

# CEMP guideline M4

Version 4.0 March 28 2019

## Common indicator: Abundance and distribution at the relevant spatio-temporal scale of cetacean species regularly present (M4) – version March 2019

(OSPAR Agreement 2018-09)<sup>1</sup>

*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, approaches and values 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	Introduction	2
2	Monitoring	2
2.1	Purpose	2
2.2	Quantitative Objectives	2
2.3	Monitoring Strategy	3
2.4	Sampling Strategy	4
2.5	Quality assurance/ Quality Control	4
2.6	Data reporting, handling and management	5
3	Assessment	5
3.1	Data acquisition	5
3.2	Preparation of data	5
3.3	Assessment criteria, values and units	5
3.4	Spatial Analysis and / or trend analysis	7
3.5	Presentation of assessment results	8
4	Change Management	8
5.	References	8

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<sup>1</sup> 2019 Version

# 1 Introduction

Cetaceans are widely distributed in a range of habitats and are present throughout the OSPAR Maritime Area. A total of 35 cetacean species have been recorded within OSPAR Regions II, III and IV, although only around a dozen occur commonly: In the Greater North Sea, Celtic Seas, Bay of Biscay and Iberian Coast, it is estimated that more than 1.5 million individuals occur, with their distribution extending beyond the OSPAR area.

Many of the less common species have their main ranges outside the OSPAR Regions and therefore are impossible to monitor systematically within OSPAR.

The M4 indicator for cetaceans has the potential to address two relevant criteria of the EU Commission Decision on GES (2017/848):

- D1C2 “The population abundance of the species is not adversely affected due to anthropogenic pressures, such that its long-term viability is ensured” (primary criterion).
- D1C4 “The species distributional range and, where relevant, pattern is in line with prevailing physiographic, geographic and climatic conditions” (primary criterion).

This CEMP guideline describes monitoring methods for<sup>2</sup>;

- M4-A Abundance and distribution of killer whales (pilot assessment)
- M4-A1 Abundance and distribution of coastal bottlenose dolphins
- M4-B Abundance and distribution of cetaceans other than killer whales and coastal bottlenose dolphins

Monitoring effort and assessments are made at the relevant species-specific temporal and spatial scale.

These guidelines are mainly based on the current M4-indicators and Intermediate Assessment 2017, and can be updated in the future to reflect new insights.

## 2 Monitoring

### 2.1 Purpose

As top predators, cetaceans can indicate the state of the marine ecosystem. Their abundance and distribution would be expected to respond to changes in human activities and environmental changes, including climate change. Natural factors and factors due to anthropogenic activities including disease, competition with other species, resource depletion, pollution, (acoustic) disturbance, and fisheries interactions are likely to have an effect on distribution and abundance. Although no straightforward causal relationships between cetacean abundance and distribution, and human activities have been established in the OSPAR regions, a number of human activities may, at least in part, be drivers of numerical and distributional changes. These CEMP guidelines provide a framework to monitor cetacean abundance and distribution within the OSPAR regions. The M4-indicator and consequently these CEMP guidelines do not explicitly link abundance and distribution to anthropogenic activities. The monitoring of anthropogenic activities and their effects on cetacean abundance and distribution requires another monitoring approach, not included in the M4-indicator.

### 2.2 Quantitative Objectives

The geographical scope of the indicator is species dependent. With the exception of some coastal bottlenose dolphins (M4-A1), cetacean populations extend over large spatial scales beyond national boundaries and often beyond European North Atlantic waters.

Monitoring of cetaceans should be undertaken at the appropriate spatial and temporal scale per species to detect a decline or increase in population size. A good understanding of natural variability and patterns of movement is

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<sup>2</sup> The OSPAR Marine Mammal Expert Group (OMMEG) will advise to BDC2019 to combine these three assessment methods back into one in order to facilitate a more comprehensive monitoring and assessment in the future, towards QSR2023 and thereafter. For now the methods remain separated in this document.

required prior to concluding that a decline or increase in population size has taken place, and further knowledge is needed prior to linking such changes to anthropogenic activities.

### 2.3 Monitoring Strategy

For cetaceans, there is currently no internationally coordinated monitoring scheme at the relevant spatial scales<sup>3</sup> needed for the assessment of these wide-ranging species. Large scale international surveys such as SCANS (Small Cetaceans in European Atlantic waters and the North Sea) and CODA (Cetacean Offshore Distribution and Abundance in the European Atlantic) are regarded as most suitable for the monitoring of those populations that have a wide range, while photo identification and capture–mark–recapture methods are most suitable for small local coastal/resident populations. The SCANS surveys were conducted in 1994, 2005 and 2016 (Hammond et al., 2002; 2013; 2017), and CODA in 2007 (CODA, 2009). These surveys were organized bottom-up, coordinated by the University St Andrews (UK) and were not initiated by an overarching body like OSPAR. Results of these surveys, complemented with results from national surveys to provide finer scale local density data and more spatially explicit distribution information, were used for the OSPAR Intermediate Assessment 2017 (<https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/>).

There is a general lack of data to fulfil the six-yearly reporting requirements under the Habitats Directive and the Marine Strategy Framework Directive for most species/areas. The SCANS-surveys have been conducted with an 11 year interval, and are thus not frequent enough to generate new data every six years. Power analysis of the current decadal SCANS surveys showed that the statistical power to detect trends over short-time periods is low but will increase with a higher survey frequency. The more frequently conducted national surveys are currently restricted to parts of OSPAR Regions II, III and IV. Ideally an increase in the frequency of the large scale SCANS-survey to at least once every six years, preferably complemented with more frequent regional monitoring using the same methods as SCANS<sup>4</sup>, would improve assessments. Alongside regular coordinated large scale surveys, emphasis should also be put into the integration of the results from national and other small scale surveys using standardized methods. For small coastal populations annual photo-ID mark recapture methods have shown adequate power to assess trends in abundance, and, in addition, allow the gathering of other useful data (i.e. reproduction, mortality and age-structure). Passive acoustic monitoring can be the most efficient method to monitor harbour porpoises in areas with low densities or low visibility (e.g. the Wadden Sea). The minimum requirements to obtain the necessary temporal coverage and to enable the assessment of changes, are summarised in Table 1.

Table 1: Suggested minimum requirements for monitoring of abundance and distribution of all species under indicator M4.

	<b>Regional monitoring</b>	<b>SCANS type surveys</b>
<b>Frequency of data collection</b>	Annually to fill in gaps between SCANS type surveys	Ideally, at least every 6 years
<b>Monitoring method</b>	Line transect distance sampling methods: shipboard or aerial.  Mark-recapture Photo-ID  Passive acoustic monitoring (PAM)	Line transect distance sampling methods: shipboard and aerial
<b>Who is responsible for monitoring?*</b>	CP for national monitoring schemes, CP cooperation needed	CP cooperation, coordination body to be determined (OSPAR/lead CP?)
<b>Frequency of indicator update and assessment</b>	6 years (MSFD/HD reporting cycle)	6 years (MSFD/HD reporting cycle)
<b>Minimal amount of monitoring locations</b>	Monitoring must cover representative parts of CP's waters in the OSPAR subregions.  Photo-ID for relevant coastal	Monitoring should ideally cover all OSPAR regions

<sup>3</sup> An advice from OMMEG about a structural international strategy on a relevant temporal (frequency to be decided) and spatial scale (dependent per species) will be presented to BDC in March 2019.

<sup>4</sup> Frequency to be determined based on power analyses

	populations PAM stations dependent on area	
<b>Current data availability</b>	National monitoring in national databases	3x SCANS/CODA, not yet available in ODIMS but in OBIS Seamap

\* All member states have a legal obligation to monitor cetaceans for the implementation of the EU Habitats Directive (HD), Marine Strategy Framework Directive (MSFD) and other agreements.

## 2.4 Sampling Strategy

The abundance of cetaceans can be monitored using a variety of techniques; which method is most appropriate depends on the species or population (Evans & Hammond 2004; Hammond 2010). For M4 assessment, the objective of the monitoring is to detect trends in abundance. Frequencies of surveys should be such to allow appropriate estimation of trends and ensure continuous adequate information for MSFD (and HD) 6-yearly reporting cycles.

Dedicated line transect (sightings) surveys (Buckland *et al.*, 2001) using ships and/or aircraft to cover the survey area, are expected to be the most effective method to provide abundance estimates for species that range widely over large areas (ICES, 2014). These design-based estimates can be supplemented with model-based estimates, especially where there is the potential to include more frequent but smaller scale surveys into a modelling framework (e.g. Gilles *et al.*, 2016; Paxton *et al.*, 2016).

The data used to infer distribution (MSFD Criterion D1.1 – Species Distribution) and to estimate abundance (MSFD Criterion D1.2 – Population Size) so far mostly have derived from large-scale aerial and shipboard surveys that used line transect methodology to generate robust estimates of abundance: SCANS (Hammond *et al.*, 2002), SCANS-II (Hammond *et al.*, 2013), CODA (Cetacean Offshore Distribution and Abundance in the European Atlantic; CODA, 2009) and SCANS-III (Hammond *et al.*, 2017). Shipboard survey methods have mostly used a double platform set up to account for animals missed on the transect line and for the responsive movement of animals with respect to the observation platform. Several aerial surveys used tandem aircraft or the circle-back procedure for harbour porpoises (*Phocoena phocoena*) to correct for animals missed on the transect line (Hiby, 1999); this was extended to dolphin species and minke whales (*Balaenoptera acutorostrata*) during SCANS-III in 2016 (Hammond *et al.*, 2017). In other cases, conventional aerial survey methods were used, corrected for availability and observer bias where possible (Hammond *et al.*, 2013). Where possible, information on species distribution has been obtained from modelled density surfaces fitted to data collected during large-scale surveys (e.g. Gilles *et al.*, 2016; Rogan *et al.*, 2017). Where this was not possible, distribution was derived from the distribution of animals seen on these and other surveys.

The results of other large-scale surveys using similar methods have also been used for assessment purposes: North Atlantic Sightings Surveys (NASS) and Norwegian Independent Line Transect Surveys (NILS) for minke whales (e.g. Solvang *et al.*, 2015). Smaller-scale (mostly national) surveys have been conducted using the same or a similar methodology, such as in Belgium, Denmark, France, Germany and the Netherlands (Scheidat *et al.*, 2008; Haelters *et al.*, 2011; Viquerat *et al.*, 2014; Gilles *et al.*, 2016; Laran *et al.*, 2017). The large-scale surveys provide information on distribution and abundance over a large area but are infrequent, with SCANS taking place once approximately every decade. SCANS surveys have also taken place in summer only. The smaller-scale surveys are undertaken more often and reveal seasonal patterns at smaller scales. A strategy to develop more frequent large scale-monitoring is being drafted (OMMEG, 2019).

Mark-recapture analysis of photo-identification data is more appropriate for coastal populations of naturally well-marked species with a limited range, such as the bottlenose dolphins and killer whales. This method is based on individual distinctiveness (Urian *et al.*, 2017).

Passive acoustic monitoring (Marques *et al.*, 2012; Sousa-Lima *et al.*, 2013) is the most efficient method to detect changes in smaller areas or in areas with low densities of acoustically active species like the harbour porpoise: e.g. the Baltic Sea.

## 2.5 Quality assurance/ Quality Control

Quality assurance of the data from large and small scale surveys is maintained following the SCANS protocols (Hammond *et al.*, 2017) for data collection, validation and analysis. The qualitative approach and control of data collected by photo ID follows the guidelines described in Urian *et al.*, 2017. In an attempt to standardise data from smaller scale surveys and collate these, a Joint Cetacean Protocol has been established in the UK (Paxton *et al.*, 2016).

OMMEG is working on collating national monitoring efforts for future assessment purposes, and will do so in co-operation with relevant initiatives e.g. Marine Ecosystem Research Programme (MERP).

## 2.6 Data reporting, handling and management

Each Contracting Party has its own data storage mechanism for national monitoring data. Within each assessment unit, indicator M4 is assessed using, where possible, available data from CPs. National data would need to be submitted to OSPAR or a central data custodian (to be decided), that disseminates the data to the body responsible for data analysis and subsequent assessment. Which body this will be, needs to be agreed upon.

For large scale surveys a centralised reporting format should be developed. Central data management and data calls should be organized. Currently most data are not available yet in ODIMS. The latest process can be found in OSPAR-COBAMs data streams.

Data calls for the QSR2023 will take place by the end of 2020. With assessment deadlines by the end of 2021.

## 3 Assessment

This indicator is generated using time series of cetacean abundance and distribution across the entire OSPAR region. Precise assessment methods for all three assessments can be found in the Intermediate Assessment 2017:

Abundance and distribution of Killer whale (M4-A):

<https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/biodiversity-status/marine-mammals/abundance-distribution-cetaceans/pilot-assessment-abundance-and-distribution-killer-whales/>

Abundance and distribution of coastal bottlenose dolphins (M4-A1)

<https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/biodiversity-status/marine-mammals/abundance-distribution-cetaceans/abundance-and-distribution-coastal-bottlenose-dolphins/>

Abundance and distribution of cetaceans other than killer whales and coastal bottlenose dolphins (M4-B)

<https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/biodiversity-status/marine-mammals/abundance-distribution-cetaceans/abundance-and-distribution-cetaceans/>

### 3.1 Data acquisition

Currently data is being provided on request from each Contracting Party and supplied to the indicator leads. The data flow process within each Contracting Party will need to be organised internally. Data handling and reporting at an OSPAR level will be agreed upon and formalised, preferably this should be aligned with similar processes being established on an EU level.

### 3.2 Preparation of data

Visual survey data are needed to be processed using standardized methods to provide quantitative data for an indicator assessment. In general, distance sampling data will be used to generate robust estimates of abundance which are corrected for bias in the observation survey process.

For coastal populations of bottlenose dolphins and killer whales, photo-ID data need to be processed using standardized capture-recapture methods to provide quantitative data for an indicator assessment.

A time series of estimates is required to assess trends.

### 3.3 Assessment criteria, values and units

OSPAR ICG-COBAM has proposed an assessment value for cetacean abundance, to “*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*”. An index of relative abundance could be used to determine whether this assessment value was being met or not, but where possible one should strive for measures of absolute abundance for assessing the impacts of human activities.

There is currently no quantitative evidence of *deterioration due to anthropogenic influence* among the ‘regularly present’ species within the OSPAR Maritime Area. However, assessment is contingent on the challenges to obtain

robust population estimates across the range of the putative assessment unit and the lack of knowledge on baseline population sizes. Historical abundance is unknown. Consequently, a modern baseline has been utilized for the time being. It could be noted that the European Commission is currently reviewing Favourable Reference Populations (FRPs) under the Habitats Directive which could be considered in future development work.

The proposed long-term assessment values are measured by assessing short-term trends<sup>5</sup>, which are defined as:

- Declining means a decreasing trend of  $\geq 5\%$  over 10 years (*significance level  $\alpha < 0.05$* )
- Increasing means an increasing trend of  $\geq 5\%$  over 10 years (*significance level  $\alpha < 0.05$* )
- Stable means population changes of  $< 5\%$  over 10 years

It must be kept in mind that most cetaceans are long-lived, slowly reproducing species, implying that problems affecting reproduction as well as effects from sub-lethal anthropogenic pressures may show significant time lags before being detected.

The most useful abundance data for offshore cetacean species derives from the results of large-scale surveys, currently yielding the best overall abundance estimates for some species. To quantify changes, a trend analysis relative to the best baseline estimates should be performed. These baselines should be kept under review as more information becomes available. OMMEG will provide species specific estimates when available.

Table 1: Proposed assessment values and assessment units (AU). These assessment criteria are often based on limited data.

Species	Present in OSPAR region	Population size baseline (abundance)	Additional information	Proposed assessment value	Proposed assessment unit(s)
<b>M4-A</b>					
Killer whale ( <i>Orcinus orca</i> )	Largely beyond shelf edge but also inshore, in regions I, II, III, IV	Needs to be set		n.a. (pilot indicator)	Yet to be fully determined although shelf population considered distinct from northern, more pelagic, population
<b>M4-A1</b>					
Coastal bottlenose dolphins ( <i>Tursiops truncatus</i> )	Inshore in regions II, III, IV	Needs to be set	Some interaction with offshore populations, more research needed into connectivity	For each assessment unit, maintain inshore bottlenose dolphin population sizes at or above baseline levels, with no decrease of $\geq 30\%$ over any ten-year period	a) West coast of Scotland; b) East coast of Scotland; c) Coastal Wales d) Coastal Ireland e) Southwest England; f) Normandy/Brittany; g) Northern Spain; h) Southern Galician Rias (Spain); i) Coast of Portugal; j) Gulf of Cadiz
<b>M4-B</b>					
Harbour porpoise ( <i>Phocoena phocoena</i> )	II, III, and IV, likely part of population with distribution extending into region I	Baseline proposed by ICES (2014) needs to be reassessed with regard to a revision of the historical abundance estimates	More research needed into interactions with other regions  Large-scale surveys at a frequency of 11 years are inadequate to monitor trends of a species with life expectancy much less than this	For each assessment unit, maintain harbour porpoise population size at or above baseline levels, with no decrease of $\geq 30\%$ over a three-generation period (36 or 22.5 years).	1) North Sea: ICES Subarea IV, Division VIII, and part of Division IIIa (Skagerrak); 2) Kattegat and Belt Seas: Part of ICES Division IIIa (Kattegat) and Baltic Areas 22 and 23; 3) Western Scotland and Northern Ireland: ICES Division VIa and Subdivision VIb2; 4) Celtic Sea and Irish seas: ICES Subarea VII with the exception of Division VIII; 5) Iberian Peninsula: ICES Divisions VIIIc and IXa. Also see proposed revised delineations for AUs 1) and 2) in ICES 2018.

<sup>5</sup> To assess trends, at least three abundance estimates are required over a relevant time scale. Robust assessments will require additional abundance estimates. Paragraph 3.4

Offshore bottlenose dolphins ( <i>Tursiops truncatus</i> )	III, IV, likely part of population with distribution extending into region V	Baseline proposed by ICES (2014) needs to be reassessed with regard to a revision of the historical abundance estimates	Requires monitoring over relatively large area (including deeper Atlantic waters) at more regular intervals	Maintain the offshore NE Atlantic bottlenose dolphin population size at or above the baseline level, with no decrease of $\geq 30\%$ over a three-generation period (63 years).	No information as yet on AUs. For the time being assumed to form a single AU.
White-beaked dolphins ( <i>Lagenorhynchus albirostris</i> )	Region II and III with distribution extending into region I	Baseline proposed by ICES (2014) needs to be reassessed with regard to a revision of the historical abundance estimates		Maintain the white-beaked dolphin population size at or above the baseline levels, with no decrease of $\geq 30\%$ over a three-generation period (54 years).	ICES (2014) advised a single AU for OSPAR regions II and III for white-beaked dolphin. The species does not occur regularly in Region IV.
Minke whale ( <i>Balaenoptera acutorostrata</i> )	Regions II and III with distribution extending into region I	Baseline proposed by ICES (2014) needs to be reassessed with regard to a revision of the historical abundance estimates	Hunted in region I, depletion status unknown	Maintain the minke whale population size at or above the baseline levels, with no decrease of $\geq 30\%$ over a three-generation period (66 years).	ICES (2014) advised a single AU for minke whale for OSPAR regions II, III, and IV.
Common dolphin ( <i>Delphinus delphis</i> )	Regions II, III, and IV, part of a wider Northeast Atlantic assessment unit with distribution extending into region V	Baseline proposed by ICES (2014) needs to be reassessed with regard to a revision of the historical abundance estimates	Requires monitoring over relatively large area (incl. deeper Atlantic waters) at more regular intervals (three to five years).	Maintain the Northeast Atlantic common dolphin population size at or above the baseline level, with no decrease of $\geq 30\%$ over a three-generation period (44 years).	ICES (2014) advised a single AU for OSPAR regions II, III, and IV based upon an apparently wide-ranging population of short-beaked common dolphin in the Northeast Atlantic, from waters off North Scotland to Portugal.

### 3.4 Spatial Analysis and / or trend analysis

#### *Spatial analysis*

Model-based density estimates have been used to predict the distribution and abundance of those species for which sufficient data are available from large-scale purpose-designed surveys. Such model-based results are not available for relatively rare species. Maps of observed sightings provide information on distribution based on recent data for which results from density surface models are not yet available. An analysis of changes in distribution for the most common species from collated survey datasets (1990-present, MERP) is currently underway and should be supplemented whenever new data becomes available in the future.

#### *Trend analysis*

Abundance of animals per species per assessment unit has mostly been estimated using data collected from large-scale purpose-designed surveys using line-transect distance sampling methods (Buckland et al., 2001); these are known as design-based estimates (e.g. Hammond et al., 2013). Some abundance estimates come from models fitted to these data to generate a density surface from which abundance is derived; these are known as model-based estimates (e.g. Gilles et al., 2016). To assess trends, at least three abundance estimates are required over a relevant time scale. Robust assessments will require additional abundance estimates.

To assess trends it is needed to consider the statistical power to detect changes. Hammond et al. (2017) conducted simple power analyses to determine the annual rate of change that could be detected with high (80%) power from the available SCANS abundance estimates. The annual rates of change that can be detected with 80% power from the three SCANS estimates in the North Sea are 1.8% for harbour porpoise and 5% for white-beaked dolphin. ICES (2014) considered that an appropriate time interval to measure change would be a 30% change over three generations such as used by IUCN (See Table 1 for generation times). Irrespective the rate of change to be measured, a higher survey frequency is needed to increase the power to detect changes; ideally at least to match the six-yearly reporting requirements.

### 3.5 Presentation of assessment results

The presentation of the results is best kept as simple as possible. Self-explanatory graphs and maps are most effective, but the exact methods are still to be agreed upon.

Specifically, the assessment will use plots and maps of the abundance and distribution assessment period for each OSPAR region or on otherwise ecologically relevant scale. Assessment and associated figures should also provide data on inter-assessment period statistical analysis.

## 4 Change Management

The monitoring strategy proposed by OMMEG, will be necessary in order to better assess cetacean abundance and trends on the spatial-temporal scale required within the OSPAR region to fulfil the six-yearly reporting cycles. Additionally, some suggestions for future work are included by OMMEG in their multi-year working plan:

- An agreement on the delimitation of assessment units (coordinated with assessment units from other relevant organisations)
- The definition of a baseline for each species in each assessment unit
- The development and implementation of a standardized monitoring methodology, and/or a mechanism for standardizing data post collection. Although progress has been made, both effort-related monitoring of cetaceans and analytical procedures need further refinement and standardisation, both in methodology as well as frequency (preferably every 6 years large scale surveys) and organisation
- The development of an assessment tool and agreement on the body that makes the assessment

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