https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/abundance-distribution-cetaceans/) and update management accordingly, particularly in relation to timeframes of assessments for e.g., OSPAR assessments. There is now a commitment from contributing parties to increase the frequency of SCANS surveys to six-yearly intervals. These widescale surveys enable robust assessment of abundance and distribution of cetaceans in the North-East Atlantic area and increased frequency will vastly improve capacity to identify trends in abundance and distribution. By-catch management crucially hinges on accurate and recent abundance information on marine mammals (Wade et al., 2021). Of note though is the need to better discriminate between striped and common dolphins when using aerial surveys: these two species can be difficult to identify from an aircraft, resulting in uncertain species identity and increased uncertainty in abundance estimates (ICES 2020a). The use of digital data (e.g., high resolution pictures or videos) can help in species identification.

With respect to seals, knowledge gaps are highlighted in Seal Abundance and Distribution: https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/seal-abundance-and-distribution/ and Grey Seal Pup Production: https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/grey-seal-pup-production/. The next assessment should endeavour to reduce uncertainty in seal abundance estimates, and to clarify further Assessment Units, especially in the Celtic Seas MSFD subregion / OSPAR Region III (**Figure k**).

Threshold setting methods

Thresholds represent the upmost limit to anthropogenic mortality beyond which conservation objectives will not be met. The threshold values derived are entirely dependent on the conservation objective to be achieved. Furthermore, some model-based threshold setting procedures (including the Removals Limit Algorithm and Potential Biological Removal) require a quantitative objective. OSPAR has agreed a conservation objective that is suitable for model-based threshold setting procedures for marine mammals. However, that conservation objective differs between cetaceans and seals. For cetaceans, the conservation objective is 'the population should be able to recover to or be maintained at [80]% of carrying capacity, with [0,8] probability, within a [100]-year period'. For seals, the conservation objective is 'the population should be able to recover to or be maintained at [50]% of carrying capacity, with [0,95] probability, within a [100]-year period', which corresponds to the conservation objective of the US Marine Mammal Protection Act. The conservation objective for cetaceans aligns with the ASCOBANS “short-term practical sub-objective” “to restore and/or maintain stocks/populations to 80% or more of the carrying capacity” (Res.3.3). There is no equivalent conservation instrument through ASCOBANS for seals in the North-East Atlantic.

To meet these conservation objectives, two control rules, RLA or PBR, can be used. The choice of one rule over another largely depends on data requirements with RLA being more data-hungry but also potentially less conservative than PBR. The only species for which an RLA could be developed was the harbour porpoise, and only in the Greater North Sea AU. For all other AUs for this species, a mPBR was used. Developments of RLAs for the other AUs of harbour porpoises and the other species of marine mammals should be undertaken but this crucially hinges on the availability of historic times series of by-catch estimates. Given the generally poor quality of by-catch data (ICES 2020b), meeting these data requirements for the RLA seems unlikely.

Thresholds are precautionary and aligned with conservation objectives which go beyond the non-deterioration principle and also aim to restore or maintain populations. Current depletion levels of marine mammal populations are largely unknown with some populations nevertheless thought to be depleted or recovering (e.g., seals; Seal Abundance and Distribution / Abundance and Distribution of Cetaceans). Improved knowledge on current depletion levels would allow to update thresholds accordingly.

Likewise, improved knowledge on critical inputs for the modelling necessary to carry out a MSE would enable updates to the thresholds. In particular, an important input is the assumed population growth rate and productivity which control how fast a depleted population may recover. For example, robust values for the recovery factor used in mPBR hinges on correct specification of this input. In particular, the value of this input may already subsume the effects of sub-lethal threats such as (among others) noise or pollution which may decrease the fitness of individuals, and ultimately population growth rate. Currently, the threshold is used only to assess fisheries by-catch. Inclusion of other human activities resulting in removal would result in a lower threshold value for by-catch alone. Further guidance on an allocation process of the total anthropogenic removal limits from multiple causes would benefit future assessments to further refine the by-catch-only thresholds.

Conservation objectives

OSPAR 2021 agreed on a parameterisation for the conservation objective underpinning both mPBR and RLA: "a population should be able to recover to or be maintained at 80% of carrying capacity, with probability 0,8, within a 100-year period". OSPAR applies a time horizon of 100 years as recommended by ICES (2013). This conservation objective is one possible quantitative interpretation of the ASCOBANS interim objective "to restore and/or maintain stocks/populations to 80% or more of the carrying capacity". This objective is more precautionary than the US one set at 50% of carrying capacity (ASCOBANS 1997). Setting such a high standard relative to carrying capacity makes for a lower threshold, which is then compounded under conditions of biases and/or uncertainties in abundance, mortality or productivity. Future policy discussions around conservation objectives must take place in order to resolve long-standing issues (ICES 2013, 2020a), including:

1) The appropriate level of confidence with which the ASCOBANS (1997) conservation objective ‘to allow populations to recover to and/or maintain 80% of carrying capacity in the long term’ should be met. This choice drives the ambition level of the objectives as it strongly influences the population level as a percentage of carrying capacity achieved in the long term.

2) The definition of ‘long term’ to achieve the conservation objective.

3) The definition of a zero-mortality rate goal to minimise and, where possible eliminate, by-catch as required under several international legislations or conservation instruments (e.g., the EU Habitats Directive, OSPAR NEAES 2030). A zero mortality rate goal defines a level below which by-catch has no biologically significant effect on marine mammal populations (although by-catch levels may not be numerically zero; Federal Register 2004). By-catch levels below the zero mortality rate goal would mean that fishing related mortality is no longer a significant factor in the population dynamics

(Federal Register 2004). The US MMPA lists, among others, the following requirements for a zero mortality rate goal: (i) a target for reducing by-catch and a deadline by which the target is to be achieved; (ii) a statement that fisheries that have achieved the target shall not be required to further reduce by-catch; and (iii) a mechanism to reduce levels of by-catch in fisheries that have not met the target.

4) Recommendations on a phase-out rule. A phase-out rule defines the downwards adjustments to be made when absolute abundance estimates required for setting a threshold have not been updated, and run a high risk of de-aligining with current population dynamics.

The current conservation objective requires review to ensure the level of caution applied is appropriate. The 26th Advisory Committee of ASCOBANS agreed to organise an 'Expert workshop to recommend small cetacean conservation objectives in relation to anthropogenic removals'. The aim of this two-part workshop is to decide an appropriate precautionary, yet practical and realistic conservation objective not only for small cetacean species (ASCOBANS 2021).

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Assessment Metadata

Field	Data Type	
Assessment type	List	Indicator assessment
Summary Results (template Addendum 1)	URL	https://odims.ospar.org/en/submissions/ospar_mam_bycatch_msfd_2022_06/
SDG Indicator	List	14.2 By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans
Thematic Activity	List	Biological Diversity and Ecosystems
Relevant OSPAR Documentation	Text	Agreement 2022-03 OSPAR CEMP Guideline: QSR23 Common Indicator Assessment: M6 Marine Mammal By-catch (harbour porpoise; common dolphin; grey seal) Region II, III and IV
Linkage	URL	https://ices-library.figshare.com/articles/report/Workshop_on_estimation_of_MOrtality_of_Marine_MAmmals_due_to_Bycatch/18621857 The Workshop on estimation of Mortality of Marine Mammals due to Bycatch (WKMOMA) addressed a special request from OSPAR regarding the bycatch mortality of marine mammals (harbour porpoise *Phocoena phocoena*; common dolphin *Delphinus delphis*; and grey seal *Halicho-erus grypus*) within the OSPAR maritime area. Detailed results for thresholds: https://www.frontiersin.org/articles/10.3389/fmars.2021.795953/full https://gitlab.univ-lr.fr/pelaverse/rla_paper
Date of publication	Date	2022-06-30
Conditions applying to access and use	URL	https://oap.ospar.org/en/data-policy/
Data Snapshot	URL	https://github.com/osparcomm/By-catch-of-Marine-Mammals
Data Results	Zip File	https://odims.ospar.org/en/submissions/ospar_mam_bycatch_datares_2022_06/
Data Source	URL	https://ices-library.figshare.com/articles/report/Workshop_on_estimation_of_MOrtality_of_Marine_MAmmals_due_to_Bycatch/18621857 https://gitlab.univ-lr.fr/mauthier/qsr2023_m6

OSPAR's Quality Status Report 2023

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Our vision is a clean, healthy and biologically diverse North-East Atlantic Ocean, which is productive, used sustainably and resilient to climate change and ocean acidification.

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