REPORT OF THE ICES WORKSHOP ON CETACEAN ABUNDANCE ESTIMATION THROUGH DISTANCE SAMPLING METHODS (WKCETAB) 2024

Issue: Abundance and distribution monitoring methods

Background

Abundance estimates of cetacean species are a key factor in assessing their conservation status and the impact of anthropogenic activities, whose management is a priority at the European level. EU Marine Strategy Framework Directive (MSFD) also requires Member States to report coherent values of the abundance of cetacean species at regional or subregional level, for which close collaboration and coordination are essential between neighbouring states.

During the Western Mediterranean sub-regional online meeting held on 20 September 2023, organized by the Spanish Ministry for Ecological Transition and the Demographic Challenge, the marine mammal expert group emphasized the importance of establishing a dedicated data analysis group. This group was tasked with meeting regularly to review and analyze data collected at regional and subregional levels by national MSFD coordinators. The goal was to conduct joint analyses, with expanded participation to include other Mediterranean Member States (MS) and relevant parties. Following contacts with the International Council for the Exploration of the Sea (ICES), the ACOM and Scientific Committee (SCICOM) agreed to organize the 1st Workshop on Cetacean Abundance Estimation (WKCETAB), which was hosted by ISPRA in Rome, Italy, on 16-18 April 2024.

WKCETAB aimed to create a forum for coordinating international experts from the Atlantic and Mediterranean regions on cetacean abundance and distribution monitoring methods. The long-term goal was to adopt a common methodology for regionally coherent reporting under the MSFD and similar frameworks, assess the quality and accuracy of current data, and work towards a coordinated approach and protocols in the ICES and GFCM areas for cetacean abundance estimation.

The attached report provides (i) an initial overview on distance sampling initiatives and data available for regional assessments and related analytical issues, with a view at discussing their main strengths and weaknesses; and (ii) a roadmap embedded into the ICES system to achieve inter-regional and intra-regional methodological harmonization and coherent reporting.

WORKSHOP ON CETACEAN ABUNDANCE ESTIMATION THROUGH DISTANCE SAMPLING METHODS (WKCETAB)

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ICES CIEM International Council for the Exploration of the Sea
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Contents

i Executive summary

Survey data are collected over large spatial scale to align with the wide-ranging movements and ecology of cetacean species. Assessing the conservation status of these species with current regulatory frameworks in the Northeast Atlantic and Mediterranean Sea (i.e.: EU Marine Strategy Framework Directive, OSPAR, HELCOM, EcAp/IMAP Barcelona Convention, Bucharest Convention) requires both (i) the definition of ecologically-meaningful spatial units for which cetacean abundance must be estimated from survey data, and (ii) the coordination of countries/parties whose maritime waters overlap with those units.

The first Workshop on Cetacean Abundance estimation (WKCETAB) met to discuss: (i) available Distance Sampling data for regional assessments, and (ii) the need for methodological harmonization and coordination across countries at regional level for a coherent reporting. WKCETAB also started considering the effects of survey design and analytical approaches on the quality of final estimates.

WKCETAB defined a roadmap to reach the harmonization and coordination goals also leveraging on results and tools from other relevant ICES working groups, with initial focus on: (i) promoting a common terminology, (ii) defining assessment units and (iii) providing methodologies for policy-relevant and management-ready abundance estimates.

ii Expert group information

Expert group name	Workshop on Cetacean Abundance estimation under the MSFD (WKCETAB)
Expert group cycle	Annual
Year cycle started	2024
Reporting year in cycle	1/1
Chairs	Caterina Fortuna, Italy
	Matthieu Authier, France
	José Antonio Vázquez, Spain
Meeting venue and dates	16-18 April 2024, Rome, Italy (16 participants)

1 Introduction

Foreword: Although WKCETAB deals with abundance estimation, this report does not provide a soft introduction to methods and models used to estimate abundance of cetaceans within a specific policy framework. Instead, this report provides: (i) an initial overview on distance sampling initiatives and data available for regional assessments and related analytical issues, with a view at discussing their main strengths and weaknesses; and (ii) a roadmap embedded into the ICES system to achieve inter-regional and intra-regional methodological harmonization and coordination and coherent reporting.

The WKCETAB also provides initial considerations on the effects on the quality of estimates of survey design and analytical approaches.

Key papers and textbooks are provided in the bibliography to the interested reader.

A list of acronyms is available in Annex 3. A common terminology will be developed as WKCETAB makes progress toward its goals, outlined in the roadmap (see Section 3.5, in particular Section 3.5.4), and some tentative technical terms (e.g. with respect to the several venues for post-stratification) may change or evolve in the future.

1.1 Context

The Marine Strategy Framework Directive[1] (MSFD) requires Member States (MS) to implement all necessary measures 'to achieve or maintain good environmental status (GES) in the marine environment by 2020 at the latest' (Article 1(1)). To achieve this objective, MS must develop and implement coordinated marine strategies (Article 5). In order to achieve such coordination (Art 5.2), MS shall use existing regional institutional cooperation structures, including those under Regional Sea Conventions (RSC[2]; *e.g.* Oslo-Paris Convention, Helsinki Convention, Barcelona Convention, Bucharest Convention).

For the first cycle of MSFD reporting, MS national reports were found to display significant heterogeneity in their assessment methodology, even from MS sharing the same marine region of subregion (see Palialexis *et al.* 2014). In order to ensure regionally coherent and coordinated reporting, MS shall, as far as possible, build their national monitoring programmes upon existing relevant programmes and initiatives developed in the framework of RSCs or Convention on the Conservation of Migratory Species of Wild Animals (CMS) regional agreements.

In this context, the OSPAR (Oslo-Paris convention) Quality Status Report (QSR) published in 2023[3] and the HELCOM (Helsinki Convention) HOLAS 3 assessment[4] represent a significant step toward regionally coherent assessment for MSFD sub-regions overlapping the areas (i.e. north-eastern Atlantic, North and Baltic Seas) through common indicators of MSFD relevance. For example, with respect to cetaceans, OSPAR common indicators M4 (abundance and distribution of cetaceans[5]) and M6 (marine mammal by-catch[6]) can inform national reports without the risk of inconsistent assessment between northern European MS sharing the same sub-regions. A serious

[1] https://eur-lex.europa.eu/eli/dir/2008/56/oj
[2] https://water.europa.eu/marine/countries-and-regional-seas/regional-conventions
[3] https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/
[4] https://helcom.fi/baltic-sea-trends/holistic-assessments/state-of-the-baltic-sea-2023/
[5] https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/abundance-distribution-cetaceans/
[6] https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/marine-mammal-bycatch/

issue may arise when there is not coordination between RSCs (e.g. Barcelona or Bucharest Conventions and OSPAR and HELCOM), especially for MS having to deal with uncoordinated RSCs (e.g. France and Spain dealing with the OSPAR and the Barcelona Convention with rather different monitoring and assessment approaches).

Within the Barcelona Convention, the coordination is developed in the IMAP framework (Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria). However, given the extremely variable socio-economic and logistic context within Barcelona Convention and the need to ensure equity, key decisions on the cetacean monitoring and assessment framework should be adopted at COP 24 in 2025.

Among the aspects that need coordination, which are key for monitoring and assessment of species status, there are the issues of obtaining baseline values and set thresholds. The recent *Commission Notice on the threshold values set under the Marine Strategy Framework Directive 2008/56/EC and Commission Decision (EU) 2017/848* (Commission Communication C/2024/2078) requires MSs to apply 'threshold values set through Union, regional or subregional cooperation, as well as threshold values deriving from existing legislations already established in the Annex to the Decision for the criteria that they will use to assess environmental status'. This Communication reinforce the key role of the regional and subregional coordination efforts. In addition, in the case of species characterized by a wide range (regional or beyond) and a lack of clearly identifiable reproductive sites (e.g. calving or hauling sites) – such as cetaceans and some protected elasmobranchs – the identification of agreed methodologies to assess the criteria on abundance and distribution becomes important also the in context of Habitats Directive assessments of the *Favourable* status of these species and of the national reporting.

The most recent ICES Advice on bycatch (2023; https://doi.org/10.17895/ices.advice.24681123) - adopted by its Advisory Committee (ACOM) and developed upon request by ICES clients (European Union, Iceland, NASCO[7], NEAFC[8], Norway, and United Kingdom) includes also considerations on Mediterranean populations of marine mammals, sea turtles and sea birds. This entails the need by ICES (i) to enlarge the geographical scope of experts participating in these assessments, and (ii) to ensure consistency on the monitoring and analytical methods to estimate abundance used for management purposes among northern and southern European MS.

In the *EU Action Plan: Protecting and restoring marine ecosystems for sustainable and resilient fisheries*, the Commission calls on MSs to '[b]y end of 2023, develop threshold values for the maximum allowable mortality rate from incidental catches of the species selected by Member States, as part of the implementation of the Marine Strategy Framework Directive (MSFD)' (COM(2023) 102 final). This implies the use of abundance estimates of concerned species for the assessment of the impact on populations of recorded Endangered, Threatened or Protected (ETP) species bycatch in EU waters.

On 20 September 2023, the Spanish Ministry for the Ecological Transition and the Demographic Challenge organized a western Mediterranean sub-regional online meeting in the context of the current MSFD reporting cycle. The meeting was attended by representatives and experts of Spain, France, and Italy with the aim to boost sub-regional cooperation within the MSFD Mediterranean subregion for a more coordinated implementation of the MSFD. The meeting also aimed to share information on MS approaches to develop their marine strategies, including characterization of criteria, monitoring, and reporting plans and how the new challenges, such as climate change, are being addressed. One of the main conclusions of the marine mammal expert group was the need to create a data analysis group that meets regularly to consider all data collected at regional and subregional scale by national MSFD coordinators and carry out collective

[7] North Atlantic Salmon Conservation Organization
[8] North East Atlantic Fisheries Commission

analyses, after having agreed on a shared methodological approach. Such approach would ensure complementarity and comparability of abundance estimates at regional, sub-regional and national scale, allowing consistency of reporting in each MSFD 6-year cycle among MS. In this occasion, it was agreed to explore the possibility to organize a workshop under ICES auspices as a first step for the creation of an expert group or recurring workshops, extending the participation to other Mediterranean MS and all other relevant parties (e.g. experts of relevant RSCs and Multilateral Agreement and other Conventions, such as OSPAR, HELCOM, Barcelona Convention/UNEP MAP[9], Bucharest Convention/Black Sea Commission, ASCOBANS[10], ACCOBAMS[11], NAMMCO[12], IWC[13], Pelagos Agreement).

Following contacts with the ICES Secretariat, the ACOM and Scientific Committee (SCICOM) agreed to the organization of the first Workshop on Cetacean Abundance Estimation (WKCETAB) that was hosted by ISPRA in Roma, Italy.

1.2 Aims

The aims of WKCETAB was to create a forum favouring the coordination of European experts from all EU marine regions (https://www.eea.europa.eu/en/datahub/datahubitem-view/940c7194-ce7b-45ba-ad22-0d47cc2b5c9e) on monitoring and estimation methods for cetacean abundance and distribution with a long-term objective to adopt a common methodology fit for the purpose of regionally coherent reporting with respect to MSFD and/or similar frameworks. Ultimately, the aim is to fully coordinate the ongoing large-scale monitoring initiatives, including analytical and reporting efforts.

An agreed-upon methodology will be used periodically to collectively analyse data collected during aerial and ship surveys. The resulting consolidated values obtained during these periodic analytical sessions will be instrumental to regional coherence and consistency of reporting among MSs for MSFD primary indicators on abundance (D1C2), and by-catch (D1C1) for cetaceans.

Other MSFD indicators that would benefit from such an analytical initiative would be demographic parameters (D1C3), distribution (D1C4) and habitat for the species (D1C5). These additional criteria are also of interest to WKCETAB and may be addressed in the future.

The resulting annual reports from WKCETAB, presented to the ICES Advisory Committee, are expected to contribute to the assessment of cetacean conservation status and inform aspects of management of fishery management and nature protection at the European level. Consolidated results by the WKCETAB will facilitate the work of other ICES working groups, such as the Working Group on Bycatch of Protected Species (WGBYC) and the Working Group on Marine Mammal Ecology (WGMME) to achieve their own objectives. The WKCETAB will also coordinate with the Working Group for the Joint Cetacean Data Programme (WGJCDP).

Given that large-scale cetacean surveys are usually collecting data on other taxa, WKCETAB reports could also produce relevant information on other taxa (e.g. sea turtles, pelagic elasmobranchs, and sea birds) for which 'at sea' abundance estimates under the MSFD and similar frameworks is required.

[9] Mediterranean Action Plan of the United Nations Environment Programme
[10] Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas
[11] Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic area
[12] North Atlantic Marine Mammal Commission
[13] International Whaling Commission

2 ToR A: Sources of Distance Sampling data

2.1 Scope

Several methods are available to estimate the abundance of marine mammal populations; each can be considered within the conceptual framework of extrapolating from counts, corrected as appropriate, to an estimate of total abundance or population size using statistical models. The two most commonly used methods for marine mammal populations are *capture-mark-recapture* (CMR) and *distance sampling* (DS) (Hammond *et al.,* 2021a). Which method is most appropriate and how to implement it depends on the species and other factors such as logistics, human and financial resources and, in some cases, the end-use of abundance estimates.

The simplest CMR method relies on the fundamental assumption that the ratio of naturally marked animals to the total animals captured during a second sampling period is equal to the ratio of naturally marked animals to the entire population during the initial sampling period: this simple estimator of abundance is often called the Petersen estimator (Goudie & Goudie, 2007). CMR methods have expanded enormously from this basic estimator/concept. Nowadays they are often used with data collected on individual animals over several years, assuming that individuals are uniquely marked (naturally or with a tag), that marks cannot change or be lost, and that all marked animals are recognized and recorded correctly.

The DS method used also for cetaceans assumes that, during a line-transect survey (usually either ship- or plane-based) the probability of an observer detecting an animal, or a group of animals, decreases with the distance from the transect line. By fitting a detection function to the histogram of perpendicular distances recorded for all sightings, it becomes possible to calculate the *effective strip width* - under the assumption that all objects directly on the transect line will be detected (i.e. $g(0) = 1$) - and to estimate the density of the sampled area by taking into account additional corrections factors such as availability of diving animals at the sea surface or observer's perception among others (aka $g(0)$ see below). If perfect detection can be assumed, then the effective strip width is the actual strip width or maximum distance at which observers were instructed to scan accordingly to protocol.

Survey design assumes that transects are randomly placed with respect to the distribution of animals and uniformly distributed within the study area. These are to ensure an equal probability coverage of space in the study area in order to obtain a representative sample for accurate abundance estimation. Equiprobability coverage is key to ensure accuracy when scaling up results from the survey sample to the whole study area. Data collection with distance sampling also assumes that:

- all animals directly on the transect line are detected (*i.e.* $g(0) = 1$),
- animals do not move prior to detection,
- detection events are independent (in the statistical sense),
- upon detection, animals are not counted more than once, and
- data (in particular perpendicular distances to the transect and group sizes) are measured and reported accurately.

However, during observer-based surveys for cetaceans, both aerial and ship surveys, it is never possible to detect all on the transect line, i.e. one of the fundamental assumptions is not met. In general, two factors are influencing the detection during any survey: (i) *availability bias*, and (ii) *perception bias*. Both terms sometimes are collectively referred to as *visibility bias*. As such, the visibility bias is a vital parameter in producing estimates of absolute abundance and absolute density (Buckland et al., 2001).

2.2 Data

For its first iterations, WKCETAB focused on DS data, although CMR data will be considered in the future[14], as CMR data can inform on other MSFD criteria beyond D1C2 (abundance), such as D1C3 (demographic parameters). However, cetacean species or populations that are amenable to CMR studies are few compared to the number of species that can be monitored during a dedicated survey using a DS protocol to estimate abundance on a wide region.

The following sections include non-exhaustive examples of large-scale surveys realized as implementation of EU Directive, regional multilateral initiatives, bilateral scientific cooperation and other national surveys. The examples provided below are a non-random sample of surveys that are carried out in the Northeast Atlantic Ocean, in the Mediterranean Sea, and in the Black Sea. This non-random and non-exhaustive sample mostly reflects the presentations that were given by the in-person participants of WKCETAB. More in-depth information on surveys can be found in reports from the ICES Working Group on Marine Mammal Ecology (WGMME).

2.2.1 Examples of national surveys

SPAIN: The monitoring programmes designed by the Spanish Ministry for the Ecological Transition and the Demographic Challenge to monitor the abundance trend of the different management units include distance sampling aerial surveys and capture-mark-recapture surveys. In the case of distance sampling aerial surveys, a megafauna protocol is used whereby marine mammals and other marine megafauna sightings (e.g. seabirds or turtles) are collected. The plan is to carry out sampling in each of the five national subdivisions, called marine demarcation (DM), every three years, so that every six years, the national sampling coincides with the international large-scale surveys: SCANS (Atlantic) and ACCOBAMS Survey Initiative (ASI, Mediterranean). In these cases, the field protocol used will be the same used in SCANS and ASI surveys. The sampling design covers the entire area of each marine demarcation (DMNOR: Bay of Biscay, DMSUD: Gulf of Cadiz, DMESAL: Strait of Gibraltar and Alboran Sea, DMLEBA: Levantine and Balearic Sea, and DMCAN: Canary Islands) and sampling will be carried out during the month of July for all marine demarcation, except for the Canary Islands demarcation where sampling will be carried out during the months of September-October. In the case of capture-mark-recapture surveys, the *robust-design* protocol is used, and the plan is to carry out sampling annually, in order to obtain, information on demographic parameters other than abundance, such as death rate, birth rate and survival rate.

Apart from these specific surveys of its monitoring programmes, Spain also carries out another series of surveys on oceanographic ships in all marine demarcations at different seasons, applying the distance sampling protocol for marine megafauna. In the case of the Mediterranean, Spain also has access to aerial survey data from the International Commission on the Conservation of Atlantic Tunas (ICCAT). ICCAT uses an adapted version of the conventional distance sampling method, and which is carried out during the month of June around the Balearic Islands.

ITALY: In 2009, Italy launched a series of projects to assess and monitor abundance and density of cetaceans in the seas around Italy in the context of the implementation of Pelagos Sanctuary and ACCOBAMS Agreements. Since 2020, on behalf of the Ministry of the Environment, ISPRA

[14] Recapture-data are sometimes collected during line-transect surveys with double observer platforms to estimate g(0). Hence the distinction drawn between distance sampling and capture-mark-recapture is one of convenience.

carries out a specific research programme for the MSFD monitoring activities. All these initiatives have been conducted using line transect DS design for aerial platforms. The sampling design covers the seas around Italian peninsula and fall within the MSFD subregions as follows: (i) Italian Tyrrhenian Sea (including the International Sanctuary for the protection of the marine mammals – known as Pelagos Sanctuary), which represent the 35% of the Western Mediterranean; (ii) Italian Central Mediterranean and Ionian Sea, which represents 14% of this MSFD subregion; and (iii) the whole MSFD Adriatic subregion. Survey designs are either *equal angle zig-zag* or *systematic parallel sampling*, and the effort coverage ranges between 6% and 10%, respectively.

Abundance estimates of cetaceans and other megafauna (e.g. sea turtles, large pelagic fish and elasmobranchs, etc.) are produced via design- and model-based methods (Conventional Distance Sampling and Multiple Covariate Distance Sampling; Miller *et al.* 2019). Data aim to allow for comparison of abundance and distribution patterns between years and seasons.

Italy plans to conduct future surveys synchronized with the second edition of the ACCOBAMS Survey Initiative (ASI 2).

FRANCE: As part of the Monitoring Programme under the MSFD, France undertakes large scale aerial surveys of marine megafauna since 2012. The SAMM surveys (*Suivi Aérien de la Mégafaune Marine*) started in 2012 with surveys in both winter and summer (Laran *et al.* 2017a, b). France took part in the ASI survey of summer 2018 (Cañadas et al., 2023), the SCANS surveys of summer 2016 (Hammond *et al.* 2021b) and 2022 (Gilles *et al.* 2023) and used the results to report on MSFD. In winter 2018 and 2021, a second SAMM survey was carried out in the North-Western Mediterranean Sea and Atlantic waters adjacent to mainland France respectively. These data were used to produced design-based abundance estimates for the winter season and used for MSFD reporting. Ship-based surveys include the ecosystemic surveys carried out by Ifremer (e.g. Doray *et al.* 2018) on which marine mammal observers are operating and implementing a single platform distance sampling protocol for data acquisition. These ship-based surveys (aka the MEGASCOPE programme) are not solely dedicated to cetaceans as the design of these survey is primarily for commercial fish stock assessment purposes.

2.2.2 Examples of international surveys

SCANS: The first large-scale line transect DS survey for cetaceans (Small Cetaceans in European Atlantic Waters and the North Sea, known as SCANS) was conducted in summer 1994 (Hammond *et al.* 2002). SCANS generated abundance estimates for harbour porpoise that allowed bycatch (and other anthropogenic pressures) to be assessed in a population context. Abundance was also estimated for white-beaked dolphin and minke whale in the North Sea. SCANS 1994 was envisaged to be the first in a series of large-scale, long-term surveys with an approximately decadal frequency. Accordingly, a second survey covering all European Atlantic shelf waters was conducted in 2005, supplemented by a survey in offshore waters (CODA[15]) in 2007 (Hammond *et al.* 2013). A third survey, SCANS-III, followed in 2016 (Hammond *et al.* 2021b) covering the same area as SCANS-II and CODA combined but excluding waters to the south and west of Ireland. SCANS-IV was conducted in summer 2022, with a primary aim to provide robust large-scale estimates of cetacean abundance to inform MSFD assessment of GES in European Atlantic waters in 2024 (Gilles *et al.* 2023).

[15] Cetacean Offshore Distribution and Abundance

MEDITERRANEAN AND BLACK SEA: The ACCOBAMS Survey Initiative (ASI) is a programme aimed at establishing an integrated and coordinated monitoring system for cetaceans across the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic (ACCOBAMS) area. Conducted in coordination with Mediterranean coastal countries, it supports the implementation of EU and regional policies, in particular the MSFD and the Barcelona Convention Ecosystem Approach (EcAp) process. In summer 2018, the first synoptic survey was conducted across the Mediterranean Sea and contiguous Atlantic area, combining visual monitoring from aircrafts with visual and passive acoustic monitoring from vessels. In summer 2019, an aerial survey was conducted in the Black Sea. Species density and abundance were estimated through both design and model-based approaches in a line-transect sampling framework (Cañadas *et al.* 2023; Panigada *et al.* 2024; Paiu *et al.* 2024). The ASI survey offers an overall summer snapshot of the distribution and abundance of cetaceans throughout the Mediterranean and the Black Seas, with robust estimates that represent a baseline for future regional systematic monitoring programmes. The ASI survey was the first step towards establishing an ACCOBAMS Long-Term Monitoring Programme (LTMP) across the entire ACCOBAMS area, and, as such, it has set the basis for the use of systematic, shared, coordinated and comparable methods. ASI data will contribute to enhancing our knowledge on cetacean status, informing the development of area- and threat-based conservation and mitigation measures, as well as supporting the implementation of international obligations. It will also inform the process of identification of IUCN Important Marine Mammal Areas (IMMA) and Cetacean Co-occurrence with Human activities (CCH).

Acoustic surveys for sperm whales (*Physeter macrocephalus*) were also conducted in the Mediterranean Sea in summer 2018 as part of the vessel-based component of the ACCOBAMS Survey Initiative (ASI). Equal-spaced zigzag transects provided uniform coverage of key sperm whale habitats and were surveyed using a towed hydrophone array deployed from a research vessel at speeds of 5-8 knots (Boisseau *et al.* 2024).

2.2.3 Other types of cooperative efforts

ADRIATIC: Since 2010 in Adriatic Sea, basin-wide multispecies surveys have been carried out quite regularly in the context of a consolidated research cooperation between Italian Institute for Environmental Protection and Research (Italy), the Blue World Institute (Croatia) and the Croatian Natural History Museum of Zagreb (Croatia). Data was collected for the whole basin in summer 2010, 2013, 2018, 2021, and 2023, and for the northern portion of the Adriatic in spring 2019 and winter 2020. Funds were gathered from various sources (e.g. implementation of – the now repealed – Regulation 812/2004; MSFD and HD monitoring, EU-funded LIFE Nature and IPA Adriatic projects, ACCOBAMS ASI, etc.) and data have been used to provide advice to national and international authorities in several different policy contexts.

2.3 Some lessons learnt and relevant considerations

2.3.1 Capacity building – capacity sharing

In order to evaluate and report on abundance in accordance with the MSFD, it is necessary to establish and agree upon ecologically relevant assessment units (AU) for the different cetacean species present (ICES, 2014a). The delimitation of AUs should be based on the best available scientific evidence, established following common guidelines from relevant organizations (e.g. OSPAR's CEMP Guideline M4) and agreed between countries or CPs and experts, which may be achieved by making use of RSCs or expert groups, for example the ICES WGMME, the

Biodiversity & Fisheries EcAp Correspondence Group on Monitoring (CORMON), or the ACCOBAMS Scientific Committee.

In the European Atlantic, these assessment units have been established and agreed for some cetacean species (ICES, 2014b; Geelhoed et al. 2022), as part of the work carried out by OMMEG, but some may need to be revised or added based on the most recent scientific evidence (e.g. delimitation of the Iberian Peninsula AU of harbour porpoise, by reducing off-coast area). In the Mediterranean, no AUs have been established for any cetacean species, so the process must still be undertaken, possibly capitalizing on lessons learnt since 2014.

Geospatial data delimiting the AUs agreed (e.g. shapefiles or geopackages) must accompany these decisions and could be incorporated into a repository available for the workshop or the public under request (e.g. https://github.com/osparcomm/Abundance-and-Distribution-of-Cetaceans). These files would represent milestones towards coherent regional assessments.

2.3.2 Coordination of monitoring

Robust assessment of highly mobile species requires large scale surveys, for which coordination between the different MS involved is necessary. This coordination is not only needed for conducting such surveys, but also for defining both their periodicity and coverage, and for ensuring their continuity over time and alignment with national plans. Coordination between MSs is also needed to agree data format, which may enable the design of a common approach for analysing the data. Regional sea conventions or agreement, such as the Barcelona Convention, ASCOBANS and ACCOBAMS, may also intervene to facilitate part of such coordination (e.g. the ASI; Cañadas *et al.* 2023; Panigada *et al.* 2024).

In the case of CMR data, which are also used for the estimation of the abundance of specific AUs or populations, it may take longer for assessment-ready results to be obtained. However, this should not result in preventing the set-up or continuation of such monitoring programmes. In fact, the data collected are useful not only for abundance assessment (D1C2) but also for other criteria assessment such as D1C3, which in turn can be used to feed or assist in the assessment of other criteria (e.g. setting thresholds for bycatch for D1C1). For the first iteration of this workshop, CMR data will not be considered but they will in future.

WKCETAB participants are involved in other regional expert groups and workshops such as the WGJCDP (relevant for data acquisition, standardization, and storage), WGMME (relevant for delimitation and update of AUs), WGBYC (relevant for bycatch of protected species and species of conservation concern and discussions on data needs), OMMEG (OSPAR's Marine Mammal Expert Group; delimitation and update of AUs; data needs), ACCOBAMS (relevant for delimitation of Aus and discussions on data needs), and Biodiversity & Fisheries CORMON (relevant for delimitation of AUs, and discussions on data needs).

To avoid duplicating work, whenever possible, this workshop will take advantage of available regional coordination groups, infrastructures and tools. For example, instead of creating a specific data call for this workshop, some tools could be developed (e.g. python or R scripts) to ease the conversion of databases between formats to feed existing data calls such as the data call carried out/to be established by the WGJCDP. Data restrictions should also be considered (e.g. access to the data under request).

Similarly, the reutilization of a shiny app created in a recently finished EU project has been considered (https://www.cetambicion-project.eu/research/). Such applications are very useful when dealing with abundance and distribution patterns that help visualize the results in a very easy and intuitive way.

2.3.3 Long-term commitment and governance

Although there have been four successful SCANS project, they do not form a comprehensive programme of surveys; each one has been developed independently by a team of dedicated scientists and funding sought through various funding streams, including national monitoring programmes. In many fora (e.g. ASCOBANS, OSPAR, HELCOM, ICES), European Atlantic range states emphasize the value of the information provided by SCANS as well as the need to establish a clear governance structure to create an ongoing programme of work driven by government agencies responsible for implementing national and European policy. Coordination of surveys across the whole European Atlantic, and possibly the Mediterranean, facilitates implementation of consistent data collection, enables comprehensive data analysis, and facilitates timely reporting of results (Gilles *et al*. 2023).

To date, the SCANS widescale systematic cetacean survey events have been driven *ad hoc* and bottom-up by a small community of dedicated scientists justifying the need and seeking financial support from government and other sources. Each survey event has constituted a discrete project in itself. While SCANS is acknowledged by managers as being an established long-term programme of survey work, some governments have committed to funding the project at intervals of approximately 6 to 10 years. This is to ensure the incorporation of critical population abundance and trend information into the statutory reporting and assessment requirements across the North-East Atlantic region. However, to create resilience and stability for the SCANS surveys and analysis, the scientific expert knowledge and the assessment programme, there is a need to identify a long-term governance framework to support it; including timely securing of funding to enable the full planned programme of work to be completed. The currently running SCANS-IV project seeks to establish such a governance structure to ensure long-term implementation of the SCANS cetacean abundance monitoring programme.

ACCOBAMS is now working to implement the Long Term Monitoring Programme (LTMP; ACCOBAMS Resolution 8.10), aimed at collecting reliable data to obtain robust estimates of abundance and distribution of cetacean species in the ACCOBAMS area. This information will feed into the ongoing ACCOBAMS process to identify high-risk areas of interaction between cetaceans and human activities and inform necessary conservation measures. The ultimate objective is to provide a robust scientific basis for the setting and the regular adjustment of management measures that allow achieving a favourable conservation status and good environmental status for cetaceans in the Agreement area. The periodic implementation of the ASI and systematic implementation of national monitoring initiatives would ultimately allow the evaluation of trends in cetaceans distribution and abundance and, hopefully, of conservation measures' effectiveness. ACCOBAMS has agreed that conducting synoptic surveys of the whole ACCOBAMS area on a six-year frequency would provide the right balance between monitoring costs and regular updating of information on abundance and distribution of cetacean species and would be in line with the general recommendations from the EU and the Barcelona Convention, as well as with previous large-scale efforts elsewhere in the world (e.g. Hammond *et al*. 2021b, Gilles *et al*. 2023).

3 ToR B: A coordinated approach, a Roadmap and protocols in the ICES and GFCM areas

3.1 Abundance estimation CDS/DSM

This ToR currently focuses on abundance estimation from data collected via line-transect surveys of cetaceans using a distance sampling protocol. A recent review is provided by Hammond *et al*. (2021a), and the topic is covered in detail in several technical textbooks (Buckland *et al*. 2001; Buckland *et al*. 2015). In this type of surveys, a study area is encompassing several survey blocks, which are assumed to be *a priori* homogeneous so that estimating an average animal density (in number of individuals per surface unit) in each block is meaningful. Given the heterogeneity of distribution, this density can however be different between blocks. Blocks thus encompass known variations in animal density at a rather large spatial scale. Abundance is then derived from density by multiplication with an area. The total abundance can be obtained by summing the estimated abundance in each block.

Two main approaches for estimation are available: design-based and model-based approaches. The design-based approach capitalizes on the care in which the survey was prepared, particularly with regard to block delineation and the random placement of transects within blocks (ensuring equiprobability coverage) to estimate the average density for each block with minimal assumptions. This average density is then scaled up by the block area to obtain an unbiased estimate of abundance. Statistical unbiasedness is guaranteed from the random placement of transects within blocks: this ensures that no bias is introduced on average (that is no higher-than-average area within a block is more likely to be sampled than any lower-than-average one). A clear advantage of the design-based approach is that it makes minimal assumptions (compared to the other approach) and, hence, is more robust. Such estimates are usually named Conventional Distance Sampling (CDS) estimates. A drawback is that any spatial variations in animal density within a survey block is smoothed over.

The model-based approach relaxes the equiprobability assumption and allows to incorporate additional information such as environmental covariates (seafloor depth, sea surface temperature, etc.) to investigate finer-scale variations in density (that is at scale smaller than a block). An advantage of this approach is that spatial variations in density can be investigated in great details, and some gains in precision may be expected from the additional information taken onboard by the model used to estimate density (so called Density Surface Models DSM; Miller et al. 2013). A drawback is that using a model can introduce bias if the model is misspecified (that is using a model comes at the cost of additional assumptions which, if violated, may lead to bias). In that sense, a model-based approach is less robust than a design-based one.

It is not uncommon to have several survey blocks overlapping one AU for a cetacean species (Figure 1). In such a case several options may be pursued to derive an abundance estimate for the AU.

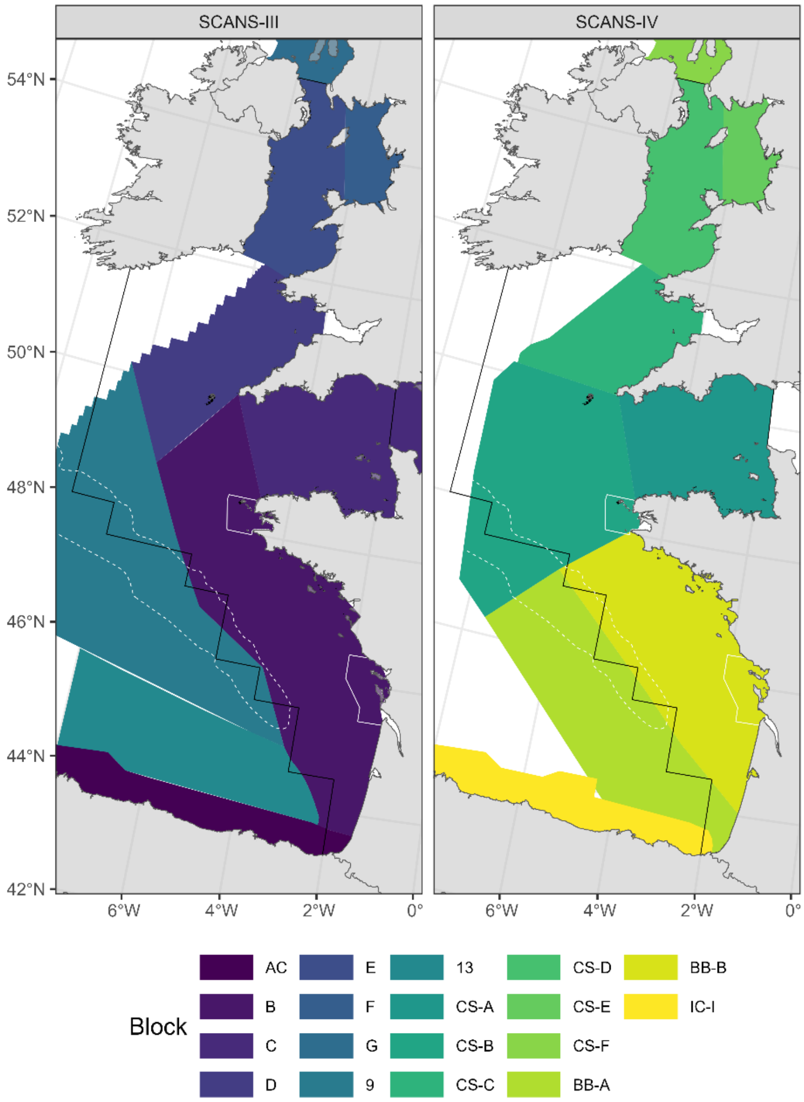

Figure 1: SCANS survey blocks (colour-coded) overlapping the Irish and Celtic Seas AU for harbour porpoises (black line). Several blocks are partially overlapping the AU, and other are completed enclosed within the AUs. Two Marine Protected Areas (MPAs) are delineated by a white solid line. These MPAs are largely contained within a single survey block. The 'Biscay Shelf Edge and Slope' Important Marine Mammal Area (IMMA; IUCN-MPATF 2024) is delineated by a white dashed line and is overlapping several blocks. These MPAs and IMMA are displayed to illustrate cases for estimating abundance from survey blocks.

When choosing an approach to estimate abundance (e.g. design-based, model-based, post-stratification, etc.), several factors must be considered including the objectives, the management context, and the data available. Population structure also has to be considered when looking at particular threats. There is no silver bullet approach that would meet all objectives and a case-by-case approach is required. Guidance on the fit-for-purpose of abundance estimates for various objectives is provided by the IWC (e.g. Hedley and Bravington 2014, Miller and Bravington 2017) but does not necessarily cover all possible cases.

With respect to reporting requirements under MSFD/HD and similar directives, it may be more difficult to produce robust abundance estimates for AUs that are smaller than designed survey blocks. Also, assessments at the scale of administrative areas that are smaller than the actual range of the population to conserve may fail to reflect accurately the status of that population (and selected criteria under study).

When an AU is contained within a survey block of a well-designed survey (see Section 3.1 above; Hammond *et al*. 2021a), the CDS density estimate for that block can be used and scaled by the area of the AUs to obtain an abundance estimate. This case is illustrated on Figure 1 with two small MPAs (solid white line) that are nested within survey blocks. The scaling procedure is both straightforward and simple, and inherits the statistical properties attached to CDS (such as unbiasedness and so on). Because design-based estimates assume homogenous survey blocks, this approach may be perceived by stakeholders as too crude and spatial variations within the survey blocks may be of interest, especially for MPAs within a survey block (Figure 1). To investigate those intra-block spatial variations in animal density, down-scaling is required. In other words, a model-based approach for abundance may be sought for down-scaling but the resulting estimate will come with several caveats due to the several modelling choices and assumptions that must be made. In general, down-scaling is more difficult that up-scaling (see post-stratification below) and it must be done with great care as the associated results might come with more limitations and caveats. Depending on the objectives and the species to assess, a model-based approach can be preferred but this must be considered on a case-by-case basis. For example, this can be the case when management objectives also include spatially explicit information such as to inform distribution (e.g. D1C4 under MSFD). In the latter context, one option might be to use a model-based approach for reporting relative cetacean densities rather than an absolute abundance, highlighting the caveats involved and the limits with respect to the assessment.

Irrespective of the approach used to estimate abundance for an AU, assumptions and caveats linked to the chosen approach must always be attached to the results. The model-based approach can provide a higher precision than design-based approach due to the additional information (e.g. environmental variables that can soak up some of the variance) used in model fitting and then to predict abundance. However, care must be taken in ensuring to include all sources of uncertainties arising from each of the modelling steps (e.g. error in covariate values if those are themselves outputs from a model; model selection, choice of a statistical distribution for the response variable, etc.) in the final prediction. In addition, this lower precision on average may be misleading and mask heterogeneity in case some parts of the prediction grid have a very high uncertainty and others a lower one. Therefore, it is of utmost importance that spatially explicit uncertainty maps be produced and displayed alongside predicted densities for correct interpretation.

The model-based approach requires a succession of modelling choices and statistical assumptions to be made as well and expert knowledge and know-how[16] for model validation. These decisions depend on the species considered and the data available: there is no unique way (no cookbook recipe) to build a model. Nevertheless, these decisions will influence the results of the models and so the robustness of predictions against modelling choice – and all assumptions – needs to be investigated. **By nature, the model-based method may thus be less robust than a design-based method that will offer less variability in the results independently of who is performing the analysis.** A possible solution would be to perform a data-simulation study to test for the robustness of distribution models in different contexts (Hedley & Bravington 2014; Miller & Bravington 2017). One hurdle is how large number of contexts to encompass may make this analysis informative for only a handful of cases that can be thoroughly investigated. Some preliminary guidelines were prepared by Miller & Bravington (2017) in the IWC context, but these were focused on general issues. Miller & Bravington (2017) concluded that testing for the robustness of the model is both data-hungry and data-dependent, and very time-consuming. Further investigations are clearly needed and may be carried out under future ToRs to provide guidance on how to assess the robustness of model-based approaches for abundance estimation

[16] Shoe-leather *sensu* Freedman (1991)

and where they are fit-for-purposes with the context of MSFD/HD and similar frameworks with sharp deadlines for reporting on a large panel of species with uneven data availability.

3.2 Up- and Down-scaling abundance from survey blocks

The decision to obtain abundance estimates over areas other than the blocks a well-designed line-transect surveys must be made on a case-by-case basis. Available options are outlined below for illustration and linked to two scenarios: (i) assessment units larger than survey blocks (up-scaling), and (ii) assessment units smaller than survey blocks (down-scaling). The outlined options will be refined in future meetings of WKCETAB to provide clear guidelines.

3.2.1 Assessment units larger than survey blocks: up-scaling

This case concerns an AU that is larger than the survey blocks, encompassing several of them in totality and other partial areas. It is illustrated on Figure 1 with the large AU in solid black line overlapping several survey blocks. If the AU contains only whole survey blocks, the abundance in the AU is simply the sum of the estimated abundances in each block (taking into account, for example and if relevant, the covariance due to a common detection function estimated across blocks). When survey blocks only partially overlap with an AU, so-called post-stratification is needed (Note that the design of blocks is *a priori* stratification or prior-stratification: density is assumed homogeneous within a block). An illustration is provided on Figure 1 where the Irish and Celtic Seas AU for harbour porpoises overlaps several survey blocks of the SCANS-III and SCANS-IV surveys. Two main choices are available:

- **Design-based approach: post-stratification**
  - ***'Design-preserving' post-stratification (naïve post-stratification)***
    Rationale, *pros* and *cons*: this post-stratification is easy and quick to perform as it only requires the area and estimates for each block (and their associated uncertainty) and the area for each block and that of the AU. An area-weighted mean density for the AU is computed from the overlap between each survey block and the AU. Computing the sampling variance of the resulting average density is straightforward. A clear pro is the ease of implementation as the raw data are not required to perform this post-stratification. This naïve post-stratification has the further advantage of preserving the original survey design, thereby inheriting the statistical guarantees (e.g. unbiasedness at the scale of the AU) associated with the CDS estimates. A con is that the resulting average density is just that: an average that smooths over any spatial variations within the AUs (and some are expected given that different survey blocks are combined).
  - ***'Design-shifting' post-stratification***
    Rationale, *pros* and *cons*: this post-stratification is a more involved process as it requires the raw data. Only data that are falling inside the AU are kept for analysis, treating the AU as if it were a 'new survey block'. Estimation then proceeds to obtain an estimate for the AU using only the effort and sighting data that are within the AU. A pro for this choice is the increase in relevance as survey data and AU are closely matched at the first step of analysis: this can result in more meaningful estimate of average density for the AU. One con is the loss of the initial statistical guarantee of unbiasedness stemming for the equiprobability coverage associated with the original design of the survey: valid variance estimation can be more involved.

Another con is the need to process the raw data and to re-run analyses for every AUs. This is more time-consuming[17] than the naïve post-stratification approach.

An empirical comparison of estimates arising from these two possible choices may be explored in future iterations of WKCETAB.

- **Model-based approach**
  Rationale, *pros* and *cons*: a DSM can be fitted to the whole data and the resulting estimated density surface can then be extracted for each AU from the predicted density surface. Advantages are those associated with model-based approaches in general (such as additional environmental information taken onboard, increased precision, fine-scale variation in density revealed within an AU), with the additional pro that, once a density surface has been obtained on the whole study area, clipping this surface to any AU within the study area is straightforward. Cons include those associated with any model-based approach (such as concerns over robustness against model misspecification) and the need for the actual fitted DSM objects (for example with software R and the package DSM; Miller *et al*. 2022) to be available for accurate variance estimation of the abundance estimate associated with each AU.

3.2.2 Assessment units smaller than survey blocks: down-scaling

This case concerns an AU or, for example, an MPA or waters under national jurisdiction, is smaller in size than a survey block and may be contained entirely within one such block (see Figure 1 for an illustration with two small MPAs in solid white line).

- **Design-based approach**
  Rationale, *pros* and *cons*: in the simplest case, the average density estimated at the survey block may be used to obtain an abundance for the AU/MPA simply by multiplication with the AU/MPA surface. This is both straightforward and justifiable from the design of the survey. Variance estimation of the abundance estimate is also straightforward and there is no need of the raw data. A disadvantage that may be perceived in the case of small AU/MPA is that sighting data outside the AU/MPA are used to inform on abundance, leading to potential bias at the local scale of the AU/MPA. On the other hand, design-shifting post-stratification (as explained above) is usually not an option: given the small size of the AU/MPA, there may be too few sightings to attempt a statistically meaningful estimation with only the data collected within the AU/MPA (statistically meaningful with respect to the bias-variance trade-offs: an estimate may be obtained but it will have a large variance which will prevent its use for management).

[17] This con is somewhat mitigated by the increase in computing power and may be completely avoided in the case of well designed databases and workflows to analyse data.

- **Model-based approach (choice by default)**
  Rationale, *pros* and *cons*: a DSM can be fitted to the whole data and the resulting estimated density surface can then be extracted for any AU/MPA in the study area. Advantages are those associated with model-based approaches in general (additional information taken onboard, increased precision, fine-scale variation in density revealed within an AU), with the additional once that, once a density surface has been obtained on the whole study area, clipping this surface to any AU within the study area is straightforward. Disadvantages include those associated with any model-based approach (such as concerns over robustness against model misspecification) and the need for the actual fitted DSM objects (for example with software R and the package DSM; Miller et al. 2022) to be available for accurate variance estimation of the abundance estimate associated with each AU.

Overall, it is more difficult in practice to achieve down-scaling than up-scaling despite demands from managers to assess MPA or small areas or even waters under national jurisdiction only. The design-based approach is straightforward but may be perceived as less attractive in practice because statistical justifications from the design of the survey may not be given a premium over considerations such as including data from outside the MPA to inform on density within the MPA. The model-based approach may be the favoured one although it is more time-consuming and involve additional assumptions.

3.3 Some general remarks on model-based approach to abundance estimation

Below are some technical points that must be considered when using a model-based approach to assess abundance. The list is not exhaustive of all modelling choices but rather illustrative, detailing some decisions that must be considered as they may greatly influence the results obtained:

- **Size matters**. It is important to ensure that the area selected for the application of down-scaled abundance estimates using a model-based approach is not too small, especially if abundance is to be assessed within HD/MSFD and similar frameworks. Paxton et al. (2016; their appendix 5 pages 165-169) provided a preliminary analysis focusing on two species, one with large prediction uncertainty (the Risso's dolphin *Grampus griseus*) and one with low prediction uncertainty (the harbour porpoise *Phocoena phocoena*). Their main result was, for both species, inaccuracy, at least compared to the overall area, declined rapidly once a few hundred square kilometres is considered. A conservative rule of thumb at this stage may be to ensure that an area of at least 1 000 km^2 are considered when using model-based approach to down-scale abundance estimates.
- **Input data**. A DSM uses two main kinds of data as input. The first input data come from the cetacean distance sampling survey. Usually, a two-staged approach is followed wherein a detection function is first fitted on distance data to estimate the effective strip width, which is then multiplied by linear survey effort and included in a DSM as an offset. This two-staged approach usually ignores uncertainty in estimating the detection function: Bravington *et al*. (2021) explained how to propagate variance in the first stage to the second one. The second input data are the environmental variables (aka co-variates) that may be used in the model to predict population densities. These data might also come from a model with its own uncertainty that should also be considered. However, in the context of reporting for MFSD/HD frameworks, excluding environmental variables from model-based approaches can be justified to minimize heterogeneity

resulting from different choices from different MS when selecting environmental covariables for inclusion in DSM. A possible venue for sole reporting purposes could be to include only a (possible complex) bivariate smooth term on latitude and longitude to ensure greater stability and comparability over time (e.g. environmental covariates may be updated themselves between reporting periods or become unavailable in the future). Eventually, the inclusion of additional static variables, such as seafloor depth, may be considered. However, the objective should be to maintain the model's simplicity and avoid unnecessary complexity, in accordance with the KISS principle (Keep It Sophisticatedly Simple; Zellner 2002). This choice may be relevant for MSFD D1C2 (abundance) but is unlikely to be so when the focus shift to D1C5 (habitat) where relationships with explanatory environmental covariates (and possibly dynamic ones such as sea surface temperature, etc.) are of interest. Future workshops will discuss and propose an appropriate terminology to distinguish between the two purposes (reporting *vs* understanding habitat) as the same modelling framework can be used. One suggestion may be to use '[s]patial models applied to line-transect data' when habitat is not explicitly of interest and 'habitat-based model' otherwise.

- **Segmentation**. A whole transect needs to be divided into smaller segments which are then matched to environmental covariates (such as depth at the centroid of the segment; Hedley and Buckland 2004, Miller *et al*. 2013). Segment length is a modeller's choice reflecting a trade-off. Small segments are better matched to environmental covariates values at the costs of an increase in the number of segments with no sightings, generating an abundance of zero- observations that may later create issues during model fitting. Segment length should also be chosen in coherence with the size of individual cells in the prediction grid over the study area to avoid an illusion of precision (especially given the mobility of some cetacean species). At the very least, predictions should not be made at a scale smaller than the resolution of the environmental or other covariates used in the model. On the other hand, to avoid oversmoothed predictions and minimizing bias induced by summarizing a large area to a single value, segment length should not be larger than 10 km. Recent progress in modelling may obviate the need for segmentation altogether in the future, however the current and operational workflows still require this step.
- **Model selection and assessment**. Model selection has its own research program in statistics, with guidelines being constantly updated and discussed. One important source of uncertainty that needs to be taken into account in predictions is uncertainty stemming from several models that may fit the data equally well. Although a model-based estimate from a single model may achieved a greater precision (lower cv), this gain in precision may result from ignoring model uncertainty. Model-averaging or stacking provide steps for combining results from several, equally well-fitting, models.

3.4 For information: provisional calendar of anticipated large-scale population-wide surveys within the next 6 years

Although there is generally good scientific coordination among Member States (MS) when planning the design and implementation of joint large-scale surveys in both the Atlantic and the Mediterranean Sea, one of the most significant limitations can be the capacity of each country to manage the allocated funds for carrying out the surveys within the same timeframe. Recognizing the complexity involved in coordinating the temporal aspects of national monitoring programme surveys within the framework of international sampling schedules, the current outlook (as of mid-2024) for the next cycle of the MSFD is as follows.

In the Mediterranean and Black Sea regions, ACCOBAMS is working on implementing the LTMP to potentially repeat ASI survey in 2026 and 2027, respectively. In the Atlantic region, SCANS-IV survey occurred in 2022, thus the subsequent survey, SCANS-V, would be scheduled for 2028. However, there is consideration to advance the sampling to 2027 to allow enough time for obtaining all necessary data products for the subsequent reporting in 2030.

3.5 A Roadmap

3.5.1 Potential formats for a way forward

The WK discussed the potential ICES options to host these discussions, that are: (i) recurring WKs, (ii) Joint Workshops between IGOs, or (iii) a Study Group, with a view to becoming a WG in future. The first two options are more flexible in terms of participation and funding requirements.

After a brief discussion, the WK agreed to start with recurring workshops ensuring an appropriate participation of interested parties.

3.5.2 Workshop targeted experts/participants

In terms of targeted experts/participants to the future WKCETAB, it was agreed that they should represent, at least, the following categories:

- MSFD coordinators of marine mammal monitoring,
- National coordinators of marine mammal monitoring in non-EU Countries or under other National arrangements,
- Experts on relevant statistical approaches,
- Representatives of relevant ICES WG (i.e. WGBYC, WGMME, WGJCDP),
- Scientific representatives/experts of Regional Sea Conventions and Agreements (i.e. OSPAR, HELCOM, Barcelona Convention/UNEP MAP, Bucharest Convention/Black Sea Commission, ASCOBANS, ACCOBAMS, NAMMCO, IWC, Pelagos Agreement).

3.5.3 Possible next meeting date and location

It was proposed that the next WKCETAB could take place in June 2025 in Zagreb, or Copenhagen, or La Rochelle, or Paris.

However, given that the next meeting of the ACCOBAMS Scientific Committee is planned in Tunis (Tunisia) for 03-06 December 2024, one option could be to plan the next meeting before or after the ACCOBAMS SC, to benefit from support with local organization.

3.5.4 Proposed roadmap: topics and timeline

WKCETAB will further discuss and investigate the different options described above in its future meetings. The ultimate goal of this discussion is to map a decision-tree to help selecting the most appropriate approaches on a case-by-case basis, thereby ensuring coherent assessment (with respect to methodology and data) between countries/MS for reporting purposes.

In order to achieve this goal, data products such as shapefiles or geopackages with survey design information (survey blocks) and results (abundance estimates and their associated coefficients of variation) shall be created for large scale surveys (Section 3.2 for some examples). These data products, which WKCETAB will maintain and update on a regular basis, will be fed into user-friendly tools such as shiny applications to facilitate the design and sharing of post-stratification techniques that maintain the integrity of the original survey design.

Other data products can include the collation of predictions from DSM fitted on these data and their visualization through another shiny app (see for an example the following app delivered by the project CetAMBICion: https://www.cetambicion-project.eu/research/).

Special care and attention will be paid to the visual design of such apps, along with the caveats involved in their use or interpretation. Such operational data products and tools will be discussed and possibly added as specific ToRs in future meetings of WKCETAB.

WKCETAB agreed to focus on the following points:

1. Achieve ecological and administrative coherence on Assessment Units (AU) based on the best available scientific evidence (2025).
    - Common terminology
    - Identify/Revise AU
        - Assess the effects of administrative boundaries on ecologically meaningful AU and related conservation measures
2. Long-term monitoring (temporal and spatial scales; approaches meeting requirements of MSFD and similar frameworks) (2025).
3. Guidance on the most appropriate (robust, precise and unbiased) approach on reporting abundance in the context of MSFD and similar frameworks (2025).
4. Set up a system to ensure data flow and data handling (including use of tools to organize data) and data call specifications/restrictions in coordination with WGJCDP, and other relevant groups/fora.
5. Provide regionally agreed tools/products (e.g. shape files and abundances of survey strata, AUs, shiny applications, etc.) for coherent reporting at ecological relevant scales in the context of MSFD and similar frameworks.
6. Facilitate the coordination among MS/countries, at sub-regional level, on synchronization of large-scale surveys (ecologically meaningful surveys).

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Annex 1: List of participants

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Annex 2: Resolutions

2023/WK/DSTSG04 The **Workshop on cetacean abundance estimation through distance sampling methods (WKCETAB)**, chaired by Caterina Fortuna, Italy, Jose Antonio Vázquez, Spain, and Matthieu Authier, France, will be established and will meet in Rome, Italy, 16-18 April 2024 to:

Produce and overview of available sources of cetacean distance sampling data to be used for the MSFD D1C2 (and D1C1) subregional assessments, including:

- data collected in institutional dedicated surveys;
- data available from other sources.

Agree on a coordinated approach and protocols in the ICES and GFCM areas to prepare and analyse distance sampling data on cetaceans for the MSFD D1C2 (and D1C1) assessment.

WKCETAB will report by 28 June 2024 for the attention of ACOM and SCICOM.

Supporting information

Priority	Abundance estimates of cetacean species is a key factor to assess their conservation status and the impact of antropogenic activities such as bycatch, whose management is a priority at European level. MSFD also requires Member States to report coherent values of the abundance of cetacean species at regional or subregional level (criteria D1C2), for which close collaboration and coordination is essential between neighbouring states.
Scientific justifica tion	This workshop aims to bring together international experts (from the Atlantic and Mediterranean) involved in cetacean abundance estimation, to evaluate the quality and accuracy of current data sources, and to work towards a coordinated methodology that will enable a correct assessment for the MSFD D1C2 (and D1C1). The workshop will support a significant part of objectives 4.1 and 4.2 of The Roadmap for ICES bycatch advice on protected, endangered and threatened species and propose options to harmonize cetacean abundance estimation methods using data from regular ecosystemic surveys. Term of Reference a) Sources of Distance Sampling data. In the Northeast Atlantic, there has been several recent collaborative initiatives to collect and analyse distance sampling data to estimate cetacean abundance (OSPAR QSR 2023, CetAMBICion, SCANS-IV). However, in the Mediterranean Sea region, the only project of similar nature is the ACCOBAMS Survey Initative (ASI). This ToR will look at past and current data collation efforts to build synergies and capitalize on previous work from the both European marine basins (Atlantic and Mediterranean). There are other initiatives and sampling programmes, generally at the national level, with different spatial and temporal coverage that can complement these data to better specify the status of many cetacean populations, as has been done in the Atlantic in the OSPAR QSR 2023 or in the CetAMBICion project. These approaches can be extended to the Mediterranean region, taking into consideration the EcAp/IMAP framework under the Barcelona Convention. This would strengthen the harmonization of data and assessments. Term of Reference b) Agree on a coordinated approach Roadmap and protocols in the ICES and GFCM areas. Work will be carried out under this ToR on a series of relevant points (i.e., subregional list of species, calculation methods, GES definition, models, and parameters) and a common approach structuring key steps to continue this work towards harmonizedreporting . The approach will, in particular, seek to identify future actions necessary to report on MSFD criteria D1C1 and D1C2; and to harmonize cetacean abundance estimation methods in ICES and GFCM areas.
Resource requirements	The research programmes, which provide the main input to this group, are already underway, and resources are already committed. The additional resource required to undertake additional activities in the framework of this group is negligible.

Participants	The Workshop will be attended by approximately 10–20 experts.
Secretariat facilities	None besides SharePoint facilities and secretariat support with report formatting
Financial	No financial implications.
Linkages to advisory committees	ACOM
Linkages to other committees or groups	WGMME, WGBYC and WGJCDP.
Linkages to other organizations	OSPAR, ASCOBAMS, ACCOBAMS, UNEP/MAP, NAMMCO

Annex 3: List of abbreviations and acronyms

ACCOBAMS: The Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic area

ASCOBANS: Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas

ASI: ACCOBAMS Survey Initiative

CDS: Conventional Distance Sampling

CODA: Cetacean Offshore Distribution and Abundance

D1C1: Descriptor 1 (Biodiversity) Criterion 1 (by-catch); Marine Strategy Framework Directive indicator on by-catch mortality

D1C2: Descriptor 1 (Biodiversity) Criterion 2 (abundance); Marine Strategy Framework Directive indicator on abundance

DSM: Density Surface Model

EU: European Union

GES: Good Environmental Status

GFCM: General Fisheries Commission for the Mediterranean

ICCAT: International Convention for the Conservation of Atlantic Tunas

IMAP: Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria

IMMA: Important Marine Mammal Area

ISPRA: Istituto Superiore per la Protezione e la Ricerca Ambientale

LTPM: Long-Term Monitoring Programme

MAP: Mediterranean Action Plan of the United Nations Environment Programme

MCDS: Multiple Covariate Distance Sampling

DM: Marine demarcation (Spain)

MPA: Marine Protected Area

MS: Member States of the European Union

MSFD: Marine Strategy Framework Directive; Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy

NASCO: North Atlantic Salmon Conservation Organization

NEAFC: North East Atlantic Fisheries Commission

OSPAR: Oslo and Paris Convention for the Protection of the Marine Environment of the North-East Atlantic

RSC: Regional Sea Convention

SCANS: Small Cetaceans in European Atlantic waters and the North Sea