OSPAR CEMP Guideline

Common Indicator: Seal abundance and distribution (M3)

(OSPAR Agreement 2016-11)[1] [2]

This OSPAR biodiversity indicator is still in the early stages of implementation and as a result of iteration and learning, it is anticipated that there will be evolution of the methods and approaches documented in the CEMP guidelines. Version updates will be clearly indicated and be managed in a phased approach via ICG-COBAM through its expert groups and with the oversight and steer of BDC.

Contents

[1] This document exists in English only

[2] Update 2022

1 Introduction

The OSPAR Common Indicator: M3 – Seal abundance and distribution will contribute to assessments of the state of marine mammals and assessments of Good Environmental Status under the Marine Strategy Framework Directive: MSFD criteria: 1.1 Species distribution and 1.2 Population size; MSFD indicators: 1.1.2 Distributional pattern and 1.2.1 Population abundance.

The importance of seals as a component of marine biodiversity has been recognised in that they are included in the Indicative list of characteristics for assessing Good Environmental Status in the Marine Strategy Framework Directive. They are also listed in Annex II and V of the Habitats Directive and so are species which are the subject of additional Community legislation. This indicator would serve to trigger the investigation of possible cause-effect relationships as a basis for measures.

As of 2021, this indicator assesses changes in the abundance and distribution of across OSPAR Regions I, II and III (Arctic Waters, the Celtic Seas and the Great North Sea).

This indicator describes the abundance and changes in distribution for both species, the grey seal (*Halichoerus grypus*) and harbour seal (*Phoca vitulina*) and uses estimates of seal numbers from monitoring programmes many of which began in the late 20th century and are run on a regular basis. The frequency and timing of seal surveys varies among OSPAR Contracting Parties and take place during one or more of a seal key life stage, such as moulting or breeding, when the seal species comes ashore.

Grey seals are highly mobile and range over large distances for individual foraging trips as well as dispersal from breeding sites throughout the year (Russell et al. 2013; Brasseur et al. 2015) so their abundance is assessed at a large scale with the single unit covering OSPAR Regions I, II and III. Harbour seals exhibit limited interchange between areas within these regions (Carroll *et al*. 2020) so their abundance has been assessed at 25 assessment units, although there is limited data for some of these units. The change in distribution for both species is assessed using the same 25 units used for harbour seal abundance. These units were selected to be used as the boundaries had been based on both the ecology of the animals and the scale at which data were collected, and hence a suitable assessment could be made. When data availability limited the ability to provide quantitative data, participating CP's have provided additional qualitative summary statements support conclusions.

2 Monitoring

2.1 Purpose

As top predators, seals may reflect the state of the marine ecosystem. They have a varied diet and are mobile to varying degrees depending on the species, so that their abundance and distribution would be expected to respond to significant natural and manmade changes in the marine environment or at their haul out sites. Natural as well as events with anthropogenic causes, including disease outbreaks, competition with other species, shifts in resources, disturbance, and fisheries interactions are likely to influence distribution and abundance of the species.

Seals were hunted well into the 20th century, resulting in population depletions across OSPAR Regions. Protective legislation to reduce those anthropogenic threats has supported the recovery of colonies in more recent years however the legal removal of seals to protect fisheries or for hunts are still carried out and the persistent threat from bycatch remains present across many areas (Granquist & Hauksson, 2019). Exposure to persistent organochlorine and petroleum compounds are well established as an identifiable cause of substantial historic reproductive failure and hence declines in abundance within the Baltic Sea sub-population of Atlantic grey seals and across the Greater North Sea (Jenssen, 1996; Sørmo et al., 2003; de Wit et al., 2020).

Further changes in distribution or declines in abundance would signal the need for further investigative research to establish a cause.

2.2 Quantitative Objectives - Temporal trend and spatial distribution for the monitoring programme

The monitoring required for seal indicator M3 records numbers and locations of individuals on land at colonies or haul out sites throughout the Arctic Seas, Great North Sea, and the Celtic Seas (OSPAR Regions I, II and III).

Monitoring should be conducted on a site-by-site basis and needs to be representative of each assessment unit. Monitoring must coincide with the period of pupping or moulting and some additional work to establish the local phenology is required to ensure monitoring is appropriately timed. Seal phenology will vary not only from species to species but can also vary from one Assessment Unit to another.

In an ideal world, both grey and harbour seals would be surveyed repeatedly throughout the year. However, in most areas this level of monitoring is not economically feasible, and most CPs undertake population counts in one or perhaps two seasons of the year. There are two key periods during the year when most grey and harbour seal surveys take place, which cover key life-stages –breeding (pupping) and moulting. Harbour seals give birth to pups in early summer and moult in late summer. During the latter period, usually in August, when large numbers of harbour seals, including juveniles and non-breeders are hauled out, is often utilised for surveying. Atlantic grey seals pup in the autumn or winter and moult in early spring. The frequency of surveys varies across CPs during these periods due to differences in the total number of resident animals, funding, geography, and historical development of the monitoring programmes. Particularly for grey seals, choosing an ideal single time to survey is difficult because of the potential discrepancy between the breeding population and the population present during other times of the year (Brasseur et al. 2015; Russell et al. 2013).

2.3 Monitoring Strategy

Data collection is largely carried out and funded by national monitoring schemes (see Annex 2 and 3 for details of current and known seal monitoring programmes in each Assessment Unit).

Most schemes have a central data storage mechanism (e.g. national database). Colony survey frequency varies by Assessment Unit and ranges from multiple surveys annually to approximately every 5 years.

2.4 Monitoring Methods

All CPs have in place some form of monitoring of harbour seals during their annual summer moulting period (August), when the probability that animals will haul out, and be detectable during a survey, is higher. These surveys are conducted either using ground-based surveys or various aerial imagery techniques.

During the harbour seal moult surveys, most CPs also count grey seals present at the haul-outs although the probability of these animals hauling out during this time of year is variable and not particularly high (Russell et al. 2016). Some CPs in continental Europe also survey grey seals during their annual moulting period in the early spring. Within the UK, grey seal moult surveys are not conducted, but instead the species are monitored during the harbour seal moult surveys between the first and third week of August. For the QSR2023, these data have been used to assess grey seal abundance within the UK. Although variable, summer counts provide an index of abundance that is independent from pup production estimates. For harbour seals, an index of abundance can be estimated from the haul-out counts, here assuming the hauled-out fraction of individuals is stable compared to the total abundance.

Grey seals can form large breeding colonies in the late autumn. In many continental Europe AU's, repeated surveys of the regions are utilised to generate peak counts of hauled out grey seals during the moult. This metric can then be used to examine trends in abundance over time. Counts of pups produced during the breeding season can also be used alongside other parameters to estimate total population size (Thomas et al., 2019). These grey seal pupping data are used for the common indicator M5 – Grey seal pup production and were previously used for part of the M3 indicator in the IA2017 assessment. Following discussions with OMMEG, the increased scale of the assessment area for the QSR2023 has justified the removal of pup production data and the population model that was used in the IA2017 assessment being utilised in this assessment.

2.5 Quality assurance/ Quality Control

Each national monitoring scheme has its own QA/QC protocols, although it is recommended that European standards should be developed. A minimum standard should be to follow internationally recognised monitoring methods and nationally funded monitoring schemes currently meet this standard.

Data reporting, handling and management

Each CP has its own data storage mechanism. Within each assessment unit, indicator M3 is constructed from all available data from constituent CPs before being assessed. For the QSR2023 assessments, national data were submitted to an ICES data portal, which operated as the central data custodian. The data were then disseminated to Sea Mammal Research Unit at St Andrews University (UK) for analysis.

Reporting format (see Annex 2)

3 Assessment

This indicator is generated using time series of seal abundance and distribution data from colonies and haul-out sites along the Great North Sea, the Celtic Seas and Arctic Waters.

Harbour seals and grey seals (for assessing distribution only) were sub-divided into 25 AUs (Figure a). AUs were initially based on proposals by the International Council for the Exploration of the Sea (ICES, 2014a) and have since been further developed through OMMEG, and now for the QSR2023 include Regions I and III to enable the prediction of trends in abundance at the full scale of the Celtic and Greater North Seas and provide valuable insight into Arctic Waters. As previously noted, it is important to note that as the AUs used as part of this assessment reflect a reflect a balance between biological units and feasibility in monitoring and so do not all represent demographically independent populations.

These AUs are the same as those used under M5: Grey seal pup production. Assessment Units were not developed for waters around Greenland and Faroe Isles as the data available were not suitable for a quantitative assessment within QSR2023.

3.1 Data call

Following a Data Call in February 2021; all Contracting Parties were asked to provide data on grey seals and harbour seals for the period 1992–2019. Data for both species were received from the UK, Ireland, France, Belgium, Germany, the Netherlands, Denmark, Sweden, Norway, Iceland and Greenland.

The data request will likely be modified for future assessments as lessons continue to be learned from each round of reporting.

3.2 Preparation of data

Assessment Units

The harbour seal AUs are shown in Figure a. The AUs in the Greater North Sea are broadly similar to those previously defined as OSPAR Ecological Quality Objectives (EcoQO) sub-units and have not changed considerably since this time, bar the addition of other OSPAR Regions. Individual units have been defined based on both an understanding of spatial distribution of haul out sites, local harbour seal population structures and practical monitoring units. For example, while separate AUs, distinct connectivity has been identified between harbour seals in the south of the UK and the Wadden Sea, and across European harbour seals (Goodman, 1998; Olsen et al., 2014, Olsen et al., 2017; Carroll et al., 2020;).

Harbour seals are largely faithful to haul-out areas during their breeding and moult seasons, and as such, the AUs for harbour seal are much smaller than those used for assessing the abundance of grey seals.

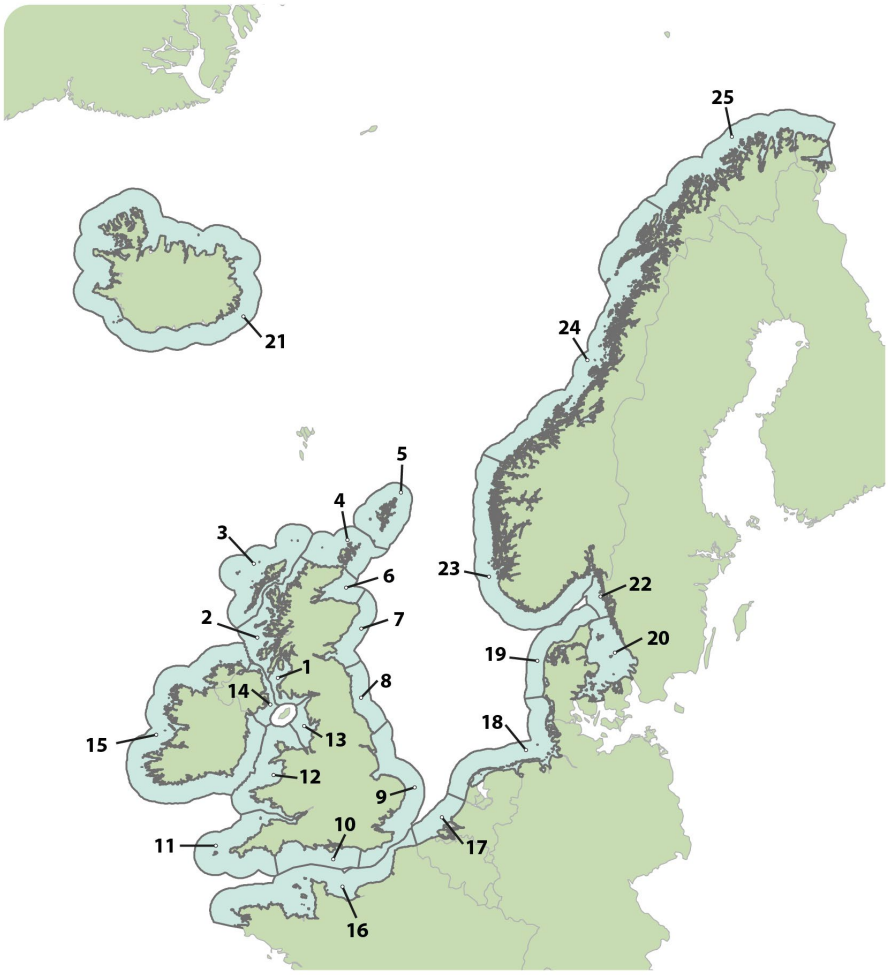

Figure a. Assessment units (AUs) for seal distribution and for harbour seal abundance.

Key: 1. Southwest Scotland, 2. West Scotland, 3. Western Isles, 4. North Coast & Orkney, 5. Shetland, 6. Moray Firth, 7. East Scotland, 8. Northeast England, 9. Southeast England, 10. South England, 11. Southwest England, 12. Wales, 13. Northwest England, 14. Northern Ireland, 15. Ireland, 16. French North Sea & Channel Coast, 17. Belgium coast and Dutch Delta, 18. Wadden Sea, 19. Limfjorden, 20. Kattegat, 21. Iceland, 22. Skagerrak, 23. Norway (Hvaler – Stad), 24. Norway (Stad – Vesterålen), 25. Norway (Troms – Finnmark)

[Grey seal abundance has been assessed at a larger scale with a single AU covering OSPAR regions I, II and III, but for the purpose of analysis, data was requested at the scale of the units presented in this figure.]

Grey seals range more widely at sea than harbour seals and may visit multiple distant haul-out sites. Individual mature grey seals of both sexes are usually faithful to particular breeding sites and may return to within 10–100 m of individual breeding locations (Pomeroy et al., 2000). Insights into the seasonal movement of grey seals in the United Kingdom and France from telemetry data indicate that grey seal breeding distribution can be considerably different from their foraging distribution during other times of the year (Carter et al., 2020, Vincent et al., 2017). Hundreds of pups born in the UK, and adults breeding in the UK are known to visit the Wadden Sea temporarily to feed throughout the year (Brasseur et al., 2015; Russel et al., 2019). Grey seal abundance was therefore assessed on the scale of OSPAR Regions I-III (Figure b).

A single large AU was not considered appropriate for assessing the distribution of grey seals at haul-out/colony sites because of the substantial loss of local-scale information. Grey seal distribution at haul-out/colony sites was therefore assessed using the smaller AUs defined for harbour seals (as below) (Figure b).

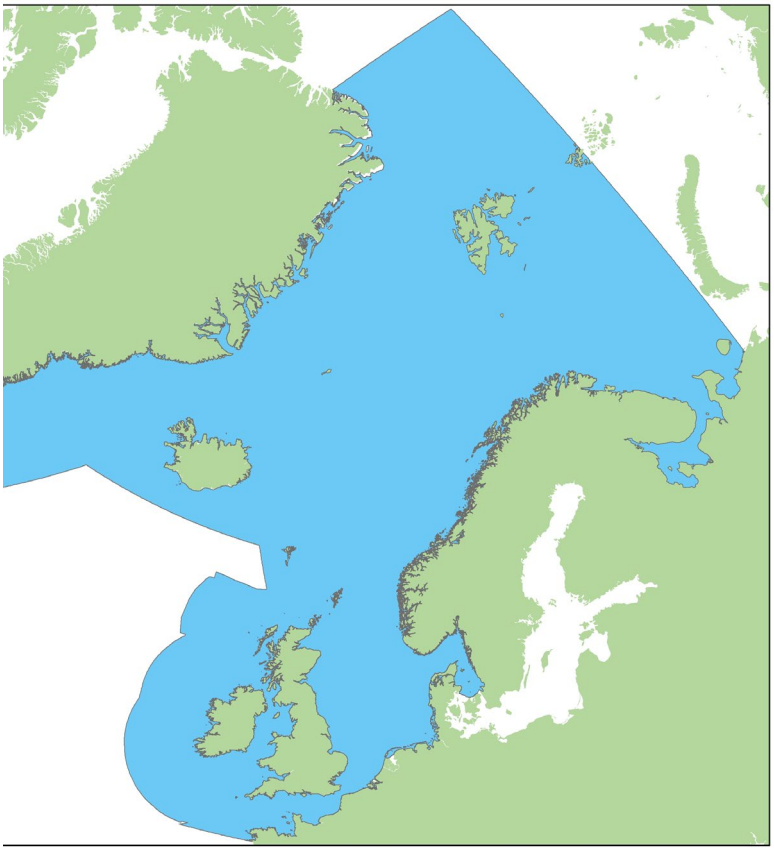

Figure b The single assessment unit for grey seal abundance

3.3 Assessment criteria

The current abundance should, in an optimal approach, be assessed against baselines that equate to reference conditions, i.e., the status at a set at a point in the historical time-series when human impacts were considered to be negligible. However, seals have been historically hunted both illegally and legally and it is not possible to know the undisturbed state, nor, for some areas, the current carrying capacity that could be attained alongside protection from illegal hunting. Time series data for abundance and distribution of both seal species do not provide an indication of a time when seal populations were not impacted by anthropogenic pressures such as hunting or natural diseases and what that would look like in terms of abundance and distribution. It would also be unrealistic to expect to be able to achieve reference conditions again as they reflect a past level of negligible human impact (by definition) which cannot now be restored, given for instance large-scale coastal developments and tourism. Reference conditions would also not reflect changes due to drivers such as climate.

An alternative approach is to set the baseline at a recent value of grey or harbour seal abundance, noting that the baseline could later be changed to a more meaningful value as knowledge allows. ICES WGMME highlighted the problems in setting baselines to the time series and proposed that trend-based targets, such as the EcoQO on grey and harbour seal abundance, which do not require comparison to a baseline, could be adopted for the common indicators (ICES 2014a). As a consequence of these considerations, two baselines were utilised for M3.

1. A ‘fixed’ reference level (1992 or nearest).
2. A ‘rolling’ baseline of the previous reporting round (6 years).

The 1992 fixed reference level year used was selected based on the baseline year used by some Member States for reporting under the European Union Habitats Directive (Council Directive 92/43/EEC). This year does however represent a time following recent protective measures in many countries, and so populations had not yet recovered from severe depletion at this time. For harbour seal, data as far back as 1992 were not available in all AUs; in such cases, the start of the data time series was used as a historical baseline. The baseline year for the long-term trend in grey seal abundance was based on availability of data from the most populous subAUs. Indicator assessment values were set as a deviation from the baseline value (Method 3; OSPAR, 2012). Using these baselines allowed for assessment of trends in the seal populations.

This rolling baseline provides a means to indicate change in population abundance size compared with a previous OSPAR assessment's six-year period (e.g., 2009-2014 in IA2017), rather than relying solely on an historical fixed baseline, which probably reflects a point in time when the when the population is already subject to anthropogenic pressures, such as culling or natural pressures such as phocine distemper virus (PDV) outbreaks.

A potential challenge with this type of quantitative trend thresholds, known as 'shifting baselines' is that each successive assessment uses a different starting point as the basis for comparison. This could result in a substantial cumulative decrease occurring over more than one six-year assessment period not being flagged as a problem, because in each six-year period the rate of decline remained below the assessment value (OSPAR, 2012). Use of the two types of baseline and associated assessment values seeks to provide an indicator that would warn against both a slow but long-term steady decline (the problem of 'shifting baselines' associated with only having a rolling baseline) and against a recovery followed by a subsequent decline (potentially missed with a fixed baseline set below reference conditions). The two assessment values together would be able to act as a trigger for investigation of any necessary management measures to promote recovery. It should however be noted that in many AU's, the baseline year of 1992 represents a severely depleted population state (e.g from PDV outbreaks, or historic anthropogenic removal) and so caution should be taken when interpreting any assessment outputs as the safeguard intended by applying two baselines and assessment values is not present.

Bearing in mind that the arbitrarily assigned baseline does not necessarily reflect a state without impacts, it is not possible to assess the status of seals in relation to the concept of a "favourable conservation status" as applied in the EU Habitats Directive using the assessment values applied in this indicator.

The ICG-COBAM expert group on marine mammals has suggested the following threshold be applied separately to each seal species:

"Maintain populations in a healthy state, with no decrease in population size with regard to the baseline (beyond natural variability) and restore populations, where deteriorated due to anthropogenic influences, to a healthy state".

The M3 indicator assessment values are:

Assessment value 1*:* No decline in seal abundance of > 1% per year in the previous 6 year period (this is approximately 6% over 6 years).

No decline in seal abundance over 6% in the 6-year period. This is approximately 6% over 6 years)

This uses a rolling baseline (Method 1; OSPAR, 2012) based on the most recent six-year period, seeking to identify if seal populations are maintained, with no decrease in population size with regard to the (short-term) baseline (beyond natural variability (<1% per year)) and to identify if efforts are needed to restore populations, where they have deteriorated due to anthropogenic influences, to a healthy state.

To estimate the annual increase or decrease in the number of animals counted within the most recent six-year reporting round, the fitted trend abundance in 2014 was compared against that of 2019. To maximise

robustness of trends, the whole time series provided (ie. pre 2014 and post 2019) were used for both the short and the long-term assessments. This deviates from those methods used previously in 2017 when a trend was fitted to all the available data in each AU for the period 1992-2019 and short-term trends were fitted using only a subset of the time series.

Assessment value 2*:* No decline in seal abundance of >25% since the fixed baseline in 1992 (or closest value).

The baseline chosen (1992) relates to that used by some Member States for reporting under the European Union Habitats Directive (Council Directive 92/43/EEC) (or if such data are not available, the start of the data series). Testing shows that there is sufficient monitoring to assess against this assessment value with confidence. It should however be noted that if data are not available from 1992, and a shorter timescale is assessed, the 25% decline since the baseline is not equivalent to those AUs where data do extend to 1992 (i.e. a 25% decline since 2003 would describe a more rapid contraction in the population than a 25% decline since 1992).

Assessment of distribution

A similar set of assessment values as used for seal abundance were suggested for seal distribution, but as meaningful changes in seal distribution are currently difficult to detect and assess from abundance surveys, this aspect of the indicator will be considered as a 'surveillance indicator'. Describing the distribution of seals from surveys that are designed primarily to assess abundance is problematic because these are designed for when the seals are on land. Any distribution metric based on these data will have inherent limitations arising from three main issues:

a) Spatial coverage: Seal abundance surveys necessarily census animals hauled-out on land and do not consider the distribution at sea. To estimate at-sea usage, long-term telemetry data are necessary (e.g. Jones et al., 2013, Carter et al., 2020).
b) Sampling effort: Ideally in studies of distributional change, a complete and standardized survey is conducted repeatedly in the area of interest. The areas of interest for this indicator assessment are the AUs. AUs are not all surveyed completely on regular basis due to geographical and / or financial constraints. Surveys have been prioritised towards areas of known and high seal occurrence. Statistically, this could lead to a bias in seal distribution metrics due to preferential sampling.
c) Temporal coverage: the surveys cover narrow time windows during key life-stages such as moulting, breeding and pupping. The distribution of seals can be different between these stages. Grey seals, for example, may completely vacate breeding areas for the rest of the year. The present analysis assesses changes in moulting distribution for harbour seals, and changes in breeding colony distribution for grey seals.

Despite these limitations, survey data may be useful to detect large-scale contractions in population distributions in terms of reduced use or abandonment of haul-outs, depending on the spatial resolution with which presence / absence data are reported.

3.4 Statistical Power of Assessments

To address the points above, two assessment values were used to assess grey and harbour seal abundance in each Assessment Unit.

There are many ways in which the number of seals counted during any one year could vary, aside from representing true changes in population size. These include variation in weather, or a disturbance at a haul-out site prior to counting. It is therefore advisable to examine the variability in survey counts and to

incorporate this variability into trend or population size change estimates. The International Council for the Exploration of the Sea (ICES) Working Group for Marine Mammal Ecology (WGMME) (ICES, 2014b) provided general advice on the need to understand the statistical power of current and proposed monitoring programmes.

In the present context, statistical power is the percentage confidence in not missing a significant decline. Statistical power depends on the sample size (number of surveys), the level of statistical significance set (α-level), variance in the counts, and the magnitude of the trend to be detected, that is, -1%/yr (6% over 2014-2019) and -25% (between the historical baseline of 1992 and 2019). The ICES WGMME (ICES, 2014b) recommended that monitoring should achieve a minimum of 80% power – which equates to a 20% chance of making a Type II error (i.e. the frequency with which a true decline would not be detected). The same group also recommended that the threshold for detection of a 'significant' trend be relaxed from the traditional $\alpha = 0.05$ to $\alpha = 0.20$. The α parameter, or significance level, equates to the probability of concluding that a significant trend exists when in fact it does not (Type I error). An α value of 0.2 and power of 80% means there is equal probability of making an incorrect conclusion (either Type I or Type II error) about the detection of a trend. These recommendations have been carried over for the QSR2023 assessments.

Current monitoring programmes vary in the level of statistical power achievable. To carry out a full study of retrospective power to detect changes in the observed population trends, detailed information about the between- and within-year variability in all survey counts would be necessary. A full assessment of power has however already been done for the Wadden Sea and Southern Scandinavia where comprehensive coordinated survey efforts throughout the year provide some of the most robust estimates of trends in seal counts (Meesters et al., 2007; Teilmann et al., 2010). In other areas, however, the survey area is too large or complex so comprehensive and repeated surveys have not been feasible (such as in many parts of the Scottish coast) and the power to detect change in these units is reduced (SCOS, 2020).

Because 80% statistical power is not feasible to achieve in most areas, confidence intervals (CIs) were used to provide a relevant measure of confidence in the assessment. Simply said, they describe the frequency with which the true, unobservable, population parameter (here, the mean count) could be expected to fall within the intervals described by an upper and lower confidence limit. Where the confidence intervals encompass the assessment value, the data do not provide conclusive evidence for the calculated value being above or below the assessment value.

3.5 Development of assessment methods

i. *Abundance*

Generalised linear or additive models (GLMs, GAMs; Wood 2011) were fitted to count data on a log scale using negative binomial error (or a Poisson error distribution if necessary) as part of both assessment values of abundance. All analysis was conducted within R (R Core Team, 2021).

The assessment for grey seal abundance was made based on two separate trends (driven by data availability): summer counts (UK & Ireland) and moult counts (continental Europe). These two generalised additive models allowed a different temporal trend for each subAU, and for these trends to be constant (non-existent), exponential or smooth (not restricted to a simple trend). For summer and moult counts, a combined trend was predicted (with confidence intervals) using parametric bootstrapping.

This is a modification from the 2017 Intermediate Assessment (Russell et al, 2016; Thomas, 2016) in which an age-structured population dynamics model was used to estimate population size through time; pup production estimates (subAU scale) and a single independent estimate of population size (from August counts) were combined with knowledge of demographic parameters within a Bayesian state-space (Thomas et al. 2019). The option of extending the population model used for the IA2017 was considered by OMMEG,

however, the number of assumptions that would have to be made to generate a consistent data set for use in an extended version of the mode, justified the change and has been discussed and approved within the group. The baseline year for the long-term trend was based on availability of data from the most populous subAUs.

Harbour seal abundance is assessed using counts of harbour seals on land at haul-out sites during moult as an index of abundance within each assessment unit. This proxy for population size is an underestimate of the true population size as it includes only those animals hauled out at the time of counting. This metric was previously used to construct the EcoQO on harbour seals.

For all datasets, at least three models were fitted to the count data: an intercept-only GLM (null model), an exponential (linear on the link scale) year effect within a GLM, and a nonlinear smooth year effect within a GAM (restricted to 5 knots). Akaike information criterion (AIC) was used to select a final model.

In contrast to the IA2017, additional models were fitted that offered a step change in abundance and/or trends. Two such change points were offered: 1988-1989 and 2002-2003 (one year earlier for AU 20 Kattegat) representing the Phocine Distemper Virus (PDV) outbreaks. GLMs were fitted offering constant or exponential trends with and without a step change for each inter-PDV period (prior to 1988, 1989-2002, 2002 onwards); exponential trends with the same and different rates of change between these periods were both offered. The final model formulation was selected via AIC. In some AUs there was evidence of a non-linear trend in the final period (2002 onwards), thus for this final period GAMs (smooth trends) were, if preferred by AIC, used instead. Note that a GAM was not offered for the period between the first and second PDV epidemic.

The percentage change in abundance since baseline year (Δbaseline) and 80% confidence intervals were calculated for each AU from fitted values of the short- and long-term assessment periods. 80% confidence intervals were calculated to reflect the choice to set the significance level, α, equal to 0.20 or 20% (Formula A). Where confidence intervals encompass the assessment value, the data do not provide conclusive evidence for the calculated value being above or below the assessment value.

Not all Contracting Parties monitor all sites annually. Assessment of trends in abundance of grey seal and harbour seal has only been completed where at least four data points are available for each assessment unit.

$$\Delta abundance = \frac{C - A}{A} * 100$$

Formula A: Calculation of long-term trend in abundance. Where A is the count fitted by the model in the baseline year and C is the count fitted by the model in the most recent survey year during an assessment of long-term shifts.

ii. ***Distribution***

Moult and summer seal count data for both species that were provided through the Data Call were supplied as "haulout units" with a mixture of point and survey polygons. To explore changes in seal distribution from available survey data, these count data were aggregated to produce presence/absence data on a 15km^2 grid. For the analysis of grey seal distribution, data from UK and Ireland (AU's 1 – 15) were taken from summer counts, and data from elsewhere were taken from the moult counts where available, otherwise summer counts. Comparisons of counts from moult with summer and vice versa within individual AU's were avoided as the distribution of seals between these times may significantly different (Russell et al. 2013).

The presence or absence of seals at monitored haul-out and breeding sites was used to evaluate changes in the number of sites occupied ('occupancy rate') and from this, conclude the number of sites deserted or newly colonised ('distributional shift'). Changes in occupancy rate and distributional shift were compared

using specific years of data (hereafter referred to as 'focal years'), relating to those used for Assessment Values 1 and 2 for both species in each of the 25 AUs (Figure a). This is a deviation the IA2017 assessment of distribution in particular, whereby data were taken in two contiguous windows of 6 years (period A: 2003–2008, period B: 2009–2014). Within this, if a presence was recorded on any of the surveys in a given area (e.g. survey polygon) within the 6 year reference period, then this was counted as a 1 for that period. This previous approach risked comparison between two years with no separation (i.e. an assessment of distribution if presence was recorded in 2008 for period A and in 2009 for period B). The focal years utilised as part of the QSR 2023 were 2014 (Year B) and 2019 (Year C) when analysing short-term trends in distribution, and 1992 (Year A) and 2019 (Year C) when analysing long-term trends in distribution.

When no survey occurred in the focal year, data were taken from the closest survey year whilst still trying to maximise the gap between assessment focal years. For example if there was no survey in focal year 2014, but surveys in 2013 and 2015, 2013 would be selected to maximise the gap to focal year 2019. As often only subsections of the AU are covered in any one year, to get sufficient spatial coverage of the haulout units within an AU, multiple years of surveys occasionally were combined (to a maximum of 3 years) to reach as close to complete coverage as possible for assessment. But if any haulout units were surveyed multiple times, the value from the focal year was taken (e.g. if counts were merged from 2013 and 2014, and a haulout unit was surveyed in both years, the value from 2014 was taken as this is the focal year). Only analytical units (15km^2 grid cells) that were covered in all the focal years were included in analysis, thus comparing equal samples for all assessments. If counts were not present in the focal year, but overlapped in other years, the value from the year closest to the focal year was taken. Furthermore, only analytical units (grid cells) that were covered in all the reference periods were used, thus comparing equal samples for all assessments.

a) Distributional pattern (percentage occupancy)

Percentage change in occupancy by seals between two periods for a given spatial unit:

$$\Delta distribution = \left(\frac{C}{N} - \frac{A}{N}\right) * 100$$

Formula B: Calculation of changes in distributional pattern. Where A is the number of grid cells occupied by seals during Year A; C is the number of grid cells occupied in Year C and N is the total number of spatial units surveyed in the AU during an assessment of long-term shifts.

b) *Shift in occupancy*

An index to describe the overall shift in the seasonal distribution of seals between grid cells over time:

$$Shift = \frac{2(A\&B)}{A + B}$$

Formula C: Calculation of shift index. Where A&C is the number of identical grid cells occupied in both Year A and Year C within an assessment of long-term shifts. The shift index value is between 0 and 1: a value of 0 indicates that there has been a complete shift in the spatial units occupied; a value of 1 indicates there has been no shift.

3.6 Presentation of assessment results

Data need to be collated for each assessment unit and then analysed to provide an estimate of abundance at a location. Any changes in abundance can then be compared to the threshold values. For QSR 2023 the data will be collated and assessed for each AU centrally by Sea Mammal Research Unit, St Andrews (UK).

The method of presentation used for assessments so far is shown by an example of harbour seal abundance. Harbour seal abundance assessment results showing each Assessment Unit against the threshold of no decline in abundance of more than 25% since baseline year on a map is shown in Figure c. A second example using the same format and showing harbour seal abundance for each AU assessed against the threshold of no decline in mean annual abundance of more than 6% in the previous 6 years is shown in Figure d.

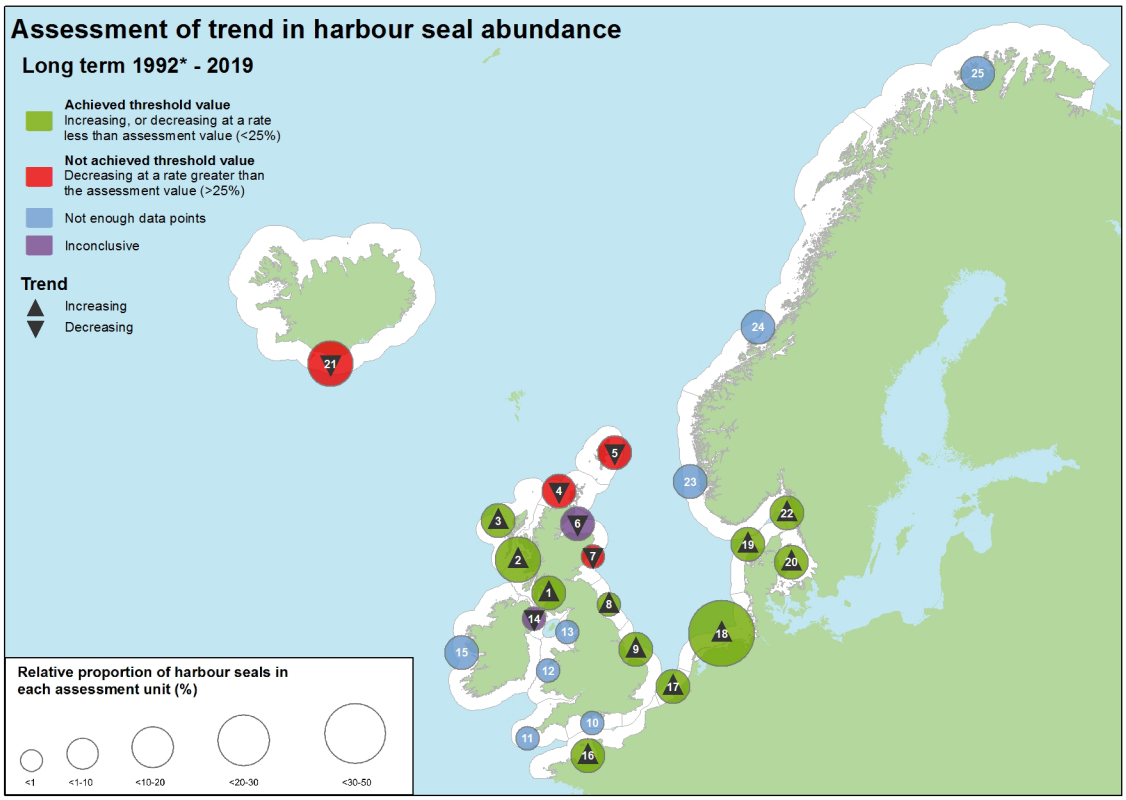

Figure c. Example of a display format for a harbour seal abundance assessed against a threshold of no decline >25% since 1992.

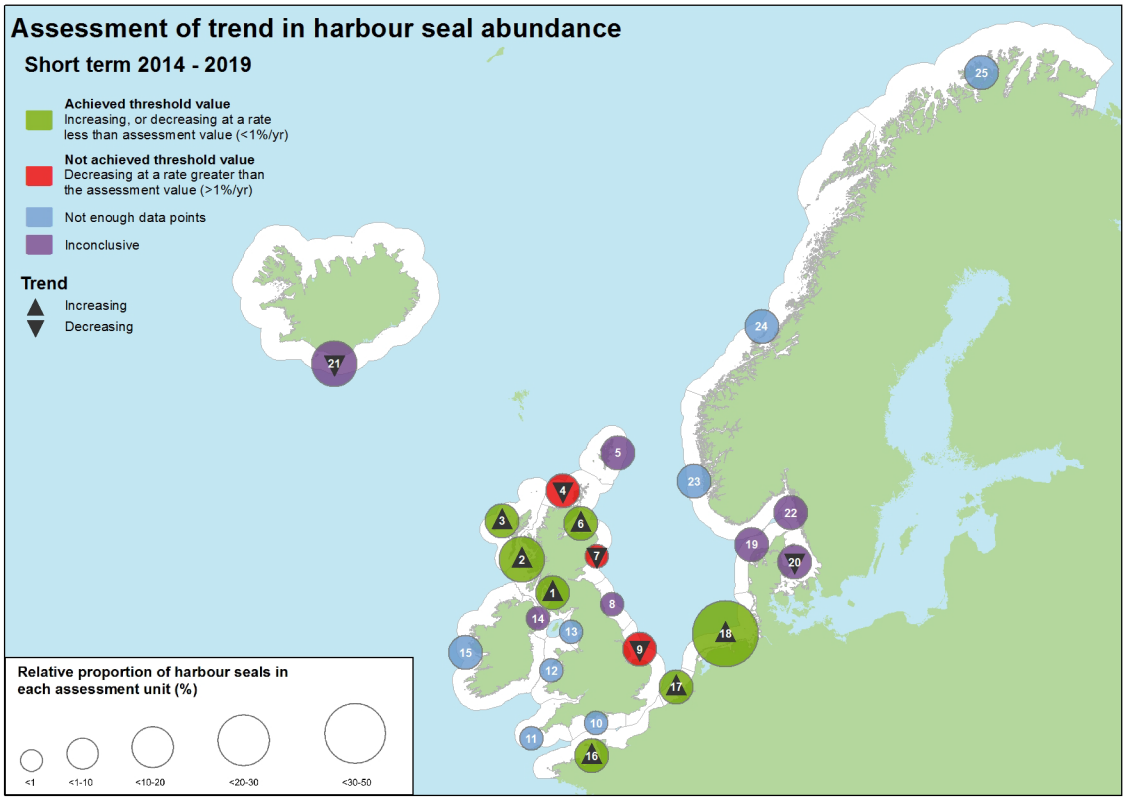

Figure d. Example of a display format for a harbour seal abundance assessed against a threshold of no decline in abundance >6% in the previous 6 years (approximately 1% per year).

The interim assessment provided a table with an arrow indicator for the change in occupancy result. ↑ indicated an increase in occupancy of 10% or more, ↓indicated a decrease of 10% or more and ↔ a change in either direction of <10%. For this assessment it was determined that this threshold could be misleading as it is strongly influenced by the number of analytical units (grid cells) in each AU. Instead of this arrow system, the percentage change in occupancy, and the number of cells included in the analysis for each AU has been reported.

4 Change Management

The common indicator is maintained under ICG-COBAM which is under BDC.

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Annex 1. Instructions for filling in the OSPAR Seal Data Reporting Format (February 2021)

Since the last OSPAR seal data call in 2016, some changes have been made to the data format and to the data submission method. These changes have been necessary to store new variables not included in 2016 but which are in the new OSPAR Biodiversity Database hosted and maintained by ICES. Please ensure you read all the guidance below:

- **Always use the latest version of the reporting sheets, which will be delivered as part of the OSPAR data call. Do not use old versions.**
- **Please do not use any thousand separators (commas, apostrophes, or blanks) in number fields.**
- **Latest guidance and formats will always be available on http://biodiversity.ices.dk**

1. Data Use

Contracting Parties will report data (as specified below) that will enable an assessment, of two Biodiversity Common Indicators:

M3 - Seal abundance and distribution (harbour and grey seal)

M5 - Grey seal pup production

These indicators have been adopted by some Contracting Parties as part of their cooperation with other EU Member States in implementing the Marine Strategy Framework Directive (MSFD - 2008/56/EC).

The data will also contribute to OSPAR achieving its thematic strategy on Biological Diversity and Ecosystems; in particular with the "regional, coordinated development of monitoring and assessment of marine biodiversity and ecosystem functioning".

Marine mammals, including seals, are top predators, and comprise an important part of marine biodiversity. Seals are most reliably counted when they are hauled out on land, and counts are usually conducted during breeding or moulting seasons. The current monitoring does not account for distribution at sea. Further information on the assessments and required spatial scale is provided below. Current and known plans for monitoring harbour and grey seals are detailed in Annex 1 to Annex 3. A glossary of key terms is in Annex 4.

M3 - Seal abundance and distribution (harbour and grey seal)

The distribution and abundance assessments for both grey and harbour seal (M3) use counts of hauled out animals, as well as location of haulouts surveyed.

- **Harbour seal moult counts** – all counts of harbour seals by haulout unit (see next section for description of unit) and Assessment Unit made during their moulting period for that year.
- **Harbour seal pup counts** – where available, all counts of harbour seals by haulout unit and Assessment Unit made during their pupping period for that year

- **Grey seal moult counts** – where available, all counts of grey seals by haulout unit and Assessment Unit made during their moulting period for that year.
- **Grey seal August counts** – where available, all counts by haulout unit and Assessment Unit of grey seals made during the harbour seal moult surveys.

M5 - Grey seal pup production

For the assessment of grey seal pup production, counts of hauled out grey seal pups during the pupping/breeding season are used, as well as location of breeding colonies surveyed:

- **Grey seal pup counts** – all counts of grey seal pups by breeding unit divided into categories if used (e.g. dead, alive, whitecoat, moulted).
- **Grey seal pup production** – estimates of total pup production if available.

Spatial scale (count locations)

The count data are requested on two spatial scales depending on the indicator:

- Haulout units (required) and by AU (if available) for M3 harbour and grey seal abundance and distribution.
- Breeding unit (required) and by AU (if available) for M5 grey seal pups.

Assessments of distribution of hauled out seals of both species, harbour seal abundance and grey seal pup production are made at the scale of the assessment units (AUs) in Figure 1. Grey seals are highly mobile and range over large distances, so their abundance will be assessed at a larger scale with a single AU covering

OSPAR regions I (Arctic Waters), II (Greater North Sea) and III (Celtic Seas), but for the purpose of analysis, data are requested at the scale of the grey seal pup production units (Figure 1).

The finer resolution (haulout unit or breeding unit) will allow investigation of changes in harbour seal distribution (of haulout units) and in grey seal distribution (of haulout units and breeding units). Each finer resolution data entry should be ascribed to one of the relevant AUs (see Figure 1).

To generate the M3 distribution indicator, submitted data will need to be converted into gridded presence/absence data covering OSPAR regions I, II and III. All data should be provided by the scale of a haulout unit, or on a 5 x 5 km grid. To minimise the processing required to submit data, haulout unit is an arbitrary unit which can represent part of what may biologically considered a haulout (e.g. a count associated with the location of an individual photograph), a haul out or a cluster of haulouts. Haulout units for which the spatial extent is < c. 2.5 km can be input as Points. Polygons should reflect the approximate extent of haulouts/clusters and can be used instead of points for any haulout unit but must be used for any haulout units which are >2.5 km in spatial extent. Haulout units do not need to be consistent across surveys, but every haulout unit must be described in **Table 4. Haulout/breeding unit description.** A new haulout unit in Table 4 should be added if the location of the associated point or the extent of the associated polygon has changed since the last survey – this is important for the distribution element of the indicator. For example, for a particular haulout (e.g. Pandora Sands), there may be two associated haulout units, one for surveys in prior to 2000, and one for post 2000 due to a movement of the sandbank.

For M5 assessments, distributional change is not examined in the same way and thus data should be provided by individual breeding unit. 'Breeding unit' refers to a grey seal breeding colony(ies) on which pup counts and pup production estimates are provided. Irrespective of spatial extent, such colonies can be represented by points or polygons and must be identifiable (i.e. consistent) between surveys.

Unless data are provided on a 5 x 5 km grid, survey effort data must also be provided for the M3 indicator (**Table 5. Seal_Survey_Effort)** so areas of no seals can be distinguished from areas from areas of no survey. Such data should be provided per survey round (e.g. one row for each moult survey conducted in a year). Survey data should be indicated as a polygon. Effort data is not necessary for M5 breeding units because breeding units stay constant through time and thus survey effort will be indicated by the presence of a count (e.g. 0). All survey IDs should be added to **Table 5. Seal_Survey_Effort** whether spatial information is required or not. Where spatial information is not required (for M5 grey seal pup data and for M3 data supplied on a 5 x 5 km grid) 'breeding units' or '5km grid' can be selected under data_resolution and survey effort containing presence and absence data can be selected under data_type.

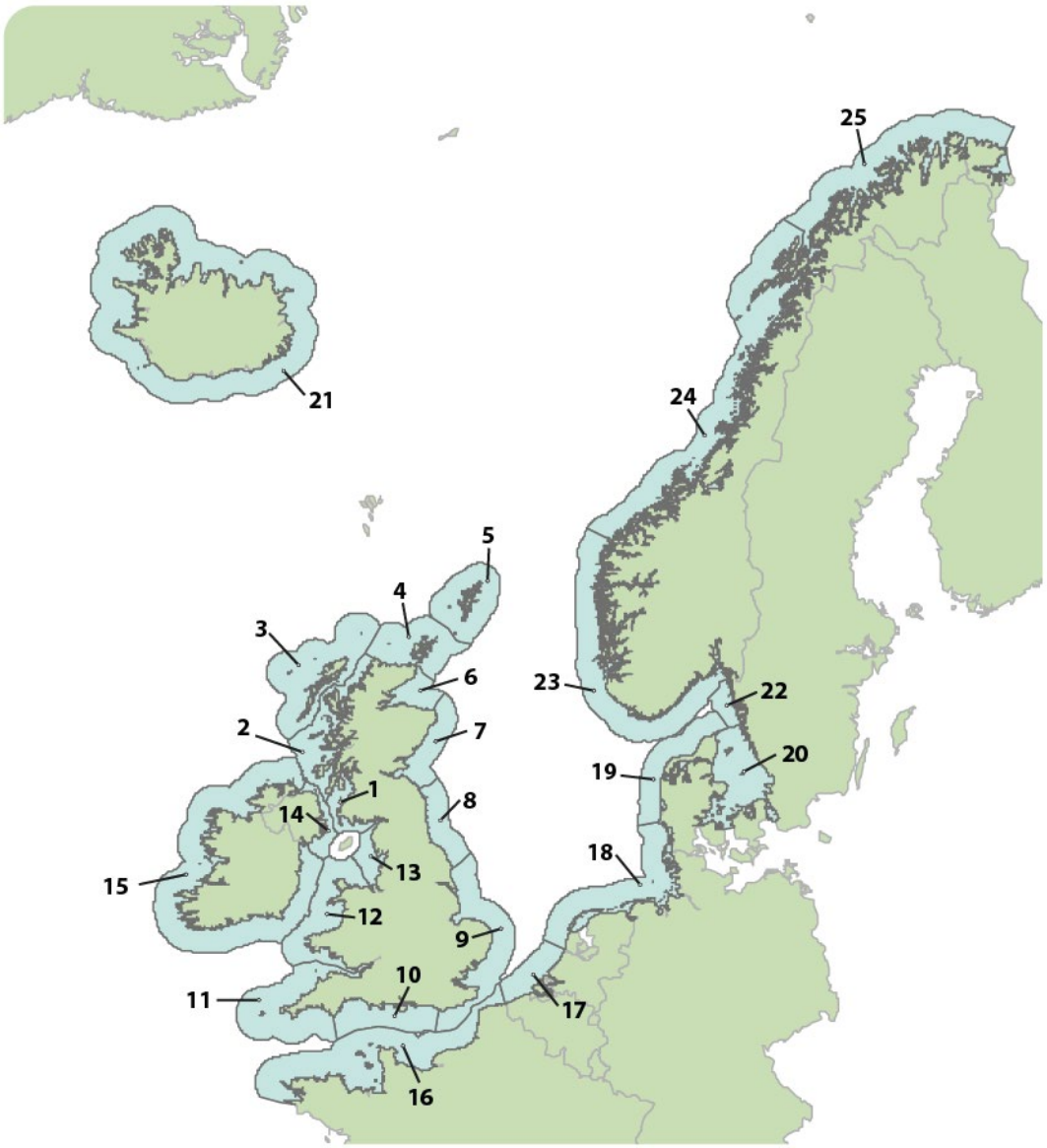

Figure 1. Assessment units (AUs) for distribution for both species indicators, harbour seal abundance and grey seal pup production. [Grey seal abundance will be assessed at a larger scale with a single AU covering

OSPAR regions I, II and III, but for the purpose of analysis, data are requested at the scale of the units presented in this figure.] More information on the AUs are available as a shapefile: here: https://odims.ospar.org/layers/geonode:ospar_assessment_areas_2021_02_001

1. Southwest Scotland, 2. West Scotland, 3. Western Isles, 4. North Coast & Orkney, 5. Shetland, 6. Moray Firth, 7. East Scotland, 8. Northeast England, 9. Southeast England, 10. South England, 11. Southwest England, 12. Wales, 13. Northwest England, 14. Northern Ireland, 15. Ireland, 16. French North Sea & Channel Coast, 17. Belgium coast and Dutch Delta, 18.Wadden Sea, 19. Limfjorden, 20. Kattegat, 21. Iceland, 22. Skagerrak, 23. Norway MA1 (Lista – Stad), 24. Norway MA2 (Stad – Lofoten), 25. Norway MA3 (Vesterålen – Varanger).

2. Reporting Format 2021

To report data on seals, please use the latest version of the document "OSPAR_Seals_reporting_format.xlsm" available from http://ices.dk/data/data-portals/Pages/Biodiversity.aspx.

The data required are described in detail in Tables 1-6 below. For code and drop-down references please refer to the vocabulary lists that accompany the MS Excel data entry sheets:

a) **File_information**
b) **Seal_AU_totals**
c) **Haulout_Breeding_Unit_Abundance**
d) **Unit_description (for haulout / breeding units)**
e) **Seal_survey_effort**
f) **Seal_survey_programme_metadata**

3. Submitting data online

Each Contracting Party should submit their data to the ICES data portal. **Data submission deadline is 28-Feb-2021.**

Step 1: The Excel sheets should be downloaded via http://ices.dk/data/data-portals/Pages/Biodiversity.aspx and filled out with data.

Step 2: When the data sheets are filled out, the <**Export data to XML**> button on the 'Export_data' worksheet should be pressed to produce the xml data file (see Figure 2).

> ***Note:*** *the Excel file contains macros that are used for transforming the worksheets to the XML data format for uploading. Generally, you should only enable macros from a trusted source, please ensure you download the Excel file from ICES directly to be sure of a clean, virus free file.*

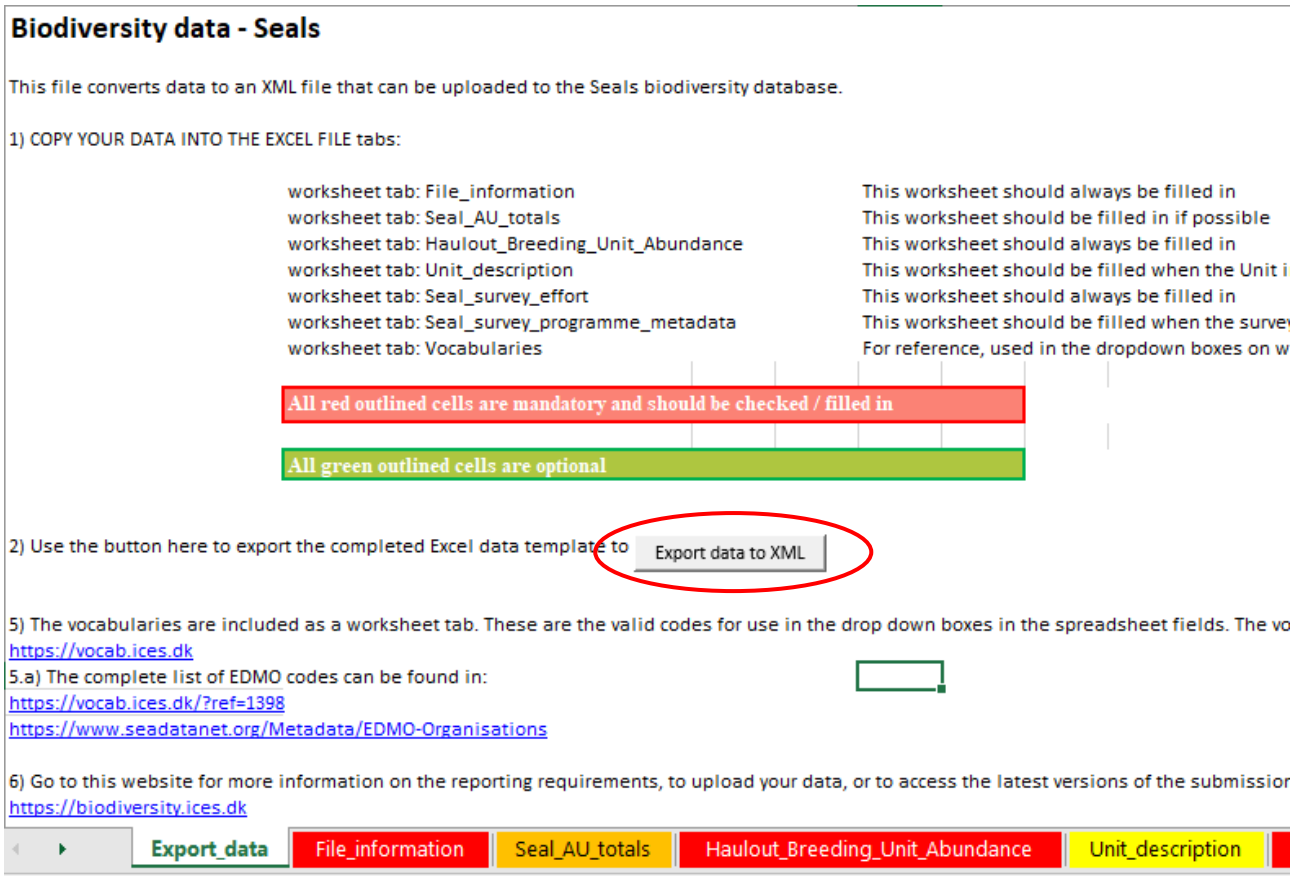

Figure 2. Excel sheet with the button for XML export.

Step 3: The XML file should then be uploaded to the ICES website (**http://biodiversity.ices.dk/ManageSeals**).

Login

A login is required in order to upload and manage data. The ICES sharepoint login can be used, if you do not have an ICES login please contact accessions@ices.dk

During data submission, data will be checked for correct use of vocabulary codes and data types. This quality control will ensure that the data standards have been met, a report of control issues will be generated and made available to the submitter online. Data not complying with the correct format will not be accepted by the uploading utility.

The Excel worksheets are described on the following pages. Fields marked in red are mandatory whereas fields marked in green are optional. The sheets [File_information], [Seal_AU_totals], [Haulout_breeding_unit_abundance] and [Seal_survey_effort] are the actual data tables that are to be submitted every year, whereas the worksheets [Unit_description] and [Seal_survey_programme_metadata] are reference tables that are filled out initially, and only updated when changes occur.

Some fields have specific 'fixed' values that need to be entered. These values are contained in the sheet 'Vocabularies' included with the Excel data entry sheets.

Data Access

OSPAR is committed to making as much information as possible publicly available, consistent with achieving other similarly important goals of public policy. The framework for this is set out in Article 9 of the OSPAR Convention and Annex 3 of the OSPAR Rules of Procedure (2013-2).

Contracting Parties should contact Chris Moulton (chris.moulton@ospar.org) if they have any queries over what data to include in the submissions.

Data access can be specified by the submitters directly in the submission form as:

Public Data are sourced outside the terms of the OSPAR data policy and are publicly accessible

Restricted Data, in their reported form, are not to be made publicly accessible. All aggregated data products are, by default, publicly available, including those derived from restricted data

Data will be made available in line with the terms of the OSPAR Data Policy where they are not restricted: https://odims.ospar.org/data_policy.html

Table 1. File information

Column Header	Optional / mandatory	Format Example	Explanation
Country	Mandatory	SE	ISO 3166 Code (2 ALPHA) (Vocabulary)
Reporting_organisation	Mandatory	3512	EDMO code lookup (Vocabulary)
Contact	Mandatory	Jon Smitsson	Name or email for point of contact for data submission (person who can direct queries to relevant survey co-ordinator or data manager)

Table 2. Seal AU Totals

Column Header	Optional / mandatory	Format Example	Explanation
Species_name	Mandatory	*Phoca vitulina*	Scientific name, according to the World Register of Marine Species (WoRMS) – www.marinespecies.org Vocabulary: *Phoca vitulina* (harbour seal); *Halichoerus grypus* (Atlantic grey seal)
Focal_year	Mandatory	1989	This year which the data most pertains to. If the AU is covered in a single year, this is the survey year. If providing an AU total derived from incomplete surveys over multiple years this should be the year which you think best represents these data.
Start_year	Optional	1987	Please include a row for each year from 1980 (or earliest year) to 2019. Enter different start and end years if providing an AU total derived from incomplete surveys over multiple years.
End_year	Optional	1989	Enter different start and end years if providing an AU total derived from incomplete surveys over multiple years.

Seal_assessment_unit	Mandatory	20	Refer to Figure 1. Vocabulary: 1, 2……25.
PARAM	Mandatory	Pup count	Vocabulary: pup count (all); adult/juvenile count; total count (all ages); pup production.
Value	Mandatory	400	Number of individuals or pups; or pup production
Estimate_type	Mandatory	Count on single day	Type of abundance estimation Vocabulary: modelled estimate; count on single day; count over multiple days; counts over multiple years; maximum; average
Activity_type	Mandatory	GSM	Activity within the unit related to the species being reported, i.e. moult or breeding counts for harbour seal, and summer, breeding or moult counts for grey seal. Vocabulary: moult; breeding; summer.
Survey_start_month	Optional	03	Start month of the survey, MM
Survey_end_month	Optional	06	End month of the survey, MM
Survey_programmeID	Mandatory	1	This is a unique identifier that provides links to Table 6 - Survey_programme_metadata
Data_access	Mandatory	Public	Indicates if data are public or restricted “Public” for data that are publicly accessible “Restricted” if data, in their reported form, are not to be made publicly accessible. All aggregated data products are, by default, publicly available, including those derived from restricted data

Table 3. Haulout_Breeding Unit Abundance

Column Header	Optional / mandatory	Format Example	Explanation
Species_name	Mandatory	*Phoca vitulina*	Scientific name, according to the World Register of Marine Species (WoRMS) – www.marinespecies.org Vocabulary: *Phoca vitulina* (harbour seal); *Halichoerus grypus* (Atlantic grey seal)
Year	Mandatory	1987	The year that the reported data applies to. Please include a row for each year from 1980 to 2019.
Date	Optional (mandatory for pup counts only)	20160921	The date (yyyymmdd) count was made. Mandatory for pup counts, optional for all others.
UnitID	Mandatory	4427	A national unique numerical identifier for each unit (used to link to Table 4 – Haulout_breeding_unit_description). Allow for multiple entries of a unit in the same year if multiple counts available.
PARAM	Mandatory	Pup count (all)	Vocabulary: pup count (all); pup count (whitecoat); pup count (moulted pups); pup count (dead pups); pup count (other categories); adult/juvenile count; total count (all ages); pup production. Please note if dead pups are included separately, they should not be included in whitecoat or moulted pups.
Value	Mandatory	400	Number of adults or pups; or pup production
Estimate_type	Mandatory	single count	Type of abundance estimation Vocabulary: modelled estimate; single count
Activity_type	Mandatory	GSM	Activity within the unit related to the species being reported, i.e. moult or breeding counts for harbour seal, and summer, breeding or moult counts for grey seal. Vocabulary: moult; breeding; summer.

Survey_start_month	Optional	03	Start month of the survey, MM
Survey_end_month	Optional	06	End month of the survey, MM
SurveyID	Mandatory	1	This is a unique identifier that provides links to Table 5 - Seal_survey_effort
Survey_programmeID	Mandatory	1	This is a unique identifier that provides links to Table 6 - Seal_survey_programme_metadata
Data_access	Mandatory	Public	Indicates if data are public or restricted "Public" for data that are publicly accessible; "Restricted" if data, in their reported form, are not to be made publicly accessible. All aggregated data products are, by default, publicly available, including those derived from restricted data;

Table 4. Unit_description (for haulout / breeding units)

Column Header	Optional / mandatory	Format Example	Explanation
UnitID	Mandatory	4427	A national unique numerical identifier for each count site (used to link to Table 3 – Haulout_Breeding Unit_Abundance).
Unit_name	Optional	Lazy Sandbank	free text
Unit_type	Mandatory	Breeding unit	Vocabulary: breeding unit, haulout unit
Geometry_type	Mandatory	Point	Vocabulary: point; line; polygon
Latitude	Optional	61.36	If providing point data. WGS84, decimal degrees
Longitude	Optional	-6.97	If providing point data. WGS84, decimal degrees
Polygon	Optional	{ "type": "Feature", "geometry": { "type": "LineString",	Define the polygon using GeoJSON (http://geojson.org/)

		“coordinates”: [
		[102.0, 0.0], [103.0, 1.0], [104.0, 0.0], [105.0, 1.0]
		]
		},
		“properties”: {
		“prop0”: “value0”,
		“prop1”: 0.0
		}
		}
			WGS84, decimal degrees

Area_type	Optional	OSPARRegion	Area reference type. Vocabulary: OSPARRegion
Area_reference	Optional	2	Vocabulary: 1 = Arctic Waters, 2 = Greater North Sea, 3 = Celtic Seas, 4 = Bay of Biscay and Iberian Coast, 5 = Wider Atlantic
Seal_assessment_unit	Mandatory	20	Refer to Figure 1. Vocabulary: 1, 2……25.

Table 5. Seal_Survey_Effort

Column Header	Optional / mandatory	Format Example	Explanation
SurveyID	Mandatory	A	Use a unique identifier that provides link to the survey for which data is being provided as per Table 3 – Haulout/breeding unit Abundance. One row show be provided by survey round. E.g. one per duplicate moult survey in a given year
Survey_programmeID	Mandatory	1	This is a unique identifier that provides links to Table 6 – Seal_survey_programme _metadata
PlatformClass	Mandatory	Land	Please fill out the survey platform, use only one option per cell. Vocabulary: aerial, boat, land (ICES accepted vocabulary)
Count_method	Mandatory	Observed	Please fill out the count method, use only one option per cell.

			Vocabulary: observed, photo
Start Date	Mandatory	20160821	Date which the survey started on
End Date	Mandatory	20160825	Date which the survey ended on
Data_resolution	Mandatory	Haulout units	Please fill out the resolution for the data being provided. Spatial effort data supplied as a polygon or multipolygon is required if M3 data is not supplied on a 5 x 5 km grid. M5 grey seal pup data and M3 data supplied on a 5 x 5 km grid do not require spatial effort data. Vocabulary: haulout units, breeding units, 5km-grid
Data_type	Mandatory	Presence only	Please select one option for data type to describe the survey effort. Vocabulary: Presence&absence, presence only
Geometry_type	Optional	Polygon	Effort data supplied as a polygon or multipolygon is required if M3 data is not supplied on a 5 x 5 km grid. M5 grey seal pup data and M3 data supplied on a 5 x 5 km grid do not require a polygon, so the field can be left blank. Vocabulary: polygon, multipolygon.

Polygon	Optional	{ “type”: “Feature”,
		“geometry”: {
		“type”: “LineString”,
		“coordinates”: [
		[102.0, 0.0], [103.0, 1.0], [104.0, 0.0], [105.0, 1.0]
		]
		},
		“properties”: {
		“prop0”: “value0”,
		“prop1”: 0.0
		}
		}
			Define the polygon or multipolygon covered using GeoJSON (http://geojson.org/)
			WGS84, decimal degrees

Table 6. Seal_survey_programme_metadata

Column Header	Optional / mandatory	Format Example	Explanation
Survey_programmeID	Mandatory	1	Use a unique identifier that provides link to the survey programme for which data is being provided as per Table 2 – Seal_AU_totals or Table 3 – Haulout_Breeding Unit_Abundance or Table 5 – Seal_survey_effort
Programme_name	Mandatory	Seals Monitoring Programme (SMP)	Full name of survey with abbreviation in parentheses.
Start_year	Mandatory	1986	Enter the year the survey started.
End_year	Optional	2005	Enter the year the survey ended. If the survey is ongoing, please leave blank.
Country	Mandatory	SE	ISO 3166 Code (2 ALPHA) – see Vocabulary. Enter one country only per cell.
Institute	Mandatory	"3512" for The Swedish Agency for Marine and Water Management	Data monitoring organisation. EDMO code lookup (Vocabulary)
Contact	Optional	Jon Smitsson	Point of contact for survey (e.g. co-ordinator or data manager).
Website	Optional	www.slu.se/en/seals	Website dedicated to survey (or survey protocol) if available.
Survey_protocol	Optional	Counts are usually conducted between 10:00 and 16:00 (local time) within 2 hours of low tide in dry weather	Free text Please add additional information on survey protocol (e.g. counts are usually conducted between 10:00 and 16:00 (local time) within x hours of low tide in dry weather).
References	Optional	Smitsson et al (2012)	Any relevant references that describe methods and/or results.

Annex 1. Current and known plans for monitoring harbour seals during the moult in the OSPAR area (adapted and updated from ICES 2014b).

Country	MSFD assessment unit	Monitoring method	Comments
Ireland	Entire coast	Single aerial survey, approximately every 6 years	Three such surveys to date (2003, 2011-2012, 2017-2018)
Ireland	East and Southeast Ireland	Aerial survey of known moult sites	Commenced in 2013 on an annual basis. Data yet to be analysed.
Ireland	Southwest Ireland	Combination of boat-based and ground-based counts of key sites	Began in 2009. Efforts mainly centred on SACs for the species
Ireland	West Ireland	Combination of ground-based and boat-based counts of key sites	Began in 2009. Mainly ground-based counts. Efforts mainly centred on SACs for the species
Ireland	Northwest Ireland (not formalised within MSFD and under review)	Ground-based counts of key sites	Began in 2009. Efforts mainly centred on SACs for the species
United Kingdom	Shetland	Single aerial survey, approximately every five years.	_
United Kingdom	Orkney and North Coast	Single aerial survey, approximately every five years.	_
United Kingdom	Moray Firth	Repeat annual aerial survey for part of the Moray Firth	_
United Kingdom	East coast Scotland	Single aerial survey, approximately every five years. Single annual aerial survey in Firth of Tay.	_
United Kingdom	Southeast England	Repeat annual aerial survey.	_
United Kingdom	Southwest Scotland	Single aerial survey, approximately every five years.	_
United Kingdom	West Scotland	Single aerial survey, approximately every five years.	_
United Kingdom	Western Isles	Single aerial survey, approximately every five years	_
United Kingdom	Northern Ireland		No formal monitoring programme in place yet for Irish section but is currently under consideration.
Netherlands**Error! Bookmark not defined.**	Wadden Sea, Dutch Delta	Wadden Sea and Dutch Delta: Repeat annual aerial survey.	Monitoring also undertaken during pupping.

Germany**Error! Bookmark not defined.**	North Sea: Wadden Sea (Lower Saxony/Hamburg, Schleswig–Holstein)	Aerial survey conducted five times per year from June to August.	Monitoring also undertaken during pupping.
Germany**Error! Bookmark not defined.**	North Sea: Helgoland	Daily land counts	Since 2016. Monitoring also undertaken during pupping.
Denmark**Error! Bookmark not defined.**	North Sea: Wadden Sea	Repeat annual aerial survey (two flights).	One survey also undertaken during pupping.
Denmark**Error! Bookmark not defined.**	North Sea: Limfjord	Repeat annual aerial survey (two flights).	One survey also undertaken during pupping.
Norway/Sweden	Skagerrak and Oslo Fjord	Annual aerial survey (Skagerrak East coast: three flights within two-week moult survey season by Sweden).	_
Denmark/Sweden	Baltic Sea: Kattegat	Repeat annual aerial survey (two flights in Denmark, three flights in Sweden, within the two week moult survey period). Breeding only monitored in Denmark.	Monitoring also undertaken during pupping.
Denmark/Sweden	Baltic Sea: Belt seas	Repeat annual aerial survey (two flights).	
Norway	West coast, south of 62°N	Aerial survey, every five years.	_
France	French North Sea and Channel coasts	Baie du Mont Saint Michel – aerial surveys, 18 per year + 15 census (boat and land).	Monitoring also undertaken during pupping.
France	Baie de Somme and adjacent haul-outs	Land census every ten days (January–June). Daily from June to September	_
France	Baie des Veys.	Monthly land and aerial surveys	_

Annex 2. Current and known plans for monitoring harbour seals during the moult, and where applicable, concurrent grey seal counting (August) in the OSPAR area (adapted and updated from ICES 2021 & ICES 2014b).

<table>
<tr><th>Country</th><th>OSPAR Assessment Unit</th><th>Monitoring region</th><th>Monitoring method</th><th>Grey seals August counts (in conjunction with harbour seal moult counts)</th><th>Comments</th></tr>
<tr><td rowspan="11">United Kingdom</td><td>1. Southwest Scotland</td><td rowspan="9">Entire coast</td><td rowspan="5">Single aerial survey, approximately every five years.</td><td rowspan="9">Y</td><td rowspan="9">_</td></tr>
<tr><td>2. West Scotland</td></tr>
<tr><td>3. Western Isles</td></tr>
<tr><td>4. North Coast & Orkney</td></tr>
<tr><td>5. Shetland</td></tr>
<tr><td>6. Moray Firth</td><td>Repeat annual aerial survey for part of the Moray Firth</td></tr>
<tr><td>7. East Scotland</td><td>Single aerial survey, approximately every five years. Single annual aerial survey in Firth of Tay.</td></tr>
<tr><td>8. Northeast England</td><td>Single aerial survey, approximately every five years.</td></tr>
<tr><td>9. Southeast England</td><td>Repeat annual aerial survey.</td></tr>
<tr><td>10. South England</td><td colspan="4">N/A</td></tr>
<tr><td>11. Southwest England</td><td colspan="4">N/A</td></tr>
</table>

	12. Wales	N/A			
	13. Northwest England	N/A			
	14. Northern Ireland			-	No formal monitoring programme in place yet for Irish section but is currently under consideration.
Ireland	15. Ireland	Entire coast	Single aerial survey, approximately every 6 years	N	Three such surveys to date (2003, 2011-2012, 2017-2018)
		East and Southeast Ireland	Aerial survey of known moult sites		Commenced in 2013 on an annual basis. Data yet to be analysed.
		Southwest Ireland	Combination of boat-based and ground-based counts of key sites		Began in 2009. Efforts mainly centred on SACs for the species
		West Ireland	Combination of ground-based and boat-based counts of key sites		Began in 2009. Mainly ground-based counts. Efforts mainly centred on SACs for the species
		Northwest Ireland (not formalised within MSFD and under review)	Ground-based counts of key sites		Began in 2009. Efforts mainly centred on SACs for the species
France	16. French North Sea & Channel Coast	French North Sea and Channel coasts	Baie du Mont Saint Michel – aerial surveys, 18 per year + 15 census (boat and land).	Y	
		Baie de Somme and adjacent haul-outs	Land census every ten days (January–June). Daily from June to September		–

		Baie des Veys	Monthly land and aerial surveys		
Belgium	17. Belgium Coast & Dutch Delta	N/A			
Netherlands[3]		Dutch Delta	Monthly aerial survey	Y	
	18. Wadden Sea	Wadden Sea	Repeat annual aerial survey (two flights).		
Germany[3]		Wadden Sea (Lower Saxony/Hamburg, Schleswig–Holstein)	Aerial survey conducted five times per year from June to August.	Y	
		Helgoland	Daily land counts		
Denmark[3]		Wadden Sea	Repeat annual aerial survey (two flights).		
	19. Limfjorden	Limfjord	Repeat annual aerial survey during moult (two flights), one annual survey during pupping.	Y	
	20. Kattegat	Baltic Sea: Kattegat	Repeat annual aerial survey (two flights in Denmark, three flights in Sweden, within the two week moult survey period). Breeding only monitored in Denmark with one annual survey.	Y	
Sweden					

	22. Skagerrak	Skagerrak and Oslo Fjord	Annual aerial survey (Skagerrak East coast: three flights within two-week moult survey season by Sweden).		–
Norway	23-25. MA1-3	West coast, south of 62°N	Aerial survey, every five years.	N	–
Iceland	21. Iceland	Entire coast	Aerial survey, annual surveys carried out approximately every five years since 1980. Survey frequency has increased to every two-three years since 2015	Y	2014 survey was a partial census where only the larger harbour seal haul-out sites were surveyed

Annex 3. Current and known plans for monitoring grey seals during the moult (spring) in the OSPAR area

Country	OSPAR Assessment Unit	Monitoring region	Monitoring method	Comments
France	16. French North Sea & Channel Coast	French coast	Combination aerial and land surveys, ~2-3 per month	
Belgium	17. Belgium Coast & Dutch Delta	Belgium Coast	Voluntary observers report almost daily on haul out numbers, often accompanied by photographs	Seal haul-out sites are small and in close proximity to coastal towns. No dedicated monitoring by scientists
Netherlands[3]		Dutch Delta	Monthly aerial survey	
	18. Wadden Sea	Wadden Sea	Aerial survey conducted five times per year from November to March/April.	
Germany		Wadden Sea (Lower Saxony/Hamburg, Schleswig–Holstein)	Aerial survey conducted five times per year from November to March/April.	
		Helgoland	Daily land counts since 2016.	
Denmark		Wadden Sea	Aerial survey conducted five times per year from November to March/April.	
Denmark	20. Kattegat	Kattegat	Aerial survey conducted 3 times during the Baltic grey seal pupping and moulting seasons and from 2021.	Dedicated moult survey for grey seals in May-June

Annex 4. Glossary.

Unit refers to the spatial scale at which data are provided, i.e. assessment unit, haulout unit or breeding unit, and is defined throughout.

Haulout unit is an arbitrary unit which can represent part of what may biologically considered a haulout (e.g. a count associated with the location of an individual photograph), a haul out or a cluster of haulouts. Haulout units for which the spatial extent is < c. 2.5 km can be input as Points. Polygons should reflect the approximate extent of haulouts/clusters and can be used instead of points for any haulout unit but must be used for any haulout units which are >2.5 km in spatial extent.

Breeding unit refers to a grey seal breeding colony(ies) on which pup counts and pup production estimates are provided. Irrespective of spatial extent, such colonies can be represented by points or polygons and must be identifiable (i.e. consistent) between surveys.

Survey ID is a unique identifier that provides a link to the survey effort for which haulout unit or breeding unit abundance data is being provided.

Survey programme ID is a unique identifier for the survey programme, that provides a link between survey programme metadata, survey effort and the AU, haulout unit or breeding unit abundance data that is being provided.