Agenda Item 4.1 Review of New Information on Other Matters Relevant for Small Cetacean Conservation

Population Size, Distribution, Structure and Causes of Any Changes

Document 4.1.b

ICES 2013: Report of the Working Group on Marine Mammal Ecology (WGMME)

Action Requested

- Take note

Submitted by United Kingdom

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DELEGATES ARE KINDLY REMINDED TO BRING THEIR OWN COPIES OF DOCUMENTS TO THE MEETING

ICES WGMME REPORT 2013

ICES ADVISORY COMMITTEE

ICES CM 2013/ACOM:26

Report of the Working Group on Marine Mammal Ecology (WGMME)

4–7 February 2013

Paris, France

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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Conseil International pour l'Exploration de la Mer

H. C. Andersens Boulevard 44–46
DK-1553 Copenhagen V
Denmark
Telephone (+45) 33 38 67 00
Telefax (+45) 33 93 42 15
www.ices.dk
info@ices.dk

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Contents

Executive summary

The Working Group on Marine Mammal Ecology (WGMME) met in Paris, France from 4–7 February 2013. Eunice Pinn chaired the meeting of 18 participants, representing ten countries.

Six ToRs were addressed. The first reviewed progress with the CRR report on monitoring strategies for marine mammals with a view to submitting a new resolution to publish it. The second looked at new information on abundance and provided advice on suitable management units in relation to potential marine mammal indicators building on the work undertaken last year and also that of OSPAR ICG-COBAM expert group on marine mammals and reptiles. Although the third ToR could not be fully addressed due to delays in a report that was to be reviewed, some progress was made with regard to outlining the policy decisions required for determining safe bycatch limits. The fourth ToR could not be fully addressed either. This was to review the applicability of the Joint Cetacean Protocol for European reporting requirements such as MSFD and the Habitats Directive. Unfortunately the report was not available to review, but some progress was made with the further development and operationalization of ICG-COBAM's common indicators. The fifth ToR covered the further development of the seal database and the sixth looked at monitoring requirements in relation to marine mammals during the development and deployment of marine renewables.

In 2009, ICES requested that the Working Group on Marine Mammal Ecology (WGMME) "Develop a framework for surveillance and monitoring of marine mammals applicable to the ICES area that is realistically achievable by contracting parties". This remained a term of ToR for the WG in 2010 and development of this work into a Cooperative Research Report was approved by ICES in 2011. Subsequently, due to continued slow progress during 2012, the decision was taken, in consultation with ICES, to withdraw the proposed CRR until such time as progress justified submission of a new proposal. During the meeting it was decided to refocus the report on the monitoring requirements for the common indicators identified by ICG-COBAM which could potentially contribute to OSPAR Joint Assessment and Monitoring Programme (JAMP) for biodiversity monitoring.

Requests from the European Commission and OSPAR on the development of indicators and targets for determining Good Environmental Status (GES) under MSFD and building on work undertaken in 2012, management units were further reviewed and delineated for cetaceans. Boundaries were specified so that the management units can be populated with abundance and bycatch estimates. As previously agreed, these boundaries coincide with ICES Area/Division boundaries where possible. It was not possible to provide a similar consideration of seal management units.

Linked with this, further consideration was given to ICG-COBAM's common indicators for marine mammals. The proposals were accepted in principal but some changes will be required to make them operational. The WG focused on trying to make the indicators operational and, in the process, it was inevitable that a few issues would be identified. The WG took care not to change the most important messages relating to the indicators (name, metrics and targets), although there were some minor editorial changes. However, changes were proposed to other elements with the most important objective being to make them operational in practice. The further development of the seal database was also linked with these indicators.

Current monitoring efforts to determine the distribution and habitat use of marine mammals, in relation to environmental impact assessments, e.g. for marine renewable energy developments, typically take place at much smaller spatial scales than are ecologically relevant to marine mammals, and are often undertaken independently without broader coordination. This results in numerous disparate datasets that are difficult to integrate when assessing overall impacts of marine renewable energy developments. Case studies were provided for Germany, The Netherlands, Belgium, and UK. A need for strategic decision-making in the early stages was identified. In the initial monitoring design stages, regulators and developers must develop clear, achievable monitoring objectives, and design realistic ways to achieve them, so that robust scientific data with sufficient statistical power can be gathered given available resources. There is also a critical need to improve integration of data collection efforts throughout the lifetime of a project, thereby ensuring that data gathered during pre-consenting *site characterization* stages can act as the "before" dataset for later studies of *magnitude of impact*. This requires that BACI / BAGI or other suitable approaches be adequately considered and evaluated with respect to statistical power at, or near, the outset of site characterization data gathering. Too often, monitoring programs in adjacent marine renewable energy developments occur independently without broader coordination. Regulators and seabed owners need to acknowledge the need for data pooling, require it as an integral part for marine renewable consenting and develop internationally standardized comparable data formats for easy access and analysis. The Joint Cetacean Protocol (JCP) may serve as such an example.

1 Introduction

The Working Group on Marine Mammal Ecology (WGMME) met in Paris from 4 February to 7 February 2013. The list of participants and contact details are given in Annex 1.

The Working Group gratefully acknowledges the support given by several additional experts who kindly provided information and/or reports for use by WGMME and reviewed parts of the report. These included Aurore Sterckeman, Callan Duck, Lucy Greenhill, Florence Caurant, Sophie Brasseur, José Antonio Vazquéz and José Vingada. Thanks are also due to Annabelle Aish for helping to organize everything for us in Paris.

The Chair also acknowledges the diligence and commitment of all the participants before, during and after the meeting, which ensured that the Terms of Reference for this meeting were addressed.

2 Adoption of the agenda

The following Terms of Reference and the work schedule were adopted on 4 February 2013.

a) Review progress with the report on monitoring strategies for marine mammals with a view to submitting a new resolution to publish it as an ICES CRR;

b) Review and report on any new information on population sizes, population/stock structure and management frameworks for marine mammals; specifically, the MUs for harbour porpoises will need to be revisited as indicators for MSFD become better defined. Such units will need to be aligned with the appropriate ICES rectangles to enable the calculation of more accurate bycatch estimates;

c) Collaborate with WGBYC to develop bycatch management procedures (based on the SCANS-II and CODA projects) for assessing bycatch at a European level. This work should include harbour porpoise (SCANS II), common dolphin (CODA) and consideration of additional species for which bycatch estimates have been made or suggested as a potential MSFD indicator. Such species include bottlenose dolphin, striped dolphin, harbour seal and grey seal;

d) Assess the Joint Cetacean Protocol outputs with a view to their contribution to international transboundary reporting requirements (e.g. for Article 17 of the Habitats Directive) and the development of MSFD indicators, targets and appropriate baselines;

e) Update on development of database for seals and status of intersessional work, assessing its potential contribution to the development of MSFD indicators, targets and baselines;

f) Review and assess how the monitoring of effects around offshore wind and marine renewable energy devices is or could be undertaken.

WGMME will report to the attention of the Advisory Committee (ACOM) by 25 February 2013.

Supporting information

Priority:	High, as only group that can support requirements in ToR b.
Scientific justification and relation to action plan:	a) This work originated in response to an ICES request in 2009. It is also relevant to the current European Commisison and OSPAR requests to ICES in relation to scientific and technical support of the MSFD. b) This work is required under MoU between the European Commission and ICES: "provide new information regarding the impact of fisheries on other components of the ecosystem including small cetaceans and other marine mammals…" and also the OSPAR request in relation to MSFD indicator development. c) OSPAR request in relation to MSFD indicator development. d) OSPAR request in relation to MSFD indicator development and also to a request from WGBIODIV. e) This will facilitate future work of the WG and also OSPAR request in relation to MSFD indicator development. f) Following reviews of the impacts of marine renewables on marine mammals, it was considered necessary to evaluate montioring practicves to address the research topic "Influence of development of renewable energy resources (e.g. wind, hydropower, tidal and waves) on marine habitat and biota" within the ICES Science Plan.
Resource requirements:	No specific requirements beyond the needs of members to prepare for, and participate in, the meeting.
Participants:	The Group is normally attended by some 20–25 members.
Secretariat facilities:	None.
Financial:	No financial implications.
Linkages to advisory committees:	WGMME reports to ACOM
Linkages to other committees or groups:	SCICOM SSGSUE
Linkages to other organizations:	

3 TOR a: Review progress with the report on monitoring strategies for marine mammals with a view to submitting a new resolution to publish it as an ICES CRR

In 2009, ICES requested that the Working Group on Marine Mammal Ecology (WGMME) "Develop a framework for surveillance and monitoring of marine mammals applicable to the ICES area that is realistically achievable by contracting parties". The rationale was that an international cooperative approach needs to be established for the long-term surveillance and monitoring of marine mammals in the Northeast Atlantic and such a framework is essential to the success of long-term management of marine mammal populations within the ICES area.

This topic remained a Term of Reference for WGMME in 2010 and a recommendation from WGMME to develop relevant material from both reports into a Cooperative Research Report was approved by ICES, and reflected in a new Term of Reference for WGMME in 2011 "*Finalize production of the Cooperative Research Report on the framework for surveillance and monitoring of marine mammals applicable to the ICES area*".

The intention was to write a generic manual of "best practice" in marine mammal monitoring. The original proposed structure envisaged a description of the relevant legislation (extending to North America as well as Europe), evaluation of the various existing monitoring approaches and best practice both for evaluating Conservation Status and for dealing with different threats faced by marine mammals. The report was also intended to examine how monitoring results could be used for management. Material from the 2009 and 2010 WGMME reports was mainly focused on reviewing current monitoring, and progress with writing the remaining sections of the report was slower than anticipated. Due to continued slow progress during 2012, the decision was taken, in consultation with ICES, to withdraw the proposed CRR until such time as progress justified submission of a new proposal.

The Marine Strategy Framework Directive (MSFD) (2008/56/EC) requires EU Member States to determine Good Environmental Status (GES) for their marine waters (Article 9) and establish environmental targets and indicators in order to guide progress towards achieving GES (Article 10). Marine strategies for achieving GES across regions and subregions need to be coherent, coordinated and have common approaches, including monitoring (Article 5.2). OSPAR has a role in coordinating implementation within the Northeast Atlantic region, with the Intersessional Correspondence Group for the Coordination of Biodiversity Assessment and Monitoring (ICG-COBAM) being the main delivery group within the OSPAR framework for coordination in relation to the biodiversity aspects of the MSFD. In November 2011, a workshop was organized by ICG-COBAM to undertake an in depth comparison and analysis of indicators and associated targets for MSFD biodiversity descriptors 1, 2, 4 and 6 between OSPAR Contracting Parties that were also involved in the implementation of the MSFD. Hosted by the Netherlands, the three-day workshop brought together sixty-six policy and technical experts from nine Contracting Parties. The workshop resulted in summary report and detailed analyses per ecosystem component, with proposed indicators, associated targets, relevance to different subregions and agreement on species/metrics and targets. From the results, it was concluded that there are some promising common indicators, especially relating to abundance, biomass and bycatch of key species including marine mammals (OSPAR, 2012).

WGMME (2012) considered and contributed towards the further development of the common marine mammals indicators proposed in November 2011. Subsequently, ICG-COBAM has set up expert groups for each component, including one for Marine Mammals and Reptiles, to operationalize the core set of common indicators (Table 1, and see Annex 3 for further details). OSPAR Joint Assessment and Monitoring Programme (JAMP) aims to establish, in 2014, monitoring programmes under the MSFD.

Table 1. Common indicators under the MSFD (descriptor 1, biodiversity).

CODE	INDICATOR
M-1	Distributional range and pattern of grey and harbour seal haul-outs and breeding colonies
M-2	Distributional range and pattern of cetaceans species regularly present
M-3	Abundance of grey and harbour seal at haul-out & breeding sites
M-4	Abundance at the relevant temporal scale of cetacean species regularly present
M-5	Harbour seal and Grey seal pup production
M-6	Numbers of individuals within species being bycaught in relation to population

The need to now elaborate these indicators, setting metrics, reference levels, and quantitative targets where possible, plus designing monitoring programmes and putting them into practice with a coherent assessment as the final aim, provides renewed justification for involvement of WGMME in writing a manual of best practice in marine mammal monitoring. With these developments in mind, at the 2013 meeting of WGMME, the decision was taken to refocus the proposed CRR on the MSFD descriptor 1 indicators. The marine mammal species covered by these indicators are harbour seal, grey seal, harbour porpoise, and common dolphin, and also (with specific reference to indicators 2 and 4), bottlenose dolphin, white-beaked dolphin and minke whale.

The proposed structure of the new report is shown in Figure 1. Within each part of Sections 2 (the indicators) and 3 (making the indicators operational), the intent will be to include a generic overview as well as specific information. Because marine mammal monitoring programmes in the EU are mandated by several other regulations, directives and agreements (notably the Habitats Directive, Regulation 812/2004, ASCOBANS and OSPAR Eco-QOs), the report will also cover the associated indicators, their implementation and monitoring requirements. Section 4 of the report refers to monitoring of anthropogenic threats that are not specifically addressed, in relation to marine mammals, by MSFD descriptor 1. This section covers underwater noise, renewable energy development, pollution (including marine litter), boat traffic, hunting, illegal killing, and climate change. Note that the MSFD addresses pollution (Descriptors 5 on eutrophication, 8 on contaminant levels, 9 on contaminant levels in fish, and 10 on marine litter) and underwater noise (Descriptor 11), but not with specific reference to marine mammals. MSFD Descriptor 7 refers to permanent alteration in hydrographical conditions, a possible consequence of climate change. A section on habitat loss and prey depletion (relevant to MSFD descriptors 3, 4 and 6) may also be included in the CRR.

It is proposed that the original editorial team for the CRR (Eunice Pinn, Sinead Murphy, Graham Pierce and Kelly Macleod) will be joined by Begoña Santos and Jan Haelters. This team will jointly take responsibility for coordinating input from

WGMME members (and, where appropriate, experts external to the group) and such additional writing and editing as may be required.

1. General introduction
2. The common indicators
   - 2.1. Summary of Indicators proposed
   - 2.2. Reasoning for the development of indicators
   - 2.3. Appropriateness
3. Making indicators operational
   - 3.1. Parameter – metric
   - 3.2. Baseline – reference level
   - 3.3. Target
   - 3.4. Spatial scope – identification of Management Units
   - 3.5. Monitoring requirements: methodology, frequency, spatial aspect
   - 3.6. Reporting
   - 3.7. Assessment (frequency, methodology)
   - 3.8. (Implementation)
   - 3.9. Further work
4. Monitoring for other specific threats to marine mammals
   - 4.1. Noise
   - 4.2. Renewables
   - 4.3. Pollution
   - 4.4. Boat traffic
   - 4.5. Hunting
   - 4.6. Deliberate illegal killing
   - 4.7. Climate Change
   - 4.8. Further work

Appendices

A1. Legislation

Figure 1. Proposed structure of the CRR on monitoring.

References

OSPAR 2012. MSFD Advice Manual and Background Document on Biodiversity. A living document - Version 3.2 of 5 March 2012. Approaches to determining good environmental status, setting of environmental targets and selecting indicators for Marine Strategy Framework Directive descriptors 1, 2, 4 and 6. Available at: http://www.ospar.org/documents/dbase/publications/p00581_advice%20document%20d1_d2_d4_d6_biodiversity.pdf.

WGMME. 2010. Report of the Working Group on Marine Mammal Ecology. 12–15 April 2010 Horta, The Azores. ICES CM 2010/ACOM:24.

WGMME. 2011. Report of the Working Group on Marine Mammal Ecology. 21–24 February 2011. Berlin, Germany. ICES CM 2011/ACOM:25.

WGMME 2012. Report of the Working Group on Marine Mammal Ecology. March 5–8, Copenhagen, Denmark. ICES CM 2012/ACOM:27.

4 ToR b): Review and report on any new information on population sizes, population/stock structure and management units for marine mammals; specifically, the MUs for harbour porpoises will need to be revisited as indicators for MSFD become better defined. Such units will need to be aligned with the appropriate ICES rectangles to enable the calculation of more accurate by-catch estimates

4.1 Background

Annex II of the 2012 MoU between the EU and ICES includes a recurring request for ICES to '*Provide any new information regarding the impact of fisheries on other components of the ecosystem including small cetaceans and other marine mammals, seabirds and habitats*' and also to '*propose reference points as guidance for management purposes in an ecosystem context for each ecoregion, following set of indicators made available through the Data Collective Framework and descriptors of the Marine Strategy Framework Directive*.' The current requirements of EU Regulation 812/2004 on cetacean bycatch are to be included within the Data Collection Framework in future. In addition in 2012, there was a non-recurring request to provide '*scientific and technical developments in support of the Marine Strategy Framework Directive, such as by designing marine monitoring and assessment programs, identifying research needs, and methodological advice*.'

OSPAR is also seeking advice from ICES in relation to the development of indicators and targets for determining Good Environmental Status (GES) under MSFD. The Working Group on Biodiversity Science (WGBIODIV) has requested that WGMME provide some support, in relation to marine mammals and reptiles, for their Term of Reference:

'*Support to the technical specification and application of OSPAR common indicators under D1, 2, 4, and 6. ICES will be requested to under-take an independent peer review of the technical specifications and proposed operational implementation of the indicators that will be presented. The review should consider, from the perspective of producing a set of common indicators for the OSPAR Region*:

1) whether the indicators put forwards are appropriate to implement at a regional scale;
2) whether the set of indicators is sufficient as a set to understand GES;
3) identify any gaps;
4) identify where there are difficulties in the operationalization of the indicators, with proposals for how to overcome these. Based on the outcomes of OSPAR request 2013–2014 (below) (regarding maximizing efficiencies for monitoring of biodiversity);
5) identify where there are opportunities to cluster indicators that can benefit from shared monitoring/data collection.

The following common indicators have been proposed for marine mammals were considered at the December 2012 ICG-COBAM meeting:

Descriptor 1 'Biological diversity is maintained'

1) Distributional range and pattern of grey and harbour seal haul-outs and breeding colonies: No decrease, relative to the baseline, beyond natural variability.
2) Distributional range and distributional pattern within range of cetaceans: No decrease, relative to the baseline, beyond natural change OR to restore to, or maintain populations, in a healthy state.
3) Abundance of harbour and grey seals: No statistically significant decrease, relative to the baseline, beyond natural variability.
4) Abundance, at the relevant temporal scale, of cetacean species regularly present: No statistically significant decrease, relative to the baseline, beyond natural variability (1); An increase in numbers in all areas where a species occurs, and a recovery in areas where it was known to occur up to the 20th century (2).
5) Fecundity rate of harbour seal and grey seal (pup production): No statistically significant negative deviation from long-term variation / no decline of ≥10%, for each management unit.
6) Mortality rate due to bycatch: The annual bycatch rate of [marine mammal species] is reduced to below [X] of the best population estimate.

Descriptor 4: 'Foodwebs'

1) Abundance of harbour and grey seals: No statistically significant decrease, relative to the baseline, beyond natural variability.
2) Abundance, at the relevant temporal scale, of cetacean species regularly present: No statistically significant decrease, relative to the baseline, beyond natural variability (1): An increase in numbers in all areas where a species occurs, and a recovery in areas where it was known to occur up to the 20th century (2).
3) Fecundity rate of harbour seal and grey seal (pup production): No statistically significant negative deviation from long-term variation / no decline of ≥10%, for each management unit.

As a result of these two requests, this ToR is focused on the further development of the common indicators proposed, particularly the delineation of management units which are essential to any future assessment. Additionally, any new information on stock structure, surveys and abundance estimates is also included. It is evident that to make these indicators operational they require definition of baselines and an understanding of levels of natural variation, for each management unit, in addition to specification of a maximum acceptable bycatch rate. The proposed indicators and targets are also further developed in Annex 3.

4.2 Management units

WGMME (2012) discussed the development of management units (MUs) for harbour porpoise, common dolphin, bottlenose dolphin, white-beaked dolphin, white-sided dolphin and minke whale. The report of the joint ASCOBANS-Helcom small cetacean population structure workshop (Evans and Teilmann, 2009) had formed the basis for discussions for small cetaceans; whilst information from work of the IWC Scientific Committee guided discussions on minke whale. WGMME (2012) made recommendations for MUs for these species but did not explicitly specify their boundaries.

This year, proposed boundaries are specified so that the MUs can be populated with abundance and bycatch estimates. As previously agreed, these boundaries coincide with ICES area/division boundaries where possible.

WGMME (2012) also considered management units for harbour and grey seals under the ToR to develop biodiversity indicators to inform the ongoing work of OSPAR-COBAM and MSFD. New information received this year allowed this work to be taken further (Section 4.2.8) but a definitive list of MUs for seals could not be completed.

4.2.1 Harbour porpoise

In 2010, WGMME had endorsed the MUs for harbour porpoise proposed by the ASCOBANS-Helcom workshop (Evans and Teilmann, 2009). These were reviewed by WGMME (2012), which endorsed or recommended the following MUs: Iberian Peninsula; North Sea; Inner Danish Waters. WGMME (2012) had not agreed with splitting the North Sea into two MUs. There had been some discussion about the two proposed MUs to the west of Britain and Ireland but no conclusions had been reached. There had been no discussion on the putative Bay of Biscay MU.

New information was available this year on harbour porpoise distribution along the French and north Spanish coasts (see Sections 1.3.5 and 1.3.6). This indicates that porpoises seen in the Bay of Biscay are either part of the Iberian Peninsula population or (along the French coast in winter) part of a population that occurs mainly to the north in the Celtic Sea. It was concluded that there is no support for a separate MU in the Bay of Biscay. The new French data also continue to support a hiatus in distribution in the central Channel.

Regarding the North Sea, WGMME recognized that it may be appropriate to consider more than one MU in this area. The difficulty was in knowing where to place any boundary, especially taking into account ICES divisions. A single MU for the North Sea is recommended but it is also suggested that the option of more than one MU in the North Sea continues be explored in ongoing work to develop management models for setting safe limits to bycatch (see ToR c).

In conclusion, WGMME **recommends** the following MUs for harbour porpoise delineated by ICES areas/division boundaries (except in one case; Figure 4.1).

1) North Sea (NS): Area IV, Divisions VIId and part of IIIa (Skagerrak and northern Kattegat), the boundary between NS and Kattegat/Belt Seas is shown in Figure 4.2.
2) Kattegat and Belt Seas (KBS): Part of Division IIIa (southern Kattegat) and Baltic Areas 22 and 23 (see Figure 4.2).
3) Western Scotland and Northern Ireland (WSNI): Divisions VIa, VIb2.
4) Celtic Sea and Irish Seas (CIS): Divisions VII with the exception of VIId.
5) Iberian Peninsula (IB): Divisions VIIIc and IXa.

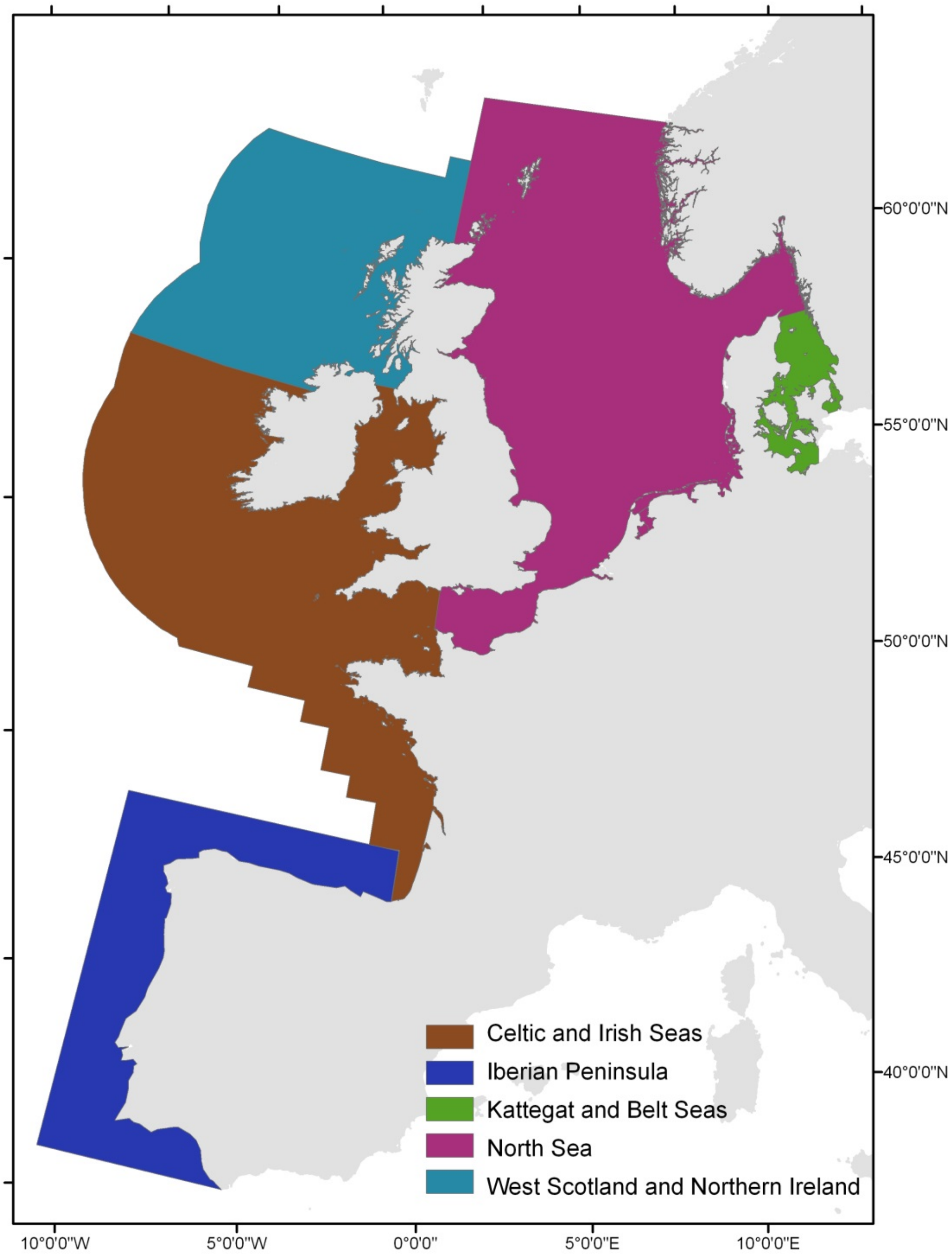

Figure 4.1. Harbour porpoise management units proposed for MSFD.

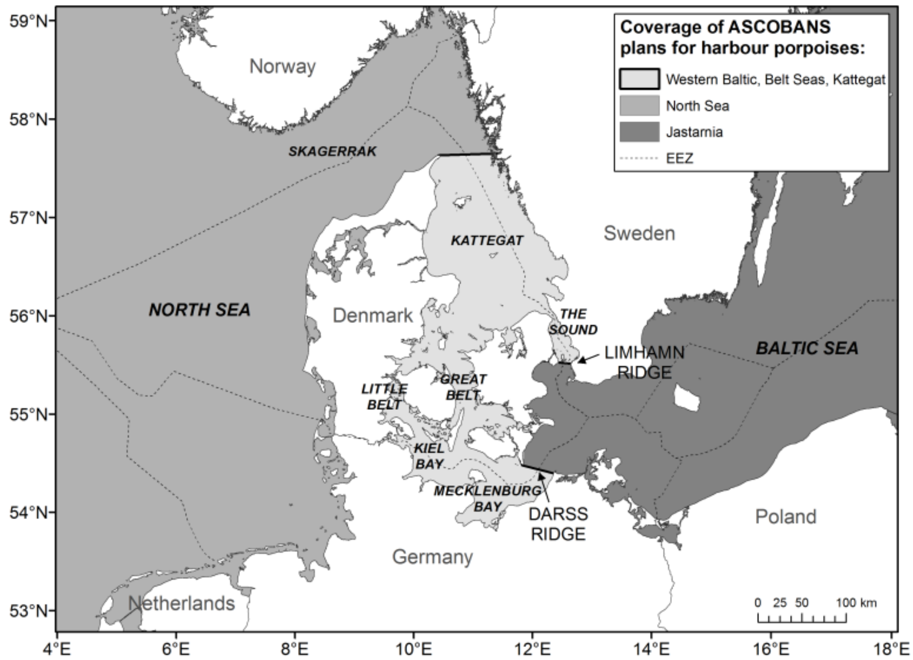

Figure 4.2. Harbour porpoise Management Unit proposed for the Kattegat and Belt Seas.

4.2.2 Common dolphin

WGMME (2012) noted that, although stable isotope and contaminant analyses suggest there may be some structuring of common dolphin populations within this region (see Caurant *et al.*, 2009), with the possible existence of neritic and oceanic ecological stocks, at present there are insufficient data to support separate "ecological" MUs.

WGMME (2012) concluded that only one population of common dolphin exists in the Northeast Atlantic, ranging from waters off Scotland to Portugal, and there is thus a single MU. Additional evidence of lack of differentiation is given in Moura *et al.* (2013). WGMME endorses this and **recommends** a single MU for common dolphin in the Northeast Atlantic comprising all relevant ICES areas and divisions.

4.2.3 Bottlenose dolphin

The ASCOBANS-Helcom small cetacean population structure workshop (Evans and Teilmann, 2009) had proposed provisional MUs for bottlenose dolphins and, based on the available information, WGMME (2012) had endorsed these MUs. This year, WGMME reviewed these proposals in more detail.

While high mobility of the species facilitates interaction and gene flow over large distances (Hoelzel, 1998; Querouil *et al.*, 2007), bottlenose dolphins display fine-scale genetic population structures resulting from localized adaptations over small spatial scales (Ansmann *et al.*, 2012). Genetic differentiation between neighbouring populations regularly occurs and may be related to habitat borders (Natoli *et al.*, 2005; Bilgmann *et al.*, 2007; Wiszniewski *et al.*, 2009), sex-biased linked dispersal potential (Möller *et al.*, 2004), anthropogenic activities (Chilvers and Corkeron, 2001), and through isolation by distance without apparent boundaries separating populations (Krützen *et al.*, 2004; Rosel *et al.*, 2009). Defining MUs at an appropriate scale is therefore a challenge. Broadly, bottlenose dolphins can be divided into three types or groups related to their patterns of mobility and habitat use. These are resident, coastal and oceanic.

4.2.3.1 Resident groups

In European Atlantic waters, based on time-series of photo-identification data, there are several discrete groups of bottlenose dolphins inhabiting small areas, which do not appear to mix with other groups, suggesting a strong degree of isolation and residency. These groups are at: Ile de Sein and Archipel de Molene, France; Barra, western Scotland; Shannon Estuary, Ireland; the southern Galician Rias, Spain and the Sado Estuary, Portugal (Liret *et al*., 1998; Hassani *et al*., 2003; Gaspar, 2003; Grellier and Wilson, 2003; Englund *et al*., 2007; Ingram *et al*., 2009; Fernandez *et al*., 2011a, b; Mirimin *et al*., 2011; Augusto *et al*., 2012; Berrow *et al*., 2012). These resident groups of animals are regularly monitored and, although the numbers of animals are small, they are appropriate to be considered as MUs because there is no evidence that these groups will be maintained by recruitment from other populations, if their numbers decline. Mark-recapture analysis of time-series of photo-identification data is the most appropriate way to monitor and derive abundance estimates at this local scale.

4.2.3.2 Coastal groups

At a larger scale, but still relatively small spatial scale, analyses of photo-identification data and some genetic studies have shown that there are coastal groups that are more mobile and range over larger areas but still show strong site fidelity along defined stretches of coast. Genetic and other studies in European waters have identified fine-scale structuring in coastal waters, with sympatric coastal and resident groups in some areas (Hoelsel *et al*., 1998; Ingram *et al*., 2001, 2003, 2009; Ingram and Rogan, 2002; Mirimin *et al*., 2011; Berrow *et al*., 2012).

The coastal/inshore groups include: the east coast of Scotland; the west coast of Scotland; Connamara–Mayo, western Ireland; the Irish Sea (focusing on the Cardigan Bay area); the English Channel/Celtic Sea (Ireland, UK and France); the north coast of Spain; the coast of Portugal; the Azores (Portugal), the Gulf of Cadiz (south coast of Spain) and the Straits of Gibraltar (south coast of Spain) (Liret *et al*., 1998; Hassani *et al*., 2003; Ingram *et al*., 2009; Lopez *et al*., 2009; Mirimin *et al*., 2011; Chico Porillo *et al*., 2011; Thompson *et al*., 2011; Berrow *et al*., 2012; Evans, 2012; Cheney *et al*., 2013). It is proposed that MUs along relevant coastal strips (predominantly out to 12 nm) should be established for these groups.

It is recognized that in some areas information is incomplete, that distribution may be ephemeral and the animals present likely comprise sympatric populations. Work is continuing in some areas and there are plans to examine population structure on a European wide scale, which may better inform conservation and management. It should be noted that the 12 nm boundary is a political one and that these coastal groups can and do range outside this area.

Some of these groups may be genetically distinct, e.g. Connamara–Mayo, Ireland (Mirimin *et al*., 2011) but are likely to range beyond these areas (Ingram *et al*., 2009; Oudejans *et al*., 2010; Rogan *et al*., 2012). Analyses of photo-identification data from multiple studies have shown that some bottlenose dolphins make long-distance movements from the east coast of Scotland to the west coast of Scotland and to Irish waters (O'Brien *et al*., 2009; Robinson *et al*., 2012). The population identity of these apparently wide-ranging individuals is unknown.

4.2.3.3 Oceanic waters

Surveys at a large spatial scale (e.g. SCANS-II/CODA) and information from platforms of opportunity have shown that there are large numbers of dolphins in the oceanic regions, beyond coastal waters. Very little is known about the population structure, ranging patterns and seasonal distribution of these animals. Mirimin *et al*. (2011), working on stranded individuals, suggested that a third population occurred in Irish waters, likely representing a large oceanic population. Across the European Atlantic arc, benthic topography is both complex and variable, with the width of the continental shelf being variable across EEZs, providing a variable neritic habitat. Bottlenose dolphins have been recorded on the shelf edge from recent French surveys (see Section 4.4.5) and a large number of slope-associated bottlenose dolphins have been documented to the southwest of Ireland and in the Porcupine bight in oceanic waters from the SCANS-II and CODA surveys. Given the wide-scale distribution of bottlenose dolphins, it is highly likely that further structure will be determined in European Atlantic waters, possibly associated with feeding specialisation. Until more information is available, it is proposed that bottlenose dolphins in oceanic waters away from the coast should be considered as a single MU.

4.2.3.4 Bottlenose dolphin summary

The following Management Units are proposed (given from north to south; Figure 4.3).

Resident groups: Barra (Scotland; although for management purposes this group is included within the wider Scottish west coast group); Shannon Estuary (Ireland); Ile de Sein (France) Archipel de Molene (France); southern Galician Rias (NW Spain); Sado Estuary (Portugal).

Coastal groups: west of coast Scotland (UK); east coast of Scotland (UK); Irish Sea (Ireland and UK); Connemara–Mayo (northern and west coasts of Ireland); the English Channel/Celtic Sea (Ireland, UK and France); north coast of Spain; coast of Portugal (except for the Sado Estuary); the Azores (Portugal), Gulf of Cadiz (south coast of Spain) and Strait of Gibraltar (south coast of Spain).

Oceanic waters: a single MU for all continental shelf/slopes/oceanic waters outside 12 nm from the coast. It should be noted that although a separate MU is ‘designated’ for the North Sea (represented by ICES Area IV, excluding coastal east Scotland), there are very few bottlenose dolphin are seen in this area. Although there is no conclusive evidence, those seen are thought to belong to the East Scottish coastal group.

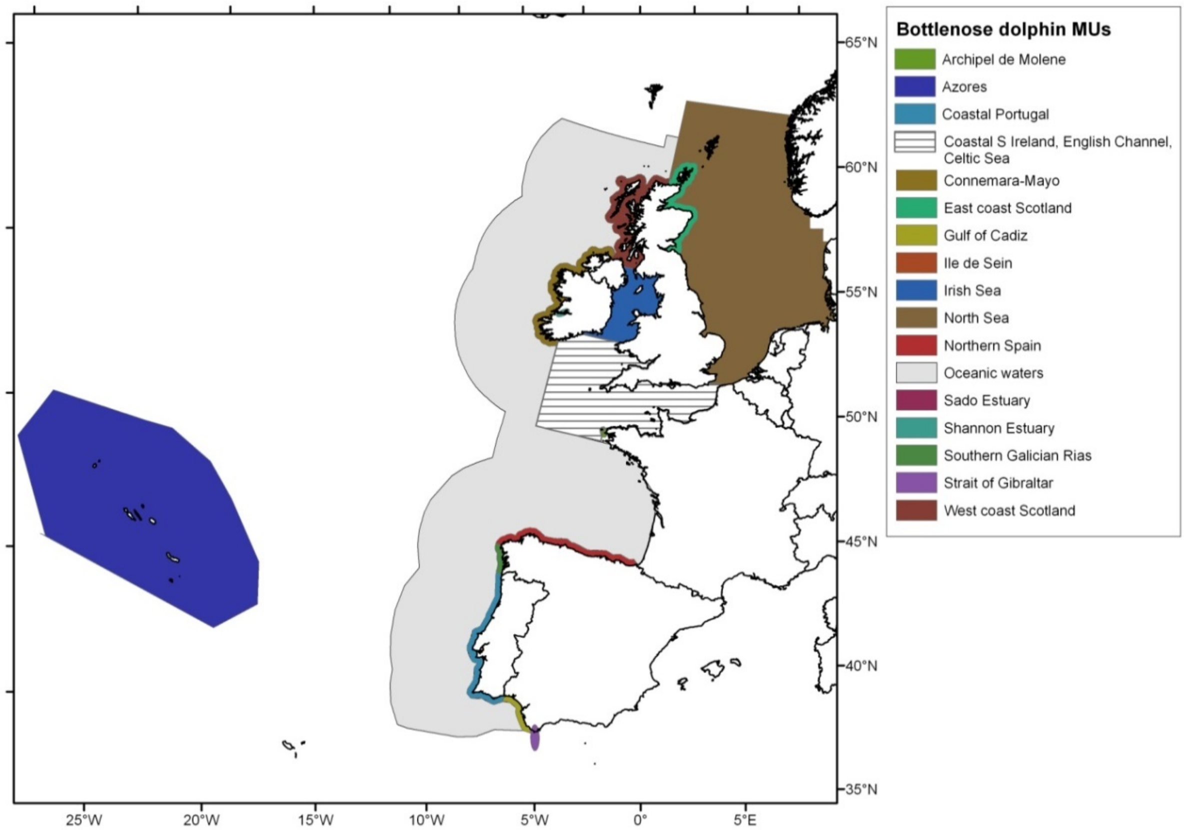

Figure 4.3. Bottlenose dolphin management units proposed for MSFD.

4.2.4 White-beaked dolphin

WGMME (2012) concurred with the ASCOBANS-Helcom workshop (Evans and Teilmann, 2009) that the data suggest a single continuous population within UK and Irish waters and endorsed the proposal for a single MU.

WGMME **recommends** a single MU for white-beaked dolphin around Britain and Ireland, comprising all relevant ICES areas and divisions. Additional MUs may be appropriate to northern Norwegian waters and waters around Iceland.

4.2.5 White-sided dolphin

The ASCOBANS-Helcom workshop (Evans and Teilmann, 2009) proposed two MUs for the white-sided dolphin in the eastern North Atlantic: a) northeastern North Atlantic including the northern North Sea; b) Central eastern North Atlantic including the Celtic Sea and western English Channel. WGMME (2012) considered the evidence of separation of the eastern North Atlantic into more than one MU to be weak and that only one MU is appropriate in this region.

WGMME **recommends** a single MU for white-sided dolphin in the eastern North Atlantic, comprising all relevant ICES areas and divisions.

4.2.6 Striped dolphin

The striped dolphin is a widely distributed species, found in tropical and warm-temperate waters of the Atlantic, Pacific, and Indian Oceans, as well as adjacent seas, including the Mediterranean. The normal northern latitudinal limit to the range is about 50°N, although there are extralimital records from southern Greenland, Iceland

and the Faroe Islands. An increase in the number of striped dolphin strandings (and occasional sightings) off western and northern Scotland (55–61°N) has been reported since 1988 (Macleod *et al*., 2005). An increase in winter occurrence and a decrease in summer occurrence of striped dolphins have been noted over the period 1996–2006 in the Bay of Biscay, although these trends were not statistically significant (Macleod *et al*., 2009).

The ASCOBANS-Helcom workshop (Evans and Teilmann, 2009) did not consider this species. Regarding population structure in the eastern North Atlantic, morphological and genetic studies strongly suggest that the Mediterranean and eastern North Atlantic populations are isolated from each other, with little or no gene flow across the Strait of Gibraltar (Calzada and Aguilar, 1995; García-Martínez *et al*., 1995; Gaspari, 2004).

There are no studies of population structure in the European Atlantic so in the absence of information, WGMME **recommends** a single MU for striped dolphin the eastern North Atlantic land, comprising all relevant ICES areas and divisions.

4.2.7 Minke whale

In 2012, WGMME considered population structure and MUs for minke whale in the context of the extensive work undertaken by the International Whaling Commission (IWC) Scientific Committee as part of the IWC process of developing the implementation of the Revised Management Procedure (RMP) for this species in this region. IWC defines three biological "stocks" in the North Atlantic: Western stock (including waters around Canada and West Greenland), Central stock (including waters around East Greenland and Iceland) and Eastern stock (European Atlantic waters, including off Norway). Additional information was also considered. WGMME (2012) recommended that these MUs delineated by the IWC be retained at this time.

WGMME therefore **recommends** a single MU for minke whale in the eastern North Atlantic, comprising all relevant ICES areas and divisions.

4.2.8 Harbour seal and grey seal

WGMME (2012) recommended that the seal EcoQOs should be revised; for harbour seals:

> Taking into account natural population dynamics and trends, there should be no decline in harbour seal population size (as measured by numbers hauled out) of ≥10% as represented in a five-year running mean or point estimates (separated by up to five years) within any of twelve subunits of the North Sea. These subunits are: Shetland; Orkney and north coast of Scotland; Moray Firth and East coast of Scotland; the Greater Wash/Scroby Sands; the French North Sea and Channel coasts; the Netherlands Delta area; the Wadden Sea; Heligoland; Limfjord; the Kattegat; the Skagerrak; the Oslofjord; and the west coast of Norway south of 62ºN.

and for grey seals:

> Taking into account natural population dynamics and trends, there should be no decline in pup production of grey seals of ≥10% as represented in a five-year running mean or point estimates (separated by up to five years) within any of nine subunits of the North Sea. These subunits are: Orkney; Firth of Forth; the Farne Islands; the Greater Wash; the French North Sea and Channel coasts; the Wadden Sea; Heligoland; Kjørholmane (Rogaland).

The subunit changes outlined by WGMME (2012) would more accurately reflect current monitoring and/or management areas. For the development of the MSFD indicators it is recommended, however, that the subunits do not get specifically listed. This would avoid the need to rewrite/update the wording of the indicator as new information on populations comes to light.

WGMME (2012) also reviewed the EcoQO subunits and other divisions outwith the North Sea in relation to their appropriateness as MUs for biodiversity indicators, to inform the ongoing work of OSPAR-COBAM and MSFD. This review was updated in the 2013 meeting.

4.2.8.1 UK

Around the UK, MUs have been proposed for grey and harbour seals (the same for both species) based on the locations of breeding colonies and haul-out sites, and on administrative boundaries (Figure 4.4). These can be extended across the Channel to include seals along French coasts but, to fit with data from seals tracked from France (see Section 4.2.8.4), the boundary in the centre of the Channel would be better placed at the boundary between ICES Divisions VIId and VIIe.

For harbour seals, genetic analyses support three northern groupings: western Scotland and Northern Ireland; eastern Scotland and the Northern Isles (Orkney and Shetland); and Norway; all of which were differentiated from harbour seals to the south in England, Normandy (France) and the Dutch Wadden Sea (WGMME, 2012). Some finer-scale structuring was also evident: harbour seals in the Tay Estuary could be distinguished from those in the rest of eastern/northern Scotland and seals from Normandy were from two different populations (Dutch Wadden Sea and eastern England and a different, but unknown, origin.

It was concluded that, although some broader genetic clustering is apparent, the structuring based on haul-out sites and associated local foraging areas is likely to be as important in the management of these populations as the maintenance of their genetic diversity. This is reinforced by the lack of movement between haul-out sites as shown by telemetry data (reviewed by WGMME, 2012).

In the UK, for ease of management, the same MUs have been defined for grey seals as used for harbour seals. It is acknowledged, however, that grey seals do not show the same population structuring as noted for harbour seals.

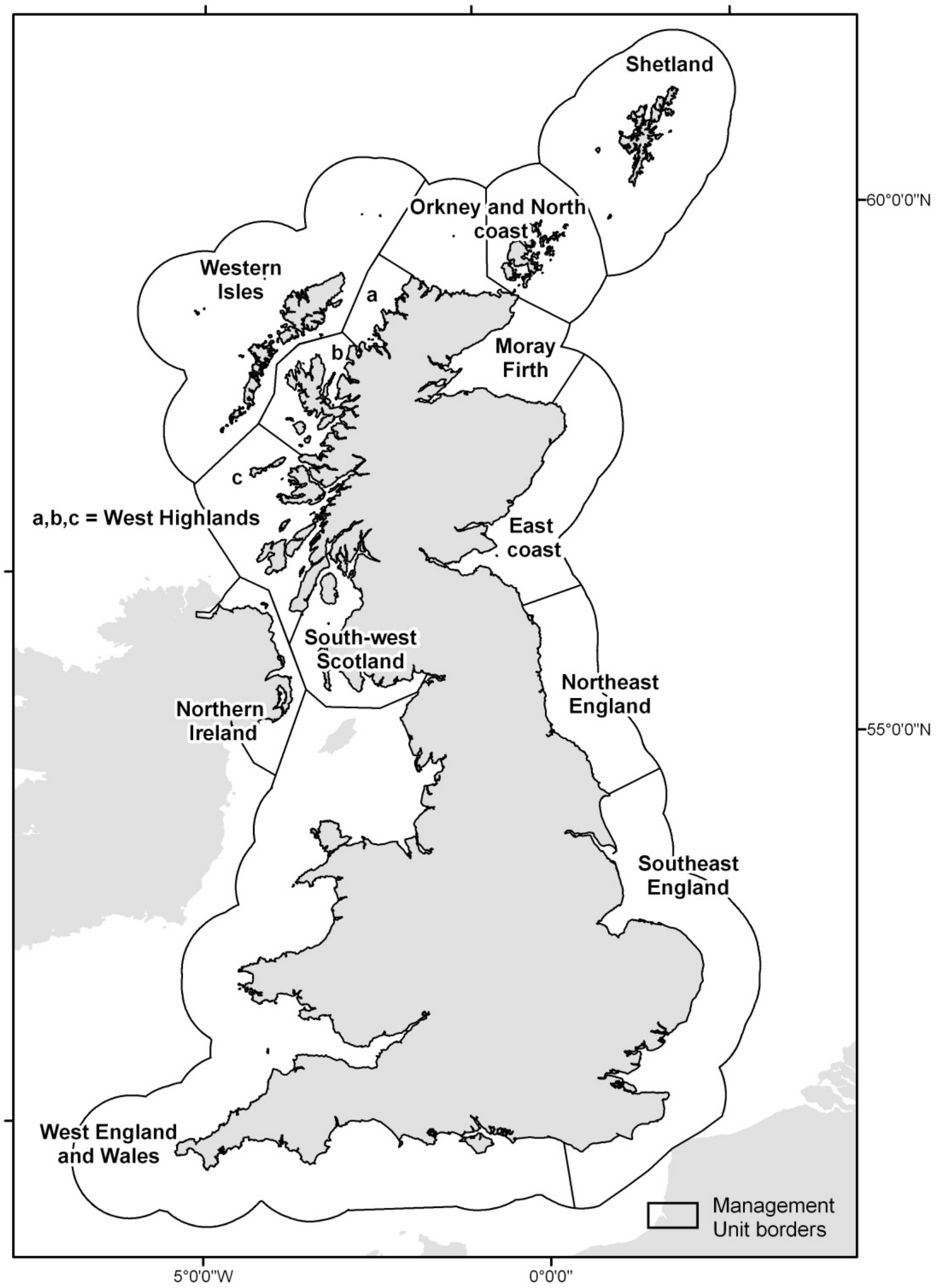

Figure 4.4. Proposed seal management units around the UK.

4.2.8.2 Netherlands

In the Netherlands, harbour seals in the Dutch Wadden Sea are considered to form a single population unit with the rest of the Wadden Sea, managed by the Common Wadden Sea Secretariat (TSEG, 2012a), although this unit experiences some exchange of animals with populations to the south (Netherlands, France, Belgium) and also in The Wash, UK.

Grey seals in Dutch waters are not independent of animals in the UK, explaining population growth of >16% per annum. A larger MU for grey seals in the southern

North Sea would appear to be more appropriate than the Wadden Sea. However, it should be noted that the monitoring undertaken within the Wadden Sea varies from that undertaken, for example, in UK sites. This could make amalgamation of data within a larger MU problematic.

4.2.8.3 Denmark

Around Denmark, there is no evidence that grey seals from Heligoland are separated from the Wadden Sea. Heligoland is surveyed as part of the Wadden Sea population under the coordination of Trilateral Seal Expert Group of the Common Wadden Sea Secretariat (TSEG, 2012b) and should form part of the same Management Unit.

Harbour seals in the Danish Wadden Sea are considered part of a single Wadden Sea MU, managed by the Common Wadden Sea Secretariat. In addition, there are MUs in the Limfjord, Kattegat (including Swedish waters), and western Baltic (also including Swedish waters), based on genetic and telemetry data (Sveegaard *et al.*, 2012). MUs in waters adjacent to Denmark are the Skagerrak (Norway and Sweden) and Kalmar Sound (Sweden).

4.2.8.4 France

Telemetry studies of grey seals tagged at haul-out sites along the north coast of France have shown clearly that animals found in French waters are part of the same populations that are found in UK and Irish waters (Figure 4.5). For grey seals, animals tagged in Brittany moved within the western Channel and to the west of Britain and Ireland and animals tagged in the Baie de Somme moved within in the eastern Channel and up the east of Britain, supporting a boundary between management units around Normandy. Little is known regarding the movements of harbour seals.

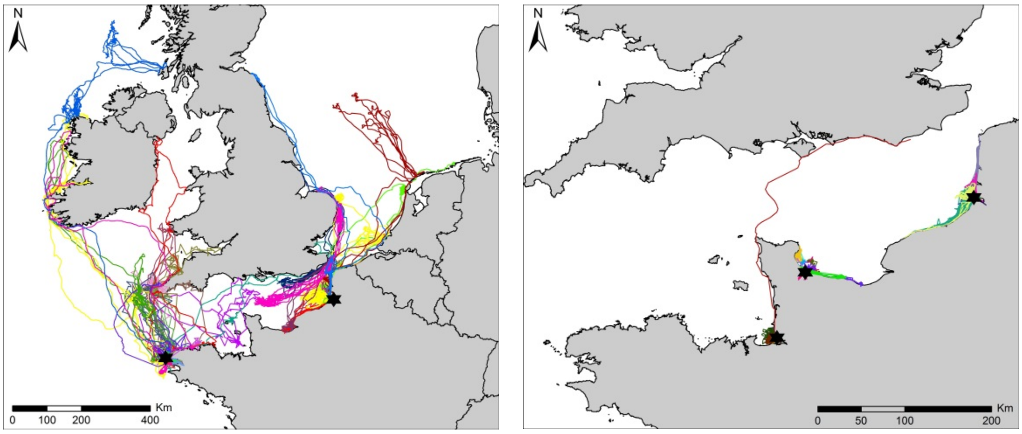

Figure 4.5. Tracks of seals tagged in France. Left panel - grey seals (Université de La Rochelle / CNRS, Parc naturel marin d'Iroise, Océanopolis, Picardie Nature, Région Bretagne, Région Poitou-Charentes). Right panel - harbour seals (Université de La Rochelle / CNRS, DREAL Basse Normandie, Réserve Naturelle de Beauguillot, Picardie Nature, La Compagnie du Vent, Région Poitou-Charentes).

4.2.8.5 Ireland

Management areas for seals in Ireland are currently being considered but were not available at the time of the meeting.

4.2.8.6 Summary

Based on the available information, WWGME **recommends** that MUs for harbour seals are based on the small MUs proposed for the UK, France, and Denmark, with a single MU for the Wadden Sea. The Irish have yet to propose MUs for this species.

For grey seals, however, because they range widely at sea and may visit multiple haul-out sites, MUs at a larger spatial scale would be more appropriate although differences (between countries) in monitoring may negate such an approach. There was insufficient time to complete this review work at the meeting.

4.3 Overarching WGMME recommendation on MUs

WGMME **strongly recommends** that Member States use the proposed management units for reporting requirements of the Habitats Directive and for the development of indicators and their assessment for the Marine Strategy Framework Directive. In summary, there is a single MU in the European North Atlantic for each of common dolphin (*Delphinus delphis*), white-beaked dolphin (*Lagenorhynchus albirostris*), white-sided dolphin (*Lagenorhynchus acutus*), striped dolphin (*Stenella coeruleoalba*) and minke whale (*Balaenoptera acutorostrata*). For bottlenose dolphin (*Tursiops truncatus*) there is a more complex structure with a total of 16 MUs ranging from small, discrete "resident" groups through larger coastal groups (which can encompass the small resident ones), to a large MU covering the whole European Atlantic to cover the wide-ranging animals that are mainly found away from coastal waters. For harbour porpoise (*Phocoena phocoena*), there are five MUs: the Iberian Peninsula, Celtic and Irish Seas, West Scotland/NW Ireland, the North Sea and Inner Danish Waters. The possibility of creating more than one MU in the North Sea for harbour porpoise should be explored in ongoing work to develop management models for setting safe limits to bycatch. Management units for both harbour and grey seals need to be more clearly defined for MSFD assessments.

4.4 New survey and abundance information

4.4.1 Abundance of harbour porpoise in the German North Sea and south-western Baltic Sea

In the framework of the Natura 2000 monitoring programme, dedicated aerial surveys to assess distribution and density of harbour porpoise are being conducted in the German North Sea and western Baltic Sea (WGMME, 2012). Surveys continued in spring, summer and autumn of 2012 within the whole German North Sea. Tables 4.1 and 4.2 show the estimated abundance of harbour porpoise from the surveys in May and July/August 2012 (Gilles *et al.*, in prep).

In 2013, surveys are planned in the German North Sea Area D in March–May and Area C in June–August. This will be repeated in 2014. In the German Baltic Sea, the Kiel Bight and Mecklenburg Bight will be surveyed in June–August 2013.

Table 4.1. Density and abundance of harbour porpoise in the German North Sea in May 2012.

Area	Density [Ind./km²] (95% CI)	Abundance (95% CI)	CV
A	2.71 (1.18–5.81)	10 562 (4621–22 681)	0.41
B	2.42 (1.26–4.74)	28 225 (14 664–55 219)	0.33
CS	0.50 (0.20–1.03)	2803 (1111–5853)	0.41
CN	2.89 (1.57–5.44)	23 163 (12 617–43 651)	0.32
DO	0.29 (0.08–0.70)	1361 (386–3325)	0.51
DW	1.88 (0.94–3.88)	13 187 (6630–27 254)	0.37
North Sea (A–D)	**1.93 (1.10–3.55)**	**79 301 (45 002–145 687)**	**0.30**

Table 4.2. Density and abundance of harbour porpoise in the German North Sea in July/August 2012.

Area	Density [Ind./km²] (95% CI)	Abundance (95% CI)	CV
A	1.13 (0.36–2.51)	4394 (1419–9816)	0.46
B	0.54 (0.20–1.29)	6263 (2298–15 064)	0.45
CS	0.97 (0.48–2.00)	5503 (2720–11 324)	0.38
CN	1.03 (0.52–2.05)	8280 (4146–16 412)	0.35
DO	0.18 (0.06–0.40)	832 (285–1901)	0.46
DW	0.78 (0.42–1.52)	5481 (2927–10 704)	0.34
North Sea (A–D)	**0.75 (0.43–1.42)**	**30 753 (17 499–58 335)**	**0.32**

4.4.2 Abundance of harbour porpoise in Dutch waters

WGMME (2012) reported on Dutch aerial surveys conducted between May 2008 and March 2011, with the aim to assess the seasonal abundance and distribution of harbour porpoise on the Dutch Continental Shelf (DCS), and how their distribution varies in space and by season. New information was available this year from surveys in March and November 2012 (Geelhoed *et al.*, 2013). Surveys were conducted in four strata (Areas A–D; Figure 4.6). In total, 260 sightings of 320 individual harbour porpoises were made. The majority were seen in March (n = 232) when the complete DCS was surveyed. Harbour porpoise density was estimated for each survey stratum separately as well as for the whole DCS (Figure 4.6). The overall density in March was 1.12 animals/km². The highest average densities were found in Area A, "Dogger Bank", and D "Delta", 1.44 and 1.42 animals/km², respectively.

The estimated total number of harbour porpoise on the Dutch continental shelf in March 2012 was 66 685 (CI 37 284–130 549). In March 2011, abundance had been estimated at 85 572 (CI 49 324–165 443; Geelhoed *et al.*, 2011). Due to adverse weather conditions it was not possible to conduct aerial surveys of the entire Dutch continental shelf in summer 2012; therefore a late autumn survey was conducted. In this period surveys were able to be conducted in three areas, but abundance estimates could only be made for areas B and C. In November, densities for area B and C were 0.50 and 0.64 animals/km², respectively.

During the surveys in 2012, a total of 17 sightings of other marine mammal species were made in March. The only other cetacean species that was sighted during all surveys was the white-beaked dolphin, for which five sightings of 12 animals were made in the northern and western part of the DCS. Apart from white-beaked dolphins, 12 single seals were seen, all unidentified except for one grey seal on 15 March.

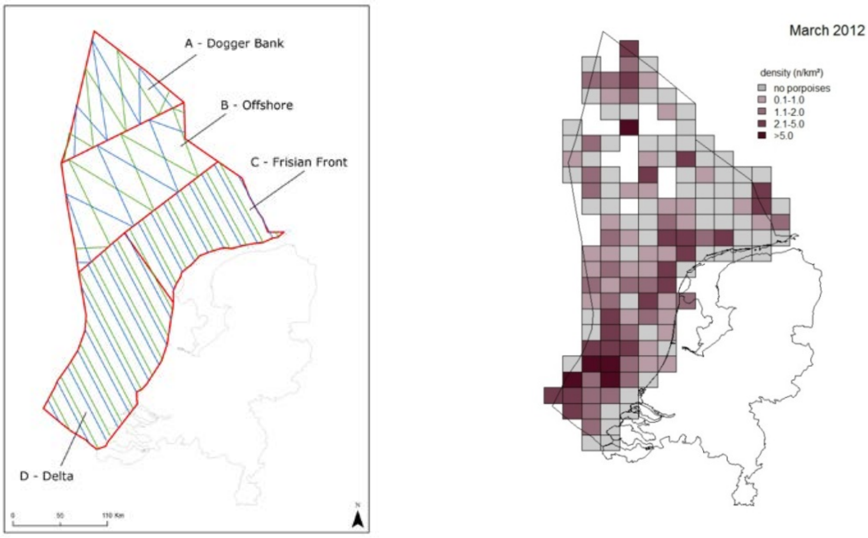

Figure 4.6. Left panel: Map of the Dutch continental shelf with the planned track lines in study areas A ("Dogger Bank"), B ("Offshore"), C ("Frisian Front") and D ("Delta"). Track lines from the same survey set are shown in the same colour. Right panel: Spring density distribution of Harbour Porpoises (animals/km²) per 1/9 ICES grid cell, March 2012. Grid cells with low effort (<1 km²) are omitted.

4.4.3 Abundance of harbour porpoise in Belgian waters

Aerial surveys in Belgian waters during the second half of March 2011 yielded an average density estimate of 2.5 harbour porpoises per km² in the survey area (Figure 4.7). Two weeks later the average density had dropped to 1.3 animals per km², possibly due to a combination of the emigration of animals and disturbance due to piling activities (Haelters *et al.*, 2012).

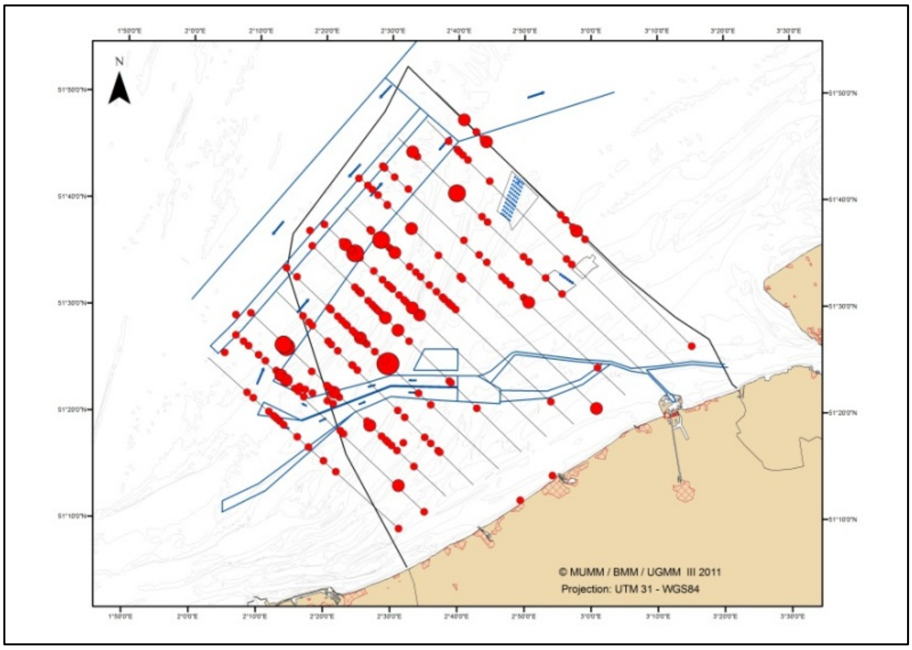

Figure 4.7. Observations of harbour porpoises (red dots) and flight tracks (grey lines) during an aerial survey on 29 March 2011; Belgian waters are indicated with a black line (data RBINS/MUMM).

4.4.4 Distribution and abundance of harbour porpoise in the Kattegat, Belt Seas and western Baltic

A shipboard survey was conducted during July 2012 at the same time and along the same transects as SCANS-II in the Kattegat, Belt Seas and western Baltic (waters of Denmark, Sweden and Germany). Methods and equipment that were identical with those in SCANS-II were used, including double platform data collection. Results will thus be directly comparable to the previous survey in 2005. Data analysis is ongoing. This project forms part of a six year monitoring period of the Danish SACs in Kattegat, the Belt Seas and the Western Baltic, which includes two acoustic surveys using towed arrays, ten C-PODs circulating in the six largest areas and one visual survey.

This project forms part of a two year monitoring period, including two acoustic surveys using CPODs and one visual survey. This area could provide a good test region to compare different data collection and analysis methodologies (ship, aerial, acoustic).

4.4.5 Distribution of cetaceans in French waters

A new Atlas of Mammals in French waters (both overseas territories and mainland France) is planned for 2014/2015. Due to its extended EEZ, spread from 50°N to 50°S in all three oceans (Figure 4.8), France hosts more than half of global marine mammal species. Gathering together existing knowledge of the biology and distribution of marine mammals has become a priority. Several organizations, among which Muséum national d'Histoire naturelle, Société française pour l'Etude et la Protection des Mammifères, Observatoire Pelagis (Université de La Rochelle - CRMM, CNRS-Centre d'Etude biologique de Chizé), Réseau National d'Echouage, GIS3M, Ifremer and local NGOs, contribute to the project. The Atlas will be divided into two parts: species summaries focused on ecological information together with regional summaries aimed at providing support to biodiversity management policies of local/regional authorities.

The *Agence des Aires Marines Protégées* (the French agency for marine protected areas) was created in 2007 to implement the French marine conservation policy. Several projects have been initiated. The *Programme d'Acquisition de Connaissance sur les Oiseaux et Mammifères Marins* (PACOMM) will:

1) identify and characterize marine mammal and bird preferred habitats;

2) identify areas of potential interactions with human-induced activities.

Work includes:

1) *Suivi Aérien de la Mégafaune Marine* (SAMM): Dedicated aerial surveys conducted across all waters under French jurisdiction, extended to some areas under neighbouring Member States' jurisdiction for the sake ecological continuity and consistency (e.g.: surveying the whole Channel instead of only the French part of the Channel) were designed to document distribution of all megafauna (mammal, birds, turtle, and large fish) visible from the air and assess seasonal variations in these distributions. The results from these surveys are outlined below;

2) Marine mammal and seabird observers placed on pre-existing and recurrent oceanographic cruises (*Ifremer* fish surveys such as *Pelgas* small pelagics in the Bay of Biscay in May, *Evhoe* demersal fish survey in the Bay of Biscay in October, IBTS pelagic fish in the Channel and North Sea in January, *Pelmed* small pelagics in the Gulf of Lion in July) inform on interannual variability and functional link between prey and predators;

3) Shearwaters telemetry tracking experiments are targeted at identifying functional hot spots in the marine ranges of birds engaged in reproduction;

4) Passive Acoustic Monitoring is planned for the harbour porpoise along the Channel and Atlantic seaboards. A pilot project consists in deploying a small set of instruments in contrasting areas to test the C-POD, their setting, recovery and the quality of the data produced.

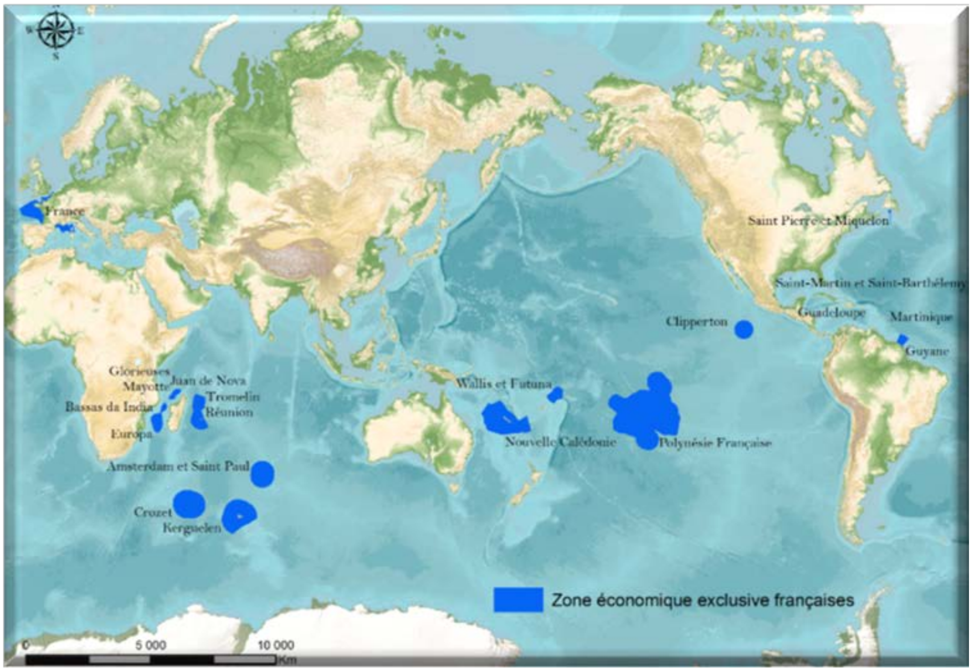

Figure 4.8. Geographical scope of the French marine mammal atlas. The atlas is going to deal with marine mammals in all waters under French jurisdiction (map source MNHN).

SAMM has two seasonal components: a winter survey was conducted from late November 2011-mid February 2012 and a summer survey was conducted from mid-May–early August 2012. Efforts were of 48 600 km in winter and 53 200 km in summer, and about 90% of all survey effort was deployed by sea state ≤3 Beaufort in all regions and both seasons (see Figure 4.9). In total about 1500 marine mammal encounters were recorded in winter and 2000 in summer. Analysis of raw data is just starting now, with an aim of completing a first series of analyses by the end of 2014 with estimation of local densities and determination of habitat model for the main species or group of species.

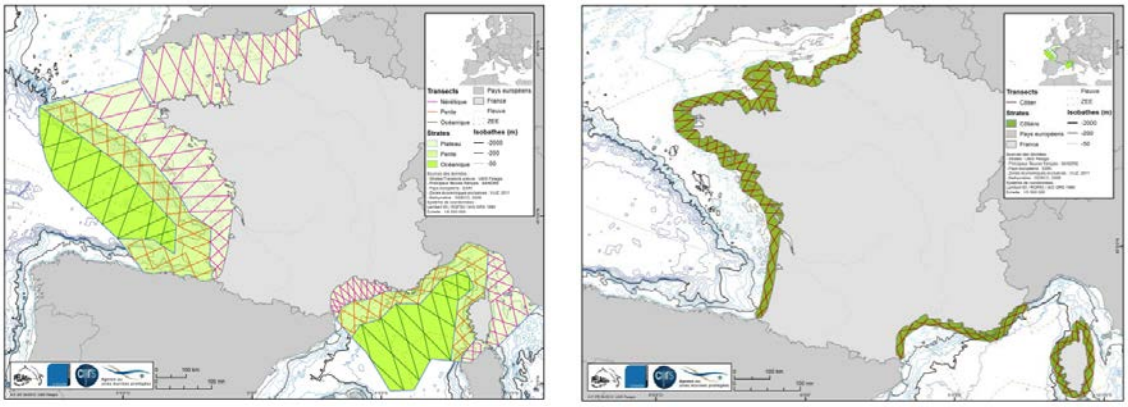

Figure 4.9. Areas covered by and general design of the SAMM survey, showing organization in three strata defined as shelf, slope and oceanic strata (left). A 12nm mile coastal band (right) received additional survey effort in order to increasing resolution where most existing N2000 sites are located (map source ULR-CNRS-AAMP).

The preliminary results from SAMM indicate that there were high encounter rates for harbour porpoise in the Dover Strait and off the North Sea coast. The species was present all along the Channel and the Atlantic seaboards in winter, with a conspicuous coastal distribution (Figure 4.10), In contrast, in summer, the species tended to be more widespread across the whole shelf area of western Channel and Celtic Sea (Figure 4.10).

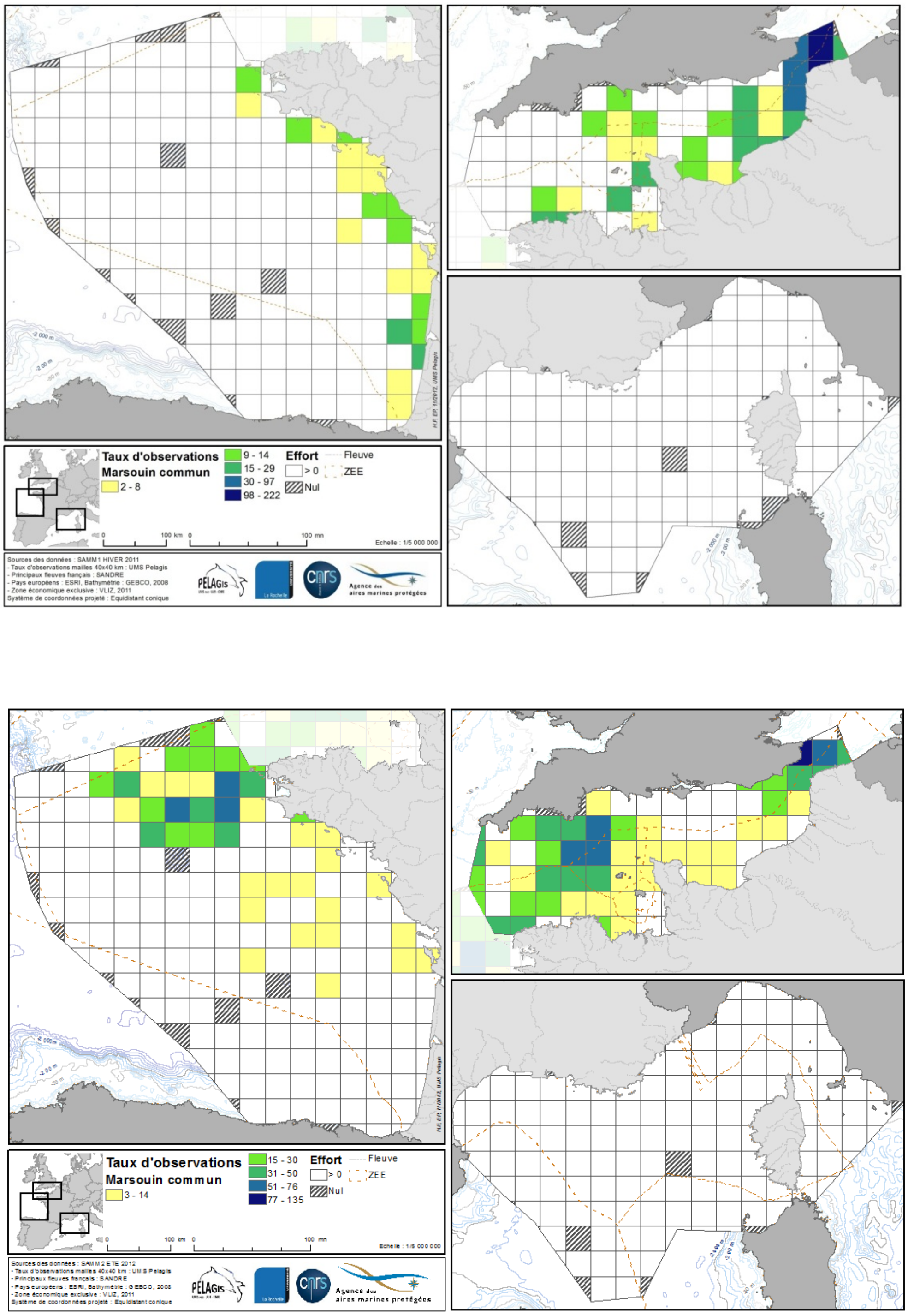

Figure 4.10. Distribution of sighting rates of harbour porpoise from the SAMM surveys of French waters in 2012. Upper panel: winter. Lower panel: summer.

Small delphinids of the genera *Stenella* and *Delphinus* can often be discriminated from the air, but a proportion of encounters remained unassigned to one or the other of the two possible species (*S. coeruleoalba* or *D. delphis*); hence at this stage all data were pooled (Figure 4.11). They were broadly distributed across the whole Atlantic area with higher frequency over the shelf of the Bay of Biscay and western Channel in winter and along the slope and in oceanic waters in summer (Figure 4.11).

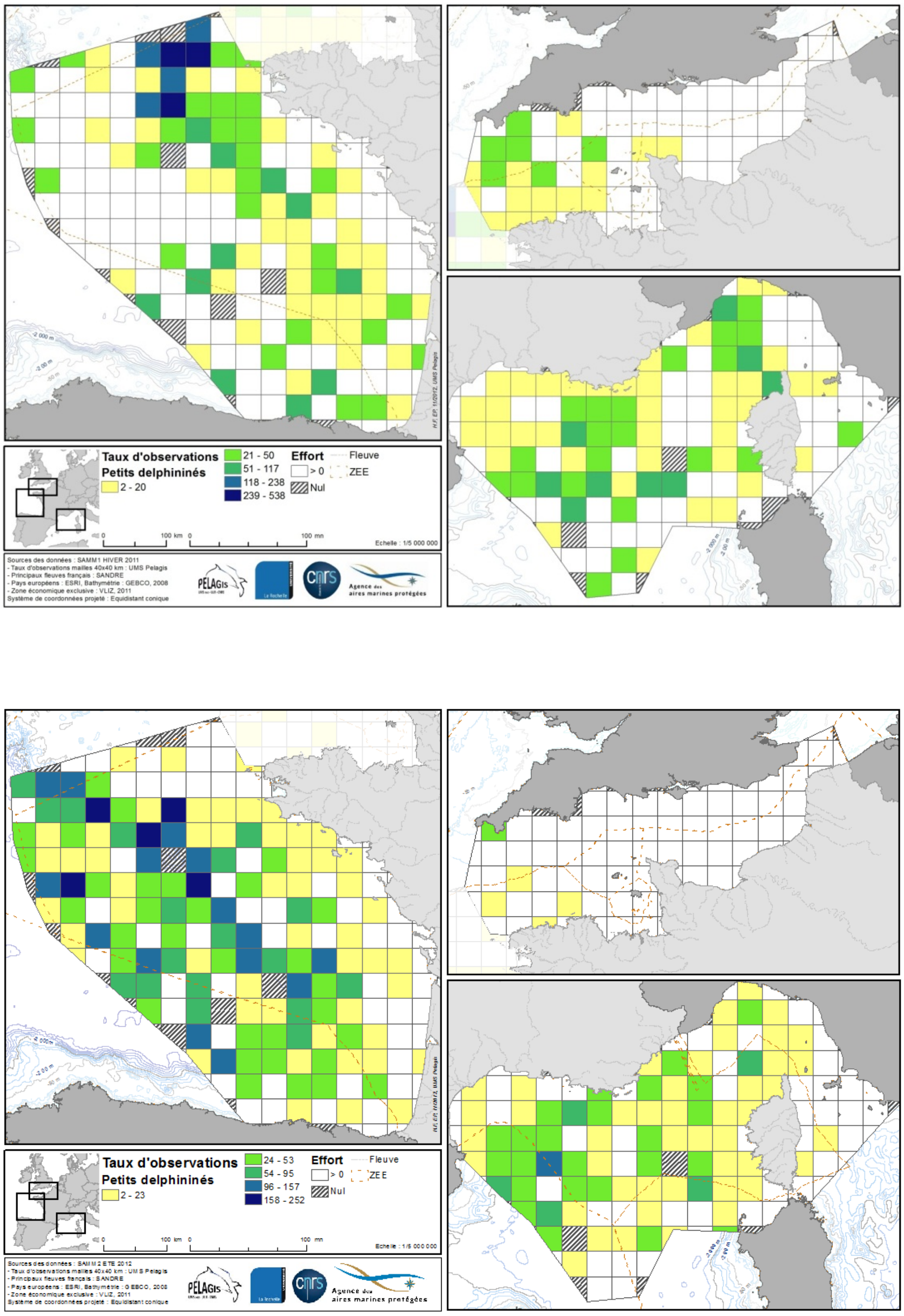

Figure 4.11. Distribution of sighting rates of common and striped dolphin from the SAMM surveys of French waters in 2012. Upper panel: winter. Lower panel: summer.

Bottlenose dolphin was found throughout the Atlantic and western Channel areas at a lower frequency than the previous two small delphinids, with only weak spatial patterns in summer along the slope (Figure 4.12). Known resident groups did not show up clearly at this resolution of sampling, except for the coastal populations known to inhabit the area between the Channel Islands and the Normandy coasts that was visible during the summer survey (Figure 4.12).

Although not reported here, the surveys also noted a surprisingly large number of turtle sightings.

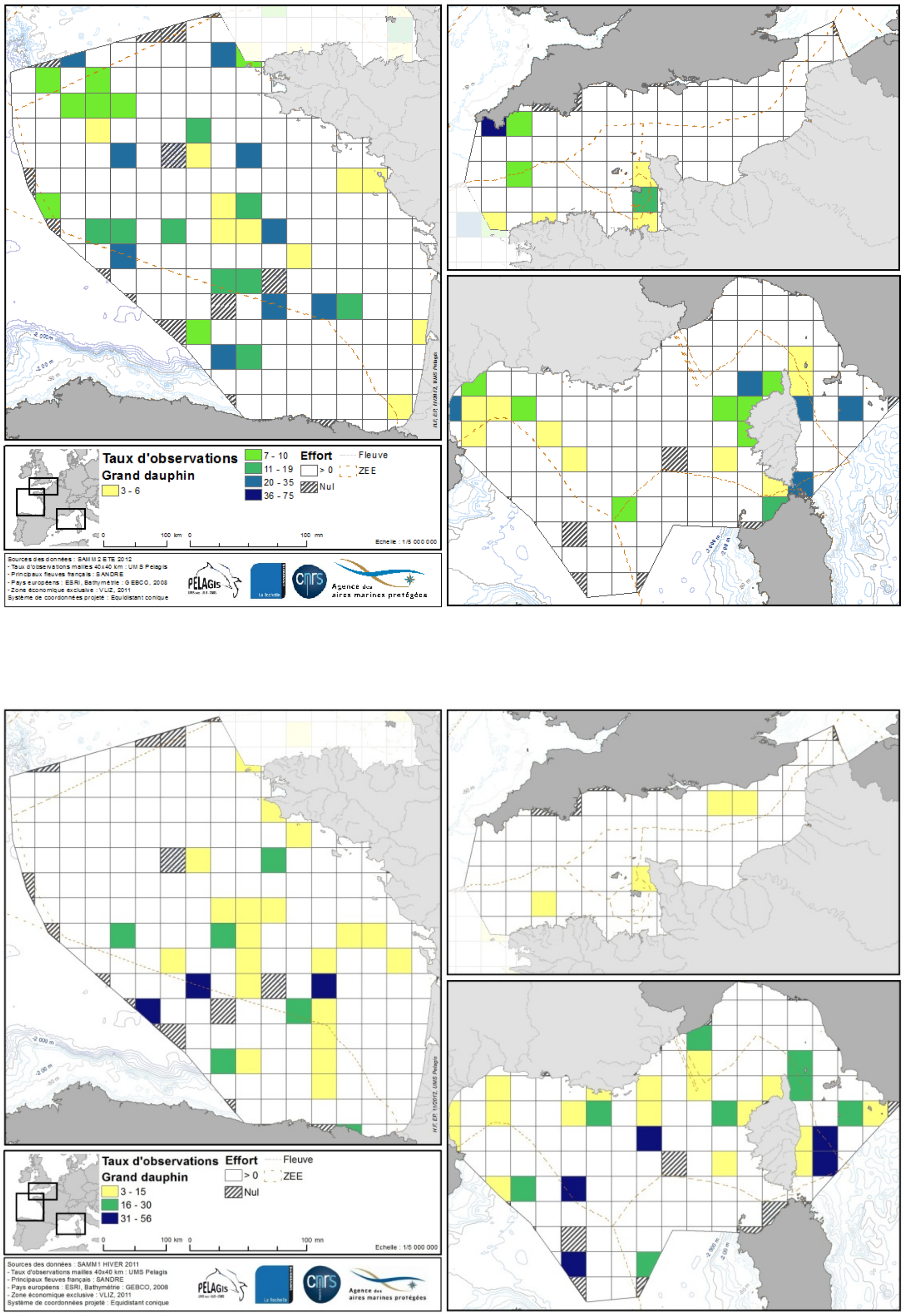

Figure 4.12. Distribution of sighting rates of bottlenose dolphin from the SAMM surveys of French waters in 2012. Upper panel: winter. Lower panel: summer.

In addition, work on determining the origin of stranded carcasses was initially reported by WGMME (2012). The number of stranding along a given stretch of coastline is supposed to be a function of the number of cetacean living off this coast together with mortality rate, carcass buoyancy, drift condition and reporting rate. Because in our regions, drift is mostly driven by wind and tidal current it was considered that drift was the main cause for short-term variability generating most of the noise in stranding datasets.

$N_{stranding} \sim N_{individual}.mortality.buoyancy.drift.reporting$

Understanding and correcting for the effect of drift conditions would be a promising way to better understand the biological components (relative abundance and mortality rate) of the signal contained in long-term cetacean stranding datasets. With this objective in mind, the drift model MOTHY developed by MétéoFrance for maritime safety issues and later adapted to cetacean carcasses (Peltier *et al.*, 2012) was used to create expected stranding dataset for the period 1990–2009 on the basis of a theoretical prior distribution set uniform in space and constant in time. Real stranding datasets gathered from the national stranding schemes of six different countries (Belgium, Denmark, France, Germany, Netherlands and UK) constituted the observed strandings dataset. Stranding anomalies, defined as the difference between observed and expected strandings, were analysed for any spatial, long-term and seasonal pattern. Reverse runs of the drift model MOTHY allow the trajectory of observed stranded cetaceans to be back calculated in order to identify the area of likely origin. Such an analysis conducted on common dolphin stranding reported in France and the UK shows that the areas of origin are concentrated in the western Channel south of Cornwall and in the southern part of the Bay of Biscay (Figure 4.13). When corrected by the probability of stranding the distribution of observed stranding death locations can be converted into a distribution of anomaly in the number of dead dolphins at sea (abundance.mortality combined), here broken down into monthly climatologies showing that the highest positive anomalies are found in winter months (Figure 4.14).

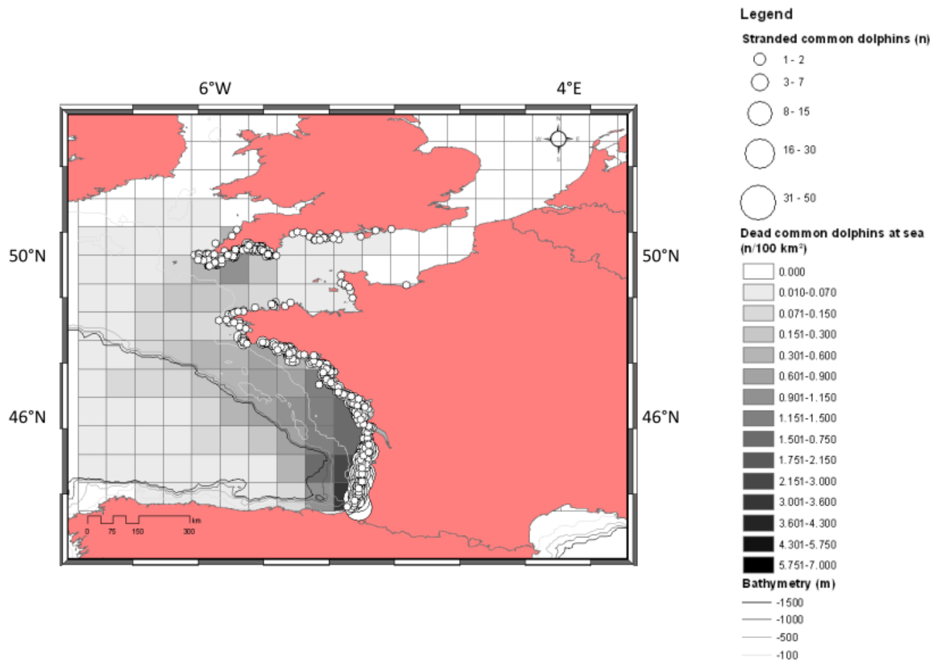

Figure 4.13. Locations of observed common dolphin stranding in the Bay of Biscay and Western Channel and inferred distribution of mortality source (map source ULR-CNRS-CSIP-IoZ).

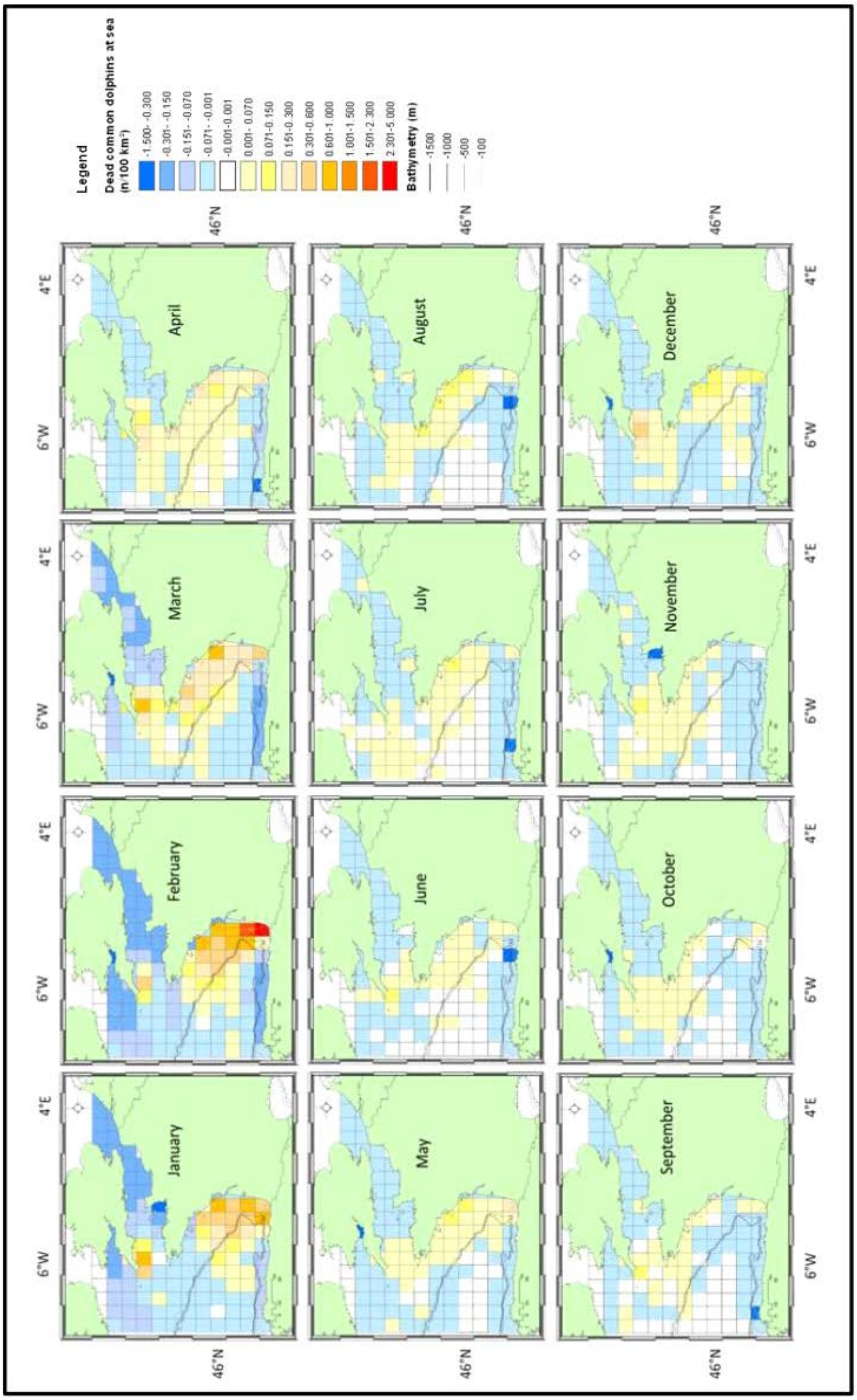

Figure 4.14. Monthly variations in the distribution of the anomalies in frequency of dead common dolphins (map source ULR-CNRS-CSIP-IoZ).

4.4.6 Distribution and abundance of cetaceans off northern Spain

Abundance of harbour porpoise, bottlenose dolphin, fin whale and sperm whale have been estimated using spatial modelling of effort-related visual data derived from both designed and non-designed surveys carried out in northern Spanish Cantabrian continental waters, including offshore waters of the Bay of Biscay, by nine different organizations between 2003 and 2011 (Vázquez, pers. comm.). In total, 64 323 km on searching effort were available for analysis during the study period. The abundance estimates (uncorrected for animals missed on the transect line) for the whole region were: 683 (CV=0.63, 95%CI: 345–951) harbour porpoises; 10 687 (CV=0.26, 95%CI: 4094–18 132) bottlenose dolphins, 10 267 (CV=0.048, 95%CI: 9507–11 101) fin whales and 865 (CV=0.12, 95%CI: 767–1041) sperm whales. Estimates in coastal areas were 273 harbour porpoises, 4934 bottlenose dolphins, 221 fin whales and 41 sperm whales.

Bottlenose dolphin photo-identification studies carried out in Galicia and the Basque Country suggest the presence of resident animals in rias on the Galician and Guipúzcoa coast (Vazquez *et al.*, 2006; Marcos *et al.*, 2010; Garcia *et al.*, 2011), with varying degrees of movement. In Galicia, animals have been detected moving between adjacent rias but also between coastal areas further away such as from the Ria de Pontevedra to the Gulf Ártabro (Vazquez *et al.*, 2006; Lopez *et al.*, 2009; Garcia *et al.*, 2011). Photo-identification studies in Galicia have documented a total of 255 bottlenose dolphins, with a low percentage of recapture during 2000–2010, indicating that only a part of the coastal population has been identified (Garcia *et al.*, 2011). Similarly, recaptures of individuals indicate that at least some groups of bottlenose dolphins show some degree of residence in eastern Guipúzcoa (Lopez *et al.*, 2012). A few animals have also been detected moving throughout the whole region, being photographed in Galicia and the Basque Country with a time interval of between one and two years (Lopez *et al.*, 2012).

Genetic differentiation has been shown between bottlenose dolphins inhabiting the southern Galician Rias and animals in adjacent waters (Fernández *et al.*, 2011a;b) with evidence also of some individuals being possible migrants. The two populations of bottlenose dolphins identified in Galicia, appear to be sympatric at least in some areas such as shelf waters. The combined analysis of stomach contents and stable isotopes (carbon and nitrogen) suggests that there is some degree of sharing of resources or habitat segregation between the two populations which would reduce intraspecific competition between the two genetically distinct units (Fernández *et al.*, 2011b).

Along the southern Atlantic coast of Spain, estimates based on photo-identification show that at least 347 (CV = 0.17, 95% CI = 264–503) individuals used the coastal waters of the area in 2005–2006 (De Stephanis, pers. comm.). Coastal animals inhabiting the Strait of Gibraltar appear to be resident, with an abundance estimate, based on photo-identification of 297 animals (95% CI = 276–332) (Chico Portillo *et al.*, 2011). Bottlenose dolphins are also seen beyond these coastal waters, in the Gulf of Cadiz, apparently associated with the benthic feature "Chimeneas de Cádiz". A modelled estimate from a large-scale survey in this area between 2009 and 2010 provided an abundance estimate of 4391 (CV=0.33, 95% CI = 2373–8356) individuals.

4.4.7 Distribution and abundance of cetaceans in continental Portuguese waters

Systematic dedicated cetacean surveys along the coast of continental Portugal were initiated in 2010 with the SafeSea project to investigate the abundance of cetaceans in Portuguese waters. Annual aerial surveys are undertaken between September and October to maintain similar weather conditions along the entire Portuguese coast. These surveys will continue annually until 2014 under the Framework of the MarPro Life+ Project.

The study area comprises the Portuguese continental coastal region between Caminha and Vila Real de Sto. António (Figure 4.15). In some years, the survey has been extended to Cap Finisterra in Galician waters. The line transect surveys have been conducted with a Partnavia P-68 aircraft modified with "bubble windows", using a systematic survey design with 100 km transects perpendicular to the coast and with 18.5 km spacing between transect lines. The observation team comprised three trained observers and a data recorder. On average, searching effort of about 21 hours of flight time and about 4533 km of transect has been surveyed per campaign.

Data from aerial surveys have been complemented with data collected from platforms of opportunity such as oceanographic research vessels and fishing boats, both operating in near shore and offshore waters. These surveys were initiated in 2003 and their main objective was the collection of data to help understand the distribution patterns of cetacean species in Portuguese waters. Some of these surveys were conducted using line transect methods but the majority did not follow any systematic pattern.

All data collected until know will be available in a preliminary project report by the end of March 2013.

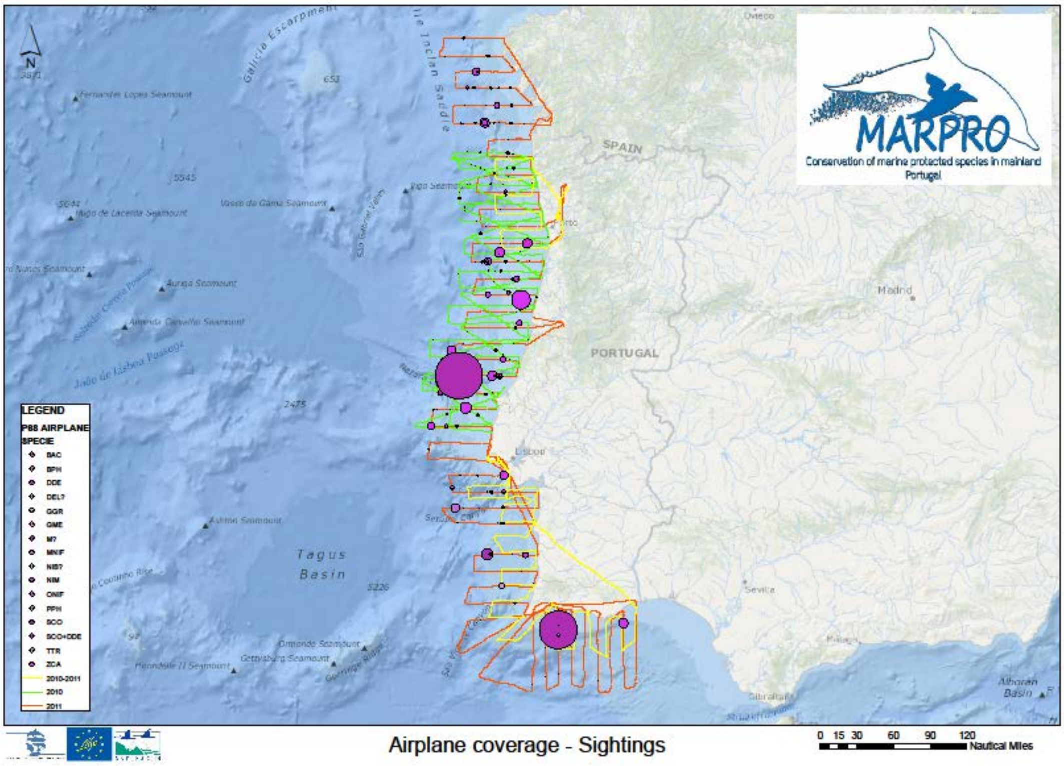

Figure 4.15. Portuguese survey tracks and preliminary results.

4.4.8 Large-scale cetacean surveys in the European Atlantic

Corrections of the minor errors discovered in the SCANS-II data last year have been made, analyses rerun and the results included in a paper to be published in Biological Conservation (Hammond *et al.*, in press).

Reanalysis of the combined SCANS-II, CODA and Faroese TNASS data is underway; results will be reported next year.

4.5 Future surveys

In 2009, WGMME recommended that surveys to estimate absolute abundance such as SCANS-II and CODA continue with frequency of at least between five and ten years and that, if possible, both the shelf and offshore waters should be covered simultaneously (WGMME 2009).

Preparations began last year with a first preparatory meeting in December 2012. The SCANS-III project will centre on a survey of all cetaceans in shelf and offshore waters in the European Atlantic in 2015. Other project elements that are planned to be included are: (a) the creation of a common European database for designed surveys; (b) the collation of data and creation of "risk layers" for bycatch and ship strikes in time and space for cetaceans in the European Atlantic; (c) assessments of risk for all cetacean species based on (a) and (b) and the new abundance data from the survey; (d) the final development and implementation using the new abundance data of a management framework for setting safe limits to bycatch for relevant cetacean species in the European Atlantic; (e) an intensive, focused trial of different methods of monitoring (visual shipboard, aerial, acoustic) to inform on best practice for monitoring by Member States.

Preparations are now focusing on developing a proposal to submit for LIFE Nature funding later in 2013.

WGMME strongly supports the proposal for a cetacean absolute abundance survey in all European Atlantic waters in 2015 and **recommends** that it is supported by all range states and by ICES, ASCOBANS and the European Commission. Continuation of these surveys is essential to the accurate estimation of absolute abundance for several species that are required for reporting under the Habitats Directive and the Marine Strategy Framework Directive.

4.6 References

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5 ToR c: Collaborate with WGBYC to develop bycatch management procedures (based on the SCANS-II and CODA projects) for assessing bycatch at a European level. This work should include harbour porpoise (SCANS II), short-beaked common dolphin (CODA) and consideration of additional species for which bycatch estimates have been made or suggested as a potential MSFD indicator. Such species include bottlenose dolphin, striped dolphin, harbour seal and grey seal

WGMME recommended this ToR at their 2012 meeting. At that time it was expected that a contract to develop further the management procedure approach to setting safe bycatch limits developed during the SCANS II (2005) and CODA (2007) projects for harbour porpoise (*Phocoena phocoena*) and short-beaked common dolphin (*Delphinus delphis*), respectively, would be completed by February 2013. Unfortunately, due to administrative delays, the work is now due to be completed by September 2013. Consequently, the joint meeting between WGMME and WGBYC has not taken place.

MSFD indicators and targets for cetacean and seal bycatch have been submitted to the European Commission by many Member States as part of the implementation of the EC Marine Strategy Framework Directive (2008/56/EC). The indicators and targets proposed were largely based on internationally agreed obligations such as those of OSPAR, ASCOBANS and, most recently, the European Commission through Fisheries Regulation 812/2004 concerning cetacean bycatch. Additionally, under the Habitats Directive (92/43/EEC), Member States are required to establish a system to monitor the incidental capture and killing of the animal species listed in Annex IV (which includes all cetaceans) and, where necessary, implement conservation measures to ensure that incidental capture and killing does not have a significant negative impact on the species concerned.

The indictor for cetaceans currently proposed by the OSPAR Intersessional Correspondence Group on the Coordination of Biodiversity Assessment and Monitoring (ICG-COBAM) expert group for Marine Mammals and Reptiles for development under the Marine Strategy Framework Directive (MSFD) is "*mortality rate due to bycatch*". The parameter or metric to be measured is '*numbers of individuals being bycaught in relation to population estimate set for each population range or Management Unit (MU)*' with the target of "*The annual bycatch rate of [marine mammal species] is reduced to below levels that are expected to allow conservation objectives to be met*". The ICG-COBAM expert group recognize that this may require different approaches for different species. They note that there is an explicit need to move away from using a simple fraction of the best population estimate. There is a very real danger that if this simplistic percentage approach continues to be utilized and is adopted to determine MSFD bycatch limits, the conservation status of some species could be negatively impacted in the long term.

This work undertaken by the Sea Mammal Research Unit during the SCANS-II and CODA projects to develop management frameworks for determining safe limits to bycatch for harbour porpoise and common dolphin is now being developed further (see below). The project aims to generate robust, safe limits to bycatch that will enable specified conservation objectives to be met, which will allow the impact of bycatch in commercial fisheries on marine mammals to be assessed and managed. The results will help enable Member States to assess whether or not Good Environmental Status has been achieved under the Marine Strategy Framework Directive, as well as meeting other international obligations such as those of ASCOBANS.

The SCANS-II and CODA projects identified several key decisions that are required from policy-makers prior to the further development of the CLA approach for setting safe limits to bycatch. These were further developed in the meeting.

5.1 Background to current project

Following a review of the SCANS-II work, WGMME (2008) recommended that ICES consider the use of an algorithm to set safe limits to bycatch equivalent to the Catch Limit algorithm (CLA) used in the IWC's Revised Management Procedure. This was, in part, because the delay in recovery of depleted populations to 80% of carrying capacity under the CLA approach tended to be shorter than using the Potential Biological Removal (PBR) equation (Wade, 1998) and because depleted populations recovered to higher population status in the long term. CODA (2009) developed a similar framework for common dolphins.

Three key issues need to be resolved before the CLA approach can be further developed and adopted as a target/indicator under the MSFD:

5) the need for policy-makers to define the conservation objectives to be used in the procedure;

6) the time frame over which the procedure should be modelled to achieve the specified conservation objectives; and

7) delineation of the spatial areas to which the procedure is to be applied (i.e. appropriate management units).

5.2 Conservation objectives

A key step in generating safe limits to bycatch for marine mammals is the establishment of conservation/management objective(s) in quantitative terms. For the purposes of the SCANS-II and CODA studies, the conservation objective agreed by ASCOBANS was utilized in the absence of any specific conservation objectives being outlined in European legislation. The ASCOBANS conservation objective is 'to allow populations to recover to and/or maintain 80% of carrying capacity in the long term'. Carrying capacity was defined as the population size that would theoretically be reached by a population in the absence of bycatch, noting that it is not necessary to actually know what this carrying capacity is to determine safe limits to bycatch.

The management procedures developed must be "tuned" to achieve the specified conservation objectives. The procedures developed during SCANS-II and CODA used two tunings based on different interpretations of the ASCOBANS objective. The most obvious quantitative interpretation of "recovering to and/or maintaining 80% of carrying capacity" is that this is an expected target that should be reached on average. Consequently, the first tuning ensured that the procedures reach or exceed the conservation objective target 50% of the time.

An alternative interpretation of the ASCOBANS objective is that the population should recover to and/or be maintained <u>at or above</u> 80% of carrying capacity. The second tuning therefore ensured that the procedures reached or exceeded the conservation target 95% of the time. This is a much stricter target, producing a more conservative procedure.

A third situation was also modelled as an example of a worst case scenario. This used the second tuning, but in addition assumed that the bycatch used by the procedure was unknowingly underestimated by 50% (i.e. actual bycatch would be twice the estimated bycatch).

The choice of tuning has important consequences on the long-term outcomes of the management procedures. In the first tuning, the population was maintained at 80% of carrying capacity, as expected, whilst in the second tuning, the population was maintained at between 85 and 90% of carrying capacity because of the requirement to achieve the conservation objective 95% of the time. The third tuning resulted in the population being maintained at an even higher percentage of carrying capacity (~95%).

Examples of the use of equivalent targets in other management frameworks include:

- the IWC's RMP aims for 72% carrying capacity on average (50% of the time; IWC, 2012);
- the Canadian Objective Based Fisheries Management approach for seals has a target to maintain populations at 70% of maximum abundance recorded 80% of the time (DFO, 2010);
- the USA's Marine Mammal Protection Act aims for stocks to equilibrate within Optimum Sustainable Population (OSP, modelled as being above 50% of carrying capacity) at least 95% of the time, assuming reasonable levels of imprecision in estimating population size, take levels, and population growth rates (Barlow *et al.*, 1995).

Policy decision required: A decision is required on whether the conservation objective should be met on average or some other percentage of the time (>50%). This choice will have a significant influence on the population level as a percentage of carrying capacity achieved in the long term (if greater than 50% the population level achieved in the long term will exceed the specified target).

5.3 Time frame and definition of 'in the long term'

As currently written, the ASCOBANS conservation objective contains no quantitative specification for the time frame over which it needs to be applied. The SCANS-II and CODA projects adopted a period of 200 years for the development of the management framework. This period was chosen to allow sufficient time for heavily depleted populations to recover to meet the conservation target under the second tuning above. More specifically, it was not possible for a depleted population with low rate of increase to recover to 80% of carrying capacity 95% of the time within 100 years, even in the absence of bycatch. However, because the status of populations in the shorter term is also of interest for conservation, it is also important to consider any delay in recovery of depleted populations due to continuing bycatch.

Other examples include:

- IWC uses 100 years as the time frame in the RMP (IWC, 2012);
- IUCN uses 100 years or three generations in many of its assessment criteria (IUCN 2010);
- The USA MMPA uses 100 years (Lerczak *et al.* (PBR/4) in Barlow *et al.*, 1995).

Policy decision required: It is proposed that in the further development of the CLA approach for determining safe limits to bycatch that a time frame of 100 years is used.

5.4 Management units

In management procedure approaches, the operating (population) model can allow for simulations of multiple subpopulations and management areas. Structural or input parameters important to multi-subpopulation/management area scenarios include the number of subpopulations, the number of management areas, the proportion of each subpopulation in each area during surveys and bycatch, and dispersal rates between each subpopulation/management unit. This allows for flexibility in simulating a range of scenarios with respect to population structure and movement and spatial management.

WGMME (2008) recommended that further research on population structure in North Sea harbour porpoises with the aim of describing suitable management areas was required. Subsequently, there was an ASCOBANS-HELCOM workshop on small cetacean population structure which proposed management units for the more common species but did not propose boundaries (Evans and Teilmann, 2009). WGMME (2012) reviewed the MUs proposed by Evans and Teilmann (2009) and largely recommended that they be adopted for reporting purposes. There were, however, two notable exceptions:

- For harbour porpoises, WGMME (2012) recommended that there should only be a single MU for the North Sea and not two as proposed by Evans and Teilmann (2009). The reason for this was the lack of support from the available data for the existence of two populations and the related impossibility to delineate boundaries.
- For white-sided dolphin, WGMME (2012) recommended that there should only be a single MU in European North Atlantic rather than the two proposed by Evans and Teilmann (2009). The reason for this was again the lack of support from available data.

Subsequently the UK have developed MUs for the more common cetaceans as well as harbour and grey seals in its waters which are largely based on the recommendations of WGMME (2012). The issue of MUs within the OSPAR area was further addressed in the current report as part of the MSFD development needs (see Section 4.2).

Policy decision required: The current debate regarding the number of MUs for harbour porpoise in the North Sea should be explored through the simulations as part of the development of the bycatch management procedures. It is recommended that the outputs of the simulations should be used as the basis for determining whether or not more than one MU is appropriate until further information becomes available.

5.5 Recommendation

In 2009, ICES advised the European Commission 'that a Catch Limit Algorithm approach is the most appropriate method to set limits on the bycatch of harbour porpoises or common dolphins. In order to use this (or any other) approach, specific conservation objectives must first be specified. In both species improved information on bycatch and the biology of the species would improve the procedure.' In 2010, ICES again advised the European Commission that 'ICES advised in 2009 of the need for explicit conservation and management objectives for managing interactions between fisheries and marine mammal populations. This advice has not been acted upon. Lacking these objectives, ICES is unable to properly consider the impacts of these interactions in its management advice.' With the current development of MSFD targets for marine mammal bycatch, WGMME **strongly recommends** that this advice is acted upon. To aid such decisions, WGMME also **recommends** that ASCOBANS consider the policy decisions required for the setting of safe bycatch limits and, intersessionally, provide the UK (as project coordinator) with their recommendations. Decisions are required on:

1) whether the ASCOBANS conservation objective 'to allow populations to recover to and/or maintain 80% of carrying capacity in the long term' should be met on average or some other proportion (>50%). This choice will have a significant influence on the population level as a percentage of carrying capacity achieved in the long term (if greater than 50% the population level achieved in the long term will exceed the specified target).
2) ASCOBANS needs to define 'long term'. It is proposed that in the further development of the CLA approach for determining safe limits to bycatch that a time frame of 100 years is used.
3) The current debate regarding the number of MUs for harbour porpoise in the North Sea should be explored through simulations as part of the development of the bycatch management procedures. It is recommended that the outputs of the simulations should be used as the basis for determining whether or not more than one MU is appropriate until further information becomes available.

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6 TOR d: Assess the Joint Cetacean Protocol outputs with a view to their contribution to international transboundary reporting requirements (e.g. for Article 17 of the Habitats Directive) and the development of MSFD indicators, targets and appropriate baselines

Following the Article 17 Favourable Conservation reporting round of 2007, WGMME (2009) reviewed the European Commission's collation of Member State reports for marine mammals in the NE Atlantic. Two or the key recommendations from that meeting were:

- WGMME strongly recommends that the European Commission (ETC/BD) reconsider the data requirements for FCS reporting with respect to highly mobile, wide ranging species and, most notably, consider allowing reporting at an appropriate biological scale where such data exist. This would allow ETC/BD to produce accurate and biologically meaningful assessments, relevant to the conservation of the species and would aid instigation of appropriate management measures where necessary.
- WGMME recommends that Member States develop international collaborative monitoring strategies for marine mammals in order to meet the surveillance requirements of the Habitats Directive.

In order to facilitate these, particularly transboundary reporting, the Joint Cetacean Protocol (JCP) was developed by the UK. This protocol provides a mechanism for bringing together the many disparate datasets on cetacean abundance and distribution at the NW European Atlantic scale. Effort-related cetacean sightings data from all major UK-lead data sources have been included e.g. the Small Cetaceans in the European Atlantic and North Sea (SCANS) and Cetacean Offshore Distribution and Abundance in the Offshore Atlantic (CODA) surveys, the European Seabirds at Sea (ESAS) surveys, SeaWatch Foundation (SWF), the Atlantic Research Coalition (ARC) and other non-governmental organizations, as well as industry (e.g. in relation to potential renewable energy installations in UK waters). These data, collected between 1979 and 2010, represent the largest NW European cetacean sightings resource ever collated.

The preliminary phase (Thomas, 2009) was a short study aimed to determining whether the final JCP data resource would have sufficient power to detect trends in distribution and abundance required to meet the Habitats Directive monitoring requirements. It concluded that the monitoring objective of detecting a 1% annual decline in abundance or range over a six year reporting period was not feasible but that trend detection over longer periods should be, at least in some cases. The project also assessed the various types of data collected and their value in such an analysis. An integrated analysis of all JCP data was recommended.

Phase I (Paxton and Thomas, 2010) aimed to standardize and combine a representative sample of JCP datasets, from the Irish sea, and use modelling approaches to predict density and detect spatial and temporal trends in derived abundance estimates. A power analysis of the modelled density data showed that declines of 0.3 to 2.2% per year, over a six year reporting period, could be detected for harbour porpoise, bottlenose dolphin and short-beaked common dolphin. However, this is only likely to be possible in data rich areas, such as the Irish Sea and for more commonly occurring cetacean species.

Phase II (Paxton *et al*., 2011) enabled further development and a more detailed analysis of Irish Sea data, with a geographic extension to include data from parts of the west coast of Scotland. The west coast geographic extension allowed modelling methods to be tested in a region with a convoluted coastline, developing methods that were more applicable for using on the entire geographical range of the JCP dataset.

The Phase III analysis (draft report submitted March 2012) produced species-specific density surfaces that faithfully reflected the spatial patterns of the input data. However, the estimated densities were higher than those previously published for similar areas (e.g. by SCANS-II and CODA). In some cases, these were considerably higher and probably unrealistic, particularly for species that tend to occur in large aggregations. The JCP Steering Group, therefore, agreed to a re-run of the analysis. The draft report for this reanalysis was submitted in January 2013 and is undergoing peer review, with publication expected later in 2013.

Consequently this report was not available for WGMME to review in 2013. In the absence of the JCP, the further development of MSFD indicators and targets for cetaceans is considered in other ToRs of this report. The results of which are collated in Annex 3 which contains further development of the information sheets as requested by the ICG-COBAM expert group for Marine Mammals and Reptiles.

7 Tor e: Update on development of database for seals and status of intersessional work, assessing its potential contribution to the development of MSFD indicators, targets and baselines

WGMME (2008) recommended that a database be created for harbour and grey seal population indices for the ICES area, and options for storing and managing the database at ICES should be investigated. The aim of this was to help ICES meet requirements of many of its member countries and international organizations (e.g. HELCOM, NAMMCO, OSPAR). During the 2009 meeting, the database was further developed.

WGMME (2009) concluded that initial development should focus on the Northeast Atlantic and the North Sea, where the European species of the harbour (common) seal, *Phoca vitulina vitulina*, and the Atlantic grey seal, *Halichoerus grypus*, are found. Denmark, Germany, the Netherlands, Belgium and the UK provided data. Norway, Sweden, Belgium, France and Ireland agreed in principle to contribute. Discussions also covered extension of the database to the Faroe Islands, the Baltic Sea in conjunction with the HELCOM Expert Group on Seals (i.e. to include the Baltic countries: Sweden, Finland, Russia, Estonia, Latvia, Lithuania and Poland and Russia), the Barents Sea (Russia) and the Northwest Atlantic (Iceland, Greenland, Canada and the USA). It was hoped this would be achieved before the 2010 meeting of the WGMME.

7.1 Issues

During the 2009 meeting, a number of issues were identified. Most importantly, the relevance and longevity of the seal database was entirely dependent on the frequency and extent to which it is populated with information from different countries. Most organizations that monitor seal populations are very understandably protective of their data, as it takes a lot of time, expense and effort to collect and collate. It is imperative that the database remained secure and that its contents were not accessible by other parties without the consent and knowledge of the contributors. WGMME (2010) noted that some data were available annually (e.g. Wadden Sea Trilateral Seal Expert Group http://www.waddensea-secretariat.org/QSR-2009/20-Marine-Mammals-(10-03-05).pdf ; UK Special Committee on Seals http://www.smru.st-and.ac.uk/pageset.aspx?psr=411 for annual reports).

WGMME (2009 and 2010) noted that there was no standard survey methodology in use across all areas or for either species, although there are similarities. Most surveys were carried out from either aircraft or helicopters, for instance. Different components of the local populations of each species may be monitored in different areas. There was also variation in survey frequency in different countries. For example, survey frequency and intensity varies according to the degree of importance of either species in each country, the extent of coastline inhabited by seals and the complexity of that coastline and the substratum on which seals are normally found.

There was also variation in reporting the results of surveys. For instance, harbour seal surveys are carried out either during their summer breeding season or some weeks later, during their annual moult. Both surveys report the minimum size of the local population. The Trilateral Group, that collates the results of surveys in the Wadden Sea, reported the maximum count for either of these periods as the count for the year between 1989 and 2002. Elsewhere, and in the Wadden Sea since 2003, surveys generally report the maximum counts for each season separately.

7.2 Database structure and update

WGMME (2010) summarized the database structure which, to date, was a simple MS Excel workbook retained by the ICES database manager. There will be separate worksheets for the following:

- Harbour seal metadata;
- Regional harbour seal moult counts;
- Regional harbour seal pup counts;
- Regional harbour seal breeding counts;
- Overview of aggregated harbour seal data;
- Grey seal metadata;
- Regional grey seal pup production estimates;
- Regional grey seal moult/summer counts;
- Overview of aggregated grey seal pup production estimates;
- Overview of aggregated grey seal moult/summer counts.

WGMME (2010) provide detail on the contents of each of these sheets. The intention was to update annually as new information becomes available. Unfortunately, the ToR for the database development at the 2011 and 2012 meetings had to be deferred due to lack of seal expertise at the meetings. WGMME (2012) did however recognize the continuing need for the database, particularly given the introduction of the EU Marine Strategy Framework Directive.

During this meeting the database was updated. For grey seals this included the addition of data from the Faroes, the Baltic, Russia, Iceland, Canada, and USA. For harbour seals this also included data from Ireland, France, Norway, Sweden, Denmark, Iceland, Greenland and Canada. The updated database was submitted to the ICES data manager for secure future storage.

7.3 Contribution to the development of MSFD indicators, targets and baselines

Annex 3 outlines the OSPAR Core set of marine mammal indicators. Of greatest relevance is M3, seal abundance, which clearly demonstrates the need for, and value of, the seal database in undertaking such an assessment and also for determining an appropriate baseline for such assessments. The same applies to M5, pup production. It is also likely that the data held will contribute towards assessment of M1 range and pattern of seal distribution.

WGMME **strongly recommends** that the seal database be maintained and updated regularly. Such development will be highly beneficial for future MSFD assessments of the OSPAR core set of indicators for seals.

7.4 References

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8 ToR f: Review and assess monitoring of marine mammals in relation to the development of offshore wind and marine renewable energy

8.1 Introduction: what is "Monitoring"?

Ambitious targets for marine renewable energy are set for a number of countries, and the extensive uncertainty remaining in understanding environmental risks presented by offshore wind, wave and tidal (particularly considering the novel technologies involved) presents a significant challenge to the development of the sector.

Of all the environmental investigations undertaken associated with the deployment of marine renewable energy projects, those on marine mammals and seabirds are the most costly. This is principally due to a) the level of regulation applied to these species, placing high demand for evidence on impacts during consenting processes and b) the inherent variability and significant cost of trying to understand impacts to mobile species, for which baseline ecological information (such as population variability) is often limited.

Decision-making on development proposals is bound by regulatory drivers (such as the Habitats Directive) with its associated high demand for evidence to ensure compliance, and as such, gathering of information on impacts to marine mammals is strongly driven by the consenting process.

Investigative works are therefore undertaken by the marine renewable energy industry, in collaboration with scientists, to provide authorities with sufficient evidence regarding impacts in their applications for consent (e.g. through Environmental Impact Assessment; EIA). As little empirical evidence exists, these are substantially based on predictive models, such as collision risk modelling, supported with surveys undertaken at the particular development site. After consent is granted, further studies are undertaken to determine what the actual impacts are, often as legal condition of consent, to build knowledge and reduce uncertainty.

The term 'monitoring' is used interchangeably to mean data gathering to inform the predictive impact assessment work to support the development of consent applications, and investigations of actual impacts when the proposed activities are underway. However, the levels of investigation, i.e. the temporal and spatial scale, and the tools used, vary according to the objectives of the investigation and in some cases it is useful to draw distinction between the data collected to inform consent, and monitoring of the impacts following consent.

A report commissioned by the UK Crown Estate (SMRU Ltd. 2010) presented the levels of survey and data gathering required in relation to project development, and provides definition of pre and post-consent monitoring work (Figure 8.1).

'Monitoring' considered in its strictest sense may be interpreted as measuring an environmental change attributable to an activity, and is here referred to as 'impact monitoring'; it is also presented as such in guidance under development by Scottish Natural Heritage (SNH; Macleod *et al*., 2011). This report attempts to maintain a distinction between impact monitoring and data gathering to inform consenting; it is, however, recognized that the term 'monitoring' will continue to be used more broadly across the ICES community.

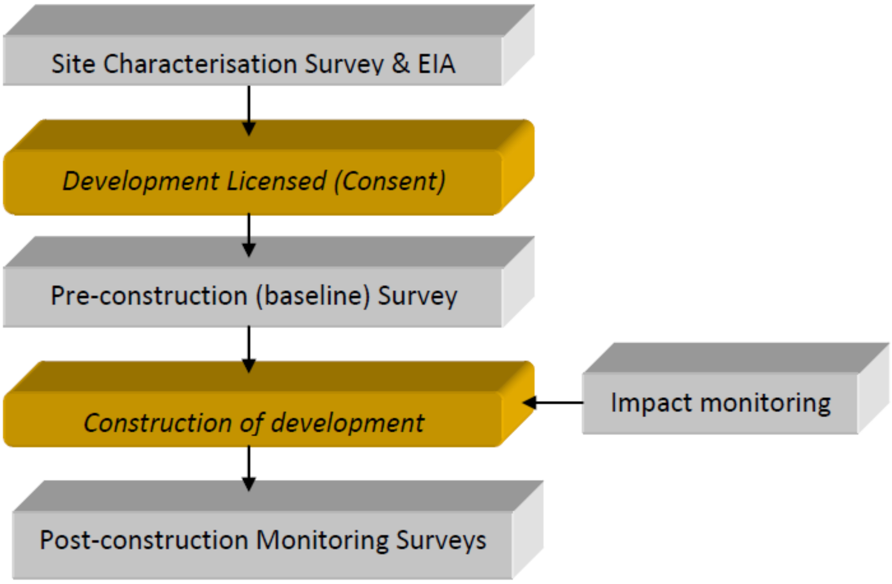


Figure 8.1. Monitoring and the stages of environmental assessment (taken from SMRU Ltd, 2010).

8.2 Recent 'monitoring' experience in the development of marine renewables

Across the North Atlantic, marine renewable energy projects are planned or under development as part of a wider policy strategy aimed at encouraging increasing renewable energy resource use (SMRU Ltd. 2010). There is, however, a strong commitment towards ensuring that environmental impacts of these developments are identified and minimized in accordance with (inter-) national legislation (e.g. Defra, 2007; European Commission, 1992; 2007; 2008). Across ICES Member States, governments have assumed responsibility for implementing licensing systems for marine renewable energy development. At the highest level, it is important to distinguish between pre-consent investigations (intended to gather information about the species diversity, distribution, etc. on the development site), and post-consent impact monitoring (intended to assess actual impacts on marine mammals and other species and habitats, i.e. the receptors). Under EU regulations, pre-consent investigations including site characterization surveys are required to satisfy the following regulatory requirements before consent can be granted (see Macleod *et al*., 2011 for more details):

- to inform Environmental Impact Assessments;
- to assess whether European Protected Species (EPS), listed under Annex IV of the Habitats Directive, are present; and
- to assess whether the development might affect sites or populations of species covered by the Natura 2000 legislation (i.e. referring specifically to relevant populations of marine mammal species occurring within adjacent Special Areas of Conservation [SACs]).

In this context, it is noteworthy that marine renewable developments are not *a priori* excluded from Natura 2000 sites in some ICES Member States (e.g. Belgium and the Netherlands). It should also be noted here that the requirement to monitor particular species on the basis of their status under Natura 2000 legislation may lead to increased levels of effort because of their scarcity, shyness or wide-ranging habits.

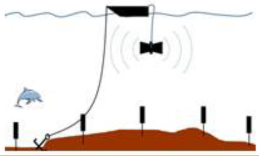
Subsequent to development, impact monitoring is required to:

- determine whether impacts are occurring as a result of activities associated with the development;
- allow a review process of the efficacy of mitigation measures, if any; and
- provide input to future consenting processes (Macleod *et al*., 2011).

While all these different activities are often lumped together under the title of "environmental monitoring", their motivations, relevance and applicability are quite different, and the approaches used (tools, time frames, sites, etc.) will also vary. There is a gradation of research (Table 8.1) from:

- studies aimed at providing the information required specifically for consenting of a particular site with an associated technology;
- through to studies providing a basic understanding how species interact with particular technology types;
- to the collection of data on the population status of particular species, independent of any particular development.

Table 8.1. Summary of the spectrum of environmental research being undertaken in association with the development of offshore wind and marine renewables.

	Site and device specific studies	Generic animal-device/ impact research	Habitat or population specific research
			
Relevance	Relevant to a **specific** development & technology **but** pioneer studies more widely applicable	Relevant to ***many*** developments & technologies	Relevant to **all** developments & technologies
Funders	Individual developer	Government / Seabed owner	Government / Seabed owner
		EU / Research Council / Developer consortia	EU / Research Council / Developer consortia
Time Frame	Relevant to specific development	Partially reliant on developments	Independent of developments

If data requirements are examined in more detail, the following drivers can be identified:

Pre-consent investigations

1) **Site characterization:** Measuring species occurrence at a potential development site to identify species likely to be present at the site that could be vulnerable to renewable energy development, construction and operation. This step identifies which species should be included within the EIA.
2) **Predictive impact assessment:** Using available tools to understand/ modelling potential impacts (e.g. collision risk).
3) **Impact parameter quantification:** Measuring ambient environmental variables and impact characteristics (noise, sediment, etc.) independent of marine mammals.
4) **Mitigation experiments:** Exploring the efficacy of mitigation options such as altering the magnitude of activities (e.g. using different foundation types for windfarms) or applying ancillary features (e.g. use of noise mitigation measures).
5) **Habitat ecology:** Understanding how and why species use energy-relevant habitats, independent of specific developments.
6) **Population assessment:** Understanding impacts at a population level, supporting understanding of cumulative effects, including quantifying population parameters of species of concern.

Post-consent: impact monitoring

7) **Impact magnitude assessment:** Determining whether impacts have occurred as a development is taking place. These studies may fit into a BACI or 'BAGI' (Before-After-Control/Gradient-Impact) framework and therefore require data from the development site before, during and after the activity at several locations at increasing distances from the development site.
8) **Impact mechanism understanding:** Identifying the mechanism(s) of how observed impacts take place through precise observations during industrial activities (e.g. sonar detection at tidal devices) or during experimental manipulations (e.g. exposure to elevated ambient noise levels).

The above framework focuses mainly on studies undertaken in conjunction with particular marine renewable energy developments. It must, however, be considered that independent academic research may also inform such developments by providing additional context of marine mammal populations and the surrounding marine environment.

Site characterization surveys are undertaken to provide information on the species which are likely to be at risk, forming the basis of EIA. In some cases, enough information might be available in literature and/or grey literature, and additional surveys might not be needed. Although data collected during site characterization surveys could provide the baseline context for assessing any changes observed during impact monitoring, often there is technically not a requirement on the developer to ensure this is the case (Macleod *et al.*, 2011).

8.3 Monitoring experience–a summary

Monitoring studies have mainly been conducted in relation to offshore windfarms and there are currently only a few studies in relation to tidal stream energy devices and fewer still on wave energy devices. Site- and device-specific impact studies in offshore windfarms are conducted wherever such developments occur (see case studies for Germany, The Netherlands, Belgium, and UK in Annex 4). The basic premise of these studies is to enable the monitoring of changes in presence or utilization of the site by marine mammals before and during construction, and during the operational phase. Most studies compare the development site in the different phases with one or more reference areas or gradients (by means of a BACI or BAGI experimental design). Both the spatial and temporal extent of these studies and applied methods differ between sites. Studies have focused on harbour porpoise, harbour seal and to a lesser extent grey seal. Studies on other species are lacking. So far decommissioning has only been considered in conceptual terms and lessons from the more mature offshore oil and gas sector are expected to be applicable.

Post-consent impact monitoring to date has had a varying level of success; for example, a significant amount of data has been collected during monitoring of windfarm sites in the UK, but it has not, so far, been possible to reach conclusions on actual environmental effects attributable to the windfarms themselves (e.g. Cefas, 2010). This was due to a lack of emphasis on objectives, data requirements and likely variability of the data at the initial design stages of the monitoring program. Broadly speaking, a successful monitoring approach requires specific focus on the statistical power of data collection to address one or more scientific hypotheses, and clarify the likely mechanisms behind potential interactions between animals and devices.

As more empirical evidence is gained and environmental risk becomes better understood, there should be a diminishing need for site-specific studies to inform consenting. There is, however, a continuing need for more generic research, independent of specific projects, that is aimed at understanding mechanisms and gaining knowledge that addresses both the marine mammal species' biological parameters and the potential effects of animal-device interactions.

8.4 Key issues

8.4.1 Abundance and distribution

Site characterization surveys are generally carried involving boat- or plane-based line-transect surveys based on the distance sampling methodology outlined in Buckland *et al*. (2001; 2004). Unfortunately, without stringent survey designs to estimate animal availability, these data are of limited use in generating absolute abundance estimates, which are generally required for meaningful quantitative impact assessment, particularly where a threshold of acceptable impact has been defined (e.g. seal mortality at a regional level). At monthly or greater intervals, surveys are also limited in their ability to detect small-scale temporal trends and are of limited use in poor weather conditions or at night (with the notable exception of surveys towing passive acoustics). At project sites, the area surveyed is small in relation to animal movement ranges, and consequently encounter rates are often low.

Thompson *et al*. (in press) compare the costs and benefits of visual boat based surveys, visual aerial surveys, digital aerial surveys and static passive acoustic monitoring (PAM; specifically C-PODs™) with particular reference to wind developments. These techniques were also assessed to determine how much additional information was gained relative to previously published data, such as SCANS-II density estimates (Hammond *et al*., in press) and species distributions from the Cetacean Atlas (Reid *et al*., 2003). Thompson *et al*. (in press) compared the most widely used techniques for offshore windfarm developments. Passive acoustic surveys by means of towed hydrophone arrays are often combined with visual surveys elsewhere, and recent improvements in analysis methodologies allow for at least minimum absolute density estimation of vocalising cetaceans (www.pamguard.org); this method has been used to assess abundance at tidal energy developments in Scottish waters but does not appear to be widely used for offshore windfarms. Other methods, such as photographic identification for bottlenose dolphins have been used to estimate population size and connectivity with protected sites. However, in European waters it is likely that such methods are only suitable for this species. Seal abundance has traditionally been estimated based on haul-out counts (e.g. SCOS, 2012) and at-sea sightings have not been used extensively to date (but see Herr *et al*., 2009). At-sea densities of grey and harbour seals in UK waters have recently been estimated through the combination of telemetry data with haul-out counts for population monitoring and are expected to be published later in 2013.

Careful thought must be given to applying the findings of Thompson *et al*. (in press) and guidance in Camphuysen *et al*. (2004) to wave and tidal development sites. Current strength is a major complicating factor that will influence the practicalities of carrying out surveys, as well as introducing problems with mooring static monitoring devices. It is not always appropriate in wave and tidal sites to follow best practice as defined for offshore wind developments, and guidance for marine renewable energy site monitoring has been produced in the UK to that effect (Macleod *et al*., 2011).

For many wave and tidal energy developments, marine mammal surveys appear to have been undertaken as an "add-on" element of surveys designed principally to monitor seabirds (as per Camphuysen *et al*., 2004), which has typically resulted in very low marine mammal detection rates due to inappropriate survey design (e.g. very close parallel survey lines). This can be a particular problem if sighting conditions during surveys are poor, e.g. due to high sea states. Sighting rates of marine mammals in wave and tidal sites are especially likely to be negatively biased, particularly during peak flow times, due to increased turbulence, standing waves, fronts and other ephemeral but recurring oceanographic features that act to locally increase sea states. As a result, encounter rates of marine mammals are often low, leading to large amounts of effort required to gather enough sightings for meaningful statistical analysis. Distance sampling theory (which forms the basis of line transect survey design) suggests that a minimum of 60–80 detections, distributed across 10–20 transects, are required to generate robust density estimates (Buckland *et al*., 2001; 2004). If detections are too few, the resulting density estimate will be suspect due to its high variance. Often improvements in survey design, without significantly increasing effort, could be sufficient to improve the statistical power of the results. In some areas, however, the amount of effort required to approach the recommended detection rates for marine mammals may be prohibitive from a logistic and/or financial perspective.

There are also additional variables to consider, such as the volume and direction of water passing through a tidal site, which will mean that the proportion of water surveyed (and thus the representativeness of the survey results) will depend critically on the direction and strength of the current relative to the direction and speed of travel by the survey vessel. More use has been made of shore based surveys of small, nearshore sites, but this approach is unlikely to be suitable for larger sites further offshore (e.g. Crown Estate, 2012), and will not yield robust absolute density estimates.

8.4.2 Behaviour and site use at different scales

Many marine energy sites are highly variable at comparatively small spatial scales and (particularly in the case of wave and tidal energy sites) are also strongly influenced by wave and tidal conditions over relatively short time-scales. An appropriate monitoring strategy has to take at least some of this variability into account to assess whether the site is of any special significance to marine mammal species. This would require in-depth survey effort at small spatial scales, for instance surveying a tidal site at a range of tidal phases. However, too narrow a focus on surveying small sites ignores the fact that marine mammals typically range over large areas, and so a regional view is also necessary. When assessing seals, the network of adjacent haul-out sites needs to be considered as well as at-sea foraging areas.

Direct visual observations of animal behaviour and site use can be made during line transect surveys, although these are limited in spatial and temporal scale and animals may be influenced by the presence of a survey vessel. Such observations may be obtained more easily from shore based surveys, but only in areas that are close enough to shore to make detailed observations. Both survey types also cannot give information on animal behaviour below the surface of the water, so are likely to miss key behaviours.

Static PAM devices such as C-PODs™ provide continuous information on the presence of echolocating cetaceans over time at a particular location, and can work in hours of darkness, thus providing information on temporal small-scale patterns of site use. Data on individual animal ranging patterns and also potentially dive characteristics can be collected using datalogging tags attached to individual animals. In European waters this technique has been largely restricted to seals, although porpoises have been tagged in Danish waters (e.g. Sveegaard *et al.*, 2010, Linnenschmidt *et al.*, 2012). For tidal developments, where a key piece of required information is whether animals avoid collision with turbines, active sonar may be a suitable technique to track movements in the water column in the immediate vicinity of the turbine, and has been demonstrated at Strangford Lough (Hastie, 2012). Vertical arrays of hydrophones may also be used for this purpose, although this technique requires further development (Macaulay *et al.*, in press).

8.4.3 Noise measurements

Noise from developments is a potential impact, particularly during construction of windfarms. In order to predict the impact of noise on particular species, noise propagation is modelled using industry standard techniques. It is best practice to test these models during construction to determine both the sound source level and its propagation at that particular site. The predicted noise levels and frequencies are then used to determine the likely impact on a given species, in relation to its hearing ability. For many species, very few, or no data exist on their hearing abilities. In such cases, data from species that are thought to have similar hearing abilities are used. Wave and tidal sites are noisy by nature, and ambient noise levels have been recorded at these sites by several developers in order to determine whether construction or operational noise will be masked.

A variety of techniques are available to record noise levels. For construction noise, including pile driving, it is necessary to make broadband recordings, which will require the use of calibrated hydrophones. These have usually been deployed over the side of a boat, but new devices which allow automated recordings to be made from seabed mounted (e.g. RUNES™) or drifting hydrophones have been developed. These devices are more useful where tidal flows affect the quality of recordings, or where source (or close to source) level recordings are required. For ambient noise measurements, moored archival devices, such as SM2Ms™ or EARs™ can be used. Pambuoy™, developed by the University of St Andrews, allows real-time assessment of marine mammal vocalisations to be made. The data can either be archived onboard, or transmitted through the mobile network. Mooring such devices in tidal and wave energy sites does, however, present significant challenges over and beyond typical offshore windsites.

8.4.4 Statistical power to detect impacts

Where it is anticipated that a development may influence the abundance or presence of a marine mammal species at a site, developers are required to collect data on this as part of their environmental monitoring plan. Many visual survey types used to date have little power to detect changes due to low encounter rates of even the most abundant species and Thompson *et al*. (in press) suggest that techniques such as passive acoustics (e.g. C-PODs) may be more suitable for detecting trends in site usage. Further development of monitoring tools used for marine renewable developments is required, in order to address specific problems, be effective at particular sites, allow studies of particular species and/or fit within increasingly restricted budgets.

Monitoring in general would greatly benefit from better consideration of appropriate tools and approaches, in order to maximize outputs of robust scientific studies. In deciding the parameters of monitoring studies, regulators and industry need to take several factors into consideration:

- What are the key habitats, species and technologies that require in-depth monitoring, and does this allow for divergent monitoring approaches at different sites on the basis of risk analysis?
- What is the analytical power required of the monitoring approach i.e. what levels of change ought to be detectable by the approach in order to trigger predefined management actions?
- How much uncertainty is acceptable to the regulator when dealing with quantifiable monitoring results, such as density estimates? There is a potential conflict between the desire to minimize uncertainty and practical considerations e.g. daylight hours available for surveying, and regulators need to be clear about what minimum levels of confidence they are demanding of developers. In a similar vein, there is a potential conflict between regulators requiring ever-increasing levels of precision in monitoring data before making a decision, and developers' abilities to provide such data within commercial time constraints.
- What is the spatial scale needed for an appropriate monitoring strategy? If the strategy requires little monitoring effort outwith the development site, the developers may assume full responsibility for implementing the entire monitoring strategy, but if larger areas beyond the site need to be surveyed (likely to be important for marine mammals) there may be an active role for the regulator, potentially involving collaboration with other developers within a larger area.
- What might be the best sites at which to study key impacts? As suggested earlier, not all projects are equal in terms of likely risks to marine mammals, and it may be more practical to focus greater monitoring efforts on a limited number of sites in order to actually detect changes and resolve key

consenting problems, rather than resources being spent across numerous developments without much gain in understanding.

- Are there new technological or methodological breakthroughs that could simplify monitoring plans, and how might such new methods be implemented without reducing the value of already collected data?

8.4.5 Strategic monitoring

A distinction needs to be made between monitoring of impacts locally at the project site (e.g. collision with devices) vs. more wide-scale monitoring of population-level effects as a result of impacts from marine renewable and other industries.

For wide ranging and low abundance species such as marine mammals, larger spatial and temporal scale datasets are of greater use and more cost-effective in understanding effects. This presents justification for larger scale programmes and strategic management of research in many cases. Understanding long-term population health (e.g. to support reporting on Favourable Conservation Status [FCS] under the EU Habitats Directive), to provide the basis for planning decisions on development and understanding the context of impacts at a project level requires a large-scale effort, across developers and jurisdictions. Emphasis at the design stages on developing clear, achievable monitoring objectives, and design of practical, realistic ways to achieve them, could maximize the overall value of monitoring activities to developers, regulators and other stakeholders alike.

Monitoring protocols vary in scope, scale and intensity, depending on the monitoring driver(s) involved. Consequently, a variety of approaches is used to collect marine mammal relevant data, both between ICES members, within individual countries, and even between neighbouring developments. A lack of standardization has the obvious potential drawback of making comparisons between sites and over time difficult. There are multiple reasons for this lack of standardization (see Table 8.2).

Some of the issues outlined in Table 8.2 are inevitable with the development of a new industry in previously little studied habitats and the rapid advance of data collection technologies. Consistency is therefore often not an appropriate request in these cases. However, methods exist to incorporate methodological progress along with a degree of standardization. Firstly a degree of backward compatibility between old and new techniques can be incorporated, perhaps by collecting ancillary data or performing calibration trials. Secondly, efforts can be made to ensure comparative variables are calculated such as total abundance or absolute density, which are not method-specific and therefore resistant to this issue.

Table 8.2. Reasons for research data being incomparable between studies.

Categories	Types	Example
Progress	Advancing technology: Technological innovation mean that higher quality data can now be collected.	The upgrade from early T-POD porpoise click detectors to higher grade C-PODS which work in a different way.
	Evolving alternative methods: Several new techniques are being progressed simultaneously to collect equivalent information. Either is insufficiently mature to establish which is superior.	The parallel development of video vs. stills autonomous plane-mounted camera systems. Both have potential to replace visual observers.
	Advancing understanding of the issue: New information on the animals or issue means that to detect the most sensitive responses, data need be collected in a different manner.	Switching from visual to acoustic data collection to include nocturnal surveillance.
Lack of coordination	No agreed standard: Alternative methods have been developed but the superior one has not been agreed.	Adoption of different criteria for acoustic harm to marine mammals.
Differing priorities	Poor objective setting: Criteria for study set too low to provide rigorous or comparable results.	Sightings surveys set up to only establish relative density rather than absolute density.
	Cost saving: Collecting insufficient or substandard data or foregoing calibration /validation or incomplete data analysis. Any of these may result from economic constraints, compromises against other priorities or error.	Conducting line-transect surveys and putting bird and mammal observers on the same platform with different sea state thresholds.
	Different objectives: Data may be collected opportunistically during other activities.	Collecting marine mammal sightings data from an active seismic ship, though perhaps useful, cannot be assumed to be as representative as other methods.
Suitability	Different environments: A technique developed for one environment may not be suitable in another.	Moorings developed in windfarm sites being deployed in tidal-stream habitats with rapid water flows.

Issues arising from *lack of coordination* are perhaps an inevitable consequence of the progress described above but should only be a temporary phenomenon. In some cases, however, it is not. Efforts should be made to encourage resolution of these instances if potential phenomena such as cumulative impact are to be quantified on international scales. Other incompatibilities arise due to there being *differing objectives, priorities* and *endpoints* to data collection, analyses and reporting. Together with un-coordination, these issues are regrettable and stand as a barrier to comparison, meta-analyses and the construction of meaningful time-series. It is these areas where standardization is to be particularly encouraged. Finally, methods or techniques developed for particular environments (e.g. large offshore windfarms) may not be *suitable* for others (e.g. small, spatially complex tidal energy sites). In this situation, it may be difficult or impossible to achieve full compatibility between different sites.

8.4.6 Consistency

There is currently little consistency in the way different regulators approach the distinction between pre-development site characterization and post-development impact monitoring. This influences the cost and complexity of projects, resulting in varying levels of survey design, amount of effort deployed and statistical power of data collected. For example, regulators in Germany and Denmark have been proactive in setting out long-term monitoring objectives to ensure that pre-development site characterization survey data can be used as part of a BACI design, but such an approach is not yet standard across ICES members.

There is also little consistency in terms of how post-consent impact monitoring is to be undertaken, particularly in terms of survey design and amount of effort deployed. The appropriate level of scientific rigour and statistical power, in terms of total monitoring effort and resolution required, may be much less for pre-development site characterization than for post-development impact monitoring. There are, at present, no firm requirements for developers to generate data of any particular level of quality upon which to base assessments; nor is there a clear understanding of the degree to which different approaches (visual boat-based surveys, moored vs. towed PAM, shore-based observations, etc.) offer comparable results, and which methods should be used under different circumstances. The wide range of conditions at sites currently under development likely precludes complete standardization of monitoring approaches, but some streamlining of methodologies would strengthen the comparability of monitoring results between sites. Some research questions may, however, only be answered by means of unique survey designs.

This diversity has implications for using characterization survey data to inform post-consenting impact assessments. Generally speaking, site characterization surveys are not designed to provide a baseline against which further changes could be assessed during monitoring. Developers are therefore required to undertake a further 'un-impacted' baseline survey, prior to activities taking place. It would be time- and cost-efficient to incorporate data arising from characterization surveys into longer term monitoring strategies, and to enable this, statistical design would need to be undertaken specific to the objectives of the monitoring study. This is usually not considered until consent has been granted, however significant savings could be made over the longer term if the statistical value of the surveys were considered in greater detail at this stage.

8.4.7 Data sharing

Many monitoring tools used in marine renewable energy developments have been based on the same basic methodology (e.g. Buckland *et al.*, 2001) or involve automated data recording (e.g. C-PODs™), suggesting a high degree of comparability. However, such data collection has rarely been standardized in Europe. Instead, countries have developed recommendation how to achieve comparability of data (e.g. BSH 2007). This concerns the data acquisition as well as the used data format to ensure the data can be pooled without extensive programming to merge differently formatted data entries.

Survey data owned by EU public agencies or studies funded by European Member States (including data collected by private companies in the implementation of a licence or as an implementation of legislation) are covered by the EU Directive 2003/98/EC on re-use of public sector information (EU, 2003) which ensures that data generated under such studies are, in principle, publicly available. Although there are as yet no common format standards or central storage facilities. Datasets collected for commercial use without licencing requirements (e.g. prospecting) do not fall under this legislation, and hence such data may be difficult to access. Coordinated steps should therefore be taken to compile existing data, including those from commercial impact studies. However the utility of such data compilation exercises strongly depends upon coordinated monitoring approaches that allow a general analysis of the data. The assessment of impacts on population level, a scale that is relevant to marine mammals, and the assessment of cumulative impacts in terms of multiple simultaneous marine renewable energy developments, but also with regard to other human activities (bycatch, pollution, etc.) is dependent upon data that can be generalized from site-specific as well as studies conducted on regional scale.

Linking to the discussion above, a scenario that may align with national monitoring requirements would be a nested approach to data collection, in which small-scale monitoring efforts are developed in such a way as to allow integration with regularly repeated large-scale cross-boundary marine mammal surveys. This would provide information at a spatial and temporal scale relevant to marine mammals while simultaneously allowing the assessment of individual development sites. To enhance the power of the results all such monitoring efforts should be coordinated between adjacent developments and between countries sharing transboundary populations. Survey methodology should be standardized as much as possible, using surveying methods appropriate to the areas and species of interest, and results should be analysed as a whole (as exemplified by Ireland and the UK's Joint Cetacean Protocol programme, see ToR d for further details).

8.5 Recommendations

8.5.1 Top-level recommendation: Integration of monitoring data

Current monitoring efforts to determine the distribution and habitat use of marine mammals, in relation to consenting, e.g. for marine renewable energy developments, typically take place at smaller spatial scales than are ecologically relevant to marine mammals, and are often undertaken independently without broader coordination. This results in numerous disparate datasets that are difficult to integrate when assessing overall impacts of marine renewable energy developments.

WGMME **recommends** that for marine renewable energy developments the concept of integrating data collected during the course of monitoring activities across different spatial and temporal scales becomes a core principle among regulators within ICES Member States, taking into account monitoring drivers and requirements as appropriate.

This top-level recommendation incorporates several more specific recommendations:

8.5.1.1 Strategic decision-making

At the initial monitoring design stages, regulators and developers must develop clear, achievable monitoring objectives, and design realistic ways to achieve them, so that robust scientific data with sufficient statistical power can be gathered given available resources. This needs to include high-level strategic decisions on which types of monitoring would be most appropriate to particular developments to inform regulatory requirements.

WGMME **recommends** that, in terms of consenting, regulators should consider the environmental data that can be derived from independent sites against each other and weigh the requirements requested by what the sites may be capable of delivering. Sites best able to provide quality information from environmental monitoring should be considered for strategic research augmentation to advance the understanding of the entire sector.

8.5.1.2 Long-term temporal integration

There is a critical need to improve integration of data collection efforts throughout the lifetime of a project, thereby ensuring that data gathered during pre-consenting *site characterization* stages can act as the "before" dataset for later studies of *magnitude of impact*. This requires that BACI / BAGI or other suitable approaches be adequately considered and evaluated with respect to statistical power at, or near, the outset of site characterization data gathering.

WGMME **recommends** that greater efforts in long-term planning of monitoring programmes be made by both regulators and developers to ensure compatibility of data collected across the entire lifespan of individual marine renewable energy developments.

8.5.1.3 Integration across developments

Too often, monitoring programmes in adjacent marine renewable energy developments occur independently without broader coordination. Regulators and seabed owners (e.g. the UK Crown Estate) need to acknowledge the need for data pooling, require it as an integral part for marine renewable consenting and develop internationally standardized comparable data formats for easy access and analysis. The Joint Cetacean Protocol (JCP) may serve as such an example.

WGMME **recommends** that efforts are made to better align monitoring programmes among different marine renewable energy developments so that true data pooling can occur.

In that light, WGMME reiterates the following recommendations of previous reports (WGMME, 2010 [offshore wind], 2011 [tidal-stream] and 2012 [wave]):

2011: WGMME **recommends** that wherever possible new data, collected as part of EIAs for marine renewable developments, should be made available to the wider community of regulators and with appropriate measures to safeguard commercial confidentiality they should be made available to carefully regulated researchers.

2012: WGMME **recommends** a cooperative monitoring approach for marine renewable energy developments is taken, which combines small-scale monitoring efforts with large-scale cross-boundary marine mammal surveys in order to provide information at a spatial and temporal scale relevant to marine mammals.

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9 Future work and recommendations

9.1 Future work of the WGMME

It is likely that the demand for advice from ICES client commissions and others on marine mammal issues will continue and will grow in future years. This WG should continue to be parented by the ICES Advisory Committee.

A list of the following recommendations can also be found at Annex 5 of this document.

Recommendation I

WGMME **strongly recommends** that Member States use the proposed management units for reporting requirements of the Habitats Directive and for the development of indicators and their assessment for the Marine Strategy Framework Directive. In summary, there is a single MU in the European North Atlantic for common dolphin (*Delphinus delphis*), white-beaked dolphin (*Lagenorhynchus albirostris*), white-sided dolphin (*Lagenorhynchus acutus*), striped dolphin (*Stenella coeruleoalba*) and minke whale (*Balaenoptera acutorostrata*). For bottlenose dolphin (*Tursiops truncatus*) there is a more complex structure with six local MUs for small discrete "resident" groups and eleven MUs for larger coastal areas encompassing these and other areas where this species is found. There is also a large MU covering the whole European Atlantic to cover the wide-ranging animals that are mainly found away from coastal waters. For harbour porpoise (*Phocoena phocoena*), five MUs are proposed for the Iberian Peninsula, Celtic and Irish Seas, West Scotland/NW Ireland, the North Sea and Inner Danish Waters. More than one MU in the North Sea for harbour porpoise should be explored in ongoing work to develop management models for setting safe limits to bycatch. Management units for both harbour and grey seals need to be more clearly defined for MSFD assessments.

Recommendation II

WGMME strongly supports the proposal for a cetacean absolute abundance survey in all European Atlantic waters in 2015 and **recommends** that it is supported by all range states and by ICES, ASCOBANS and the European Commission. Continuation of these surveys is essential to the accurate estimation of absolute abundance for several species that are required for reporting under the Habitats Directive and the Marine Strategy Framework Directive.

Recommendation III

In 2009, ICES advised the European Commission **'**that a Catch Limit Algorithm approach is the most appropriate method to set limits on the bycatch of harbour porpoises or common dolphins. In order to use this (or any other) approach, specific conservation objectives must first be specified. In both species improved information on bycatch and the biology of the species would improve the procedure.' In 2010, ICES again advised the European Commission that 'ICES advised in 2009 of the need for explicit conservation and management objectives for managing interactions between fisheries and marine mammal populations. This advice has not been acted upon. Lacking these objectives, ICES is unable to properly consider the impacts of these interactions in its management advice.' With the current development of MSFD targets for marine mammal bycatch, WGMME **strongly recommends** that this advice is acted upon. To aid such decisions, WGMME also **recommends** that ASCOBANS consider the policy decisions required for the setting of safe bycatch limits and, intersessionally, provide the UK (as project coordinator) with their recommendations. Decisions are required on:

1) whether the ASCOBANS conservation objective 'to allow populations to recover to and/or maintain 80% of carrying capacity in the long term' should be met on average or some other proportion (>50%). This choice will have a significant influence on the population level as a percentage of carrying capacity achieved in the long term (if greater than 50% the population level achieved in the long term will exceed the specified target).

2) ASCOBANS need to define 'long term'. Although the original CLA project used 200 years, it is suggested that in the further development of the framework for determining safe bycatch limits, a time frame of 100 years is used as this is consistent with the majority of other assessment approaches.

3) The current debate regarding the number of management units for harbour porpoise in the North Sea should be explored during the framework simulations. It is recommended that the outputs of the simulations should be used as the basis for defining the number of North Sea management units until further information becomes available.

Recommendation IV

WGMME **strongly recommends** that ICES members provide data so that the seal database be maintained and updated regularly. Such development will be highly beneficial for future MSFD assessments of the OSPAR core set of indicators for seals.

Recommendation V

Current monitoring efforts to determine the distribution and habitat use of marine mammals, in relation to environmental impact assessments, e.g. for marine renewable energy developments, typically take place at much smaller spatial scales than are ecologically relevant to marine mammals, and are often undertaken independently without broader coordination. This results in numerous disparate datasets that are difficult to integrate when assessing overall impacts of marine renewable energy developments. WGMME **recommends** that for marine renewable energy developments (incl. offshore wind) the concept of integrating data collected during the course of monitoring activities across different spatial and temporal scales becomes a core principle among ICES Members, taking into account monitoring drivers and requirements as appropriate.

Annex 1: List of Participants

NAME	ADDRESS	PHONE/FAX	E-MAIL
Annabell Aish	Université Pierre et Marie Curie/MNHN 55 rue Buffon 75005 Paris France	Phone +33 Fax +33	aaish@mnhn.fr
Steven Benjamins By correspondence	Scottish Association for Marine Science Dunstaffnage Marine Laboratory Oban PA37 1QA Argyll Scotland United Kingdom	Phone +44 1631 559449 Fax +44 1631 559001	Steven.Benjamins@sams.ac.uk
Arne Bjørge	Institute of Marine Research Gaustadalleen 21 NO-0349 Oslo Norway	Phone +47 22 958751	arne.bjoerge@imr.no
Kate Brookes	Marine Scotland Science Marine Laboratory PO Box 101 AB11 9DB Aberdeen United Kingdom	Phone +44 Fax +44	Kate.Brookes@scotland.gsi.gov.uk
Michael Dähne	University of Veterinary Medicine Hannover Foundation Institut für Terrestrische und Aquatische Wildtierforschung, Büsum Werftstr. 6 25761 Büsum Germany	Phone +49 511 856-8157 Fax +49 511 856-8181	Michael.Daehne@tiho-hannover.de
Steve Geelhoed	Wageningen Imares c/o Bevesierweg 4 (Fort Harssens) NL-1781 CA Den Helder Netherlands	Phone +31 317482537 Fax +31	Steve.Geelhoed@wur.nl
Patrick Haffner Invited Expert	Université Pierre et Marie Curie/MNHN 36 rue Geoffroy Saint-Hillaire 75005 Paris France	Phone +33 Fax +33	haffner@mnhn.fr

Name	Address	Phone/Fax	E-mail
Jan Haelters	Royal Belgian Institute of Natural Sciences (RBINS) 3de en 23ste Linieregimentsplein 8400 Oostende Belgium	Phone +32 59700131 Fax +32 59704935	j.haelters@mumm.ac.be
Phil Hammond	Scottish Oceans Institute University of St Andrews East Sands KY16 8LB St Andrews Scotland United Kingdom		psh2@st-andrews.ac.uk
Kjell Tormod Nilssen	Institute of Marine Research PO Box 6 N-9294 Tromsø Norway		kjelltn@imr.no
Graham Pierce	University of Aberdeen Oceanlab Main Street AB41 6FL Newburgh Ellon, Aberdeenshire Scotland United Kingdom	Phone +44 1224 272459 Fax +44	g.j.pierce@abdn.ac.uk
Eunice Pinn Chair	Joint Nature Conservation Committee Inverdee House Baxter Street AB11 9QA Aberdeen Scotland United Kingdom	Phone +44 1224 266580	eunice.pinn@jncc.gov.uk
Vincent Ridoux	University of La Rochelle 23 avenue Albert Einstein 17071 La Rochelle Cedex 9 France	Phone +33 Fax +33	vincent.ridoux@univ-lr.fr
Emer Rogan	University College Cork Dept Zoology Ecology and Plant Science University College Distillery Fields N Cork Ireland	Phone +353 21 490 4645	e.rogan@ucc.ie

Name	Address	Phone/Fax	E-mail
Maria Begoña Santos By correspondence	Instituto Español de Oceanografía Centro Oceanográfico de Vigo PO Box 1552 36200 Vigo (Pontevedra) Spain	Phone +34 986492111	m.b.santos@vi.ieo.es
Signe Sveegaard By correspondence	National Environmental Research Institute Department of Arctic Environment Frederiksborgvej 399 DK-4000 Roskilde Denmark	Phone 46301256 Cell +45 2895 1664	sign@dmu.dk
Gordon Waring By correspondence	Gordon Waring National Marine Fisheries Services Northeast Fisheries Science Center Woods Hole Laboratory 166 Water Street Woods Hole MA 02536-1026 United States	Phone +1 508-495-2311 Fax +1 508-495-2258	gordon.waring@noaa.gov
Ben Wilson	Scottish Association for Marine Science Dunstaffnage Marine Laboratory Oban PA37 1QA Argyll Scotland United Kingdom	Phone +44 1631 559346 Fax +44	ben.wilson@sams.ac.uk

Annex 2: WGMME terms of reference for the next meeting

The **Working Group on Marine Mammal Ecology** (WGMME), chaired by Eunice Pinn, UK, will meet in Woods Hole, Massachusetts, USA, 10–13 March 2014 to:

1) Review and report on any new information on population sizes, population/stock structure and management frameworks for marine mammals; specifically. This will contribute to the work required for the MoU between the European Commission and ICES to "*provide new information regarding the impact of fisheries on other components of the ecosystem including small cetaceans and other marine mammals*…" and to aid "*scientific and technical developments in the support of the Marine Strategy Framework Directive, such as by designing marine monitoring and assessment programmes, identifying research needs and methodologies advice*". OSPAR is also seeking advice from ICES in relation to the development of indicators and targets for determining Good Environmental Status (GES) under MSFD to which this will contribute;

2) Provide information on abundance, distribution, population structure and incidental capture of marine mammals in the western North Atlantic (North Atlantic right whale, harbour porpoise and white-sided dolphin);

3) To review the further development of the Bycatch Limit Algorithm framework for determining safe bycatch limits. This work should include harbour porpoise, short-beaked common dolphin and consideration of additional species for which bycatch estimates have been made or suggested as a potential MSFD indicators (e.g. bottlenose dolphin, striped dolphin, harbour seal and grey seal). This should include a comparison with approaches used to assess bycatch in USA;

4) Assess the Joint Cetacean Protocol outputs with a view to their contribution to international transboundary reporting requirements (e.g. for Article 17 of the Habitats Directive) and the operationalization of MSFD indicators, targets and appropriate baselines. Consideration should also be given to other approaches, such as those of the Atlantic marine Assessment programme (AMAPPS) which coordinates data collection and analysis for marine mammals and reptiles for population assessments;

5) Update on development of database for seals and status of intersessional work, contribution to the and the operationalization of MSFD indicators, targets and appropriate baselines. Consideration should also be given to other approaches, such as those of the Atlantic Marine Assessment programme (AMAPPS);

6) Outline and review approaches to marine mammal survey design used during pre- and post-consenting monitoring in the offshore marine renewables (wind, wave, tide) industry, and provide recommendations for best practice.

WGMME will report for to the attention of the Advisory Committee.

Annex 3: ICG-COBAM technical specification of proposed common biodiversity indicators

Part C: Technical specification of proposed common biodiversity indicators

Mammals

CODE	PREVIOUS CODE*	INDICATOR	CATEGORY
M-1	31&33	Distributional range and pattern of grey and harbour seal breeding and haul-out sites	Core
M-2	32&34	Distributional range and pattern of cetaceans species regularly present	Core
M-3	35	Abundance of grey and harbour seals at breeding and haul-out sites	Core
M-4	36	Abundance at the relevant temporal scale of cetacean species regularly present	Core
M-5	37	Grey seal pup production	Core
M-6	38&39	Numbers of individuals within species being bycaught in relation to population	Core

Draft OSPAR Common Indicators: marine mammals (M-1)

Distributional range and pattern of grey and harbour seal breeding and haul-out sites

1) Indicator

"Distributional range and pattern of grey and harbour seal breeding and haul-out sites".

2) Reasoning for the development of this indicator

Marine mammals, including harbour and grey seals, are top predators, and comprise an important part of biodiversity (Descriptor 1). As harbour and grey seal are taken up under the Habitats Directive (Annex II), their distributional range and pattern comprises a key aspect for securing and achieving GES according to the MSFD.

Number of CPs reporting/using the indicator (n=9): 7

Consensus among CPs on usefulness as part of a region wide set (n=8): 7

3) Parameter/metric

"Distributional range and pattern of harbour and grey seal breeding and haul-out sites". It should be noted that seals move between different sites depending on weather conditions and the season, range may be used instead of number of haul-outs and breeding colonies.

4) Baseline and reference level

There are baseline data on historical distribution and range for many populations of harbour and grey seals. Most current populations of harbour seal have distributions coinciding with historical distributions. However, grey seals were extirpated in the Wadden Sea in the early Middle Ages, in the Skagerrak in the 1750s and in the Kattegat in the 1930s, indicating that setting a historic baseline is not straightforward. Moreover, the historical distributional range and pattern of haul-out and breeding sites is a situation that cannot realistically be restored, given for instance coastal developments and tourism. Climatic changes may have important consequences. It is therefore likely that a modern baseline will have to be utilized, such as a favourable reference situation (Habitats Directive) or maximum range derived from surveys performed during the last decade.

5) Target setting

The proposed target is: "Maintain populations in a healthy state, with no decrease in distribution with regard to the baseline (beyond natural variability) and restore populations, where deteriorated due to anthropogenic influences, to a healthy state."

This target should be set for every Management Unit (MU; see further). MUs should not be specifically listed in the target, thus avoiding the need to rewrite or update the wording of the indicator as new information on populations comes to light. Identifying trends near the edge of the range of harbour and grey seals will be especially important, and movements of seals between MUs (immigration and emigration) need to be taken account of.

6) Spatial scope

For monitoring the EcoQO's on seals, the North Sea has been subdivided into different MUs, which include stretches of coastline with presumed major exchanges of animals between the colonies, and with a coordinated monitoring scheme in place. A subdivision into MUs should be made for the whole range of both species, with indications of current and former occupancy. Genetic criteria for setting MUs in harbour seals are available, and where appropriate other evidence that suggests demographic differences should be utilized. The widespread use of telemetry may provide for more information on foraging range and distribution.

7) Monitoring requirements

Existing OSPAR EcoQO's cover grey seal pup production and harbour seal population size based on haul-out counts in the North Sea. The indicator and target proposed here are based on the monitoring required for the EcoQO. Monitoring of distributional range and pattern is well covered in most areas. This monitoring, at seal haul-out and breeding sites, is predominantly targeted at elucidating trends in abundance (indicator M-3) and for monitoring pup production (indicator M-5).

In the Wadden Sea the monitoring and management under the Trilateral Monitoring and Assessment Programme and Wadden Sea Plan (Trilateral Seal Agreement; CMS) are well established over recent decades, and support the indicators and targets for harbour seals, and (although not under CMS) also the ones for grey seals. Similar work has also been ongoing in the UK over a similar time frame.

8) Appropriateness of the indicator

There is usually no straightforward link between the parameter and human activities. It is generally possible to detect deterioration or improvement of the distribution of harbour and grey seal by monitoring their presence on existing (and former) haul-out and breeding sites, respectively. When recording changes, it is necessary to assess and interpret these, in order to discriminate natural vs. human-induced changes. Fundamental knowledge of behaviour and health of individuals from undisturbed areas is required for this. Changes and trends may reveal a cause–effect relationship.

Changes due to climate and epizootics, not directly related to a human activity, may also be important.

9) Reporting

Given that most populations have a transboundary distribution, and that shifts between colonies and haul-out sites can occur, agreements have to be made on monitoring and reporting in order to be able to make an assessment. The reporting frequency should be in line with the monitoring frequency of indicators M-3 and M-5, and an assessment should be made at least every six years.

10) Costs

As the monitoring is coastal in nature, costs are limited. It is already partly in place: the monitoring for the indicators M-1 (distributional pattern), M-3 (abundance) and M-5 (pup production) can be combined.

11) Further work

Future steps are similar for the parameters M-1 (distributional pattern), M-3 (abundance) and M-5 (pup production).

- 11.1) Compilation of existing data on the distributional range and pattern.
- 11.2) Subdivision of the area (beyond the North Sea) into MUs, and a revision of the North Sea MUs.
- 11.3) Development of a baseline for each MU.
- 11.4) Development of a standardized monitoring methodology, or alternatively a mechanism for standardizing data post collection.
- 11.5) Development of an assessment tool.

Literature

OSPAR. 2009. Evaluation of the OSPAR system of Ecological Quality Objectives for the North Sea (update 2010). OSPAR Biodiversity Series, 406.

PART C: Technical specification of proposed common biodiversity indicators

Mammals

Code	Previous code*	Indicator	Category
M-1	31&33	Distributional range and pattern of grey and harbour seal breeding and haul-out sites	Core
M-2	32&34	Distributional range and pattern of cetaceans species regularly present	Core
M-3	35	Abundance of grey and harbour seals at breeding and haul-out sites	Core
M-4	36	Abundance at the relevant temporal scale of cetacean species regularly present	Core
M-5	37	Grey seal pup production	Core
M-6	38&39	Numbers of individuals within species being bycaught in relation to population	Core

Draft OSPAR Common Indicators: marine mammals (M-2)

Distributional range and pattern of cetacean species regularly present

1) Indicator

"Distributional range and distributional pattern within range of cetacean species regularly present".

The cetacean species for use as a core indicator under OSPAR are limited to the following species:

- harbour porpoise
- bottlenose dolphin
- white-beaked dolphin
- minke whale
- common dolphin

Common dolphin are considered representative of the wider European waters (i.e. both off and on the continental shelf). It should also be noted that bottlenose dolphins can be divided into two types. There are well known small resident coastal groups (possibly to be divided into different Management Units) and groups, comprising much more animals, that are wide-ranging both inshore and offshore ('oceanic' population).

2) Reasoning for the development of this indicator

Marine mammals, including cetaceans, are top predators, and comprise an important part of biodiversity (Descriptor 1). As all cetacean species are taken up under the Habitats Directive (Annex IV and/or II), their distribution comprises a key aspect for securing and achieving GES according to the MSFD.

With the possible exception of some coastal bottlenose dolphin populations, cetaceans are generally mobile over large spatial and temporal scales. For example, there was a significant southerly shift in the North Sea harbour porpoise population between the two SCANS surveys (1994 and 2005). Assessments therefore need to be undertaken at an appropriate scale and it should be noted that expansions in range are far easier to detect than contractions. A good understanding of natural movement patterns (e.g. seasonal patterns) is required prior to any deterioration or expansion being detected and links made with anthropogenic activities.

Because of the scale required for assessments, a transboundary approach to the collection, collation and analysis of data will be required. Such an approach has also been suggested for Favourable Conservation Status assessments for the Habitats Directive.

Number of CPs reporting/using the indicator (n=9): 8

Consensus among CPs on usefulness as part of a region wide set (n=8): 8

3) Parameter/metric

"Distributional range of cetacean species regularly present and distributional pattern at the relevant temporal scale of cetacean species regularly present."

There is a very clear overlap between distributional range and distributional pattern within range. The same monitoring will be used to undertake both analyses. An assessment of distribution, including trends over time, is required as part of the Favourable Conservation Status (FCS) assessments for the Habitats Directive (as short-term and long-term trends)[1].

4) Baseline and reference level

Although the baseline should be based on historical data, these are not available at the appropriate spatial and temporal scale. Moreover, the historical distributional range and pattern of many cetacean species cannot realistically be restored (assuming it has contracted, which is unknown for many species) as today's marine environment is very different. Climatic changes may have important consequences. For the harbour porpoise, there have been important distributional shifts in the North Sea during the last decades. For the coastal bottlenose dolphin, many populations are small, and some estuaries that historically contained populations no longer do so (e.g. Humber and Thames Estuaries, UK); in other locations (e.g. the Sado Estuary, Portugal), populations are endangered. The relationship between inshore and 'oceanic' populations is not well known, and the much larger 'oceanic' populations are relatively poorly known.

White beaked dolphins occur over a large part of the European continental shelf, including the North Sea, but are rare in the Irish Sea, Celtic Sea, Channel and Bay of Biscay, and around the Iberian Peninsula.

Minke whales are widely distributed in European shelf waters, particularly along the Atlantic seaboard and in the northern and central North Sea.

For common dolphins, there are large seasonal movements in the population on and off the continental shelf, whilst in some areas the possibility of 'inshore' and 'offshore' populations has been suggested. For this species, as with bottlenose

[1] In the 2007 FCS assessments, this was undertaken on a country by country basis which led to an unsatisfactory standard of assessment at the European North Atlantic scale (ICES, 2009). For the 2013 FCS assessments, a greater emphasis has been placed on the need for a transboundary approach (European Commission, 2011), although it seems unlikely that this will occur.

dolphin, it is essential that assessments include consideration of the species off the continental shelf.

5) Target setting

The proposed target is "Maintain populations in a healthy state, with no decrease in population distribution with regard to the baseline (beyond natural variability) and restore populations, where deteriorated due to anthropogenic influences, to a healthy state". Some difficulties can be encountered here, because there is usually no straightforward link between the distributional range and pattern, and human activities. Although the baseline for each species considered should be based on historical data, these are generally not available at the appropriate spatial and temporal scale.

6) Spatial scope

The geographical scope of the indicator is species dependent. With the exception of coastal bottlenose dolphin populations, cetacean populations cover large spatial scales often extending beyond European North Atlantic waters for example. Assessments therefore need to be undertaken at an appropriate scale and a good understanding of natural variability and patterns of movement is required prior to any change of distribution being detected and links made with anthropogenic activities. Management Units for cetacean species, also to be used in indicator M-4 (Abundance) and M-6 (bycatch) assessments, have been loosely defined by ASCOBANS (Evans and Teilmann, 2009), reviewed by WGMME (2012) and further refined by WGMME (2013; see Appendix 1).

7) Monitoring requirements

The objective of the monitoring should be to detect trends, in particular negative ones, in the distributional range and pattern, due to human pressures. Human pressures are diverse: some human activities remove individuals directly from the population (e.g. bycatch). Other pressures degrade condition and health of animals (e.g. contaminants, food depletion), or displace populations towards habitats of poorer quality (disturbance by noise, habitat modification). Monitoring is undertaken through a variety of approaches and by many different organizations. There are large-scale international surveys such as SCANS and CODA, annual national surveys that occur in the waters of some Member States and, at a more localized scale, there are various surveys undertaken by the state, academic institutions and/or non-governmental organizations[2]. Although these surveys are

[2] A mechanism, the Joint Cetacean Protocol, is being developed that can bring these disparate datasets together at the NW European Atlantic scale (JCP; Paxton *et al.*, 2011; see http://jncc.defra.gov.uk/page 5657). Effort-related cetacean sightings data from all major data sources are included e.g. SCANS I and II, CODA, European Seabirds at Sea (ESAS), SeaWatch Foundation (SWF) and other non-governmental organisations, as well as industry (e.g. in relation to potential renewable energy installations in UK waters). These data, collected between 1979 and 2010, represent the largest NW European cetacean sightings resource ever collated. It is recognised, however, that there are some significant datasets missing such as the annual national monitoring undertaken by some States. It is expected that the JCP will deliver information on the distribution, relative abundance and population trends of the more regularly occurring cetacean species occurring in NW European waters. A preliminary phase of the project, covering the Irish Sea and west coast of Scotland, was re-

mostly dedicated to provide for density estimation, they also yield information about distribution and distributional patterns.

Strandings data represent to date the most extensive and long-term source of demographic data for a number of cetacean populations (at least in areas where strandings occur). Strandings data are currently clearly underexploited and rarely analysed at an international level. They could yield useful complementary information to identify possible anthropogenic impacts, and can contribute to the identification of possibly underlying reasons for trends in the distributional range and pattern of cetaceans. Coverage needs to be reliable, and biological and pathological investigations need to be standardized.

The monitoring and assessment undertaken for distributional range and pattern of cetaceans will be made in combination with indicator M-4 (abundance).

8) Appropriateness of the indicator

In most cases it is difficult to find a straightforward link between the range and the distribution pattern of cetaceans and human activities. There are multiple pressures, and climate change is also a factor influencing abundance and distribution. However, as top predators and being charismatic animals of general public concern, changes in distribution and abundance are important, and should be assessed against changes in human activities and climate change to detect cause–effect relationships and, where necessary be followed by the appropriate management measures.

9) Reporting

Given that populations have a transboundary distribution (except for the resident and most coastal bottlenose dolphins groups), agreements have to be made on monitoring and reporting in order to be able to make an assessment. The reporting frequency should follow the monitoring frequency, and the assessment for most species should be made every six years. For the small cetaceans it is proposed that ICES makes the assessment, while for the minke whale a regular assessment of the Northeast Atlantic population is made by the IWC.

10) Costs

Monitoring distribution and distributional range of cetacean can range from fairly cheap (monitoring of an inshore population with a limited range) to very expensive (monitoring of an offshore population distributed over a large area); however, part of the monitoring is in place (in a combination of indicator M-2, M-4 and M-6), while new resources are needed, e.g. for large-scale decadal surveys and more comprehensive annual surveillance (see also indicator M-4).

11) Further work

Future steps are similar as for the indicator M-4 (abundance).

11.1) Compilation of existing data on the distributional range;

11.2) Development of a baseline for each species and MU;

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cently been completed (Paxton *et al.*, 2011). This work was used to refine the modelling techniques that had been developed in earlier projects (Thomas, 2009; Paxton and Thomas, 2010; Paxton *et al.*, 2011). A final analysis of northwest European waters will be published in 2013.

11.3) Development of a method to extract data on distribution and distributional pattern from the data obtained from the monitoring for indicator M-4;

11.4) Development of, and agreement on, a standardized reporting and assessment method;

11.5) For small cetaceans, agreement on the body that provides for the assessments.

Literature

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PART C: Technical specification of proposed common biodiversity indicators

Mammals

Code	Previous code*	Indicator	Category
M-1	31&33	Distributional range and pattern of grey and harbour seal breeding and haul-out sites	Core
M-2	32&34	Distributional range and pattern of cetaceans species regularly present	Core
M-3	35	Abundance of grey and harbour seals at breeding and haul-out sites	Core
M-4	36	Abundance at the relevant temporal scale of cetacean species regularly present	Core
M-5	37	Grey seal pup production	Core
M-6	38&39	Numbers of individuals within species being bycaught in relation to population	Core

Draft OSPAR Common Indicators: marine mammals (M-3)

Abundance of grey and harbour seal at breeding and haul-out sites

1) Indicator

Abundance of grey and harbour seals at breeding and haul-out sites.

2) Reasoning for the development of this indicator

Marine mammals, including seals, are top predators, and comprise an important part of biodiversity (Descriptor 1). As harbour and grey seal are taken up under the Habitats Directive (Annex II), their abundance comprises a key aspect for securing and achieving GES according to the MSFD.

Number of CPs reporting/using the indicator (n=9): 7

Consensus among CPs on usefulness as part of a region wide set (n=8): 7

3) Parameter/metric

"Abundance, at the appropriate spatial and temporal scale, of harbour and grey seal at haul-out and/or breeding sites (as appropriate)".

Existing OSPAR EcoQO's encompass grey seal pup production (which is scaled up to provide abundance estimates) and population size of harbour seals (estimated from haul-out counts), but the monitoring for this indicator would also yield necessary information for indicator M-1 (distributional range and pattern) and M-6 (bycatch).

4) Baseline and reference level

Although the baseline should derive from historical data, these are not available everywhere. Moreover, the historical abundance of seals at haul-out sites and colonies is a situation that cannot realistically be restored, given for instance large-scale coastal developments and tourism. Climatic changes and outbreaks of PDV also have important consequences. It is therefore likely that a modern baseline will have to be used, such as a favourable reference situation for abundance at the different Management Units (MUs), as defined in the Favourable Conservation

Status assessments under the Habitats Directive or maximum counts in the last decade. However, it should be noted that different countries have set different baselines, so there is a need for a more coherent definition. Baselines could be set to the level at which population growth rates are levelling off due to natural causes, with a need to decide a time period over which this is measured.

Baseline/reference level for:

- Harbour seal: derived from haul-out counts for each MU. Surveys techniques vary between MUs but are generally consistent at the national level.
- Grey seal: derived from pup counts for each MU or from counts of hauled-out animals. Surveys techniques vary between MUs and also at the national level depending on the location of breeding.

5) Target setting

The proposed target is: "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".

This target should be set for every MU. MUs should not be specifically listed in the target (as is the case now in the OSPAR EcoQO), thus avoiding the need to rewrite or update the wording of the indicator as new information on populations comes to light. A restoration will not be feasible if anthropogenic activities have increased to a level where habitats are no longer suitable. Identifying trends in colonies near the edge of the range of harbour and grey seals will be especially important, as will movements of seals between MUs (immigration and emigration).

6) Spatial scope

For monitoring the EcoQO's on seals, the North Sea has been subdivided into different monitoring areas which vary between the two species. A subdivision of the European populations into MUs should be made for the whole range of both species; with indications of current and former abundance (or alternatively a favourable reference situation). WGMME (2012) reviewed the EcoQO divisions and WGMME (2013) began to define MUs for seals. However, further work is required to complete the proposals. While population estimates are made at the MU level through combining site level estimates, movements between MUs need to be taken into account.

7) Monitoring requirements

It is possible to detect changes in abundance of harbour seals from haul-out counts and for grey seals from pup counts and, where this is not possible, from haul-out counts. In most parts of the distributional range of the harbour and grey seal, there is sufficient monitoring at haul-out sites and/or breeding colonies. This monitoring takes place in combination with the monitoring of the parameters M-1 (distributional range and pattern) and M-5 (pup production of grey seal). However, some MUs are monitored annually, whereas most UK and Norwegian harbour seal MUs are monitored every fifth year.

In the Wadden Sea, the monitoring and management under the Trilateral Monitoring and Assessment Programme and Wadden Sea Plan (Trilateral Seal Agreement; CMS) are well established over the last decades, and support the indicators and targets for harbour seals, and (although not under CMS) also the ones for grey seals. Similar work has also been ongoing in the UK over a similar time frame.

Monitoring methods: survey methods that yield abundance estimates per MU.

Monitoring frequency: different per MU, but at least once every five years.

8) Appropriateness of the indicator

Although no straightforward link exists between the abundance of seals and human activities, a number of human activities may lie at the basis of trends and changes in abundance. The monitoring of the indicator serves as to trigger the investigation of possible cause–effect relationships as a basis for measures. Changes due to epizootics might be important. For example, Phocine Distemper Virus (PDV) has caused past declines in European harbour seal populations, with the first and most significant outbreak in 1988 and the second in 2002. Also, there have been recent increases in the grey seal populations which could be having an impact on harbour seal distribution and abundance, whilst climate change may have important consequences for both species.

9) Reporting

Given that seals move between different sites depending on weather conditions and the season, possibly crossing national boundaries, agreements have to be made on monitoring and reporting in order to be able to make an assessment. The reporting frequency should be in line with the monitoring frequency.

As ICES have produced overviews of the abundance of seals at different EcoQO units in the past and have developed a seal database that holds the relevant data required for this assessment, it is suggested that ICES undertakes the assessments in the frame of the implementation of the MSFD.

10) Costs

Costs should be relatively low, given that seal haul-out and breeding sites are onshore. The monitoring should be combined with the monitoring for indicators M-1 (distributional range and pattern) and M-5 (grey seal pup production), and will serve in an assessment of M-6 (bycatch).

11) Further work

Future steps are similar for the indicators M-1 (distributional range and pattern) and M-5 (pup production).

- 11.1) Further development and agreement is needed on the MUs for each species.
- 11.2) Existing data for an agreed time period within each MU need to be compiled. The ICES seal database already contains much of the required data.
- 11.3) Baselines need to be set for each MU.
- 11.4) A standardized reporting method and frequency needs to be developed together with an assessment method; agreement is needed on which body will make the assessment.

Literature

OSPAR. 2009. Evaluation of the OSPAR system of Ecological Quality Objectives for the North Sea (update 2010). OSPAR Biodiversity Series, 406.

PART C: Technical specification of proposed common biodiversity indicators

Mammals

CODE	PREVIOUS CODE*	INDICATOR	CATEGORY
M-1	31&33	Distributional range and pattern of grey and harbour seal breeding and haul-out sites	Core
M-2	32&34	Distributional range and pattern of cetaceans species regularly present	Core
M-3	35	Abundance of grey and harbour seals at breeding and haul-out sites	Core
M-4	36	Abundance at the relevant temporal scale of cetacean species regularly present	Core
M-5	37	Grey seal pup production	Core
M-6	38&39	Numbers of individuals within species being bycaught in relation to population	Core

Draft OSPAR Common Indicators: marine mammals (M-4)

Abundance at the relevant temporal scale of cetacean species regularly present

1) Indicator

"Abundance, at the relevant temporal scale, of cetacean species regularly present".

The cetacean species for use as a core indicator under OSPAR are limited to the following continental shelf species:

- harbour porpoise
- bottlenose dolphin
- white-beaked dolphin
- minke whale
- common dolphin

Short-beaked common dolphins are considered representative of the wider European waters (i.e. both off and on the continental shelf). It should also be noted that bottlenose dolphins can be divided into three types. There are well known very small resident groups and slightly wider ranging coastal groups (possibly to be divided into different Management Units; MUs) and groups that are wide ranging both inshore and offshore, termed 'oceanic'.

2) Reasoning for the development of this indicator

Marine mammals, including cetaceans, are top predators, and comprise an important part of biodiversity (Descriptor 1). As cetaceans are taken up under the Habitats Directive (Annex IV), their abundance comprises a key aspect for securing and achieving GES according to the MSFD. However, as it is not feasible to monitor all cetaceans, which include uncommon, widely dispersed and oceanic species, the indicator is limited to the population size in the different MUs of a number of shelf species for which objectives were set or measures proposed in the framework of OSPAR, ASCOBANS, EC fishery regulations and the Habitats Directive (Annex II).

The monitoring and assessment of the indicator is partly in place, with monitoring already required under the Habitats Directive and fisheries legislation (Regulation 812/2004 and Data Collection Regulation).

Number of CPs reporting/using the indicator (n=9): 8

Consensus among CPs on usefulness as part of a region wide set (n=8): 8

3) Parameter/metric

"Abundance of cetacean species regularly present at the relevant temporal and spatial scale".

The same monitoring used to assess changes in cetacean abundance will be used to assess changes in distribution. An assessment of abundance, including trends over time, is required as part of the Favourable Conservation Status (FSC) assessments for the Habitats Directive[3].

4) Baseline and reference level

Although the baseline should derive from historical (i.e. pre-1900) data, these are not available at the appropriate spatial and temporal scale. Moreover, the historical abundance of many cetacean species is unknown and cannot realistically be restored (where it is known to have declined) as today's marine environment is very different. Climatic changes may have important consequences. A modern baseline has to be utilized for the species considered, such as that provided through the SCANS/CODA surveys, or less widely ranging surveys for inshore populations of bottlenose dolphins. However, such surveys usually result in data with wide confidence values, and may not have the power to statistically demonstrate changes or trends, Therefore, abundance data should always be put against any available data on distributional changes, causes of death in stranded animals, and possible links with human activities.

Reference/baseline levels for each MU:

- Harbour porpoise: can be derived from large-scale surveys (SCANS);
- Common dolphin: can be derived from large-scale surveys (SCANS, CODA);
- White-beaked dolphin: can be derived from large-scale surveys (SCANS);
- Bottlenose dolphin (resident and coastal groups): can be derived from mostly long-term local/regional surveys;
- Bottlenose dolphin (wider ranging oceanic group): can be derived from large-scale surveys (SCANS, CODA);
- Minke whale: can be taken from the regular surveys undertaken by Norway and Iceland, with additional information from large-scale surveys (SCANS, CODA, TNASS); IWC undertakes regular assessments.

5) Target setting

[3] In the 2007 FCS assessments, this was undertaken on a country by country basis which led to an unsatisfactory standard of assessment at the European North Atlantic scale (ICES, 2009). For the 2013 FCS assessments, a greater emphasis has been placed on the need for a transboundary approach (European Commission, 2011), although this is unlikely to occur.

A general target for all species is: "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".

For resident and coastal groups of bottlenose dolphins it could be further refined to: "*Maintenance of the current levels of the populations where stable, and where feasible and relevant, an increase in numbers*". A recovery in areas where it was known to occur up to the 20th century might not be realistic in the short or medium term, given the life-history parameters of bottlenose dolphins, with a slow reproduction. However, as several of the estuaries they occupied in the past are now much cleaner than they were, and fish are returning to them (e.g. Thames and Clyde estuaries), it is possible that they return to colonize these areas in future.

6) Spatial scope

The geographical scope of the indicator is species dependent. With the exception of some resident and coastal bottlenose dolphin groups, cetacean populations cover large spatial scales often extending beyond European North Atlantic waters for example. Assessments therefore need to be undertaken at an appropriate scale. A good understanding of natural variability and patterns of movement is required prior to any decline or increase in population size being detected and links made with anthropogenic activities. MUs for cetacean species, also to be used in indicator M-2 (distributional range and pattern) and M-6 (bycatch) assessments, have been defined by ASCOBANS (Evans and Teilmann, 2009) and further reviewed by ICES (2012), and are further adapted by ICES (2013) to, where possible, take account of well-known ICES block boundaries, specifically for bycatch assessment. MUs for all relevant species are proposed in Appendix 1.

7) Monitoring requirements

The abundance of cetaceans can be monitored using a variety of techniques. Because of the scale required for assessments, a transboundary approach to the techniques used, and the collection, collation and analysis of data will be required. Also strandings data can be useful as a supplementary measure to assess trends in the distribution and abundance of cetaceans[4], and are indispensable for identifying possible underlying reasons for changes or trends.

The objective of the monitoring should be to detect trends, in particular negative ones, in the abundance of cetacean populations due to human pressures. As cetacean monitoring is costly, the frequency at which data should be collected shall depend on the species monitored; it can be yearly and with a high resolution for

[4] Strandings data represent to date the most extensive and long-term source of demographic data for a number of cetacean populations (at least in areas where strandings occur). Although they cannot yield a figure for abundance, they can be interpreted to provide for a relative indication of local and temporal variations in coastal presence. Strandings data are currently clearly underexploited and rarely analysed at an international level. They could potentially yield useful information about trends in the distribution and local changes in relative occurrence of cetaceans. In addition, the investigation of stranded cetaceans can yield information on a number of life-history parameters, and on causes of death, and therefore provide some indications about human pressures.

species with a limited range (e.g. resident and coastal bottlenose dolphin groups) up to decadal and with a coarse resolution for species widely distributed offshore. Monitoring is undertaken through a variety of approaches and involving many different organizations. There have been large-scale international surveys such as SCANS and CODA, national surveys that occur in the waters of some Member States on an annual or tri-annual basis and, at a more localized scale, various surveys undertaken by the state, academic institutions and/or non-governmental organizations[5]. For the monitoring of this indicator, a coordinated combination of these types of survey will be required.

Since part of the monitoring is used to set baselines against which to set bycatch limits or trends, boundaries for MUs were defined[6], where possible taking account of well-known ICES block boundaries.

Monitoring methods and frequency for:

- Harbour porpoise: aerial- and ship-based surveys; large-scale surveys every five to ten years, but more localized surveys more frequently;
- Common dolphin: aerial- and ship-based surveys; large-scale surveys every five to ten years;
- White-beaked dolphin: together with large-scale surveys for harbour porpoise;
- Bottlenose dolphin (resident and coastal groups): yearly surveys, land-, ship-based and aerial surveys, photo-identification surveys;

[5] A mechanism, the Joint Cetacean Protocol, is being developed that can bring these disparate datasets together at the NW European Atlantic scale (JCP, Paxton *et al.*, 2011, see http://jncc.defra.gov.uk/page 5657). Effort-related cetacean sightings data from all major data sources are included e.g. SCANS I and II, CODA, European Seabirds at Sea (ESAS), SeaWatch Foundation (SWF) and other non-governmental organisations, as well as industry (e.g. in relation to potential renewable energy installations in UK waters). These data, collected between 1979 and 2010, represent the largest NW European cetacean sightings resource ever collated. It is recognised, however, that there are some significant datasets missing such as the annual national monitoring undertaken by some States. It is expected that the JCP will deliver information on the distribution, relative abundance and population trends of the more regularly occurring cetacean species occurring in NW European waters. A preliminary phase of the project, covering the Irish Sea and west coast of Scotland, was recently been completed (Paxton *et al.*, 2011). This work was used to refine the modelling techniques that had been developed in earlier projects (Thomas, 2009; Paxton and Thomas, 2010; Paxton *et al.*, 2011). A final analysis of northwest European waters will be published in 2013.

[6] Information on defining such boundaries has been collected by among others ICES WGMME, ASCOBANS, OSPAR and Helcom. ASCOBANS (2009) held a workshop of specialists to focus upon defining Management Units for the regular small cetacean species. ICES WGMME (2012) has also made an overview of, and advised on, appropriate boundaries for harbour porpoise, common dolphin, bottlenose dolphin (including inshore and offshore populations), white-beaked dolphin, white-sided dolphin and minke whale. These were further updated in 2013.

- Bottlenose dolphin (wider ranging ‘oceanic’ group): together with monitoring of common dolphins;
- Minke whale: dedicated surveys by Norway and Iceland every year (different survey blocks), with additional information from large-scale surveys for small cetaceans.

8) Appropriateness of the indicator

There is usually no straightforward link between the abundance of cetaceans and human activities. There are multiple pressures, and climate change is an additional factor influencing abundance and distribution. However, as top predators and being charismatic animals of general public concern, changes in distribution and abundance are important, and should be assessed against changes in human activities and climate change to detect cause–effect relationships, where necessary followed by the appropriate measures.

9) Reporting

Given that populations have a transboundary distribution (except for the resident and most coastal bottlenose dolphins groups), agreements have to be made on monitoring frequency. The reporting frequency should follow the monitoring frequency, and the assessment for most species should be made every six years. For the small cetaceans it is proposed that ICES makes the assessment, while for the minke whale a regular assessment of the Northeast Atlantic population is made by the IWC.

10) Costs

Cetacean monitoring can range from fairly cheap (monitoring of an inshore population with a limited range) to very expensive (monitoring of an offshore population distributed over a large area). Part of the monitoring is in place (in a combination of indicator M-2, M-4 and M-6), while new resources are needed, e.g. for annual surveillance and large-scale decadal surveys (see also indicator M-2).

11) Further work

Work has begun on several subjects, but further work and/or agreement is needed:

11.1) A compilation of existing data on abundance[7].;

11.2) An agreement on definitions for MUs; a proposal is made in appendix 1;

11.3) The development of a baseline for each species in each MU;

11.4) The development of a standardized monitoring methodology, or alternatively 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 standardization;

[7] This has already begun through the JCP, but it is recognised that a number of significant national datasets are missing. International agreement will be required to determine whether this is the best mechanism for generating transboundary assessments.

11.5) For small cetaceans, the development of an assessment tool and agreement on the body that makes the assessment.

Literature

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PART C: Technical specification of proposed common biodiversity indicators

Mammals

Code	Previous code*	Indicator	Category
M-1	31&33	Distributional range and pattern of grey and harbour seal breeding and haul-out sites	Core
M-2	32&34	Distributional range and pattern of cetaceans species regularly present	Core
M-3	35	Abundance of grey and harbour seals at breeding and haul-out sites	Core
M-4	36	Abundance at the relevant temporal scale of cetacean species regularly present	Core
M-5	37	Grey seal pup production	Core
M-6	38&39	Numbers of individuals within species being bycaught in relation to population	Core

Draft OSPAR Common Indicators: marine mammals (M-5)

Grey seal pup production

General remark by ICES: harbour seal pup production in most areas is very difficult to monitor, and in practice is only undertaken regularly in the Wadden Sea area. Although ICES acknowledges the value of such monitoring, the proposed indicator cannot be considered as a *common* indicator for harbour seal because then it should tentatively be monitored at every MU, which is not possible. Therefore ICES advises to only use grey seal pup production as a common indicator in the implementation of the MSFD. If this would be accepted, the text below should be further adapted where appropriate.

1) Indicator

"Pup production of [harbour seal and] grey seal".

2) Reasoning for the development of this indicator

Marine mammals, including harbour and grey seals, are top predators, and comprise an important part of biodiversity (Descriptor 1). As harbour and grey seal are taken up under the Habitats Directive (annex II), their population condition comprises a key aspect for securing and achieving GES according to the MSFD.

Grey seals form breeding aggregations at traditional, remote colonies, with females often returning to the same location on a particular breeding site to give birth to their single pup. In addition, some females exhibit philopatry, i.e. returning to breed at their natal site. It is for these reasons that at some locations grey seal population estimates are based on pup production counts. In contrast, harbour seals do not aggregate into discrete colonies to breed. The females appear to move away from larger groups to give birth and raise their new-born pups in very small groups, returning to form larger groups when the pup is sufficiently old. The dispersed nature of the breeding groups and the fact that pups are able to swim within hours of birth contrive to make estimating pup production of harbour seals extremely difficult in most areas. It is for this reason that population estimates for harbour seals are undertaken during their annual moult when groups tend to be larger than at other times of the year.

Number of CPs reporting/using the indicator (n=9): 7

Consensus among CPs on usefulness as part of a region wide set (n=8): 7

3) Parameter/metric

"[Harbour seal and] grey seal pup production in each Management Unit" An existing OSPAR EcoQO encompasses grey seal pup production (as an indicator for health status of the population, while at the same time it is scaled up to provide abundance estimates), and the monitoring for this indicator would also yield the necessary information for indicator M-1 (distributional range and pattern), M-3 (abundance) and M-6 (bycatch).

4) Baseline and reference level

Although the baseline should derive from historical data, these are not available everywhere. Moreover, the historical distributional range of breeding sites nor historical pup production is a situation that cannot realistically be restored, given for instance coastal developments and tourism, and climatic changes may have important consequences. It is therefore likely that a modern baseline will have to be utilized, such as average pup production in the last decade per MU.

5) Target setting

The target is "No statistically significant long-term average decline of ≥10% in pup production estimates at each Management Unit".

While an existing OSPAR EcoQO deals with grey seal pup production, there is not an equivalent to harbour seal pup production due to the difficulties of undertaking such work. Where harbour seals breed on sandbanks (e.g. Wadden Sea) pup counts are regularly undertaken. However, where they breed on remote, rocky shores it is not possible to undertake such counts.

6) Spatial scope

For monitoring the EcoQO's on seals, the North Sea has been subdivided into different monitoring areas which vary between the two species. A subdivision of the European populations into MUs should be made for the whole range of both species, with indications of current and former abundance (or alternatively a favourable reference situation). WGMME (2012) reviewed the EcoQO divisions and WGMME (2013) began to define MUs for seals. However, further work is required to complete the proposals. While population estimates are made at the MU level through combining site level estimates, movements between MUs need to be taken into account.

7) Monitoring requirements

The monitoring required takes place in combination with the monitoring for the indicators M-1 (distributional range and pattern) and M-3 (abundance). There is sufficient monitoring at grey seal breeding sites. In contrast, for harbour seals, it will not be possible to cover all MUs, as it is much more difficult to count harbour seal pups particularly on rocky breeding sites. Harbour seal counts are undertaken during the breeding season in the Wadden Sea and limited rocky shore areas such as the Kalmarsund in Sweden. In the UK pup production estimates for harbour seals are only monitored at two sites where the seals breed on sandbanks

(Moray Firth and from the east coast of England between the Humber Estuary and Blakeney Point, covering the Wash). In the Wadden Sea, the monitoring and management under the Trilateral Monitoring and Assessment Programme and Wadden Sea Plan (Trilateral Seal Agreement; CMS) are well established since a few decades, and support the indicators and targets for harbour seals, and (although not under CMS) also the ones for grey seals. Until relatively recently, in the UK, grey seal pup production counts are undertaken annually, while nowadays they are undertaken every two years. Regular monitoring has still to be implemented in some areas.

8) Appropriateness of the indicator

There is usually no straightforward link between a human activity and pup production. There are multiple pressures, such as disturbance, coastal engineering works and pollution, possibly affecting pup production, or causing spatial shifts of pup production over time. However, changes and trends are important to detect cause–effect relationships between pup production and a certain human activity, where necessary to be followed by appropriate measures.

9) Reporting

Given that seals move between different sites depending on weather conditions and the season, possibly crossing national boundaries, agreements have to be made on monitoring and reporting in order to be able to make an assessment. The reporting frequency should be in line with the monitoring frequency.

As ICES have produced overviews of the grey seal pup production for the different EcoQO units in the past and have developed a seal database that holds the relevant data required for this assessment, it is suggested that ICES would undertake the assessments in the frame of the implementation of the MSFD.

10) Costs

As the monitoring is coastal in nature, costs are limited; the monitoring can be combined with the monitoring for the indicators M-1 (distributional range and pattern) and M-3 (abundance).

11) Further work

Future steps are similar for the indicators M-1 (distributional range and pattern) and M-3 (abundance).

- 11.1) Compilation of existing data on pup counts and production estimates;
- 11.2) Further development and agreement is needed on the MUs for each species;
- 11.3) Development of a baseline for each MU (where possible);
- 11.4) A standardized reporting method and frequency needs to be developed together with an assessment method; agreement is needed on which body will make the assessment.

Literature

OSPAR. 2009. Evaluation of the OSPAR system of Ecological Quality Objectives for the North Sea (update 2010). OSPAR Biodiversity Series, 406.

PART C: Technical specification of proposed common biodiversity indicators

Mammals

Code	Previous code*	Indicator	Category
M-1	31&33	Distributional range and pattern of grey and harbour seal breeding and haul-out sites	Core
M-2	32&34	Distributional range and pattern of cetaceans species regularly present	Core
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M-4	36	Abundance at the relevant temporal scale of cetacean species regularly present	Core
M-5	37	Grey seal pup production	Core
M-6	38&39	Numbers of individuals within species being bycaught in relation to population	Core

Draft OSPAR Common Indicators: marine mammals (M-6)

Mortality of seals and cetaceans due to bycatch

1) Indicator

The indicator is "mortality due to bycatch".

2) Reasoning for the development of this indicator

Marine mammals are usually slowly reproducing, and a high human-induced mortality, on top of natural mortality, can have serious and long-term implications for the population. An important source of human induced mortality that can be singled out is bycatch in fishing gear. While the number of animals bycaught is clearly pressure related, there is a link with a state of the population (population size–indicators M-3 and M-4).

For cetaceans, the Habitats Directive requires that incidental capture or killing is monitored, and that it should not have a significant negative impact on the species. Therefore the setting of limits for bycatch of cetaceans can be considered as a key aspect in achieving GES according to the MSFD. It has been agreed that bycatch targets can also be set for pinnipeds, as bycatch also occurs in these marine mammals. As the maximum population growth rates differ in marine mammals, different targets will be needed. Given the high mobility of marine mammals, and the distributional range of populations, assessments will necessarily need to be made on a wide scale (population range or Management Units; MUs). Difficulties exist in both measuring bycatch and population size in a sufficiently high degree of accuracy to draw conclusions, and in combining data originating from different regions for an overall assessment of GES.

Number of CPs reporting/using the indicator (n=9): 7

Consensus among CPs on usefulness as part of a region wide set (n=8): 7

3) Parameter/metric

"Numbers of individuals being bycaught in relation to population size estimates", determined separately for each MU. These MUs will vary between species.

4) Baseline and reference level

Although some historical bycatch estimates exist, the current levels of bycatch in relation to the population estimates (baseline), or alternatively a trend-based target can be used.

5) Target setting

The target "The annual bycatch rate of [marine mammal species] is reduced to below levels that are expected to allow conservation objectives to be met" may require different approaches for different species. Although bycatch occurs in a wide range of species, it should only be specifically assessed for those species for which there is sufficient data. Suggested species are harbour seal, grey seal, harbour porpoise and short beaked common dolphin. However, noting the occurrence of bycatch in other species may be useful information when assessing the factors possibly affecting the abundance and distribution (considered in M-2 and M-4). Although some targets have been proposed and accepted, a review of these is currently being made. New targets will be proposed for each relevant species and for each relevant MU.

The harbour porpoise bycatch limit reference point of 1.7% is derived from work undertaken by a working group convened by the International Whaling Commission and ASCOBANS (IWC, 2000). This has subsequently become the standard target or level above which bycatch is considered to be unsustainable. However, there has been much debate about the use of a simple fraction of the best population estimate. A very simple deterministic population dynamics model was used, which assumed a "biological" population with independent population dynamics. If this management target is to be applied to management regions for the harbour porpoise, the animals living in the areas defined by these regions are assumed to have more or less independent dynamics (which is clearly not the case in the European North Atlantic). Where the population dynamics are not independent, the management targets calculated on the basis of biological populations are unlikely to be appropriate. An alternative to such an approach is the bycatch management procedures developed under the SCANS-II and CODA projects (Winship, 2009).

In 2009, ICES advised the European Commission 'that a Catch Limit Algorithm approach is the most appropriate method to set limits on the bycatch of harbour porpoises or common dolphins. In order to use this (or any other) approach, specific conservation objectives must first be specified. In both species improved information on bycatch and the biology of the species would improve the procedure'. In 2010, ICES again advised the European Commission that 'ICES advised in 2009 of the need for explicit conservation and management objectives for managing interactions between fisheries and marine mammal populations. This advice has not been acted upon. Lacking these objectives, ICES is unable to properly consider the impacts of these interactions in its management advice'. WGMME (2013) noted again that this advice still had not been acted upon and, to aid such decisions, suggested that ASCOBANS be asked to consider the policy decisions required for the setting of safe bycatch limits.

An alternative for the parameter (bycatch as a proportion of the population size) is the use of the current bycatch numbers as the baseline and aim for it to be reduced in future years. This would mean that no information is required on the population size, but have the significant disadvantage that there is no link with the population state. Using such an approach, GES could only be considered to have been achieved when there was no longer any bycatch.

6) Spatial scope

MUs for the relevant cetaceans, also to be used in indicator M-2 and M-4 (distribution and abundance) assessments, are proposed in Appendix 1. They are, where possible, delimitated using the borders of ICES blocks as recommended by WGMME (2012) and WGBYC (2012). Seal MUs still need to be clearly defined.

7) Monitoring requirements

In 2008, the ICES Working Group on Marine Mammal Ecology tried to evaluate progress to date with the harbour porpoise bycatch EcoQO on a North Sea wide basis (WGMME, 2008). It was quickly apparent that many of the fisheries suspected to have the highest bycatch levels are conducted without bycatch observer programmes as these are not a requirement of Regulation 812/2004. Subsequently, the ICES Working Group on Bycatch of Protected Species has tried to evaluate the impact of fisheries bycatch annually.

Extrapolated estimates of total bycatch in EU waters in 2009 (based on EC/812/2004 national reports) were available for striped dolphins (about 870), for common dolphins (around 1500), for bottlenose dolphins (ten) and for harbour porpoises (about 1100; WGBYC, 2011). It is clear that these totals provide only a very patchy overview of total cetacean bycatches within European waters due to low and uneven sampling coverage (WGBYC, 2011). Reductions in bycatch should be considered as a target that will contribute to GES, but it is currently not possible to evaluate whether the indicator will provide an accurate assessment of GES. However, data collation techniques are continually improving and coverage of the relevant fisheries sectors has been increasing.

Problems in monitoring are the scale of assessment (marine mammal population distributions are wider than national waters), the different methodologies used and the different standards. In some Member States, bycatch occurs in the recreational or part-time fishery sector, which is considerably harder to monitor.

As part of their national developments of MSFD indicators and targets, the UK is following ICES advice and has started work on the use of management frameworks for determining safe limits to bycatch for harbour porpoise, short-beaked common dolphin, bottlenose dolphin, harbour seal and grey seal. This work, however, is not being restricted to national waters.

A source of information, currently underexploited, are strandings. These not only provide demographic data for cetacean populations, but can also be used to detect changes in the causes of death within some degree of confidence, certainly with species for which sufficient numbers wash ashore (WGBYC, 2012; WGMME, 2012). Although absolute estimates should be treated with caution, trends are likely to be informative, and a good coverage and a standardized methodology are needed.

8) Appropriateness of the indicator

Bycatch is considered as one of the major anthropogenic threats to marine mammals. It is easy to understand and quantify (although the methods for quantification are not straightforward), and there is a clear link with human activities (different fishing métiers). The target set should indicate the level at which, in the absence of other important human-induced threats, conservation objectives will be met.

9) Reporting

The proposed target means that knowledge is required both on bycatch and on the population size, both spatially and temporally, and within appropriate confidence values. This poses problems, as has been demonstrated by WGBYC (2010). With the available data on bycatch of harbour porpoises it was not possible to conclude whether or not the set target had been met during the most recent years. Estimates of bycatch were made on the basis of the number of fishing days per fisherman, the landings in relevant fisheries, and on-board observer schemes. Currently, observer schemes are not required in all relevant fisheries according to the fisheries legislation. There is an obligation under the Habitats Directive to monitor bycatch, but it has to date not been enforced by the European Commission, and obligations also exist under the Common Fisheries Policy.

It is proposed that reporting follows the monitoring, and that the assessment of the bycatch of seals and small cetaceans is undertaken by ICES at least every six years. WGBYC have developed a database of bycatch based on national reports which contains the relevant information from which to make such assessments.

10) Costs

Both monitoring marine mammal abundance (indicators M-3 and M-4) and bycatch rates can be expensive, especially where a high coverage of fisheries through independent observers on board is required. Cheaper methods exist, such as the use of camera systems on board, or a voluntary reporting scheme by fishermen.

11) Further work

There is clearly a lack of information on aspects of this indicator, although information is slowly improving. Concerning the population sizes of the marine mammals, and the assessment scale, the lack of information and proposed future steps are described in the summaries of the indicators M-3 and M-4 (abundance). Concerning bycatch, the following aspects should be further developed through linkages with appropriate fora:

- 11.1) Agreement on the MUs against which to set the targets; a proposal for cetaceans is included in Appendix 1;
- 11.2) Development of safe bycatch limits for each species and MU;
- 11.3) A standardized reporting method and frequency needs to be developed, together with an assessment tool. Agreement is needed on which body will make the assessment, although it is suggested that this should be progressed through ICES;
- 11.4) Investigation of the use of stranded animals to derive information on trends in causes of mortality.

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Appendix 1: Management units

WGMME (2013) recommended that Member States use the following management units for reporting requirements of the Habitats Directive and for the development of indicators and their assessment for the Marine Strategy Framework Directive. Where possible, existing ICES block delimitations were used as borders between MUs.

There is a single MU in the European North Atlantic for common dolphin (*Delphinus delphis*), white-beaked dolphin (*Lagenorhynchus albirostris*), white-sided dolphin (*Lagenorhynchus acutus*), striped dolphin (*Stenella coeruleoalba*) and minke whale (*Balaenoptera acutorostrata*).

For harbour porpoise (*Phocoena phocoena*), MUs are proposed for the Iberian Peninsula, Celtic Sea, Irish Seas, West Scotland/NW Ireland, the North Sea and Inner Danish Waters (Figure 1). More than one MU in the North Sea for harbour porpoise should be explored in ongoing work to develop management models for setting safe limits to bycatch.

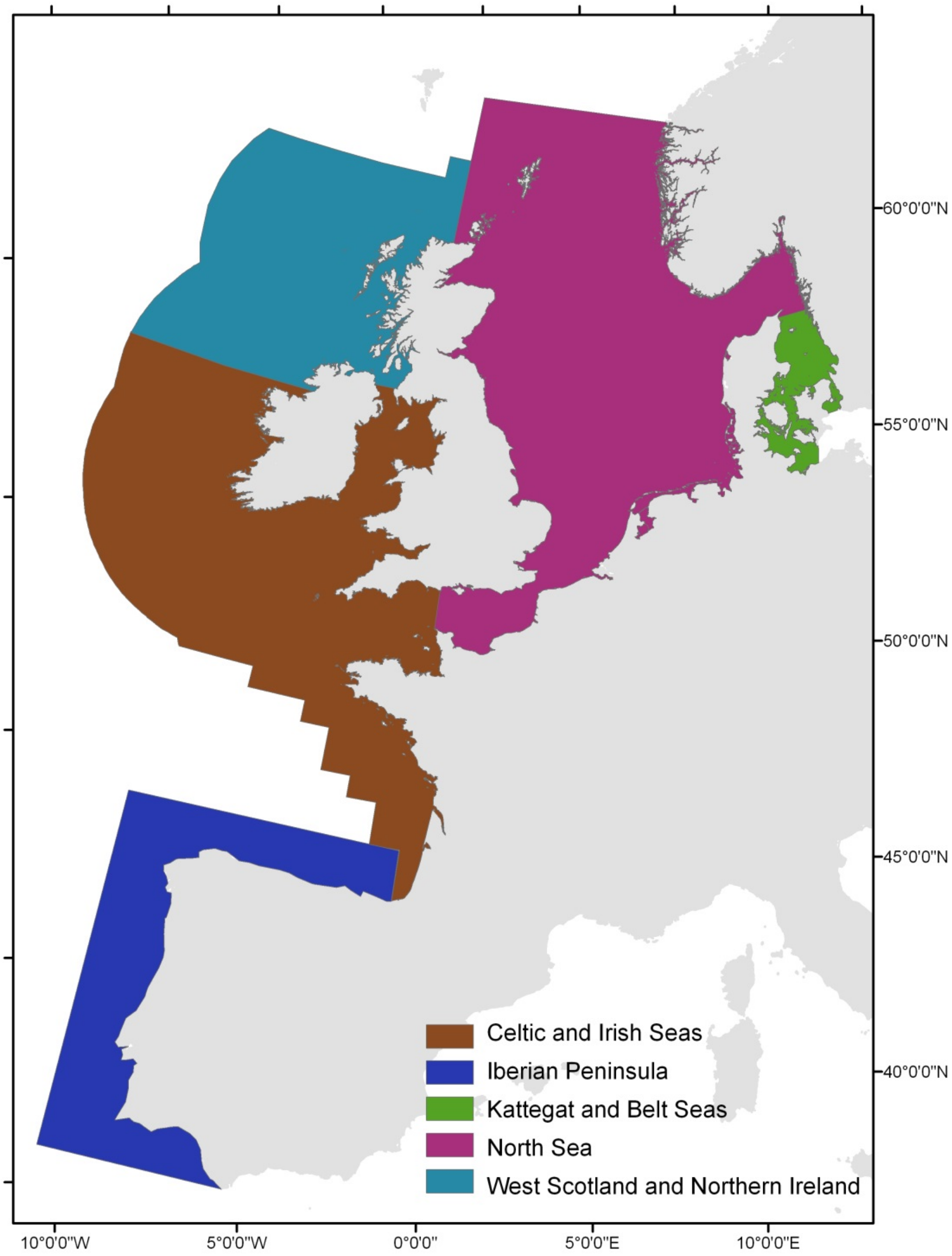

Figure 1. Harbour porpoise management units.

Bottlenose dolphins have a complex population structure, with three types being recognized: very small residential groups, slightly wider ranging resident coastal groups and the oceanic group. The following Management Units are proposed (given from north to south; Figure 2):

- Resident groups: Barra (Scotland; although for management purposes this group is included within the wider Scottish west coast group); Shannon Estuary (Ireland); Ile de Sein (France) Archipel de Molene (France); southern Galician Rias (NW Spain); Sado Estuary (Portugal);

- Coastal groups: west of coast Scotland (UK); east coast of Scotland (UK); Irish Sea (Ireland and UK); Connemara–Mayo (northern and west coasts of Ireland); the English Channel/Celtic Sea (Ireland, UK and France); north coast of Spain; coast of Portugal (except for the Sado Estuary); the Azores (Portugal), Gulf of Cadiz (south coast of Spain) and Strait of Gibraltar (south coast of Spain);
- Oceanic waters: a single MU for all continental shelf/slopes/oceanic waters outside 12 nm from the coast. It should be noted that although a separate MU is 'designated' for the North Sea (represented by ICES Area IV, excluding coastal east Scotland), there are very few bottlenose dolphin are seen in this area. Although there is no conclusive evidence, those seen are thought to belong to the East Scottish coastal group.

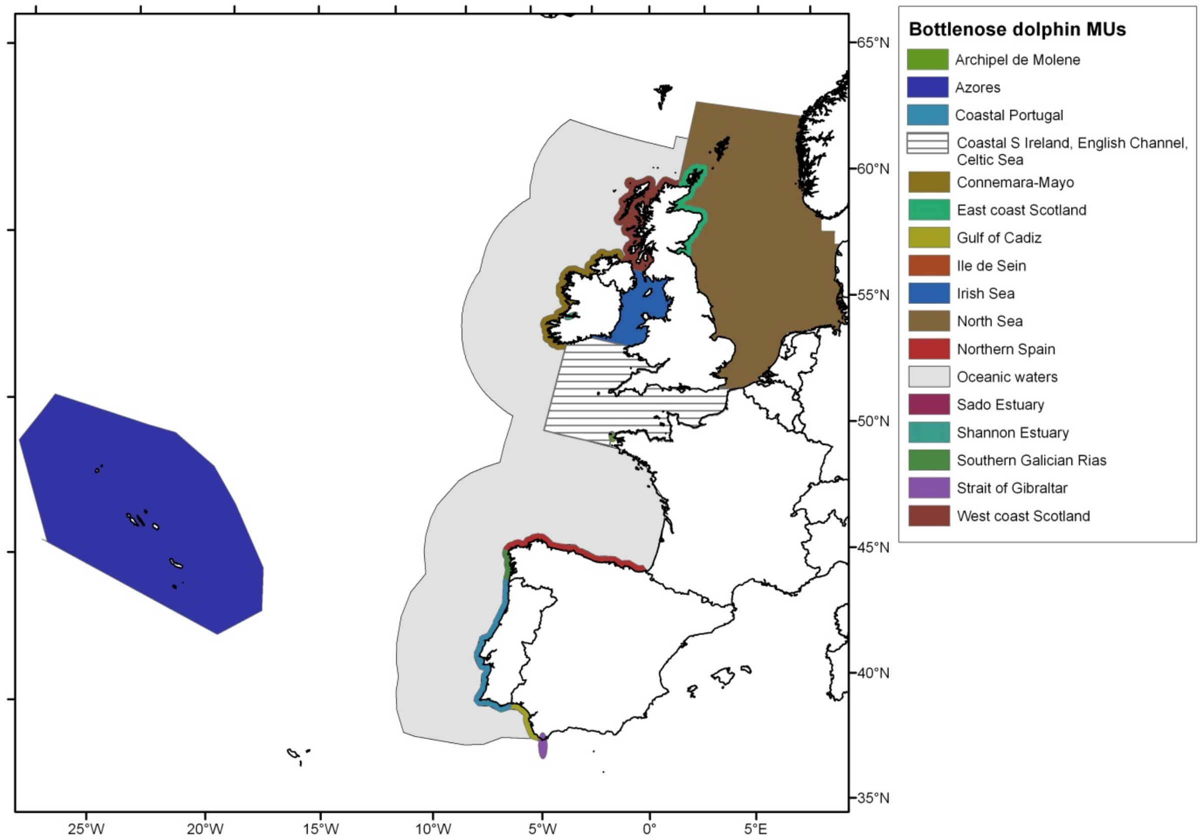

Figure 2. Bottlenose dolphin management units.

Annex 4: Feedback on renewables-relevant monitoring around wind/wave/tidal projects in ICES waters

This annex provides a brief description of studies related to marine renewable energy devices focusing on Germany, the United Kingdom, Belgium and the Netherlands. For each country, an overview of site- and device-specific impact studies, generic research and mitigation studies, supported by one or more of the monitoring drivers identified above is presented. Drivers are organized on the basis of whether they relate to specific sites and/or developments, or whether they fill a more generic research need.

Germany

Site and device specific impact studies and research are conducted in relation to offshore windfarms, but to date there are no monitoring and research programs in relation to other marine renewables. Most of the studies conducted in Germany are either focused on the building phase (including noise mitigation during pile-driving), on studies that are directly aimed at identifying impacts at the population level (still to be funded) or that aim to better describe the effect on animals (stress, startle response, noise influences).

Site and device specific impact studies

Site characterization

During the baseline period of the StUk 3 'Monitoring' the industry is required to conduct baseline surveys which are to target the 'Stock inventory of marine mammals in the assessment area in order to assess the ecological importance of the project area for marine mammals' (BSH, 2007). This consists of 12 aerial surveys per year. If combined with bird surveys then six additional cetacean-focused flights at regular altitude of 600 feet are required. In areas of high sea duck abundance combined surveys are not permitted. There is the requirement to record at least two consecutive seasonal cycles as baseline data. Line transect methods (Buckland *et al.*, 2001) are mandatory. Ship surveys are required for seabirds, but not mandatory for marine mammals. Data from 26 projects have been recorded. The baseline data acquisition was supposed to also encompass the deployment of three C-PODs™ per site, but this was changed after multiple heavy losses to a concept of POD-stations throughout the North Sea to keep positions constant independent of site-specific monitoring and to reduce the number of necessary stations by the BSH (Federal Maritime and Hydrographic Agency). Furthermore it has been suggested by Federal Agencies, researchers and consultancies that a more general framework for the StUK3-monitoring program is also needed to fill knowledge gaps instead of conducting multiple aerial surveys for different construction sites in areas possibly overlapping with each other, resulting in studying a small area in great detail without gaining knowledge of more general trends. This shift will result in aerial surveys in a coordinated framework and the deployment of C-PODs over long time periods at the same positions for acquisition of baseline data, monitoring any effects with additional C-PODs, and followed by long-term monitoring of the operational phase.

Impact magnitude assessment

Monitoring reports from two projects during construction phase and/or operation are finished (Alpha Ventus, Diederichs *et al.*, 2010; Siebert *et al.*, 2012) and Bard Offshore I (not publicly available). Aerial surveys were conducted (approximately six survey days per year for marine mammals only, and ten combined seabird and marine mammal survey flights). C-PODs were deployed ten months before start of pile driving for the transformer platform of Alpha Ventus, throughout the construction period (Diederichs *et al.*, 2010) and monitoring is supposed to continue until at least three years after commissioning are reached. The second windfarm BARD Offshore is still being built at the present time. During the construction of Alpha Ventus 12 T-PODs were deployed for the StUK 3-Monitoring program as well as 12 C-PODs for a research program to evaluate the efficacy of the current StUK-program (Diederichs *et al.*, 2010; Siebert *et al.*, 2012). Noise monitoring has been conducted on some of the foundations (Betke and Matuschek, 2011).

Generic research

Impact parameter quantification

Within the StUK 3 programme noise was monitored parallel with monitoring the presence of marine mammals. In the additional project StUKplus the current StUK 3 is currently being evaluated, and work is ongoing using C-PODs™, aerial surveys and ship-based (visual + passive acoustic) surveys. Another goal of StUKplus is building a national database from visual surveys and passive acoustic (T- and C-POD™) monitoring data. Studies on pile-driving noise will focus on sound propagation modelling, especially for the interaction of pile-driver – pile – water and the sediment. These studies will be supplemented by measured data on test piles equipped with multiple sensors to measure the pressure and particle velocity field close to the pile as well as the compression wave within the pile. Studies are also aimed at investigating sediment transmission of sound that is thought to play a major role in noise mitigation systems, as current work on noise mitigation measures suggests that noise mitigation systems working close to the pile can only attenuate the sound energy that is propagated through the water column, but not that transmitted through sediment.

Impact mechanism understanding

Within the project "Effects of underwater noise on marine vertebrates" (Cluster 7, Federal Agency for the Environment), several projects are being carried out to understand the mechanisms how anthropogenic noise might affect marine mammals. One project focuses on the validation of the Temporary Threshold Shift (TTS) limit for impulsive sounds on wild porpoises incidentally caught in Danish poundnets, as described by Lucke *et al.* (2009). Together with this research stress hormones from blood and blow samples are evaluated. A second project has provided first non-invasive estimates of grey seal hearing abilities (in air) using in-ear headphones. A third part of the project (carried out by DMU, Denmark) considers the development and evaluation of the acoustic tags (improved versions of the D-TAG™) to record the behaviour of harbour porpoises in relation to actual noise simultaneously measured with the tag.

Habitat ecology

Long-term simultaneous monitoring of low frequency sounds (using AMAR™ [JASCO, Canada] and DSG™ [Loggerhead Instruments, USA]) and harbour porpoise detection rates (C-PODs™) and abundance (Aerial surveys) in high density and breeding area Sylt Outer Reef was suggested by the University of Veterinary Medicine in Hannover as one project to evaluate the underlying ecological condition influencing harbour porpoise distribution and seasonal migration using ecological modelling. Funding was applied for, but has not been granted yet. However research should begin this year, as several windfarms are going to be built within this year in close surroundings and this provides the best opportunity to collect the necessary data.

Population assessment

Monitoring is carried out for population assessment under Natura 2000 legislation (Gilles *et al.*, in prep) and covered the whole German North Sea in 2012 (Spring/Summer/Fall). Additional surveys are carried out in the SCIs Sylt Outer Reef during summer and Borkum Reef Ground in Spring. In a coordinated monitoring approach the entire Dogger Bank (including all areas concerned of the Netherlands, United Kingdom, Denmark and Germany) was surveyed in 2011 (Gilles *et al.*, 2011). For the Baltic four aerial surveys have been carried out in German and Danish waters of the Kiel and Mecklenburg Bights in 2011 and 2012 (May, July, September/October). For the areas east of the Mecklenburg Bight monitoring is carried out using T- and C-PODs™ on 12 positions (Gallus *et al.*, 2011). Additional positions are kept operational for the SAMBAH-project (www.sambah.org) within this low density area of the critically endangered Baltic harbour porpoise population (Gallus *et al.*, 2011).

Mitigation experiments

Studies are currently being undertaken considering two approaches to mitigation: reducing the number of animals within a potentially harmful area and reducing the emitted sound during pile-driving operations. The emitted Sound Exposure Levels (SELs) are required to stay below 160 dB re μPa²s within 750 m (the potentially harmful exposure distance) of the pile by the permitting Federal Maritime and Hydrographic Agency. The first approach focuses on testing the efficacy of acoustic deterrents, like Seal Scarers for harbour porpoises. Research was focused to measure the radius of avoidance for harbour porpoises with C-PODs™. This radius may extent to 7.5 km according to Brandt *et al.* (2012). Measurements were conducted around Sylt Outer Reef and as a case study off the coast of Denmark. The second approach is research on different types of sound attenuation methods, driven by the German permit obligation of reducing the SEL to 160 dB re μPa²s at 750 m from the sound source. Multiple devices were tested in a round robin test in the Baltic Sea at a pre-existing pile (Wilke *et al.*, 2012). Those devices were Hydro Sound Dampers™, a system of fixed air filled bodies within a fishing net around the pile (Technical University Braunschweig and Karl-Heinz Elmer), small bubble curtains in a stacked system to avoid influences by heavy tidal currents (Weyres Little Bubble Curtain™ (LBC)), two alternative sheathing systems (Weyres BEKA-Schale and IHC Noise Mitigation Screen (NMS)) and a firehose system developed by Menck (Germany). All systems performed below expectations, most probably not due to their abilities to attenuate noise, but due to the properties of the test pile which was already embedded in the sediment at 65 m prior to the test. Hence sediment conduction played a major role within this experiment and could have negatively biased the result. A second large-scale test of noise mitigation measures was conducted during the construction phase of Borkum West II, presenting the first time that noise mitigation was used at nearly all piles of the windfarm. Two different air hose systems were used to test for attenuation performance. Preliminary results show good attenuation results leading to SELs that in most cases fulfilled the requirement of 160 dB re μPa²s within 750 m distance. Preliminary results of 26 C-PODs also show that the radius in which avoidance by harbour porpoises was documented was reduced.

In anticipation of further tests in German waters, Hydro Sound Dampers were also tested at the London Array (UK) within the context of this project, with results due within the next few months. A small bubble curtain was tested on one pile of the BARD I Offshore windfarm also focusing on the interactions between hammer, pile, water and sediment to get better knowledge of sound propagation. Other research effort is also focused on developing less noisy installation techniques (reviewed in Koschinski and Lüdemann, 2011) such as drilling techniques or vertical shaft machines.

Belgium

Site and device specific impact studies and research are conducted in relation to offshore windfarms, and to date there are no monitoring and research programs in relation to other marine renewables as no such projects are foreseen at present.

Site and device specific impact

Impact magnitude assessment

The acoustic impacts on marine mammals during pile driving are of considerable environmental concern. It is monitored through the following methods:

- Aerial surveys were conducted using a standardized line transect method. Surveys are planned very shortly before and very shortly after pile driving events, preferably before the first pile driving event, as secondary piling activities may start with an impacted situation. The area surveyed is much larger than the windfarm area, given the mobility of marine mammals, and given the range of potential impacts (cf. the noise levels that can be generated).
- Passive Acoustic Monitoring (PAM) have been moored, and the objective is to use these PAM devices in future studies in an impact gradient design (moored at different distances from the piling location, and deployed from a few weeks before the first piling event until a few weeks/months into the piling operations).
- Additionally, underwater noise measurements are made during pile driving.

Generic research

Population assessment

General distribution of marine mammals is recorded using aerial surveys. These are focused on harbour porpoises as this is the only common species present; seals are encountered only rarely, and can usually not be identified to the species level. For seals it might be more appropriate to detect the reactions of satellite tagged seals (which is not currently undertaken in Belgium). All marine mammals sighted during surveys are, however, recorded.

There is also constant Passive Acoustic Monitoring at a few locations, on (cheap) moorings of opportunity (not dedicated to mooring the POD).

The Netherlands

Site- and device-specific impact studies and research are conducted in relation to offshore windfarms, but no studies are conducted in relation to other marine renewables as no such projects are foreseen at present. Impact studies have to date focused on harbour porpoise and harbour seal, but impact studies on grey seal are foreseen in 2013 and beyond.

Site and device specific impact studies

Site characterizations

Studies on the presence of marine mammals have been done in two offshore windfarms (OWEZ and PAWP) during a baseline period before construction took place. For these studies ship-based visual and acoustic surveys have been conducted and Passive Acoustic Monitoring (T-PODs and C-PODs™ respectively) has been applied for harbour porpoises (Brasseur *et al*., 2004). In autumn 2012 baseline monitoring on the presence of harbour porpoises started in the planned GEMINI windfarm by using PAM (C-PODs and noise loggers). Monthly aerial surveys and satellite tagging of common and grey seals are planned for 2013. Baseline monitoring for another planned windfarm (WLUD) will start spring 2013 with tagging of seals. Negotiations with the permit are currently ongoing in order to reallocate resources from a standard baseline monitoring programme towards more generic research on harbour porpoises.

Impact magnitude assessment

Studies using PAM (T-PODs and C-PODs™) during the operational phase of the windfarms OWEZ and PAWP were conducted to assess differences in acoustic activity of harbour porpoises inside the windfarms and one or two reference areas outside the windfarms. Higher acoustic activity was measured inside the OWEZ windfarm area compared to outside (Scheidat *et al.*, 2011) but in PAWP no such difference in acoustic activity was found (Van Polanen Petel *et al*., 2012). The effect of the OWEZ windfarm was studied by means of habitat modelling of telemetry data of harbour seals tagged at haul out sites at more than 40 km from OWEZ, and count data from aerial surveys at the haul out sites (Brasseur *et al*., 2012). A similar approach was used to assess the potential impact of OWEZ and PAWP on grey seals (Brasseur *et al.*, 2009). Other methods to study harbour porpoise include aerial surveys, focused ship-based observations during piling operations, and marine mammal observations collected during ship-bases seabird surveys.

Generic research

Impact parameter quantification

In the Netherlands nowadays acoustic mapping is required to obtain a permit for construction and operation of a windfarm. Noise logging has only started in summer 2012 in a construction-level study for the GEMINI windfarm. Two acoustic loggers were deployed in an array of 15 C-PODs in and around the future windfarm area.

Impact mechanism understanding

Under the umbrella of the Shortlist Masterplan Wind 'Monitoring the Ecological Impact of Offshore Wind Farms on the Dutch Continental Shelf' 2010–2011 several generic studies were conducted. Within this programme SEAMARCO conducted auditory experiments (Kastelein *et al*., 2011; 2012):

- One male Harbour Porpoise and two Common Seals were exposed to continuous noise and to playback of pile driving sounds;

- TTS (-10 dB) after 120 min exposure to continuous noise;
- No behavioural changes were observed due to continuous noise;
- •No TTS was observed as a result from the pile driving sounds;
- Behavioural changes due to pile driving sounds were observed, with individual variation in the two seals;
- Values for TTS in harbour porpoise were lower than predicted by Southall *et al.*, 2007.

Habitat ecology

Habitat use of harbour porpoises is being studied by means of PAM around windfarm areas and two sites in the Wadden Sea (Marsdiep and Eems; Scheidat *et al.*, 2011; Van Polanen Petel *et al.*, 2012). Distribution and diving behaviour of harbour seals is being studied by means of telemetry (Brasseur *et al.*, 2009; 2010; 2011; 2012).

Population assessment

Under the umbrella of the Shortlist Masterplan Wind 'Monitoring the Ecological Impact of Offshore Wind Farms on the Dutch Continental Shelf', aerial surveys were conducted in the entire Dutch continental shelf in March, July and October/November 2010–2011, resulting in the first DCS-wide abundance estimates and distribution maps of harbour porpoises (Geelhoed *et al.*, 2011). Surveys were conducted using a standardized SCANS method. All marine mammals sighted are however recorded. Aerial surveys in four subareas in the DCS have been conducted annually since 2008. Apart from the three SMW-surveys in 2010–2011 the entire DCS was surveyed in March 2012 (Geelhoed *et al.*, 2013).

Since the 1960s standardized aerial surveys of harbour and grey seals on haul-outs have been conducted in the Wadden Sea during low tide. For the grey seals a minimum of five surveys each year are conducted: three during the pupping (November–January) and two during the moulting period (March–April). For the harbour seal a minimum of five aerial surveys each year are conducted: three during the pupping (June–July) and two during the moulting period (August). In the Delta monthly aerial counts are done.

Mitigation experiments

Seamarco has done research to test the efficacy of a number of acoustic deterrents. In another study by Kastelein *et al.* (2009) the critical ratios (CRs) of two harbour porpoises were determined for tonal signals with frequencies between 0.315 and 150 kHz, in random Gaussian white noise. By combining the mean CRs found in the present study with the spectrum level of the background noise levels at sea, the basic audiogram, and the directivity index, the detection threshold levels of harbour porpoises for tonal signals in various sea states can be calculated.

Several studies on underwater sound were conducted by TNO in 2008 and 2009. This included investigations of anthropogenic (e.g. associated with piling activities of windfarms) and natural sound sources (de Jong and Ainslie, 2008; Ainslie *et al.*, 2009).

UK

In the UK, characterization surveys to support EIA for wave and tidal developments are undertaken over two years prior to consent being granted, similar to existing seabird survey requirements around offshore windfarms (Maclean *et al.*, 2009;

Trendall *et al.*, 2011). However, implementation of the Scottish Government's "survey, deploy, monitor" strategy aims to provide a risk-based approach to justifying that a single year of baseline survey may be sufficient in some cases (Scottish Government, 2012).

In the UK, regulators have not, so far, implemented a prescriptive regulatory regimen regarding what post-consent monitoring approaches should be used by marine renewable energy developers to evaluate the impacts of their devices. This is in part due to the novel nature of many of the studies and the innovation required to develop appropriate techniques, and guidance is in development (SNH ref) to support site-specific monitoring design. Consents are currently granted with the provision that an environmental monitoring plan will be drawn up post-consent, with input from the relevant statutory consultees, to ascertain whether the predictions made during EIA were correct.

Generally, a default one year pre-construction survey programme has been considered standard, with subsequent data collection during and post-construction to ensure that the different phases of project development are assessed. However, progress in understanding the site and impact-specific experimental design requirements and discussion around the realistic value of collected data in reporting on impacts is leading to more informed discussion around the most appropriate way to approach monitoring studies.

In particular, the "survey, deploy, monitor" approach also provides the basis for an adaptive management approach, and for upcoming wave and tidal energy developments, impact monitoring may be used to provide the basis for a phased development approach. I.e. projects could be developed incrementally, with feedback on impacts at intermediate stages of development, prior to the installation of large commercial arrays.

Also for offshore wind, improvements in monitoring studies are becoming more hypothesis-driven, and developers will need to demonstrate that they have the power to detect change using their chosen sampling method. Monitoring of impacts may also be focused on specific periods, such as during pile driving. As for site characterization, proper consideration of survey design for cumulative effects assessment and monitoring may lead to collaborative effort, across industry and the regulator in some cases.

Site and device specific impact studies

Site characterization

Site characterization at windfarms in the UK has to date typically involved standard boat based line transect surveys at sites. Site characterization of wave and tidal energy developments has typically involved similar survey efforts.

Predictive impact assessment

Encounter risk modelling studies have been undertaken as part of specific EIAs involving tidal-stream energy developments (SAMS, unpublished data).

Generic research

Impact parameter quantification

In addition to site-specific monitoring, developers contribute to ORJIP (Offshore Renewables Joint Industry Program), along with regulators and The Crown Estate. ORJIP contains a suite of research projects that will answer some of the key generic questions required to determine whether offshore wind developments have population level impacts on key species such as harbour porpoise, bottlenose dolphin, harbour seal and grey seal. These include studies of the fitness impacts of exposure to noise. Similar experiments are underway to determine whether tidal turbines are audible at sufficient distance for animals to evade collision.

Impact mechanism understanding

Relatively little has been done, but one exception was the Beatrice demonstrator project, during which the University of Aberdeen deployed TPODs™ at three locations within the Moray Firth for the purpose of detecting changes in the occurrence of harbour porpoise and bottlenose dolphins (Thompson *et al*., 2010). At the same time, calibrated noise recordings were made, so the received levels of noise were known. These recordings were also used to test underwater noise propagation models (Bailey *et al*., 2010). The studies showed that porpoises were absent from the T-POD™ location close to where pile driving occurred, but the key lesson learned was that many more sampling locations were required in order to determine the level of impact.

Impact studies focusing on effects of marine mammals colliding with tidal turbine devices are currently ongoing, but have not yet been published to date.

Habitat ecology

Studies on habitat use by small cetaceans in tidal energy sites in Scotland are ongoing, using a combination of visual and acoustic monitoring methods (SAMS, unpublished data).

Population assessment

Attempts have been made to assess population level effects of potential impacts. A framework has been developed which specifically deals with population level effects of pile driving on harbour seals in the Moray Firth (Thompson *et al*., in review). Many of the key parameters, such as the effect of disturbance on survival or fecundity had to be estimated, since no data currently exist.

Annex 5: Recommendations

Recommendation I

WGMME **strongly recommends** that Member States use the proposed management units for reporting requirements of the Habitats Directive and for the development of indicators and their assessment for the Marine Strategy Framework Directive. In summary, there is a single MU in the European North Atlantic for common dolphin (*Delphinus delphis*), white-beaked dolphin (*Lagenorhynchus albirostris*), white-sided dolphin (*Lagenorhynchus acutus*), striped dolphin (*Stenella coeruleoalba*) and minke whale (*Balaenoptera acutorostrata*). For bottlenose dolphin (*Tursiops truncatus*) there is a more complex structure with six local MUs for small discrete "resident" groups and eleven MUs for larger coastal areas encompassing these and other areas where this species is found. There is also a large MU covering the whole European Atlantic to cover the wide-ranging animals that are mainly found away from coastal waters. For harbour porpoise (*Phocoena phocoena*), five MUs are proposed for the Iberian Peninsula, Celtic and Irish Seas, West Scotland/NW Ireland, the North Sea and Inner Danish Waters. More than one MU in the North Sea for harbour porpoise should be explored in ongoing work to develop management models for setting safe limits to bycatch. Management units for both harbour and grey seals need to be more clearly defined for MSFD assessments.

Recommendation II

WGMME strongly supports the proposal for a cetacean absolute abundance survey in all European Atlantic waters in 2015 and **recommends** that it is supported by all range states and by ICES, ASCOBANS and the European Commission. Continuation of these surveys is essential to the accurate estimation of absolute abundance for several species that are required for reporting under the Habitats Directive and the Marine Strategy Framework Directive.

Recommendation III

In 2009, ICES advised the European Commission 'that a Catch Limit Algorithm approach is the most appropriate method to set limits on the bycatch of harbour porpoises or common dolphins. In order to use this (or any other) approach, specific conservation objectives must first be specified. In both species improved information on bycatch and the biology of the species would improve the procedure.' In 2010, ICES again advised the European Commission that 'ICES advised in 2009 of the need for explicit conservation and management objectives for managing interactions between fisheries and marine mammal populations. This advice has not been acted upon. Lacking these objectives, ICES is unable to properly consider the impacts of these interactions in its management advice.' With the current development of MSFD targets for marine mammal bycatch, WGMME **strongly recommends** that this advice is acted upon. To aid such decisions, WGMME also **recommends** that ASCOBANS consider the policy decisions required for the setting of safe bycatch limits and, intersessionally, provide the UK (as project coordinator) with their recommendations. Decisions are required on:

1) whether the ASCOBANS conservation objective 'to allow populations to recover to and/or maintain 80% of carrying capacity in the long term' should be met on average or some other proportion (>50%). This choice will have a significant influence on the population level as a percentage of

carrying capacity achieved in the long term (if greater than 50% the population level achieved in the long term will exceed the specified target).

2) ASCOBANS need to define 'long term'. Although the original CLA project used 200 years, it is suggested that in the further development of the framework for determining safe bycatch limits, a time frame of 100 years is used as this is consistent with the majority of other assessment approaches.

3) The current debate regarding the number of management units for harbour porpoise in the North Sea should be explored during the framework simulations. It is recommended that the outputs of the simulations should be used as the basis for defining the number of North Sea management units until further information becomes available.

Recommendation IV

WGMME **strongly recommends** that ICES members provide data so that the seal database be maintained and updated regularly. Such development will be highly beneficial for future MSFD assessments of the OSPAR core set of indicators for seals.

Recommendation V

Current monitoring efforts to determine the distribution and habitat use of marine mammals, in relation to environmental impact assessments, e.g. for marine renewable energy developments, typically take place at much smaller spatial scales than are ecologically relevant to marine mammals, and are often undertaken independently without broader coordination. This results in numerous disparate datasets that are difficult to integrate when assessing overall impacts of marine renewable energy developments. WGMME **recommends** that for marine renewable energy developments (incl. offshore wind) the concept of integrating data collected during the course of monitoring activities across different spatial and temporal scales becomes a core principle among ICES Members, taking into account monitoring drivers and requirements as appropriate.