ICES WGMME REPORT 2011

ICES ADVISORY COMMITTEE

ICES CM 2011/ACOM:25

Report of the Working Group on Marine Mammal Ecology (WGMME 2011)

21–24 February 2011

Berlin, Germany

ICES International Council for the Exploration of the Sea
CIEM Conseil International pour l'Exploration de la Mer

International Council for the Exploration of the Sea
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

Recommended format for purposes of citation:

ICES. 2011. Report of the Working Group on Marine Mammal Ecology (WGMME), 21–24 February, Berlin, Germany. ICES CM 2011/ACOM:25. 204 pp.

For permission to reproduce material from this publication, please apply to the General Secretary.

The document is a report of an Expert Group under the auspices of the International Council for the Exploration of the Sea and does not necessarily represent the views of the Council.

© 2011 International Council for the Exploration of the Sea

Contents

Executive summary **5**

1 Opening of the meeting **7**

2 Adoption of the agenda **8**

3 ToR a. Review and report on any new information on population sizes population/stock structure and management frameworks for marine mammals **10**

3.1 Trans North Atlantic Sightings Survey (T-NASS) 10

3.1.1 Introduction 10

3.1.2 Methodology 10

3.1.3 Results 11

3.1.4 References 12

3.2 Update on other marine mammal abundance estimates 13

3.3 Population structure in bottlenose dolphins in the Northeast Atlantic 13

3.3.1 Overview 13

3.3.2 Recommendations 17

3.3.3 References 18

3.4 Update on the population structure of harbour porpoises in Danish waters 19

3.4.1 Reference 19

4 ToR b. Outline and review the effects of tidal-stream energy devices (construction and operation) on marine mammals and provide recommendations on research needs, monitoring and mitigation schemes **20**

4.1 Introduction 20

4.2 Features of tidal-stream energy converters relevant to marine mammals 20

4.3 Summary of the distribution and scale of some of the tidal-stream energy developments in ICES waters 22

4.3.1 UK 22

4.3.2 Channel Islands 27

4.3.3 France 27

4.3.4 Spain and Portugal 28

4.3.5 Netherlands 28

4.3.6 Norway 29

4.3.7 Russia 29

4.3.8 Canada 29

4.3.9 USA 30

4.4 Potential effects of tidal-stream developments on marine mammals 31

4.4.1 Installation effects 31
4.4.2 Operation 33
4.5 Overview of international and national guidelines on monitoring and mitigation 35
4.6 Monitoring 35
4.7 Case study-SeaGen turbines in Strangford Lough 36
4.8 Recommendations 37
4.8.1 Management framework 37
4.8.2 Interactions at close range 38
4.8.3 Noise mapping-communication 38
4.8.4 Noise quantification for device perception 38
4.8.5 Survey methods 39
4.8.6 Allowable takes 39
4.8.7 Wide-scale surveys 39
4.8.8 Data sharing 40
4.8.9 Site choice 40
4.8.10 Device diversity 40
4.8.11 Arrays 40
4.8.12 Electromagnetic fields 41
4.9 References 42

5 ToR c. Outline marine planning practices that could take account of the presence of cetaceans, and what information ICES might be able to feed into that process 43
5.1 Introduction 43
5.2 Marine planning practices that go beyond MPAs 44
5.3 Case study of the development of MSP– German EEZ waters 48
5.3.1 Overview 48
5.3.2 Objectives made in the spatial plan regarding marine mammals 50
5.3.3 Potential conflicts between harbour porpoise and human habitat use 52
5.4 Recommendations 55
5.5 References 55

6 ToR d. Catalogue the Marine Protected Areas for marine mammals in the ICES area and evaluate the efficacy of MPAs for cetaceans 58
6.1 Introduction 58
6.2 Legal framework 58
6.2.1 Europe 58
6.2.2 Canada and US 63
6.3 Catalogue of MPAs within the ICES area 63
6.4 Efficacy of MPAs for cetaceans 64
6.4.1 Examples of long-term cetacean MPAs 65
6.5 Conclusions and recommendations 68

6.6 References 69

7 ToR e. Finalize production of the Cooperative Research Report on the framework for surveillance and monitoring of marine mammals applicable to the ICES area 71

7.1 Overview 71

7.2 References 71

8 ToR f. Update on development of database for seals, status of intersessional work 74

9 ToR g. Review the output of the ICES SIBAS Workshop on 'Biodiversity indicators for assessment and management' (available February 2011) and report on: What data, information and marine mammal science are you aware of that would contribute to biodiversity advice, with an emphasis on the trade-offs between fishing and conservation that are relevant to ICES client needs as described in the ICES SIBAS report 75

9.1 Introduction 75

9.2 Current and proposed Indicators 78

9.3 Strengths and weaknesses of indicator classes in Table 4 78

9.4 References 95

10 Future work and recommendations 96

10.1 Future work of the WGMME 96

Annex 1: Working paper 1 99

Annex 2: Catalogue of MPAs in the ICES area 114

Annex 3: List of participants 195

Annex 4: Agenda 199

Annex 5: WGMME Terms of Reference for the next meeting 201

Annex 6: Recommendations 203

Executive summary

The Working Group on Marine Mammal Ecology (WGMME) met at the Federal Environment Agency in Berlin, Germany from 21 February to 24 February 2011. Sinéad Murphy chaired the meeting of 13 participants, representing six countries.

Six different ToRs were address, covering a wide range of issues, including reviewing the effects of tidal turbines on marine mammals and providing recommendations on research needs, monitoring and mitigation schemes. In addition, the WG outlined marine planning practices that could take account of the presence of cetaceans, as well as cataloguing the Marine Protected Areas (MPAs) for marine mammals in the ICES area and evaluating the efficacy of MPAs for cetaceans. Other topics included reviewing outputs from T-NASS and assessing the current population structure of bottlenose dolphins in the Northeast Atlantic. During the meeting, the WG planned the production of the Cooperative Research Report on the "Framework for surveillance and monitoring of marine mammals applicable to the ICES area". Finally, the WG reviewed the outputs from the recent ICES workshop on "Furthering ICES Engagement in Biodiversity Issues: outcomes of the Workshop on Marine Biodiversity".

It became clear to the WG that the wet renewables sector is at a very early stage of development. Most designs of tidal turbines are at early test stages of scale models while a few are at the levels of full-scale test rigs and there are currently no full-scale commercial developments of multiple devices (arrays). Accordingly, our knowledge of the potential interactions of marine mammals with these devices are predominantly speculative based on the first investigations and best knowledge derived from parallels from other industries such as fisheries, oil and gas developments and the offshore wind sector. In light of this, the WG focused on highlighting current research needs and important issues of regulation and management to be addressed in the coming years. Most importantly, the WG recommended that a strategic approach be taken to identify sites of low marine mammal risk for early stage deployments, before consenting to tidal device or array developments in more sensitive sites, i.e. Natura 2000 sites. Animal-tidal turbine interactions are likely to be both species and device (or device-type) specific and the WGMME recommended that extreme care be taken when extrapolating environmental impacts between species and device types. In addition, WGMME recommended that extreme care be taken when scaling up environmental lessons learned from studies of single tidal turbine devices up to arrays, as the nature of any impact relationships (linear or otherwise) between one and many devices is currently unknown. In light of this, a stepwise approach should be taken for array development.

The WG summarized activities typically considered within marine spatial planning practices that should take into account the presence and occurrence of cetaceans. The WG reviewed the main concerns regarding cetaceans and, in some activities, how these are taken into consideration, e.g. following best practice, mitigation measures, spatial considerations. Not all activities required an EIA, and not all activities have established mitigation measures. The WGMME recommended that data on cetacean presence and occurrence should be incorporated at a very early stage of marine spatial planning – and it is very important to include any information on seasonal changes in distribution. As a result of the wide ranging nature of cetaceans, the relevance of 'important areas' outside MPAs should be assessed within marine spatial plans. A case study was presented documenting the development of a marine spatial plan within the German EEZ and how marine mammals were incorporated within

the spatial plan. Potential areas of conflict between marine mammal habitat use and human use within the German EEZ were discussed.

The WG collated information on 344 MPAs within the ICES area, of which approximately 92% were established as part of the Natura 2000 network. Sizes of MPAs were highly variable ranging from <0.1 to 55 000 km^2. The WG noted that many of the MPAs are small relative to marine mammal movements and habitat used for essential life-history requirements (i.e. foraging, breeding, nursing). However, some countries worked jointly together to establish equivalent and/or interconnected MPAs to enhance conservation of marine mammals. The efficiency of MPAs is compounded by the scientific basis on which designations were made. The quality and quantity of data used to designate sites varied considerably, with many utilizing very little scientific data. Consequently, the WGMME recommended that the boundaries of MPAs should only be decided on the basis of a significant long-term dataseries (of at least five years). If protected areas are created in response to public opinion without the scientific evidence to support their selection, there is a risk that such sites could provide false assurance that space and resources have been set aside for marine mammals, thereby reducing the pressure for targeted action on the most significant threats. The WG therefore recommended that the appropriateness of MPAs as a mechanism to controlling or eliminating threats is given significant consideration prior to site designation.

Finally, as part of reviewing the outputs of the report "Furthering ICES Engagement in Biodiversity Issues: outcomes of the Workshop on Marine Biodiversity", the WG collated information on the current and proposed indicators for marine mammals, and discussed possible indicators that could be used for supporting policy drivers. Further development of marine mammal biodiversity indicators will be undertaken at next year's WGMME meeting.

1 Opening of the meeting

The Working Group on Marine Mammal Ecology (WGMME) met at the Federal Environment Agency in Berlin, Germany from 21 February to 24 February 2011. The list of participants and contact details are given in Annex 3.

The Working Group thanks the Federal Environment Agency for their invitation to conduct the meeting in Berlin.

The Working Group gratefully acknowledges the support given by several additional experts that kindly provided information and/or reports for use by WGMME and reviewed parts of the report. The WG acknowledges the support given to us by Genevieve Desportes, Luca Mirimin, Ruth Fernández-García, Phil Hammond, Victoria Copley and Andy Hill who kindly provided unpublished data, text and/or reports for use by the WGMME. The Working Group also thanks Rui Prieto, Simon Berrow, Jan Haelters, Iwona Pawliczka, Nilssen Kjell Tormod, Santiago Lens, Bjarni Mikkelsen, Valdis Pilats and Gísli Vikingsson for providing information on Marine Protected Areas within their respective countries.

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 February 21st 2011.

Review and report on any new information on population sizes, population/stock structure and management frameworks for marine mammals;

Outline and review the effects of tidal farms (construction and operation) on marine mammals and provide recommendations on research needs, monitoring and mitigation schemes;

Outline marine planning practices that could take account of the presence of cetaceans, and what information ICES might be able to feed into that process;

Catalogue the Marine Protected Areas for marine mammals in the ICES area and evaluate the efficacy of MPAs for cetaceans;

Finalize production of the Cooperative Research Report on the framework for surveillance and monitoring of marine mammals applicable to the ICES area;

Update on development of database for seals, status of intersessional work;

Review the outputs of the ICES SIBAS Workshop on 'Biodiversity indicators for assessment and management' (available Feb 2011) and report on:

> What data, information and marine mammal science are you aware of that would contribute to biodiversity advice, with an emphasis on the trade-offs between fishing and conservation that are relevant to ICES client needs as described in the ICES SIBAS report?

WGMME will report by 1 April 2011 for the attention of the ACOM.

Supporting information

Priority:	High, as only group that can support requirements in ToR a.
Scientific justification and relation to action plan:	a) This work is required under MoU between the European Commission and ICES; to review the status of small cetaceans in European waters; b) This is completion of the revew of the effects of renewable energy on marine mammals within the ICES Area. It addresses 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; c) This addresses the thematic area "Development of options for sustainable use of ecosystems" within the ICES Science Plan; d) This addresses the thematic area "Development of options for sustainable use of ecosystems" within the ICES Science Plan; e) An international cooperative approach needs to be established for the long-term surveillance and monitoring of marine mammals in the Northeast Atlantic, and ICES WGMME provides a suitable locus for this. Development of such a framework is essential to the long-term management of cetacean populations within the ICES area; f) This will facilitate future work of the WG;
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 and report on any new information on population sizes population/stock structure and management frameworks for marine mammals

3.1 Trans North Atlantic Sightings Survey (T-NASS)

A working paper reviewing the output and conclusions of the Trans North Atlantic Sightings Survey (T-NASS) was submitted to the WGMME (see Annex 1). The following is a summary of the main results presented in that paper.

3.1.1 Introduction

The T-NASS was planned under the auspices of the Scientific Committee of NAMMCO in 2006 and 2007 (NAMMCO 2006a, b, 2007). It was designed to generate summer distribution and abundance estimates for cetacean populations in the Northern North Atlantic from visual and acoustic survey data, collected during summer of 2007. With the participation of Greenland, and for the first time Canada and Russia, T-NASS covered areas to the west of Greenland and the entire east coast of Canada that had not been covered by earlier NASS surveys. The T-NASS covered the primary areas of summer distribution for the main target species, and contributed to a 20-year time-series of data collected by the North Atlantic Sightings Surveys (1987–2001; Lockyer and Pike, 2009). The survey was run concurrently with CODA (Cetacean Offshore Distribution and Abundance in the European Atlantic; ICES WGMME 2009) and SNESSA (Southern New England to Scotian Shelf Abundance survey; ICES WGMME 2010) in 2007, and provided the most complete synoptic coverage to date of the northern North Atlantic.

3.1.2 Methodology

Line transect methods and/or cue counting were used to collect visual data. When possible, a double platform setup was used by both the aerial and shipboard surveys. Passive acoustic data were also collected from five of the vessels (three Icelandic, Faroese, and MarEco vessels); with an emphasis on obtaining recording of sperm whale (*Physeter macrocephalus*) acoustic signals. Dedicated cetacean shipboard sightings surveys were conducted from seven vessels (one Faroese, three Icelandic, two Norwegian) from 25 June to 6 August, while dedicated aerial surveys were conducted from five aircrafts (three Canadian, one Greenlandic, one Icelandic) between 20 June and 1 October.

In addition, nine observers were placed on fishery surveys occurring simultaneously to T-NASS in adjacent areas; the ICES Redfish survey in the Irminger Sea (one Russian and one German vessels), MarEco survey on the Mid Atlantic Ridge (one UK vessel), and Norwegian Pelagic survey in the Norwegian Sea (two Norwegian vessels).

In total, 90 observers from 14 different countries participated in the T-NASS; including Russia who provided observers for the shipboard and the shipboard extension surveys.

The target species of T-NASS were fin whales (*Balaenoptera physalus*; Iceland and Faroes), minke whales (*B. acutorostrata*; Iceland, Norway, Greenland, and Faroes), humpback whales (*Megaptera novaeangliae*; Iceland, Greenland, Faroes), long-finned

pilot whales (*Globicephala melas*; Faroes) and harbour porpoises (*Phocoena phocoena*; Iceland, Greenland). However, sightings of all other species were also recorded.

The 12 platforms of the core survey covered over 58 000 nm of transects of effort in an area of c. 1.5 million nm², spanning from the Eastern Barents Sea, along the East coast of Canada to the US border, and from 78º N in the north to 52ºN in the east and 42 ºN in the west to the south (Annex 1; see Table 1, Figure 1). This represents one of the largest coordinated whale surveys to date. T-NASS observers placed on opportunistic surveys (MarEco, ICES Redfish and Norwegian pelagic) added a supplementary effort of 5253 nm, in the Irminger Sea, the Norwegian Sea, and along the Mid Atlantic Ridge (Annex 1; see Figure 2). Almost 4000 cetacean sightings were recorded - with an apparent variation in frequency between blocks and areas (Annex 1; see Figure 1, Figure 3–9). Nineteen cetacean species were observed, with fin, common minke, and humpback whales, white beaked dolphins (*Lagenorhynchus albirostris*) and harbour porpoises representing the top five observed species (Annex 1; see Table 2). Other marine megafauna, e.g. sea turtles, seals, large sharks and fish species, were also recorded.

3.1.3 Results

To date, abundance estimates have been calculated for many areas and species, although several remain to be determined. Table 1 presents the abundance estimates that have been endorsed by the NAMMCO Scientific Committee on recommendation of the NAMMCO Scientific Committee Working Groups on Abundance Estimates (AEWG; NAMMCO 2009, 2011a) and Assessment (ASWG; NAMMCO 2010, 2011b). Analyses of data were carried out by numerous institutes - each working group report submitted to NAMMCO detailed the list of analyses undertaken by the authors. Abundance estimates will be incorporated into the management framework of NAMMCO and the IWC, as well as national plans.

On-effort sighting distributional maps for minke whales, humpback whales, sperm whales, beaked whales, bottlenose whales (*Hyperodon ampulatus*), harbour porpoises, *Lagenorhynchus* sp. and short-beaked common dolphins (*Delphinus delphis*) are presented in Annex A.

The NAMMCO WGs recommended that supplementary analyses be undertaken for different areas and species (NAMMCO 2011a; see Table 4 in Annex 1). Results from many of these supplementary analyses will be presented to the AEWG, which will meet in Copenhagen, March 7–9, 2011. The AEWG meeting will be followed by a meeting of the Survey Planning WG, which will review the NASS series and initiate planning of the next NASS survey - anticipated to be also a T-NASS survey undertaken between 2013 and 2015. See Annex 1 for further details on the continued evaluation and validation by the AEWG of the abundance estimates from the T-NASS, and the development of objectives by SPWG for the next NASS survey.

Table 1. T-NASS abundance estimates endorsed by the NAMMCO SC for assessment purposes.

Survey Areas	West Greenland	Iceland Coastal	Iceland-Faroes	Canada GSS	Canada NL	Norwegian mosaïc 2002-7
Species / Survey	Aerial	Aerial	Shipboard	Aerial	Aerial	Shipboard
Fin whale	*4,359 n** (1,879-10,114)*	-	20,613 n** (14,819-25,466) 26,117 p** (17,401-39,199)	462 n** (270-791)	1254 p** (765-2,059)	To be done
Minke whale	16,609 pa[1]** (7,172-38,461) 22,952 pa[2]** (7,815-67,403)	15,055[3] * (6,357-27,278) 10,680[4] * (5,873-17,121)	10,782 n*** (4,733- 19,262)	1,927 ** (1,196-2,799)	3,748 p** (2,214- 6,345)	IWC
Humpback whale	3,272 pa** (1.230-8.710)	1,242 p** (632-2,445)	11,572 n** (4,502-23,807)	653 ** (385-1,032)	3,712 p** (2,536-5,428)	To be done
Pilot whale	**2,976 n** (1,178-7,515)**	-	**Not accepted**	6,134 n** (2,774-10,573)	-	To be done
Sperm whale	-	-	To be done	To be done?	To be done?	To be done
Bottlenose whale	-	-	To be done	-	To be done?	?
Harbour porpoise	**33,271 pa** (15,939-69,450)**	To be done	-	3,667 n** (1,565-6,566)	958 n** (470-1,954)	?
White-beaked dolphin	**9,827 p** (6,723-14,365)**	To be done	To be done			?
White-sided dolphin	-	-	To be done	4,289 n** (cv = 0.210)	3,086 p** (1,781-5,357)	?
Common dolphin	-	-	-	53,049 n** (34,865-80,717)	613 p** (278-1,355)	-

Estimates in bold are first estimates for the species in the area, estimates in *italic* have been endorsed but need further work. Further work is needed before acceptance in a few cases. For detail of the recommended supplementary analysis see Table 2.
n, uncorrected for bias; p, corrected for perception bias; a, corrected for availability bias.
[1] Availability bias is adjusted using aerial photographic images taken in Iceland.
[2] Availability bias is adjusted using satellite tagging data from three different areas.
[3] Using both primary observers
[4] Using only the most effective primary observer (much higher sighting rate)
* Endorsed at the NAMMCO WG on Abundance estimate, Copenhagen, April 2008, and subsequent Scientific Committee Meeting (NAMMCO, 2009)
** Endorsed at the NAMMCO WG on Abundance Estimates, Quebec City, October 2009, and subsequent Scientific Committee Meeting (NAMMCO, 2011)
*** Endorsed at the NAMMCO WG on Assessment, Copenhagen, March 2010, and subsequent Scientific Committee Meeting (NAMMCO, 2011)

3.1.4 References

ICES WGMME. 2009. Report of the Working Group on Marine Mammal Ecology. February 2–6 2009, Vigo, Spain.

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

Lockyer C, Pike D. eds. 2009. North Atlantic Sightings Surveys. Counting whales in the North Atlantic 1987–2001.NAMMCO Scientific Publications, vol. 7. 244pp.

NAMMCO. North Atlantic Marine Mammal Commission. 2006a. Report of the Scientific Committee Planning Committee on the Trans North Atlantic Sightings Survey. First meeting, Reykjavík March 2006. In: NAMMCO Annual Report 2007–2008, NAMMCO, Tromsø, Norway, 186–210.

NAMMCO. North Atlantic Marine Mammal Commission. 2006b. Report of the Scientific Committee Planning Committee on the Trans North Atlantic Sightings Survey. Second meeting, Reykjavík November 2006. In: NAMMCO Annual Report 2007-2008, NAMMCO, Tromsø, Norway, 186–210.

NAMMCO. North Atlantic Marine Mammal Commission. 2007. Report of the Scientific Committee Planning Committee on the Trans North Atlantic Sightings Survey. Third meeting, St Andrews, March 2007. In: NAMMCO Annual Report 2007–2008, NAMMCO, Tromsø, Norway, 219–251.

NAMMCO. North Atlantic Marine Mammal Commission. 2009. Report of the Scientific Committee Working Group on Abundance Estimates. In: NAMMCO Annual Report 2007–2008, NAMMCO, Tromsø, Norway, 252–272.

NAMMCO. North Atlantic Marine Mammal Commission. 2010. Report of the Scientific Committee Working Group on Large Whale assessment. In: NAMMCO Annual Report 2009, NAMMCO, Tromsø, Norway, 411–421.

NAMMCO. North Atlantic Marine Mammal Commission. 2011a. Report of the Scientific Committee Working Group on Abundance Estimates. In: NAMMCO Annual Report 2010, NAMMCO, Tromsø, Norway, 30pp.

NAMMCO. North Atlantic Marine Mammal Commission. 2011b. Report of the Scientific Committee Working Group on Assessment. In: NAMMCO Annual Report 2010, NAMMCO, Tromsø, Norway. 37pp.

3.2 Update on other marine mammal abundance estimates

An analysis was recently undertaken by the Sea Mammal Research Unit, UK that used spatial modelling to estimate abundance and explore species-habitat relationships of cetaceans in European Atlantic waters. The analysis combined data from SCANS-II (surveyed in 2005), CODA (surveyed in 2007) and the Faroes block of T-NASS (surveyed in 2007). Species for which abundance could be estimated were: harbour porpoise, white-beaked dolphin, white-sided dolphin (*Lagenorhynchus acutus*), bottlenose dolphin (*Tursiops truncatus*), short-beaked common dolphin, striped dolphin (*Stenella coeruleoalba*), long-finned pilot whale, minke whale, fin whale, sperm whale, and all beaked whale species combined. Results of these analyses will become available in the coming year.

3.3 Population structure in bottlenose dolphins in the Northeast Atlantic

3.3.1 Overview

In 2009, the WGMME discussed and defined the terms of use for population, ecological stock and management unit (MU). In previous years, the WGMME also reviewed existing population/stock structure in harbour porpoises and common dolphins in the Northeast Atlantic Ocean and adjacent waters, and outlined recommended management units for these species (ICES WGMME 2009, 2010). This year, the WGMME will review existing population/stock structure in bottlenose dolphins in the Northeast Atlantic Ocean and adjacent waters.

In 2009, the ASCOBANS-HELCOM Small Cetacean Population Structure Working Group reviewed all available literature from genetic (mtDNA and microsatellites) and photo-id studies of bottlenose dolphins, and assessed unpublished data, in order to decipher contemporary existing population/stock structure (see Evans and Teilmann, 2009).

ASCOBANS/HELCOM Recommended Management Units:

Eleven nearshore populations were proposed by the ASCOBANS/HELCOM WG as separate MUs; though it was noted that some areas may have overlapping communities with different movement patterns (Figure 1). It was recommended that bottlenose dolphins inhabiting the continental shelf edge were best treated as a separate MU (Atlantic Europe, AE), provisionally taken to include animals from around the Faroe Islands, southwards along the shelf, to the Iberian Peninsula. In addition, it was suggested that there may be a difference between truly oceanic areas and shelf break-outer shelf habitats (Evans and Teilmann, 2009).

ASCOBANS/HELCOM defined nearshore populations/management units:

1. North Sea (Eastern Scotland from Caithness to the borders with England);
2. Outer Hebrides (Island of Barra, OH);
3. Inner Hebrides (IH);

4. Irish Sea (IS);
5. Shannon Estuary (SHE);
6. Western Ireland (WEI);
7. Southern England (SE);
8. Channel Islands and Normandy coast (North France, NF);
9. Brittany coast and islands (West France, BR);
10. Southern Galicia (SGA); and
11. Sado Estuary (Portugal, SAE)

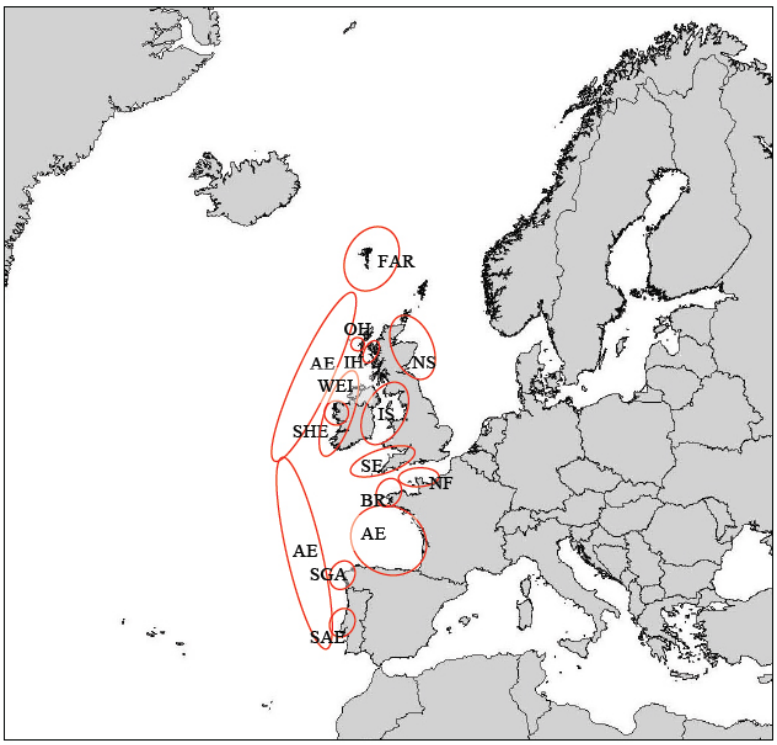


Figure 1. Map showing recommended management units for bottlenose dolphins in the ASCOBANS Agreement Area and Environs (Taken from Evans and Teilmann, 2009).

The ASCOBANS-HELCOM WG stated that these MUs are only provisional and subject to updating on a regular basis as new information becomes available. Following the publication of the ASCOBANS-HELCOM WG report in 2009, results from a number of additional genetic studies using samples from the UK, Ireland and Iberia have been published.

3.3.1.1 Ireland

In Irish waters, a genetic structure analysis was undertaken by Mirimin *et al*. (in press) using 62 biopsy samples from free ranging dolphins and 23 samples from necropsied stranded dolphins. Biopsy samples were obtained between 2000 and 2007, and stranded animals were sampled between 1993 and 2009. Results revealed fine-scale population structure among three distinct populations (see Table 2). 46 individuals biopsied in the Shannon Estuary (candidate Special Area of Conservation (SAC) for bottlenose dolphins) appeared to be genetically isolated from adjacent coastal areas - apart from a subgroup of four dolphins inhabiting Cork Harbour (south coast), which may be the result of ongoing gene flow or recent dispersal be-

tween these two areas. A second genetically distinct aggregation was identified in the Connemara–Mayo region (western Ireland) from biopsy samples of 12 individuals. Recent photo-identification studies suggested that dolphins found in this area show a degree of site fidelity. Moderate nuclear (15 microsatellites) and low mitochondrial (544 bp of the control region) gene diversity were observed in dolphins using the Shannon Estuary and the Connemara–Mayo region, while dolphins that stranded along the coast showed markedly higher levels of gene diversity at both classes of markers. Thus suggesting that these stranded dolphins formed a third genetically distinct cluster, which may be part of a larger pelagic population.

These results are in line with ASCOBANS/HELCOM proposed MU's for bottlenose dolphins off the Irish Coast: (1) Shannon estuary; (2) Western Ireland; and (3) offshore waters/Atlantic Europe. Recent population estimates for the Shannon Estuary suggests between 120 and 140 individuals in this region (Englund *et al*., 2007; Englund *et al*., 2008). To date, there are no population estimates for the Connemara–Mayo region.

It is recommended that additional analyses, using larger sample sizes, should be carried out to assess the extent of isolation of the putative population in the Connemara–Mayo region.

Table 2. Estimates of pairwise population differentiation for mtDNA data (below diagonal) and microsatellite data (above diagonal; Taken from Mirimin *et al*., in press).

	Shannon Estuary	Connemara–Mayo	Strandings
Shannon Estuary		F_{ST}=0.179***	F_{ST}=0.170***
	–	R_{ST}=0.146**	R_{ST}=0.062*
Connemara–Mayo	F_{ST} = 0.353***		F_{ST}=0.177***
	φ_{ST} = 0.398***	–	R_{ST}=0.095
Strandings	F_{ST} = 0.432***	F_{ST}=0.251***	–
	Φ_{ST} = 0.457***	Φ_{ST}=0.177**	

*$P<0.05$,
**$P<0.01$,
***$P<0.001$.
Significance levels are shown after Bonferroni correction.

3.3.1.2 United Kingdom

A recent study undertaken by Murray-Dickinson *et al*. (2011) assessed current genetic structure in stranded bottlenose dolphins in UK waters. Four UK regions were included in the analysis: east Scotland (n = 25), west Scotland (n = 4), Wales (n = 5), and English Channel (n = 1). Compared to an earlier study undertaken by Parsons *et al*. (2002) on UK bottlenose dolphins, this study increased the sample size, sequenced a larger portion of the mtDNA genome and assessed the spatial distribution of genetic diversity across ten microsatellites.

Results suggested a similar conclusion to that of Parsons *et al*. (2002); bottlenose dolphins off the east coast of Scotland are genetically more similar to those in Wales than to their geographically nearest neighbours off west Scotland. Although the samples size from western Scotland was very small, results suggested a level of population genetic structure among the resident populations of bottlenose dolphins from east and west Scotland (and those in adjacent waters, i.e. Wales; Murray-Dickinson *et al*., 2011). However, there appeared to be insufficient genetic divergence to suggest that these are demographic isolated populations, though other analyses suggest that they do not form a single randomly mating population. A potential confounding issue of

this study is the use of stranded animals, as the sampling location may not match the true population origin of that individual (Murray-Dickinson *et al*., 2011).

It is recommended that samples sizes for genetic analysis are increased from bottlenose dolphins inhabiting waters off western Scotland and Wales and, where appropriate, biopsy samples are obtained from individuals.

3.3.1.3 Iberian waters

Within Iberian waters, the ASCOBANS/HELCOM workshop proposed two MUs: Southern Galicia (SGA), and Sado Estuary (Portugal, SAE).

Fernández *et al*. (in press a) assessed the genetic relationships between resident populations of dolphins from southern Galicia (northwest Spain) and the Sado estuary (southern Portugal) with dolphins inhabiting neighbouring areas. Altogether 91 skin and muscle samples were taken from stranded and biopsied animals between 1994 and 2008 in southern Galicia (n = 29), the Sado estuary (n = 5) and five other geographical locations (n = 57); including sites around the Iberian Peninsula, the Canary Islands and the Azores. Individuals were genotyped at ten microsatellite loci and sequenced at the highly variable mitochondrial control region (426 bp).

Structure analysis on individual microsatellite data, based on either 51 (10 loci) or 71 samples (10 and 5 loci genotypes) indicated that the most probable number of populations within the sample set was two (Ln Pr(X/K) = -1539.27±1.81 for 51 samples and P(X/K) = -1887.28±1.18 for 71 samples). The majority of dolphins from southern Galicia and the Sado estuary were assigned to an individual genetic population, while nine dolphins were identified as possible migrants between the two genetic populations - identified as their genetic make-up did not correspond to their geographical stranding location. Pairwise estimates of genetic differentiation (F_{ST}) based on mitochondrial and nuclear DNA revealed genetic differences ($p < 0.00001$) between the southern (n = 18) and northern Galician (n = 25) populations of bottlenose dolphins.

In addition, skin and muscle from 43 bottlenose dolphins (38 juveniles/adults, 5 calves) stranded in Galicia, were analysed to determine whether stable isotope ratios ($\delta^{13}C$ and $\delta^{15}N$) could be used to assess dietary variation, habitat segregation and population substructure (Fernández *et al*., in press b). Bottlenose dolphins were divided in two putative populations (South: area delimited by the border with Portugal and "Punta Queixal" in the Mount Louro which constitutes the geographic limit between the southern inlets and the northern Galician coastline; and North: area extending from "Punta Queixal" to the border with Asturias; see Figure 2) based on previous genetic studies. GAMs identified significant differences on values of $\delta^{13}C$ ($p = 0.004$ for muscle, $p = 0.003$ for skin) and $\delta^{15}N$ ($p = 0.012$ for muscle, $p = 0.002$ for skin) between these two groups, thus confirming the existence of population structuring. Using stomach content data, significant differences ($p < 0.005$) in the presence of bottlenose dolphins' main prey species (blue whiting (*Micromesistious poutassou)* and hake (*Merluccius merluccius*)) were also found between northern (n = 30) and southern (n = 52) Galician dolphins (Fernández *et al*., in press b).

Based on these results, it is recommended to consider the resident population in southern Galicia as an independent MU, especially given that such resident individuals may be facing added threats relative to non-resident dolphins (e.g. habitat degradation, geographically restricted ranges). For the Sado Estuary, a precautionary approach should be adopted (as recommended by ASCOBANS) and an independent MU should be defined based on these preliminary data (and due to its small size, n =

26 individuals; Augusto *et al*., 2007), and until further demographic and genetic studies with increased sample sizes are undertaken.

A dedicated survey of cetacean abundance in Atlantic shelf waters of the Iberian Peninsula in 2005 provided an abundance estimate of 3935 (CV 0.38) bottlenose dolphins (SCANS-II 2008) while another dedicated survey in 2007 in Galician offshore waters estimated an abundance of 876 (CV 0.82) individuals (CODA 2009). Previously, based on opportunistic sightings from fishing boats in 1998 and 1999, López *et al*. (2004) estimated bottlenose dolphin abundance in Galician coastal and shelf waters to be 664 (95% confidence limits 251–1226) individuals. This latter estimate is best viewed as a minimum figure because it was not possible to estimate the proportion of animals present but not detected by observers, and a 100% detection rate was therefore assumed.

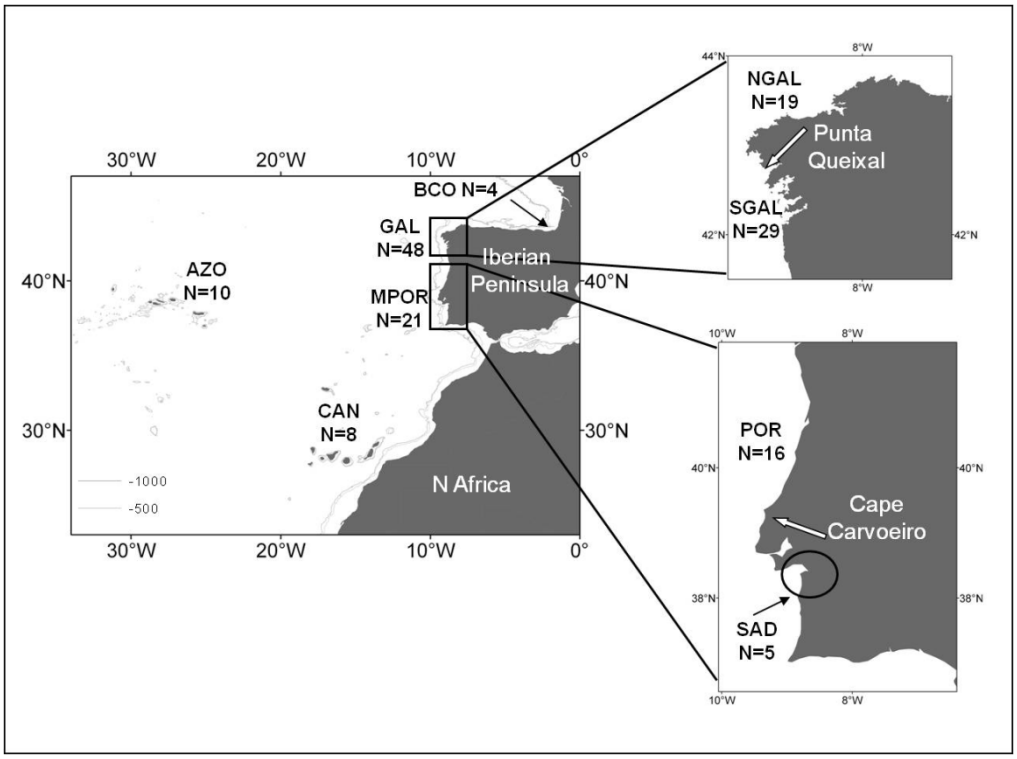


Figure 2. Locations of bottlenose dolphin tissue sampling in the Fernández *et al*. (in press a, b).

3.3.2 Recommendations

The WGMME agrees with the main recommendations from the ASCOBANS/HELCOM WG which are as follows:

- Further assessment of population structure in offshore waters/Atlantic Europe to discriminate population structure in this region.
- Further discrimination of population structure within coastal waters.
- Undertake photo-id studies of coastal populations in the southern distribution of its range in the Northeast Atlantic for establishing range movements, i.e. southern French and Iberian waters.
- Undertake other complementary approaches to assess population and ecological stock structure including skull morphometric analysis, assessment of parasite and contaminant loads, and variation in life-history parameters, and stable isotope analysis.

In addition the WGMME highlights:

- As the existence of the Connemara-Mayo putative population was only identified very recently, this highlights the importance of monitoring coastal areas in order to allow for the identification of such aggregations that may be locally adapted to specific areas.
- It is **recommended** that samples sizes for genetic analysis are increased from Iberia, Wales, western Ireland and Scotland and, where appropriate, biopsy samples are obtained from bottlenose dolphins.

3.3.3 References

Augusto, J. 2007. Análise da estrutura social, da composição dos grupos e associações nos golfinhos-roazes (*Tursiops truncatus*) residentes na região do Sado. MSc thesis, Faculdade de Ciências, Universidade de Lisboa. 56pp.

CODA. 2009. Cetacean Offshore Distribution and Abundance in the European Atlantic (CODA). 43pp without appendices; 164pp with appendices.

Englund A, Ingram SN, Rogan E. 2007. Population status report for bottlenose dolphins using the Shannon Estuary 2006–2007. Report to the National Parks and Wildlife Service, Dublin, Ireland, 1–35.

Englund A, Ingram S, Rogan E. 2008. An updated population status report for bottlenose dolphins using the lower river Shannon SAC in 2008. Cork: Final Report to the National Parks and Wildlife Service.

Evans PGH, Teilmann J. 2009. Report of ASCOBANS/HELCOM small cetacean population structure workshop. Bonn, Germany: ASCOBANS. 141pp.

Fernández R, Santos MB, Pierce GJ, Llavona A, López A, Silva MA, Ferreira M, Carrillo M, Cermeño P, Lens S, Piertney SB. in press a. Fine scale genetic structure of bottlenose dolphins (*Tursiops truncatus*) off Atlantic waters of the Iberian Peninsula. Hydrobiologia. DOI 10.1007/s10750-011-0669-5.

Fernández R, García-Tiscar S, Santos MB, López A, Martínez-Cedeira JA, Newton J, Pierce GJ. in press b. Stable isotope analysis in two sympatric populations of bottlenose dolphins *Tursiops truncatus*: evidence of resource partitioning? Marine Biology. DOI 10.1007/s00227-011-1629-3.

ICES WGMME. 2009. Report of the Working Group on Marine Mammal Ecology. February 2–6 2009, Vigo, Spain.

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

López A, Pierce GJ, Valeiras X, Santos MB and Guerra A. 2004. Distribution patters of small cetaceans in Galician waters. Journal of Marine Biological Association, United Kingdom 84:283–294

Murray-Dickson G, Berrow S, Reid RJ, Thompson PM, Piertney S. 2011. Assessment of population structure using molecular analyses of tissues from strandings. In "Distribution, abundance and population structure of bottlenose dolphins in Scottish waters". Thompson, P.M. Cheney, B., Ingram, S., Stevick, P., Wilson, B., and Hammond P.S. (eds). Scottish Government and Scottish Natural Heritage funded report. Scottish Natural heritage Commissioned Report No. 354.2011.

Mirimin L, Miller R, Dillane E, Berrow SD, Ingram S, Cross TF, Rogan E. in press. Fine-scale population genetic structuring of bottlenose dolphins in Irish coastal waters. Animal conservation.

Parsons KM, Noblea LR, Reid RJ, Thompson PM. 2002. Mitochondrial genetic diversity and population structuring of UK bottlenose dolphins (*Tursiops truncatus*): is the NE Scotland

population demographically and geographically isolated? Biological Conservation. 108(2):175–182.

SCANS-II. 2008. Small cetaceans in the European Atlantic and North Sea (SCANS II). Final report to the European Commission under contract LIFE04NAT/GB/000245.

3.4 Update on the population structure of harbour porpoises in Danish waters

A novel Danish study (Teilmann *et al*., in prep) using telemetry data confirms the presence of three separate harbour porpoise populations in the waters between the North Sea and the Baltic Sea. The three populations inhabit 1) North Sea and Skagerrak, 2) Kattegat, the Belt Sea, the Sound and the Western Baltic (named the Belt Sea Population) and 3) the Inner Baltic, respectively. These results endorse the three management units proposed by ASCOBANS/HELCOM for this region – 1) Northeastern North Sea and Skagerrak, 2) Inner Danish waters and 3) Baltic Sea (ICES WGMME 2010).

In the Teilmann *et al*. study, satellite tracking data from harbour porpoises were used to define population boundaries between these populations, and with the use of these new population boundaries, abundance estimates for the Belt Sea population were calculated based on two visual surveys (SCANS) in 1994 and 2005. The population size was calculated to be 27 767 (CV=0.45, 95% CI=11 946–64 549) in 1994 and 10 865 (CV=0.32, 95% CI=5840-20 214) in 2005. However, these estimates were not statistically different, and there may be questions over the appropriateness of using data from SCANS (a large-scale type survey) to make inferences about much smaller areas.

Based on this, the WGMME **strongly recommend** that an international survey be undertaken, funded by the Governments of Denmark, Sweden and Germany, to determine the abundance of harbour porpoises in the Belt Sea region.

3.4.1 Reference

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

Teilmann J, Sveegaard S, Dietz R. in prep. Status of a harbour porpoise population - evidence of population separation and declining abundance.

4 ToR b. Outline and review the effects of tidal-stream energy devices (construction and operation) on marine mammals and provide recommendations on research needs, monitoring and mitigation schemes

4.1 Introduction

Offshore wind technologies are at a relatively advanced stage compared to tidal-stream renewables in terms of their design, knowledge of areas of impact on species in the marine environment and the information required for environmental consenting. In 2010, the WGMME reviewed the effects of wind farm construction and operation on marine mammals and provided advice on monitoring and mitigation schemes. The extraction of tidal-stream energy from the marine environment has many parallels with the offshore wind sector. For example, developments will involve the placement of substantial structures into the marine environment, and they require large investment and specialized equipment to place and service them. While there are many parallels there are also fundamental differences between these technologies when considering the potential interactions with large vertebrates in the marine environment. The most obvious difference is that the moving structures that capture energy from tidal-streams are submerged below the water surface. A more subtle difference is that the sector is at a much less advanced stage, and there are currently many different concepts (turbine types) being simultaneously developed: the technologies being progressed are extremely diverse in size, shape, method of fixing and many other characteristics. This latter point means that it is difficult to be sure of the future relevance of current evaluations of impact and proposals for mitigation. Also the sites available for tidal energy extraction are much more specific than those available for offshore wind. In addition, as the water column moves at speed relative to the benthos, they are also fundamentally different in nature for animals operating in these areas compared to other marine areas.

At present the tidal-stream energy sector is at a very early stage. Most designs are at early test stages of scale models while a few (see below) are at the levels of full-scale test rigs and there are currently no full-scale commercial developments of multiple devices (arrays). Accordingly, our knowledge of the potential interactions of marine mammals with these devices is limited, based on the first investigations and inferences derived from comparisons with other industries such as fisheries, oil and gas developments and the offshore wind sector. In light of this, this report will focus on highlighting current research needs and important issues of regulation and management to be addressed in the coming years.

4.2 Features of tidal-stream energy converters relevant to marine mammals

There are a wide variety of tidal-stream energy extraction devices in development. These vary both in their basic energy extraction concepts (e.g. lift vs. drag devices) and in their specifics, including water depth requirements, flow speed tolerances, water column position, extent of surface piercing, methods of seabed mooring/attachment, deployment techniques, extent and velocity of exposed moving parts, size and seabed footprints, noise emissions, lubricants used and maintenance/ decommissioning requirements (Scottish Marine Renewables SEA, 2007).

Although some environmental interactions such as removal of the tidal energy itself, cable runs, maintenance boat access, anchoring and fisheries exclusions are likely to be generic, it is anticipated that, given the variability between device types, the majority of issues relevant to marine mammals will vary depending on the particulars of the individual devices.

Tidal-stream devices exploit the kinetic energy within the tidal flow itself (hence these devices are sometimes also called "hydrokinetic" technologies). Most devices exploiting the tidal-stream, work much like wind turbines but are driven by flowing water rather than air. Because water is much (800x) denser than air, equivalent amounts of energy can be extracted at lower flow rates but cavitation becomes an upper constraint on rotor-tip speeds. This phenomenon occurs when flow speeds around a device exceed a critical threshold and produce transient vapour bubbles. This cavitation can lead to significant mechanical damage. Consequently, tidal-stream devices are smaller and rotor tip speeds are lower (maximum ~ 12.5 $m.s^{-1}$ against the water) than conventional wind turbines (EMEC, 2010).

There are currently two main types of tidal-stream tidal devices: horizontal axis turbines and vertical axis turbines. Horizontal axis turbines are the most common technology type being progressed and most look broadly similar to wind turbines. Turbine blades rotate around a horizontal axis to drive a generator. The turbine may be shrouded to increase tidal flow through the turbine and better align the presentation of water to the blades. Foundation strategies vary from gravity bases through to monopiles, hanging from surface barges or floating while tethered to fixed seabed anchor points. The number of turbine blades varies from two to many; with three currently the most common. There are many variants on these themes including devices with sets of counter-rotating blades mounted one in front of the other or blades supported by a doughnut-shaped structure with an open centre. Vertical axis turbines are generally in more basic stages of development and the number of blades and the configuration of the blades also vary between devices.

In addition, several other concepts have been introduced including horizontal but transverse-to-flow rotation turbines combining both lift and drag energy extraction (e.g. the Aquascientific marine turbine), venturi devices, oscillatory motion hydroplanes (EMEC, 2010) etc.. The majority of devices are currently in the prototype stage but eventual commercial scale machines are expected to have generating capacities ranging from 40 kW to around 2 MW per device.

Depth requirements also vary between device types. Bottom-mounted devices can operate in depths of 40 to 50 m or deeper, and have the capacity for no surface expression. Conversely, devices hung from surface barges will have their clearance below them. Surface-piercing piled devices will occupy the entire water column with economic deployment depths currently in the 20 to 50 m depth range. Various anchoring options are available and will be dictated by the device requirements, the receiving environment (including need for slack water and seabed characteristics), environmental impact considerations and also infrastructure availability. Likely methods include piling, drilling, gravity structures (including caissons), anchors, weights and reverse hydrofoils.

In many devices the rotors are the only moving parts during energy production, but in the case of the oscillating hydrofoil the foil is swung vertically through the water on an arm. Venturi devices do not have moving parts exposed to the water. Other than energy gathering, most devices have no other exposed moving parts but some

swing on a mooring or pivot at the turn of each tide. In many devices much of (or the entire) mount may pivot through 180° during the reversal of tidal direction.

Rotor blades on commercial scale horizontal-axis turbines will vary in their dimensions by device and site characteristics, being in the region of 2 to 23 m in diameter. Rotation speeds are likely to be from 10 to 30 revolutions per minute with an upper tip-speed of 10 to 12.5 $m.s^{-1}$ (RPS, 2008; EMEC, 2010). Blades may be exposed or shrouded within an open ended tube. By aligning and funnelling water through the turbines, shrouding can make devices more efficient, but may also have an effect on the potential risk of submerged animals being struck by blades. Any shrouding will act to increase the visibility (visual or acoustic) of the entire devices and better indicate the arc of blade sweep but once entering the tube, the shroud itself creates a physical barrier reducing the manoeuvring options of the marine mammal and altering the chance of an enforced passage through/between the blades of the turbine. Current models of vertical axis turbine diameters are likely to be in the regions of 3 m to approximately 6 m in diameter and up to 6 m in height.

Biological fouling of tidal devices is inevitable and is most likely to have critical impacts on the efficiency of moving parts. There is less clarity on potential antifouling strategies that companies will use. Many devices will contain hydraulic fluids but these are likely to be relatively small in quantity.

As with other post-concept testing issues, maintenance schedules are less clear. The limited working windows present at tidal sites will provide a strong incentive for developers to seek strategies that involve minimal maintenance. However the techniques used – raising and lowering on a pile; complete uplift, partial uplift etc. – will potentially make a substantial difference to the vessel traffic associated with maintenance of a tidal array. Decommissioning is likely to involve similar processes to the construction phases.

At present, the bulk of the tidal-stream energy industry is focused on the deployment and improvement of single demonstrator devices, but to deliver useful electricity the industry will have to move into the next phase: the placement of multiple full-scale devices. Considerations of the appropriate geometry and spacing of such arrays for optimal energy extraction is still at an early stage and so it is difficult to extract generalities in terms of potential environmental impacts from such scale-ups. However, current discussions suggest that arrays will be composed of tens to hundreds of similar devices duplicated across discrete patches of the seabed.

4.3 Summary of the distribution and scale of some of the tidal-stream energy developments in ICES waters

4.3.1 UK

4.3.1.1 Scotland

Though still in its infancy, the tidal-stream energy sector is due to expand, rapidly, in Scotland over the next decade. At present there are just two operational grid-connected demonstrator devices in the water, both at the European Marine Energy Centre (EMEC) test facility off Eday, in Orkney http://www.emec.org.uk/tidal_site.asp. These are operated by OpenHydro and by TGL (Tidal Generation Ltd.). Five berths remain for further tidal devices, most of which are likely to be occupied by the end of 2011. A non grid-connected 'scale' or

'nursery' site for the testing of scale devices and deployment and retrieval methodologies is also due to become operational later in 2011, off the island of Shapinsay.

In March 2010, the Crown Estate announced the award of lease agreements for four commercial tidal-stream arrays in the Pentland Firth and Orkney (along with six wave-power arrays; Figure 4.3). A fifth tidal energy scheme was added later that year. The award of a lease guarantees the developer exclusive use (for energy production) of the area of sea concerned, but consent from the industry regulator (Marine Scotland) still needs to be obtained. The five tidal schemes will, if consented, have a combined generating capacity of 1 GW, and range from 100–400 MW per scheme. Most developers plan a phased build-up of their arrays but hope to have the initial phases operational by 2015.

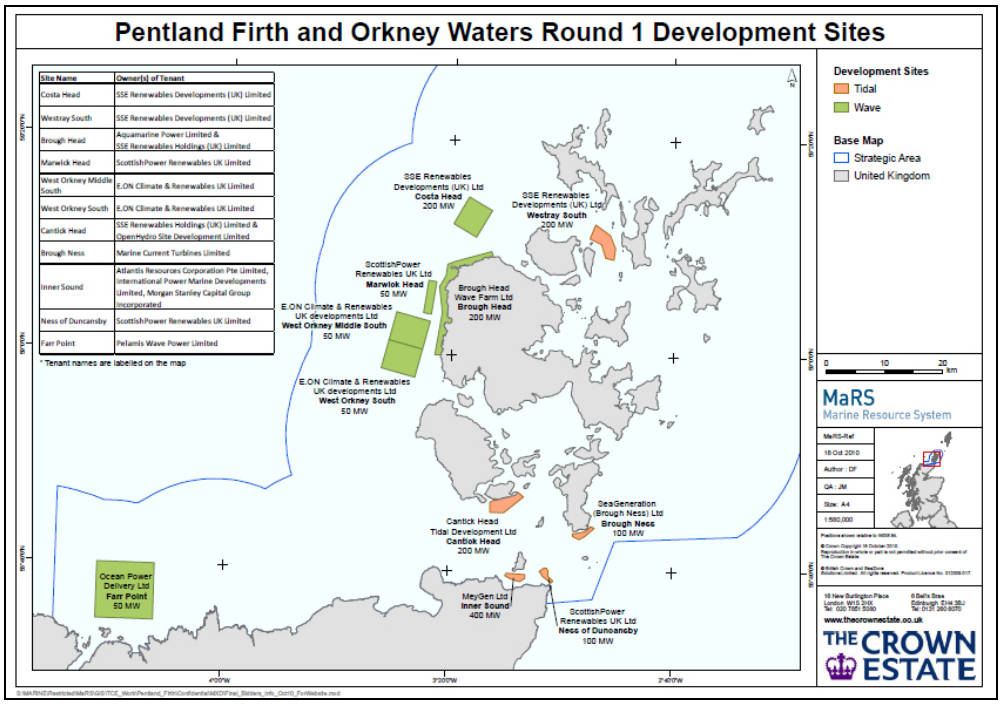


Figure 4.3. Pentland Firth and Orkney Waters Round 1 Development Sites.

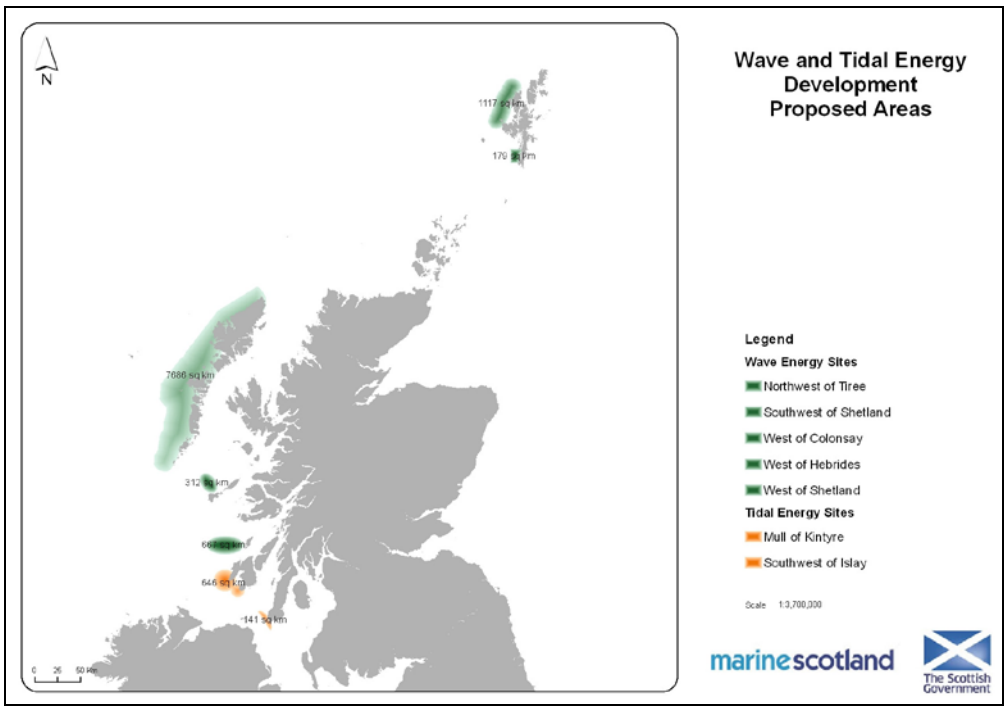


Figure 4.4. Scottish leasing round (Saltire prize projects) proposed areas.

In March 2011, consent was given to Scottish Power Renewables for the construction of a 10 MW tidal-stream array in the Sound of Islay. If constructed by 2013, as planned, this is likely to be the first operational tidal array in the world.

Further agreements for lease for commercial and demonstrator arrays are due to be announced imminently through the Crown Estate and Scottish Government's 'Saltire Prize' leasing round. These are likely to be focused around the Mull of Kintyre and the Islay, in southwest Scotland (Figure 4.4). Lease agreements for a small number of additional demonstrator schemes, elsewhere in Scotland, are due to be announced at the same time. Up to date details can be obtained from the Crown Estate website: http://www.thecrownestate.co.uk/wave-tidal.

4.3.1.2 Northern Ireland

SeaGen was used in the world's first commercial tidal-stream generator. It is sited in Strangford Lough and is a free-stream tidal energy device. The device comprises twin 16 m diameter rotors connected to a generator through a gearbox, with a rotor system supported on the end of a cross beam. The cross beam is, in turn, supported by a 3 m diameter pile. The cross beam can slide vertically up and down the pile to allow access to the rotors, generator and gearbox for servicing and inspection, thus minimizing the requirement for diver intervention.

The top of the pile is approximately 9 m above the average sea level (Figure 4.5). The twin rotors begin to generate electricity at a current speed greater than 1 m/s. At a predetermined maximum tidal speed the rotors start to adjust their pitch to limit the maximum rotational speed to 14 RPM, resulting in a peak rotor tip speed of around 12 $m.s^{-1}$. In 2008, the 1.2 MW system was installed in Strangford Lough, weighing 1000 tonnes and with a width of 43 metres from tip to tip.

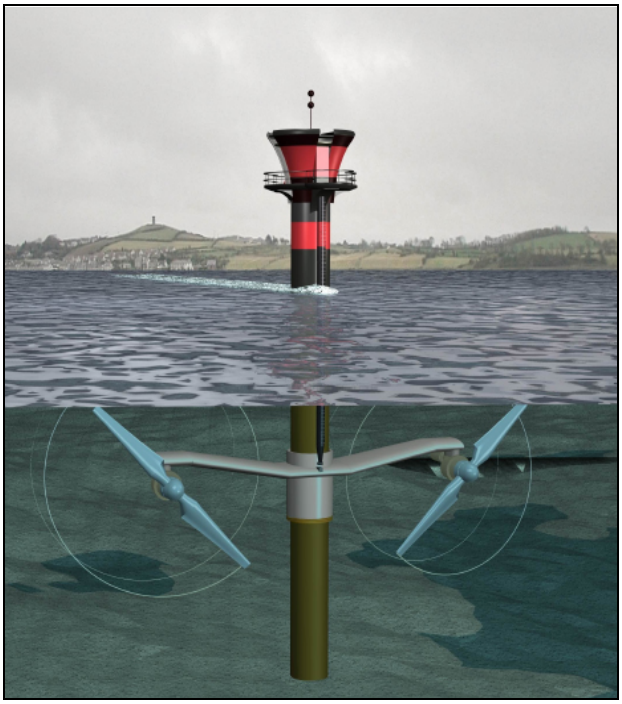


Figure 4.5.The SeaGen turbine, Strangford Lough, Northern Ireland. This figure shows the original SeaGen monopile installation concept which was modified to accommodate a change in installation platform in February 2008. The actual installation foundation is a four-footed structure, 18 m by 12 m in footprint area. Each corner of the foundation is supported on a 1m diameter pin pile. The base of the structure is raised approximately 2 m above the seabed on pin piles, thus resulting in a smaller seabed footprint than the original monopole design (taken from SeaGen Biannual EMP update 2010).

4.3.1.3 England

An experimental 300 kW test system that was the precursor to the SeaGen (above), called Seaflow was successfully installed off Lynmouth in Devon in May 2003 (Figure 4.6). Seaflow met its design specification in full (exceeding both its rated power of 300 kW and rotor design efficiency) as well as having remained operable in open sea exposed conditions for almost three years (http://www.bwea.com/marine/devices.html).

The Isle of Wight Council will soon hear if its bid for £20 m of Regional Growth Funding to develop a tidal energy test facility at the Solent Ocean Energy Centre off the Island's south coast is successful. Reports have suggested that the proposed tidal scheme could be operational within three years and will consist of small 1 MW devices off the west coast of the island, and larger 10 MW arrays off St Catherine's Point, south of the island. The Isle of Wight is also keen to seek further private and EU matched funding to generate 250 MW of tidal power - which is enough to provide power to the entire island (http://social.tidaltoday.com/intelligence-brief/fortnightly-intelligence-brief-16-february-%E2%80%93-2-march-2011).



Figure 4.6. Seaflow installed off Lynmouth, Devon.

The "Neptune Proteus" tidal stream power device has been designed to generate 1000 MWh/yr of electrical energy in estuarine sites with a typical tidal stream current of less than six knots. The target capital cost of producing this tidal energy is less than £1 m/MW. Neptune Renewable Energy Ltd has built a full-scale Proteus Demonstrator which was brought to the Humber Estuary at Hull, England, in July 2010. Upon successful completion of trials with the Demonstrator, a tidal stream power array, consisting of advanced NP1500s, will be built and deployed during 2011–2012. The Neptune Proteus is 20 m in length, 14 m in width and weighs more than 150 tonnes (Figure 4.7). It contains a vertical axis, crossflow turbine measuring 6 m x 6 m. The turbine is mounted within a patented, symmetrical Venturi diffuser duct, and beneath a very simple steel deck and buoyancy chambers. It is designed specifically for estuarine sites with associated valves and electrical and electronic processing and control mounted onshore. The device is moored in the free stream, lessening the environmental impact, and it will operate equally as efficiently in either an ebb or a flood tide. From above it will look very much like a simple pontoon with the flat roof lining up with the level of the water, with 80% of its bulk lying under the water (see http://renewableenergydev.com/red/tidal-energy-neptune-proteus-np1000-tidal-energy-device/).

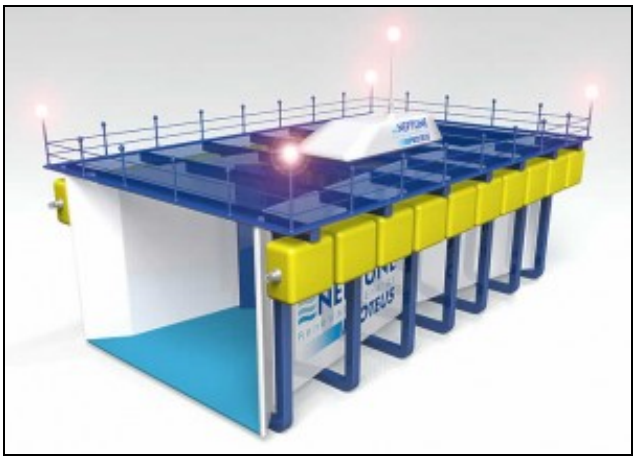


Figure 4.7. Neptune Proteus.

4.3.1.4 Wales

In 2008, RWE Npower renewables and Marine Current Turbines Ltd (MCT) announced a partnership to help deliver a commercial-scale tidal-stream project off the

coast of Anglesey, north Wales, "Anglesey Skerries Tidal Stream Array". In March 2011, the partnership submitted a consent application to install a 10 MW array of tidal stream turbines in 2015. The array will consist of seven twin rotor turbines arranged across an area of 0.56 km², generating enough power for over 10 000 homes. The array will be situated between the Skerries islands and Carmel Head, about 1 km off the Anglesey coast.

In March 2011, it was also announced that consent had been provided for Tidal Energy Ltd's 1.2 MW tidal energy demonstration project, which will be located in Ramsey Sound off Pembrokeshire. This will provide electricity to St Davids (approximately 1000 homes) during a 12 month test period. The DeltaStream device uses the same concept as a wind turbine together with ship propeller technology, and sits on the seabed without the need for a positive anchoring system (http://www.tidalenergyltd.com/technology.htm). The device generates electricity from three separate horizontal axis turbines mounted on a common frame. The use of three turbines on a single, ca. 30 m wide triangular frame produces a low centre of gravity enabling the device to satisfy its structural stability requirements including the avoidance of overturning and sliding. If this trial is successful, the development of a pre-commercial array is expected in 2014.

4.3.2 Channel Islands

In the Channel Islands, several locations have been studied extensively regarding their suitability for tidal-stream arrays. Five tidal races have been regarded to be suitable: Race of Alderney (http://www.energy.soton.ac.uk/marine/arrays.html), Casquets (http://www.carbontrust.co.uk/SiteCollectionDocuments/Various/Emerging%20technologies/Technology%20Directory/Marine/Other%20topics/PhaseIITidalStreamResourceReport.pdf), NW Guernsey, Big Russel, and NE Jersey (http://www.energy.soton.ac.uk/marine/resource.html).

4.3.3 France

SABELLA D03 is an experimental project conducted by the SABELLA Consortium. This project involved testing at sea, with on-board equipment, a pilot tidal turbine made to a 1:3 scale. During the two sets of trials which spread over a year, a series of submarine measurements and observations were regularly carried out. The engineering of the SABELLA D03 project began in May 2007, and the building of the turbine (3 m diameter) was completed in March 2008 and immersed in April 2008 in the estuary of Bénodet (http://www.sabella.fr/eng/sabellaD03.html).

In addition to this, there are six other intended projects at various stages of development:

1. A device is planned to be placed at the offshore island location of Cote d'Ouessant (West of Brest), though permission/permit has not been granted yet.
2. EDF-EN intends to immerse a prototype at Paimpol-Brehat (West of Saint-Malo) in summer 2011.
3. A device is planned to be placed at Raz-Blanchard (Northeast of Guernsey) together with OpenHydro.

4. An Eco-Cinetic device is planned to be placed in the Gironde estuary (near Bordeaux).
5. Hydro-Gen tests floating devices near Brest (10-20m by 5-10m with 100-300 kW possibly up to 1 MW).
6. Alstom and DCNS have shown interest in becoming involved in this industry. No further plans are known at this moment, but the sizes of these industries make their involvement rather likely.

4.3.4 Spain and Portugal

Spain provided information on wave and tidal power installations to the meeting of the OSPAR Biodiversity Committee (BDC) in Stockholm on 23–27 February 2009. The projects described all related to exploitation of wave energy. The following plants were in operation or in construction:

- BIMEP (Biscay Marine Energy Platform), in Armintza-Lemoniz (Vizcaya, Pais Vasco). This series of Wave Energy Converters (total area of 8 km^2) was at the stage of Environmental Impact Assessment.
- Mutriku Port (Guipuzcoa, Basque Country). The plant, consisting of 16 turbines with Oscillating Water Column (OWC) technology, was under construction and predicted to be in operation during 2009.
- Wave Energy Prototype in Pasajes (Guipuzcoa, Basque Country). This prototype was designed to test the viability of a bigger wave energy device in the area.
- SWEP (Santoña Wave Energy Project; Cantabria). Installation of this wave power pilot plant started in September 2008.

In addition, at least two wave energy projects were under technological analysis or development in Galicia.

Portugal has undertaken various pilot projects to develop wave energy, including the AWS Pilot Plant at Póvoa de Varzim and a coastal Water Oscillating Column (OWC) device off Pico in the Azores. In 2008, Portugal designated a "Pilot Zone" off São Pedro de Moel for the installation of wave energy technologies. The private non-profit Wave Energy Centre (www.wavec.org) has carried out a range of testing, monitoring and environmental impact assessment work related to wave energy extraction in Portuguese waters, including studies focused on marine mammals.

4.3.5 Netherlands

The famous Dutch sea defence in the south of the Netherlands offers excellent tidal energy generating possibilities. Tocardo Inc. is developing a site to generate almost 1 MW of commercial tidal power, and is to be commissioned in 2011 (permission was granted end 2010).

Both the Oosterschelde sea barrier and Grevelingendam are very promising locations for tidal developments, and recently a study was prepared for the Dutch Government investigating the exploitation of the Grevelingenhevel for (tidal) energy production. In the "Oosterscheldekering" plant, the companies Tocardo and Ecofys planned six turbines 4.5 m below the surface in Oosterschelde. Each turbine is suspended in a 7 m by 7 m opening with current velocities of up to 9 m/s.

In the Waddenzee, between the Island of Texel and the seaport of Den Helder, the first offshore tidal farm in Holland is being developed. According to the proposed monitoring plan for "Marsdiep", the design of the array has been adjusted to 2 turbines (in autumn of 2011; 500 kW). There is a working demonstration array (a 45 kW T50 turbine) near Den Oever in the Afsluitdijk, between the Waddenzee and lake Ijsselmeer.

4.3.6 Norway

A 300 kW prototype tidal turbine was developed and installed in 2003 (at 50 metres depth) in Kvalsundet off Hammerfest. This is the first tidal turbine in the world that generates electricity which is supplied directly to the electricity grid onshore.

Hydra Tidal's floating tidal power plant "Morild II" was opened in Gimsøystraumen in Lofoten in November 2010 (Figure 4.8). Morild II, which has unique laminated wood turbine blades with a 23 m diameter generating up to 1.5 MW of power, has a two-year trial period for testing of the plant and the technology (http://www.renewableenergyfocus.com/view/14191/floating-tidal-power-plant-opened-in-norway/).

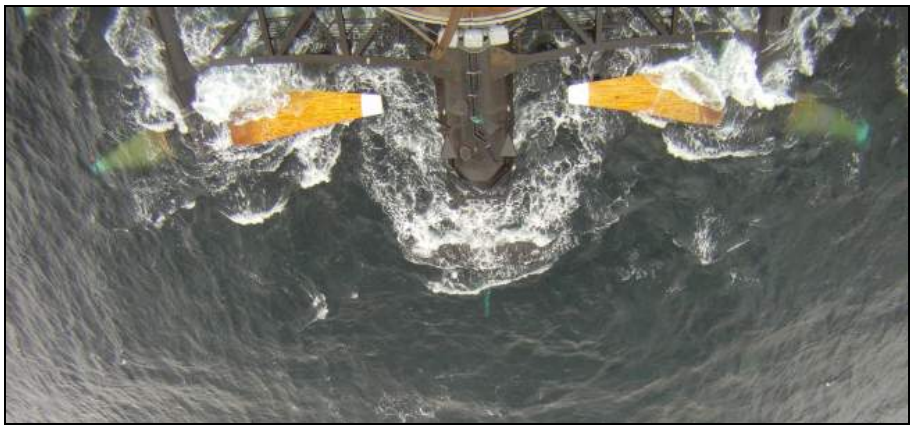


Figure 4.8. The Norwegian tidal power plant Morild II is probably the biggest floating power plant in the world (photo: Hydra Tidal).

4.3.7 Russia

A small turbine, with 0.4 MW installed capacity, was built by the Soviet Union at Kislaya Guba in the Barents Sea. In 2006, it was upgraded to a 1.2 MW experimental advanced orthogonal turbine. The station is the world's 4th largest tidal power plant with a current output capacity of 1.7 MW. Construction on the project began in 1968 but was later suspended until December 2004, when funding resumed. The site was originally chosen because the long and deep fjord had a fairly narrow outlet to the sea which could easily be dammed for the project. There are plans for two larger scale projects based on this design near Mezen, on the White Sea and Tugur on the Sea of Okhotsk (http://en.wikipedia.org/wiki/List_of_tidal_power_stations).

4.3.8 Canada

FORCE (Fundy Oceans Renewable Centre for Energy) is currently constructing the Minas Basin commercial scale demonstration in Minas Passage, Bay of Fundy, Nova Scotia. In 2009, OpenHydro paired up with Nova Scotia Power to deploy a 1 MW tidal turbine in the Bay of Fundy in Canada. The project was to serve as part of Nova

Scotia's tidal power test facility. The Open Center Turbine was manufactured in Ireland by OpenHydro. The turbine rests directly on the seabed using a subsea gravity base fabricated by Cherubini Metal Works. The uncabled 10 m diameter OpenHydro was deployed for one year, with further plans to lay an 80 MW cable during summer of 2011 to provide four berths. When placed on the seabed of the Minas Passage it had the ability to collect certain data and transmit it to shore via a modem. Ten days after deployment however, contact was lost with the turbine's modem. Future devices planned for deployment are MCT, Clean Current, OpenHydro and Atlantis.

The New Energy Corporation Inc (NECI) EnCurrent™ Generation system was customized for the particular conditions of the Bay of Fundy resulting in a short trial run of a 5 kw system in 2010. A 25 kw system will be deployed to inform the development and customization of the EnCurrent 250 kw System with particular emphasis on the mooring and anchoring required for strong tidal currents. (http://www.fundytidal.com/index.php?option=com_content&view=article&id=12:tidal-power-project-planned-for-grand-passage-nova-scotia&catid=11:news).

Information on other projects planned for the Bay of Fundy can be found at http://www.fundyforce.ca/ and http://www.fundytidal.com/.

4.3.9 USA

A number of tidal projects have been developed/or are in development including:

- "Long Island Sound Tidal Energy Project" (2006) in Orient Point, NY;
- "Ward's Island Tidal Power Project" (2006) in Ward's Island, East River, NY;
- "Cape Cod Tidal Energy Project" (2007) in Cape Cod Canal, MA;
- "Housatonic Tidal Energy Plant" (2007) in Housatonic River, CT;
- "Shelter Island Tidal Energy Project" (2008) in Shelter Island Sound, NY;
- "Kingsbridge Tidal Energy Project" (2009) in Manasquan River, NJ;
- "Cuttyhunk Tidal Energy Plant" (2009) in Nantucket Sound, MA;
- "Cobscook Bay site" turbine testing from a barge (2010) in Eastport, Maine;
- "Fishers Island Tidal Energy" (2011) in Long Island Sound, NY;
- "Rockaway Tidal Energy Plant" (2011) in Rockaway Inlet, NY;
- "Wiscasset Tidal Energy Plant" (2010) in Sheepscot Bay, Wiscasset, ME;
- "New England Marine Renewable Energy Consortium" (2011) is currently assessing the viability of sites in Muskeget Channel;
- "Center for Ocean Renewable Energy (UNH-CORE), University of New Hampshire, Durham, NH" (2011) is testing turbines under a river bridge.

Ocean Renewable Power Company (ORPC) is applying to the Federal Energy Regulatory Commission (FERC) for a pilot project licence for the Cobscook Bay Tidal Energy Project in Maine (http://www.oceanrenewablepower.com/home.htm). ORPC obtained an initial preliminary permit for the project area in Cobscook Bay from FERC on July 23, 2007; FERC issued a successive preliminary permit on January 13, 2011. As part of the pilot licence, ORPC plans to install five tidal turbines in Cobscook Bay with a total capacity of 300 kW. Under their preliminary permit, ORPC has been testing a prototype turbine moored off of a barge in Cobscook Bay (Figure 4.9). The prototype turbine generation unit is 46' wide x 14' high x 11' deep, and is moored off a barge. The prototype generation unit is a reaction cross-flow machine that consists of

four helical blades running along a cylindrical surface like a screw thread. The helical blades, which have an airfoil, teardrop-like design (similar to an airplane wing), provide a reaction thrust from water currents to rotate a turbine shaft, generating electricity.

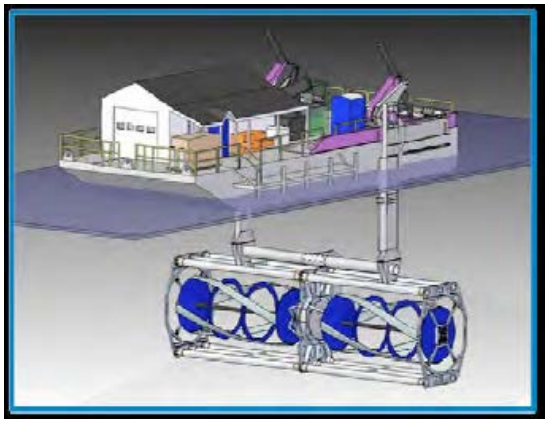


Figure 4.9. Ocean Renewable Power Company prototype tidal generating unit in Cobscook Bay.

4.4 Potential effects of tidal-stream developments on marine mammals

Marine mammal species can potentially be impacted from installation and operation of tidal-stream devices in a number of ways. Most of the effects described below are considered probable or hypothetically feasible, but require databased verification with any new device being built. Further information on possible impacts can also be found in Masts Marine Predator JRT (2010).

4.4.1 Installation effects

4.4.1.1 Physical disturbance

The presence of installation vessels and equipment can disturb marine mammals, particularly hauled-out seals. This would be most significant for breeding seals hauled out at the coast and on intertidal banks, as it may lead to temporary abandonment of the young and could result in increased juvenile mortality. In addition, if moulting seals are scared into the water, they may lose condition as a result of additional energetic costs.

4.4.1.2 Noise emissions

As with other anthropogenic activities in the marine environment, tidal-energy extraction is likely to result in an injection of acoustic energy into the water. In the construction phase, some aspects of introduced underwater noise will have direct parallels with the offshore wind industry particularly when heavy lift vessels are used to deploy the devices. However the methods of site preparation and attachment are likely to differ and be more diverse, particularly as most tidal-energy sites are in areas of hard rather than soft substrate and there is a mixture in the mounting requirements of the turbines. In addition, where dynamically positioned ships are used, the energy and associated acoustic output needed to keep to their station is likely to be greater when these vessels need to keep station against the tidal-streams. Acoustic disturbance of marine mammals due to installation of devices and cable-laying can occur both within the water and in the air for seals using haulout sites. Should piling be the chosen method for installation of the foundation, in conjunction with other

activities such as drilling, the impulsive noise input without applied mitigation measures may have a higher potential for injurious impacts (such as Temporal or Permanent Threshold Shifts) and wider displacement of animals (see ICES WGMME 2010). Though it should be noted in the case of installation of tidal energy devices, much smaller diameter piles are likely to be used compared to the offshore wind sector.

Exclusions for lengthy periods are particularly relevant in constrained areas (such as mouths of sea lochs and straits between water masses) as loud noise sources may prevent transit, effectively trapping individuals. Ships used for construction contribute to the ambient noise level in the area, especially those using lower frequencies, as this poses the risk of masking biological significant signals of passive acoustic sensing in baleen whales, thus effectively shrinking the space of their acoustic soundscape.

4.4.1.3 Reduced visibility

Increased turbidity leading to reduced visibility can occur during seabed installation, as fine particles travel further from the disturbed area, swept by tidal currents, which have the potential to effect foraging, social and predator/prey interactions. Grey and common seals have been identified as having a high sensitivity to reductions in visibility. However, tidal devices will be placed in high energy environments and it is likely that the relatively small amounts of sediment that are likely to be released into the water column during turbine and cable installation will be rapidly dispersed and accordingly have a negligible impact on background suspended sediment and turbidity levels. The introduction of devices and the associated increased hydrodynamic drag into areas with tidal-streams may however result in some relocation of previously stable (or dynamically stable) sediments at downstream sites. Such consequences have, so far, received little attention.

4.4.1.4 Impacts due to contaminated sediment

Possible release of contaminants when dispersing sediment during cable and device installation could become problematic for marine species that are sensitive to contamination, i.e. marine mammals; though as noted above, as with fine particles, any release of contaminants may be rapidly dispersed and are unlikely to have accumulated in tidal-stream areas themselves.

4.4.1.5 Collision risk with installing vessels and constructing machinery

Vessels are needed for installation of tidal devices and export cables. As both activities are likely to happen in an either stationary or slowly travelling mode, on first consideration collision risk during construction periods is likely to be lower than by commercial shipping activities. However, it should be remembered that these vessels may need to operate at full tidal flows and thus while stationary above the bottom may be moving at speed through the water (i.e. $\geq$3 $m.s^{-1}$). During 2009/2010, unusual seal mortalities were noted in the UK east coast and in Northern Ireland; the carcasses having characteristic spiral injuries (Thompson *et al.*, 2010). The injuries are consistent with the seals being drawn through a ducted propeller such as a Kort nozzle or some types of Azimuth thrusters. Such systems are common to a wide range of ships including vessels likely to be associated with tidal-stream developments, for example tugs, self-propelled barges and rigs, various types of offshore support vessels and research boats.

4.4.2 Operation

4.4.2.1 Collisions with moving parts

There is a misconception that the probability of cetaceans failing to detect and avoid a large static structure is extremely low, as they echolocate and are agile and quick moving. However, collision risk is considered to be a key potential effect during tidal device operation and, looking at the wide range of devices that may be deployed, all species of marine mammals are at some risk of collision impacts. The information odontocetes derive from echolocation is limited by the update frequency of sound pulses. In addition, updates rates are limited by the travel time of the sound. Their active echolocation is continuously tuned to the objects of interest, e.g. while foraging. Thus although animals may be capable of detecting distance objects, they may be effectively blind to them when foraging on prey immediately in front of the devices. Factors which can contribute to the possibility of negative interactions with moving parts are for example detection failures, diving constraints, group effects, attraction, confusion, distraction and diseased/injured animals.

One mitigation option to lowering the risk of collision in the absence of a good understanding for potential impacts is the "precautionary turbine shutdown" approach. In Strangford Lough, work is progressing towards achieving full automation of the device shut down procedure, if marine mammals are within a certain distance to the operating SeaGen tidal turbine. Device shut down may be in the interests of the developer, to avoid damage to their turbines, however it prevents further assessment of the implications of interactions of wildlife with operational devices.

4.4.2.2 Noise emissions

During operation, lower levels of noise are expected than during installation because the turbines are optimized to remove energy from the environment. They will however produce sound associated with the motion of the rotors against the water, internal gearing and so forth. Currently little is known about the actual and potential acoustic outputs of operating turbines both when first deployed and when they have had a period of operation; after wear and fouling. Coupled with this, information on the levels of ambient sound, relevant to marine mammals, in areas of strong tidal-streams is poorly known so that it is currently difficult to forecast over what range turbines will be audible to marine mammals. Initial modelling work has suggested that these ranges may be highly variable depending on the specifics of ambient sound and turbine noise levels (Carter, 2008). However because both of these levels are likely to exceed the marine mammal hearing sensitivities, the precise hearing capabilities of species of risk are less important than is typically the case. The results of this study also showed that in some circumstances, such as quiet devices in noisy waterways, may be undetectable by animals until they are at very close ranges (e.g. <10 m, Carter, 2008).

4.4.2.3 Generation of electromagnetic fields

When in operation, cables may generate electromagnetic fields that could alter behaviour and migration pattern of species susceptible to those (e.g. sharks and rays). Electricity cables produce small electric and magnetic fields, which have the potential to affect migration and prey detection in seals and cetaceans. Heat dissipation from transfer losses increase the temperature in the vicinity of power cables and may potentially affect the survival rate of bottom living species. There are various mitigations options to minimize these risks such as good construction of cables, i.e. using

materials with very high conductivity and permeability values, using high voltage direct current and burying of the cables.

4.4.2.4 Contaminants

Parts of the different types of tidal devices are likely to need antifouling. Methods of achieving this for many devices have not yet stipulated though antifouling paints will undoubtedly be used. Although organotins are now banned for these, copper is still in use. Further potential sources of contaminants are leaching of toxic compounds from sacrificial anodes, or leakage of hydraulic fluids e.g. due to storm damage, device malfunction or collision with vessels such as transiting ships. The latter could even lead to significant leaks of cargoes or fuel carried by the vessel involved.

4.4.2.5 Habitat exclusion

It is unknown how animals will respond to operating devices. As with other anthropogenic activities, responses are likely to be species-specific. While some may be attracted, it is likely that neophobic species will show avoidance reactions to the novel, moving structures. Such avoidance may result in displacement and even long-term habitat exclusion.

4.4.2.6 Entrapment

Operating devices, especially arrays, could from a barrier for migration routes and transit patterns of marine mammals, which again is of particular relevance in constrained areas; where noise and the physical presence of moving structures may prevent transit, leading to entrapment of individuals.

4.4.2.7 Water column changes

To species that are sensitive to changes in tidal flows a decrease in water flow resulting from extraction of tidal energy could be a relevant impact. Seals have been shown to use their vibrissae to sense small-scale hydrodynamic vibrations and flow vortices in the water column. It is likely that that they use this sense to track the wake of prey organisms swimming through the water column.

4.4.2.8 Additional haulout sites

In cases where tidal-stream devices have horizontal surfaces near water level, seals will potentially use them as haul-out sites. If these provide a sufficiently long-term and extensive opportunity, this may extend local foraging pressures from any seals using them. Conversely, there may be some physical risk of injuries to animals from sharp or exposed moving parts.

4.4.2.9 New hard surfaces (artificial reefs)

Offshore wind turbines and tidal turbines with associated seabed moorings and vertical structures may function as artificial reefs and thus aggregate fish potentially leading to increased foraging opportunities for marine mammals. Also if schooling fish or squid become scattered due to moving parts of a tidal turbine, opportunistic feeders such as seals or small cetaceans might take advantage.

4.5 Overview of international and national guidelines on monitoring and mitigation

In 2010, the WGMME undertook a review of general national and international guidelines and regulations for marine mammals, and those focused on monitoring and mitigation of the effects of offshore windfarms (see ToR A). The tidal-stream energy sector is not as mature as that of the offshore wind industry and, consequently, nor are the national guidelines. In the UK, where operations involve the use of piling, for example, the standard guidance applies while other more novel activities require greater levels of adaptation to guidelines. Additionally, in light of the seal deaths possibly associated with ducted propellers (see Thompson *et al*., 2010), the UK Country Agencies are advising that, in some circumstances, operations using such vessels should not be conducted during key times of the year and, when they do occur, that MMOs scan the area for seals prior to operations commencing. Should a seal be observed in the vicinity of a vessel, the operation requiring the use of ducted propellers should be delayed until the animal has moved away.

At the Falls of Warness in Scotland, marine mammal (and bird) monitoring is provided by land-based observers coordinated through the EMEC. The observer carries out a defined system of four-hour watches throughout the year and records species and numbers present and ancillary behavioural information. Because this is a test centre, additional routine long-term monitoring is not required by individual developers. Marine mammal observers will normally be required on installation vessels if the process is likely to be "noisy", and the observer will enforce a soft-start approach and cessations of operations if an animal comes within a defined distance. "Noisy" operations are normally avoided during sensitive times of the year, such as the seal pupping season, if weather conditions provide a long enough window for construction. If "noisy" operations are to happen during the pupping season, targeted observations of the behaviour of seals at haulout sites located close to the test site are required. There are currently no other mitigation practices other than soft-starts and seasonal controls.

4.6 Monitoring

Recommendations on baseline and impact monitoring of offshore wind farms are provided in ICES WGMME (2010, see ToR A). The majority of these recommendations are relevant to wet renewables (including tidal-stream energy extraction); however there is a need to develop new methods for surveying the abundance/distribution of marine mammals in flowing water. In addition, collision risks are not well understood for marine mammals. Understanding how marine vertebrates perceive, avoid and evade such devices needs to be assessed. In addition, quantification of the potential rate of collisions and the population level consequences of individual physical injury, arising from collisions, and habitat exclusions are required (Wilson *et al*., 2007).

Given the difficulties of inferring animal interactions with tidal-stream turbines from other anthropogenic marine structures and the obvious scale problems of experimenting with part-devices on captive animals, it is currently difficult to empirically test many of the potential marine mammal issues described in Section 4.2. Consequently the Scottish Government is developing a so-called "survey, deploy and monitor" approach. This strategy gets passed a potentially halting precautionary approach by permitting the staged industry advancement, with the opportunity to observe and study real device-environment interactions. A pragmatic tactic such as this is clearly

necessary if the sector is to grow at rates required to meet European and other carbon-reduction energy targets. However this approach suffers from the difficulties associated with many diverse device concepts (see Section 2) and types of deployment site being progressed simultaneously. To work, this approach therefore will have to be coupled with attempts to much better understand how animal-device interactions will actually occur and what factors lead to negative or positive outcomes. Consequently, a range of new tools are needed to understand the potential impacts of tidal-stream energy devices on marine mammals. For example, in terms of understanding collisions better methods to survey the abundance and distribution of animals in flowing water are required. Also, methods to actually detect and monitor the movements of animals that approach turbines are required along with the ability to recognize any impacts should they occur either by registering them at the turbine or correctly recognizing injuries on carcases. Should fatalities be registered then quantitative methods are then required to establish how many interactions are acceptable in balancing the conservation needs of the animals and our priorities for tidal-stream generated marine renewable energy.

4.7 Case study–SeaGen turbines in Strangford Lough

An environmental monitoring and associated research programme was designed for SeaGen in Strangford Lough to 1) detect, prevent or minimize environmental impact attributable to the turbine installation and operation; and 2) provide an ongoing monitoring strategy to determine any immediate or emerging adverse impacts on the habitats, species and physical environment of Strangford Lough. A multi-scale approach to monitoring was designed to meet these objectives. For harbour seals, these were:

1. Aerial thermal imaging surveys for harbour seals at haul-outs along the Irish Sea coastline;
2. Telemetry (SMRU GPS/GSM tags) of harbour seals around the turbine location;
3. Shore based carcass surveys and necropsies of all marine mammals;
4. Passive acoustic monitoring (TPODs) for porpoise presence around the turbine location;
5. Shore based visual observations at the turbine location to measure relative abundance and distribution;
6. Turbine based MMO observations post installation to initiate turbine shutdown on animal approach;
7. Turbine based active sonar monitoring to assess fine scale movements around the turbine.

The turbine was installed in June 2008 and only a limited period of operation is available for analysis, though results so far have suggested:

- There was no evidence of a change in seal haulout behaviour, transit rates through the Narrows, time spent within the Narrows and time spent in the immediate vicinity of the device;
- Post-mortems of marine mammal carcasses have shown no link between mortality and the operating SeaGen turbine;

- Following analysis of T-POD data, detection positive minutes per day of porpoises were considerably lower within the Narrows during installation compared to the pre- and post-installation periods;
- No significant difference between porpoise detections during baseline and post-installation were observed in the inner Lough;
- Shore based observations of porpoises showed a decrease in their average relative abundance over time in the Narrows, which supports the T-POD findings;
- Shore based observation of seals showed no evidence of disturbance during installation phase, and there was no evidence of a change in underlying relative seal abundance in the area;
- Active sonar monitoring showed that both marine mammals and 'other' targets moved past the turbine in close proximity. However, due to the current requirement for "precautionary turbine shutdowns" it is not possible to determine how marine mammals would interact with the turbine during operation.

4.8 Recommendations

Looking at the forecasts for the development of renewable energy deployments in the wider OSPAR/ICES/European marine environment, together with the predicted spatial scale of any impacts, it is important to develop consistent approaches (at least on a regional sea basis) to providing basic information about the ecological features within a region, especially those that are protected and/or are known to be especially sensitive to pressures resulting from construction and operation of tidal-stream devices.

Because current marine mammal monitoring is not designed to address impacts of renewable energy extraction, it is almost certain that additional measurements of population trends of abundant and sensitive species needs to be carried out; both small-scaled for the actual construction site (and also to assess changes in behaviour) as well as larger-scaled to gain an overview of the regional sea area and mitigation pattern. Coordination of monitoring of adjacent developments is required, ideally leading to joint action, e.g. distributional surveys which cover the national spatial distribution of marine mammal populations. In general, impacts of wet renewable energy (especially tidal-stream devices) during normal operations will probably be more significant than those related to installation. Mitigation will become more relevant once the actual impacts are better known and will need to consider additional effects such as the collision with moving parts of the tidal-stream devices or operational noise.

In the 2010 WGMME report, the effects of construction and operation of offshore windfarms on marine mammals were assessed. The majority of the recommendations on monitoring and mitigation are also relevant to wet renewables. In addition, within that report, the WGMME recommended a focus on installation methods other than pile driving. The following text provides additional comments relevant also to tidal-stream devices and includes our recommendations.

4.8.1 Management framework

Probably the most important consideration concerns the effects of renewable devices at population level. The renewable industry is developing rapidly and regulators

need to make decisions on granting consent for licensing in the near future. As the industry expands from a few sites to a large number of sites over larger areas of sea, it will become increasingly important to be able to predict population effects in order to meet management objectives such as Favourable Conservation Status under the Habitats Directive (and GES under the MSFD). A good management framework should benefit from ongoing data collection (monitoring) to allow the incorporation of a feedback mechanism and to enable determination of whether management actions are allowing objectives to be met.

In situations where relevant data are not available:

*The WGMME **recommends** the development of an appropriate precautionary management framework for wet renewables (including tidal-stream technologies).*

4.8.2 Interactions at close range

Interactions between tidal devices and marine animals remain poorly understood. The principal environmental concerns derive from the potential for physical injury to animals through direct contact with the device's moving structures. In addition other potential effects include habitat exclusion, barrier effects to passage, and noise-related injury.

*WGMME **recommends** that independent research be carried out into the nature of close-range interactions between marine mammals and tidal devices and the potential population consequences of these.*

4.8.3 Noise mapping–communication

It is likely that the construction and maintenance phases of tidal-energy devices will significantly add to the levels of ambient noise in and around development sites. This addition of noise has the potential for masking, i.e. prevent animals from hearing important sounds, such as conspecifics' calls or those associated with predators or prey. This masking would effectively result in the shrinkage of the communication area for species of concern.

*The WG **recommends** that our understanding of ambient underwater noise in tidal-sites is improved and that the noise associated with construction and maintenance of tidal devices be assessed so that impacts on marine mammals can be minimized.*

4.8.4 Noise quantification for device perception

During operation of tidal-stream devices, lower levels of noise output are expected compared with the construction phases. However the motion of the rotors, internal gearing and so forth will introduce acoustic energy to the water. It is currently unknown over what range this will be audible to marine mammals manoeuvring in close proximity. Coupled with this, information on the levels of ambient sound, relevant to marine mammals, in areas of strong tidal-streams is poorly known. It is currently unknown over what ranges operating turbines will be audible to marine mammals to aid them in avoiding collisions.

*To understand the perception range available to marine mammals in the vicinity of operating tidal turbines, WGMME **recommends** that the sound output of operating devices is quantified along with the surrounding ambient underwater sound of the sites.*

4.8.5 Survey methods

Methods to determine the distribution and abundance of marine mammals have been developed over many years and for a variety of applications (Hammond, 2010). Further adaptation is currently underway to allow these methods to serve the needs of assessments associated with offshore wind and other renewable energy sites (SMRU Ltd. 2010; ICES WGMME, 2010). Several key features of tidal-stream energy sites are shared with these other energy technologies; particularly their location in frequently rough waters and the discrete nature of the developments in relation to the more expansive ranges of the animals using them. However tidal sites are fundamentally different from others in one key feature: the water mass containing the animals of interest is itself mobile relative to the footprint of the development site. Local tidal speeds targeted by the industry typically range from 9 to 15 km.hr-1. This runs the risk of violating some of the assumptions of traditional survey techniques such as boat based visual surveys, towed or fixed passive acoustic monitoring or when performing stationary observations from coastal vantage points.

The WGMME **recommends** *that current methods used to quantify marine mammal distribution, activity and abundance are adapted or improved so that they can be appropriately applied to studies in and around fast moving water.*

4.8.6 Allowable takes

At present, Potential Biological Removal (PBR) estimates for populations of marine mammals at both local and regional scales are being widely used to set limits on 'takes'. However, this is not necessarily the most effective or sensitive method. The target of conservation management should be to achieve and maintain suitable population sizes and structures, and take limits are a tool to achieve this. PBR provides a relatively simple automated process but its target population size is implicit and generally unknown. An additional criticism of the PBR methodology is that it does not use all available data. Where time-series data are available they can provide additional information to refine the take limits, consistent with predefined population targets; e.g. the Catch Limit Algorithm approach (ICES WGMME 2009).

ICES WGMME ***recommends*** *that appropriate metrics be developed to regulate any population level deleterious effects of marine renewable developments. To achieve this, target population size should be explicitly chosen and all appropriate data should be used to assess allowable impacts.*

4.8.7 Wide-scale surveys

Marine mammals are typically wide ranging and consequently are likely to spend only a proportion of their time within the footprints of any particular demonstrator or commercial-scale renewable energy array. Thus to view any impacts within a population level context, either surveys in adjacent developments need to be coordinated, or a wider portfolio of monitoring needs to be implemented across the whole area relevant to marine mammal populations of concern. Such wider scale surveys would also have the capacity to detect changes resulting from cumulative impacts.

The WGMME ***recommends*** *that additional coordinated monitoring is carried out at scales greater than the footprints of a demonstrator or commercial-scale arrays to determine population scale changes in distribution and abundance.*

4.8.8 Data sharing

Lack of reliable information is a major constraint on our ability to predict the likely effects of marine renewable developments and on our ability to design and estimate the efficacy of mitigation strategies. For most developments there are strict and well defined EIA requirements and the issuing of permits and consents is usually contingent upon some form of baseline data collection and/or some level of pre- and post-deployment monitoring. For commercial reasons, these new data are often unavailable to the research community. However, as part of the consenting process the results of such studies must be reported to the regulators.

*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.*

4.8.9 Site choice

Because of the scarcity at present of operational tidal turbines, subject to robust monitoring schemes, our understanding of the nature and significance of any impacts they might have upon marine mammals is speculative. In order to furnish such data with minimal environmental risk, a strategic approach to device or array deployment is strongly recommended. Thus, development should focus initially on tidal resource areas of lesser importance for marine mammals (and other environmental interests), and discouraged in areas of relatively greater importance (e.g. Natura 2000 sites). This will enable data to be gathered and interpreted that is necessary to inform and guide consenting decisions in areas of higher sensitivity.

*WGMME **recommends** a strategic approach to identify sites of low marine mammal risk for early stage deployments before consenting to tidal device or array developments in more sensitive sites.*

4.8.10 Device diversity

There are currently a large number of different device types being simultaneously progressed by the sector. These range both in their manner of energy extraction to their specifics of size, rotor number and rotation speed and their location, particularly placement in the water column and preferred current speeds. This design variety is at a range of different stages of development from conceptual or scale models to a small number of full-scale test-rigs deployed at sea. Because the most significant lessons on likely interactions with marine mammals are to be learned with full size turbines in operation it will be tempting to extrapolate from the environmental monitoring carried out on these to the other turbine types. However until the parameters that shape any impacts (or absence of impacts) are known then extreme caution should be applied when extrapolating results from one turbine trial to another, one species to another or one habitat to another.

*In recognition that animal-tidal turbine interactions are likely to be both species- and device-(or device-type) specific, WGMME **recommends** that extreme care be taken when extrapolating conclusions about environmental impacts between species and device types.*

4.8.11 Arrays

As with the offshore wind installations, the ultimate goal of the tidal-stream energy industry is the placement of multiple full-scale devices in array configurations that

optimize energy capture. It is currently unknown how marine mammals encountering turbines in arrays are likely to behave. It may be that they respond to each one in isolation or that there are emergent properties generated by the stimuli coming from multiple devices which elicit alternative responses.

*WGMME **recommends** that extreme care is taken when scaling-up environmental lessons learned from studies of single tidal turbine devices up to arrays as the nature of any impact relationships (linear or otherwise) between one and many devices is currently unknown. In light of this, a stepwise approach should be taken for array development.*

4.8.12 Electromagnetic fields

Large marine generators and the high voltage alternating and direct current cables that transmit power between devices and the land have the potential to interact with aquatic animals that are sensitive to electric and magnetic fields. Although this is known to affect some fish species there is currently little understanding of its potential to affect marine mammals; although recent experimental studies of the effects of electric fields on pinnipeds indicates that they may be unexpectedly sensitive to, and show avoidance of, relatively low intensity electric field.

*WGMME **recommends** that the sensitivity of marine mammals to environmental perturbations from electromagnetic fields, possibly generated by cables, should be investigated and the potential displacement implications considered.*

4.9 References

Carter, C. 2008. Marine Renewable Energy Devices: A Collision Risk for Marine Mammals? MSc Thesis, Scottish Association for Marine Science / UHI Millennium Institute.

EMEC. 2010. www.emec.org.uk/tidal_devices.asp.

Hammond, PS. 2010. Estimating the abundance of marine mammals. *In* I.L. Boyd, W.D. Bowen & S. Iverson (eds). Marine Mammal Ecology and Conservation: A handbook of techniques, pp 42–67. Oxford University Press, Oxford.

ICES WGMME. 2009.Report of the Working Group on Marine Mammal Ecology. February 2–6 2009, Vigo, Spain.

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

Masts Marine Predator JRT. 2010. Marine Top Predators and renewables; survey and research requirements. MASTS Marine Predator JRT Workshop Report 18-19th March 2010, Perth. Downloaded from http://www.masts.ac.uk/documents/MASTSPredReneWshop.pdf on 17th May 2011.

RPS. 2008. Marine Renewable Energy Strategic Framework for Wales Stage 1 Report. A report to the Welsh Assembly Government.

SeaGen Biannual EMP update. 2010. SeaGen Environmental Monitoring Programme: Biannual Update. Version 1-SeaGen Biannual Environmental monitoring July 2009–January 2010. Report prepared by Royal Haskoning Ltd. For Marine Current Turbines Ltd.

Scottish Marine Renewables Strategic Environmental Assessment (SEA). Downloaded from http://www.seaenergyscotland.net/SEA_Public_Environmental_Report.htm on 17th May 2011.

SMRU Ltd. 2010. Approaches to marine mammal monitoring at marine renewable energy developments. 110pp.

Thompson D, Bexton S, Brownlow A, Wood D, Patterson T, Pye K, Lonergan M, Milne R. 2010. Report on recent seal mortalities in UK waters caused by extensive lacerations. Available at: http://www.smru.st-and.ac.uk/documents/366.pdf.

Wilson, B. Batty, R. S., Daunt, F. & Carter, C. 2007. Collision risks between marine renewable energy devices and mammals, fish and diving birds. Report to the Scottish Executive. Scottish Association for Marine Science, Oban, Scotland, PA37 1QA. http://www.pstidalenergy.org/Tidal_Energy_Projects/Misc/Scottish_SEA_March_2007/Section_C7B_Fish_and_Shellfish_Appendix_B.pdf.

5 ToR c. Outline marine planning practices that could take account of the presence of cetaceans, and what information ICES might be able to feed into that process

5.1 Introduction

Due to multiple stressors, such as overfishing, pollution, invasive species, coastal development and climate change, global marine ecosystems are under pressure. The existing and planned uses of the ocean are likely to further intensify the decline of marine ecosystem health (Foley *et al*., 2010). It is therefore essential that alternative strategies replace the current patchwork of complex, uncoordinated use of coastal and ocean waters around the world. In part, this can be achieved through ecosystem-based Marine Spatial Planning (MSP) or ocean zoning. The ecosystem approach developed in the context of the Convention on Biological Diversity (CBD), the Ecosystem Approach to Fisheries (EAF) and Integrated Marine and Coastal Area Management (IMCAM; syn. 'integrated coastal area management' or 'integrated coastal-zone management') represent three useful tools for making progress towards a more integrated and holistic management of ocean spaces and resources. Ecosystem-based MSP is a tool for sea use management that informs the spatial distribution of activities in and on the ocean in order to support current and future uses of ocean ecosystems and maintain the delivery of valuable ecosystem services for future generations in a way that meets ecological, economic, and social objectives (Douvere, 2008). One of the best known examples is the zoning system in Australia's Great Barrier Reef Marine Park, where zoning plans define what activities can occur in which locations, both to protect the marine environment, including its constituent species (e.g. cetaceans), and to separate potentially conflicting activities.

There is an extensive legal and policy framework relevant to the development of MSP, mainly based on the provisions of two global conventions, the United Nations Convention on the Law of the Sea (UNCLOS), the CBD and related policy developments. Several European countries, on their own initiative or driven by the European Union's Marine Strategy (2005) and Maritime Policy (2006), the Bergen Declaration of the North Sea Conference and the EU Recommendation on Integrated Coastal Zone Management (2002), have taken global leadership in implementing MSP (Douvere *et al*., 2007).

At present, there are several established processes in European Member States. Spatial Plans developed under MSP will need to consider Marine Protected Areas (MPAs) and will be subject to an assessment of the potential impacts (alone or in combination with other plans or projects) on NATURA 2000 sites including cetacean Special Areas of Conservation (SACs; Habitats Directive). Any Spatial Plan that is likely to have significant effects on the environment will need to consider potential impacts to cetaceans as part of the Strategic Environmental Assessment (SEA Directive). For individual activities and projects within the plan an Environmental Impact Assessment (EIA) is needed, within which cetaceans will be considered (Directive 85/377/EEC 1985; amended 1997/2003). Alongside any MSP there are also projects to identify MPAs from OSPAR and MSFD drivers in addition to Habitats Directive drivers.

It seems therefore that, at least in Europe, MSP would not require any new processes to take cetacean presence into account, as existing environmental regulations, e.g.

SEA and EIA, already require this. More generally in the ICES area, implementation of MSP may help to highlight conservation issues related to cetaceans (e.g. potential adverse impacts on migratory routes or a MPA) and could help to steer some developments away from sensitive areas. However, because of the highly mobile/wide ranging nature of cetaceans, it would be inappropriate to focus on MPAs as being the only areas of importance to cetaceans that need consideration.

5.2 Marine planning practices that go beyond MPAs

As a review of Marine Protected Areas (MPA) is provided in ToR D, this section will focus on some activities typically considered within marine spatial planning practices that should take into account the presence and occurrence of cetaceans. The text briefly describes the main concerns regarding cetaceans and, in some activities, how these are taken into consideration, e.g. following best practice, mitigation measures, spatial considerations. Not all activities require an EIA, and not all activities have established mitigation measures.

Extraction activities

Sand and gravel are generally taken from the seabed by trailer-suction hopper dredgers that are capable of transporting the cargoes from offshore dredge sites directly to the unloading wharves located close to the point of use. Dredging operations can be a source of high intensity sound in the marine environment, dominated by energy at low frequencies which can be transmitted for long distances, but with also some high frequency tonal sounds. Studies have indicated the possibility of behavioural impacts on cetaceans, with some known cases of animals leaving an area where dredging is taking place. Other important effects of marine aggregate extraction (sand or gravel) are disturbance/displacement due to noise and destruction of nursery grounds for cetacean prey species such as sandeel. To date, there are no specific good practice guidelines on how to mitigate the risk of disturbance.

Fishing interactions

Cetaceans and fisheries interact in several ways. Bycatch is regarded as one of the most severe human impacts on marine mammals (e.g. Jefferson and Curry, 1994; Vinther, 1999; Harwood, 2001; Lewison *et al*., 2004; ICES SGBYC 2010), although food depletion by fisheries may also be a major cause of concern (Pauly *et al*., 1998; DeMaster *et al*., 2001). Other impacts of fisheries on cetaceans include noise pollution caused by sonar, vessel engines and acoustic deterrent devices (Nowacek *et al*., 2007) and stress/disturbance caused by fishing activities (Curry, 1999).

In Europe, the monitoring of cetacean bycatch and the use of deterrent devices (pingers) are specifically required for certain fisheries through fishery regulation EC 812/2004. Additionally, article 12 of the Habitats Directive requires Member States to *'establish a system to monitor the incidental capture and killing of the animal species listed in Annex IV (a)* [which includes all cetaceans]….*In the light of the information gathered, Member States shall take further research or conservation measures as required to ensure that incidental capture and killing does not have a significant negative impact on the species concerned.'* However, competency for fisheries management for the majority of European waters lies with Europe and the Common Fisheries Policy (CFP) rather than with Member States (see Khalilian *et al*., 2010 for a discussion of the legal conflict between the Habitats Directive and the CFP). Management actions to reduce bycatch, such as gear modifications or area closures, therefore need to be agreed and implemented

through the CFP. Member States retain competency for fisheries management in coastal areas (0–6 nautical miles) and for their own fleets between 6–12 nautical miles.

In the US, under provisions of the Marine Mammal Protection Act, NOAA Fisheries has established Take Reduction Teams (TRT), comprised of a diversity of stakeholders, to develop fishery Take Reduction Plans (TRP) to mitigate marine mammal bycatch (http://www.nmfs.noaa.gov/pr/interactions/trt/teams.htm). The TRTs have proposed a range of fishery-specific mitigation actions (e.g. gear modification and restrictions, spatial and temporal closures, etc.). Furthermore, NOAA Fisheries has implemented a Dynamic Area Management (DAM) policy to protect the critically endangered North Atlantic right whale **(***Eubalaena glacialis***)**. A DAM zone would be triggered by a single reliable report from a qualified individual of three or more right whales within an area of 75 nm^2 (139 km^2), such that right whale density is equal to or greater than 0.04 right whales per nm^2 (1.85 km^2) (http://www.nero.noaa.gov/whaletrp/plan/dam/index.htm). Management actions within a DAM zone may require gear (e.g. anchored gillnet and lobster trap/pot) modifications, removal, or fishery closure until the DAM is rescinded.

Military activities

Sounds from low- and mid-frequency military sonar fall within many cetacean species' hearing ranges. Sounds at these frequencies, coupled with high source levels, can give rise to potential impacts (from disturbance to injury) over large areas, because lower frequency sounds travel farther (Parsons *et al*., 2008). Mitigation measures associated with the deployment of active sonar being developed and applied by the UK Ministry of Defence (MoD) include sonar operated in a way that minimizes the risk to the hearing and internal organs of different animals (e.g. by beginning transmissions at low output levels to give marine life the opportunity to move away), cessation of sonar operations if marine mammals are within a predetermined safe range, and the use of Marine Mammal Observers to continuously monitor the operational area. The UK MoD also continues to develop an Environmental Risk Management Capability (Sonar) system, known as "Sonar 2117", which should provide a robust, repeatable and transparent method of assessing the environmental risk to, and impact on, marine life caused by sonar activity, and provide advice to manage the potential impact through mitigation measures. More recently, a real-time alert procedure for naval training operations has been developed. This enables local information on unusual cetacean sightings, such as the presence of a species group closer to shore than is usual, to be incorporated into the training schedule and for operations to be relocated if necessary. This was successfully implemented in April 2009, off the southwest of the UK, in relation to the presence of short-beaked common dolphin in the Falmouth Bay area.

In the US under the National Environmental Protection Act (NEPA), federal agencies must integrate environmental values into their decision-making processes by considering the environmental impacts of their major proposed actions http://www.nmfs.noaa.gov/pr/laws/. NEPA is also pertinent to seismic surveys, aggregate extraction and large-scale aquaculture proposals.

Renewable energy

Underwater noise is produced during construction, operation and decommissioning of offshore wind farms. During piling in particular, hydraulic hammers create noise with considerable sound levels and this also happens if explosives are used during

decommissioning (Nedwell and Howell, 2004). The potential effects on marine mammals are hearing loss (either temporary or permanent), masking of natural noise, increased stress levels, displacement from important habitat or reduction in range (Carstensen *et al*., 2006; Nowacek *et al*., 2007; Weilgart, 2007; Lucke *et al*., 2009; Tougaard *et al*., 2009; ICES WGMME 2010). It is also very important that the potential cumulative effects of the construction of several wind farms are considered - this in addition to other threats such as bycatch, pollutants and food depletion. As cetaceans are considered as part of EIAs, risks of injury and disturbance are considered, as well as adverse effects on cetacean MPAs. Mitigation measures, that should be mandatory according to the state-of-the-art, have been developed to reduce the risk of injury. These measures could include a soft-start/ramp-up procedure to allow animals to move away before the sound gets too loud (Richardson *et al*., 1995), air-bubble curtains to reduce the source level of the pile-driving noise (Würsig *et al*., 2000), or acoustic deterrent devices (ADDs, commonly referred to as "pingers") and acoustic harassment devices (AHD or seal scarer) to 'scare' marine mammals from the vicinity of construction activity (Tougaard *et al*., 2003; Carstensen *et al*., 2006). However, some of these are controversial as they may lead to habituation (e.g. soft-start, ADD, AHD) or attract animals by initially producing weak sounds (Cox *et al*., 2001; Compton *et al*., 2008; Shapiro *et al*., 2009). This has been illustrated experimentally by Shapiro *et al*. (2006), who exposed sperm whales to a received sound level below 160 dB rms, resulting in the individuals orienting towards the sound source rather than moving away from it. Other mitigation practices should include the use of visual observers and passive acoustic monitoring prior to and during pile driving - with operators being asked to shut down the operation if marine mammals are observed inside a designated safety zone before and during pile driving. Temporal and/or spatial restrictions of construction activities in important cetacean habitats could also follow the precautionary principle. The ICES WGMME report (2010) further reviews the effects of wind farm construction and operation on marine mammals and provides advice on monitoring and mitigation schemes. ToR B in this report reviews the effects of tidal arrays (construction and operation) on marine mammals and provides recommendations on research needs, monitoring and mitigation schemes.

Seismic and other geophysical surveys

Seismic airgun arrays are often used during geophysical exploration. In addition, sub-bottom profilers such as sparkers or boomers can be used to provide high resolution geophysical profiles, and sonar (e.g. sidescan sonar) is widely used to map seabed morphology. Seismic surveys are conducted to search for oil and gas reserves, and surveys can last for many weeks within an area. The main reason for concern relates to the high intensity multiple pulsed sounds produced by the airguns, which have the potential to cause injury and disturbance. The dominant frequencies overlap with those used by baleen whales (10 Hz–1 kHz), with the high frequency component also overlapping with the frequency range used by many odontocetes (10–150 kHz) (Richardson *et al*., 1995; Compton *et al*., 2008). Correlations between cetacean stranding events and seismic activity have been demonstrated (Engel *et al*., 2004). Studies have also showed behavioural effects caused by a variety of underwater noise sources, as well as the potential for physical damage (e.g. Gordon *et al*., 2003; Miller *et al*., 2009). Mitigation measures could include: (1) minimizing sound output, (2) safety zone, (3) soft-start, (4) visual or acoustic observation, and (5) temporal and spatial restrictions (summarized in Compton *et al*., 2008).

The use made of the seas around the UK by cetaceans has been described (see SEA reports; http://www.offshore-sea.org.uk/site/index.php) and assessed against possible future hydrocarbon development opportunities. Small odontocetes, and *Lagenoryhnchus* species in particular, show the strongest avoidance of seismic survey activity of any cetacean species, with significant increases in fast swimming activity and declines in sightings rates during periods when airguns were firing (Stone and Tasker, 2006). In contrast, mysticetes and killer whales showed localized spatial avoidance, long-finned pilot whales changed orientation, and sperm whales showed no particular behavioural reactions at all (Stone and Tasker, 2006). All operators in UK waters are required to follow JNCC guidelines (www.jncc.gov.uk/page-1534#1785) which include conducting marine mammal observations prior to and during seismic activity and utilizing procedures to reduce and avoid direct harm to animals. Over the years, most recently in 2010, these guidelines have been reviewed and revised in the light of scientific evidence, technical developments and operational understanding.

Shipping and vessel movements

Many of the waters in the ICES area are subject to intense shipping activity. Commercial shipping is a major contributor of low frequency (5–500 Hz) background noise in the world's oceans. The number of ships in the world fleet has tripled in the last 50 years. Particular concerns relate to noise generated by propeller cavitation, thrusters (such as those used in dynamic positioning systems), and noise transferred to the ship's hull from the ship's engine and other systems. Vessels associated with other marine activities will generate noise at the local level, adding to the noise signature of an activity. Little is known about the potential impact on cetaceans, however, the masking of biologically significant sounds, such as intraspecific communication and the detection of predators and prey, is of most concern. In addition to shipping noise, the possibility of collisions is also an area of concern (http://iwcoffice.org/sci_com/shipstrikes.htm).

In the Bay of Fundy, Vanderlann *et al*. (2008) demonstrated that a 62% reduction in relative risk of lethal collision is achieved through an amendment to the traffic separation scheme that was adopted and implemented by the International Maritime Organization (IMO). On the Scotian Shelf their analyses showed that a seasonal recommendatory "Area To Be Avoided" (ATBA) could markedly reduce the risk of lethal vessel strikes and thus the ATBA was adopted and implemented by the IMO. Consequently, the objective of achieving the greatest reduction in the risk of lethal vessel strikes to whales, balanced by some minimal disruption in vessel operations while maintaining safe navigation, can be reached. Vessel speed restrictions or advisory limits have been established in a number of locations, including in the Strait of Gibraltar, national parks, sanctuaries and in some US waters (sometimes to reduce the likelihood of vessel collisions with taxa other than large whales; IWC-ACCOBAMS 2010). In the Strait of Gibraltar, a recommended speed of 13 knots between April and August was implemented by Spain in 2007 in an area of important sperm whale habitat (Tejedor *et al*., 2008).

5.3 Case study of the development of MSP– German EEZ waters

5.3.1 Overview

The North Sea is one of the most intensely exploited marine areas in the world, with ongoing activities such as fishing, oil and gas exploration, sand and gravel extraction, shipping, military exercises, construction of pipelines and offshore wind farms and recreational activities. These kinds of use constitute sources of marine pollution, in varying degrees.

The coastal states ("Länder") in Germany recently extended their spatial planning responsibilities to the territorial sea, while the Federal Spatial Planning Act has been amended to extend national sectoral competencies (including MSP) to the EEZ. In 2009, a spatial plan for the German EEZ was produced in order to coordinate the growing conflict of maritime uses, as shown in Figure 6. The Spatial Plan for the EEZ in the North Sea is a contribution to the Marine Strategy Framework Directive of 17 June 2008 (Directive 2008/56/EC), which is aimed at achieving or maintaining "Good Environmental Status" by the year 2020, at the latest.

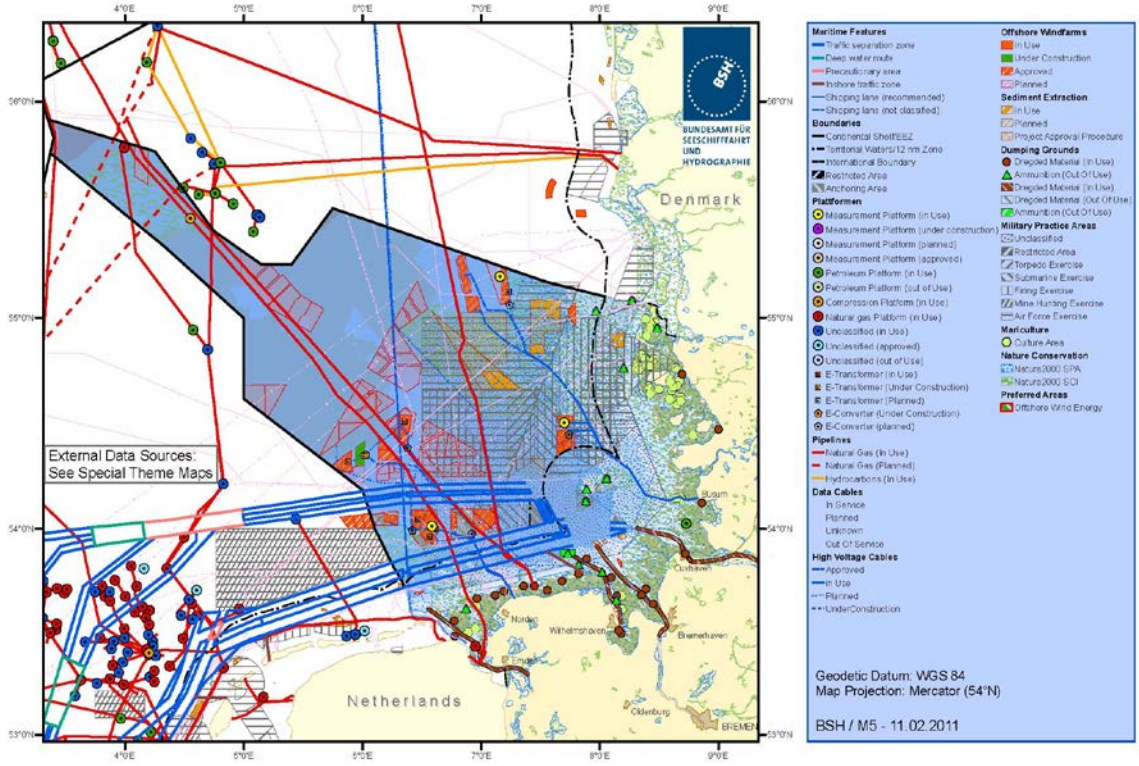


Figure 6. Existing and prospective use of the North Sea. [1].

For the first time in the EEZ, the spatial plan outlined targets and principles for economic and scientific uses, thus ensuring the safety and efficiency of navigation, as well as protection of the marine environment. Priority areas have been designated for shipping, pipelines and cables, and wind energy development; other uses are prohibited in such areas unless they are compatible with the priority uses. The areas for

[1]http://www.bsh.de/en/Marine_uses/Industry/CONTIS_maps/NorthSeaCompleteUsesAndNatureConservation.pdf

wind power production have been designated in implementation of the Federal Government's strategy for wind energy use at sea, 2002, which is part of its overall sustainability strategy and is aimed at creating framework conditions allowing the offshore wind energy potential to be exploited.

Guidelines that were followed for spatial development (in order of importance):

- Securing and strengthening maritime traffic;
- Strengthening economic capacity through orderly spatial development and optimization of spatial use;
- Promotion of offshore wind energy use in accordance with the Federal Government's sustainability strategy;
- Long-term sustainable use of the properties and potential of the EEZ through reversible uses, economic use of space, and priority of marine uses;
- Securing natural resources by avoiding disruptions to and pollution of the marine environment.

Regulations concerning the following anthropogenic activities were outlined in the marine spatial plan:

- Shipping
- Exploitation of non-living resources
- Pipelines and submarine cables
- Marine scientific research
- Energy production, wind energy in particular
- Fisheries and mariculture

Other concerns were also considered:

- Military use
- Leisure and tourism
- Ammunition dump sites and sediment deposition

The final spatial plan is shown in Figure 7.

5.3.2 Objectives made in the spatial plan regarding marine mammals

A Strategic Environmental Assessment according to SEA Directive 2001/42/EC on the impact of certain plans and programmes on the environment has been carried out in connection with the establishment of the German Spatial Plan. The objective of the SEA Directive, as stated in Article 1, is "to provide for a high level of protection of the environment and to contribute to the integration of environmental considerations into the preparation and adoption of plans and programmes with a view to promoting sustainable development, by ensuring that, in accordance with this Directive, an environmental assessment is carried out of certain plans and programmes which are likely to have significant effects on the environment."

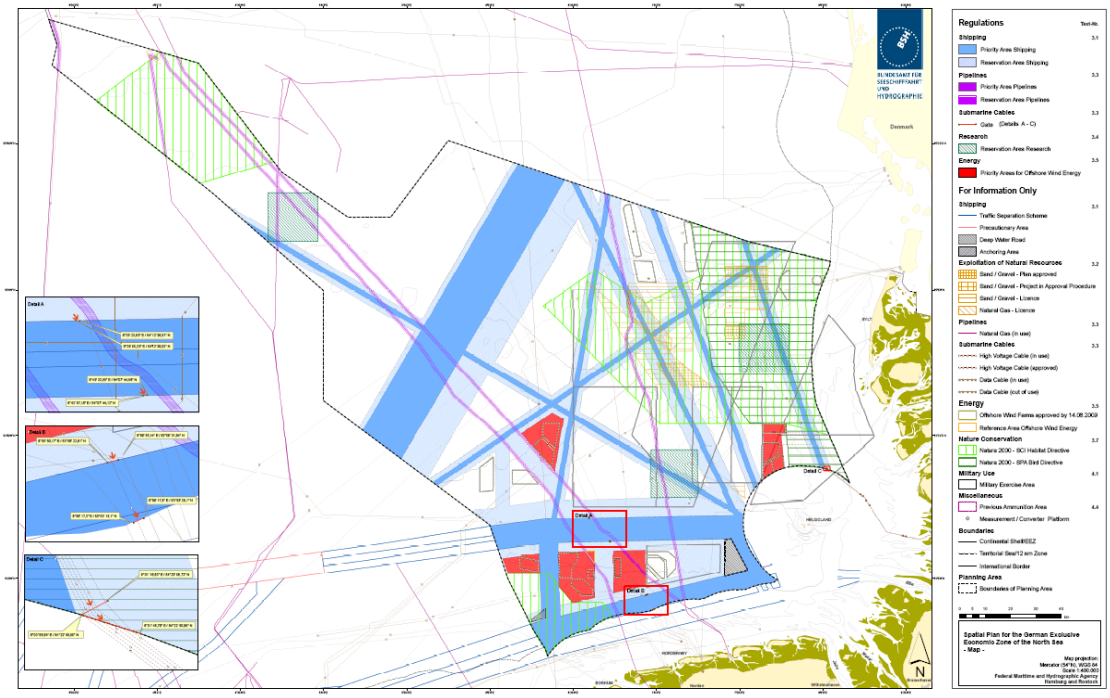


Figure 7: Spatial plan of the German EEZ of the North Sea (source: Federal Maritime and Hydrographic Agency BSH [2]).

The recent marine spatial plan incorporates, to a certain extent, knowledge gained during dedicated projects on harbour porpoise distribution and abundance undertaken between 2002 and 2006. These surveys were funded by the German Federal Ministry for Environment, to investigate whether large-scale OWFs impair or endanger harbour porpoises, seals and seabirds (Gilles *et al*., 2008; 2009), and also by the German Federal Agency for Nature Conservation (BfN) to delimit SACs (Scheidat *et al*., 2006). In addition, several EIAs, within the framework of the approval procedure for OWFs in the EEZ, were conducted according to the standards for EIA as described by BSH (2007). Prior to these projects/surveys, data were lacking on these key parameters in the German North Sea. There is still a lack of knowledge of the 'important habitats' of harbour porpoises in the EEZ and on how distribution, abundance and behaviour of porpoises could change seasonally, particularly in offshore areas.

During the designation of proposed Sites of Community Interest (pSCI, prerequisite to a Special Area of Conservation), the BfN selected three study areas (*Dogger Bank*, *Sylt Outer Reef* and *Borkum Reef Ground*) of particular ecological importance in 2002. To evaluate the importance of these sites for harbour porpoises, porpoise distribution and density were assessed using aerial surveys in 2002 and 2003 (Scheidat *et al*., 2006). Densities in the study areas were compared between study years and selected areas. The importance of the sites was also evaluated by taking into account the overall distribution of porpoises in German waters. Based on the Habitats Directive selection criteria for harbour porpoises of "continuous or regular presence", "good population density" and "high ratio of mother-calf pairs" (see ToR D for further information), only one of the three sites (the pSCI *Sylt Outer Reef*) was delineated for porpoises (based on criteria of Article 4.1, Habitats Directive), and nominated to the European Commission in 2004 (see Figure 8).

[2]http://www.bsh.de/en/Marine_uses/Spatial_Planning_in_the_German_EEZ/index.jsp

By 2007, three sites of Community importance (SCIs) for harbour porpoises were recognized by the EU in the North Sea EEZ, *Sylt Outer Reef* (5314 km^2; harbour porpoises, sandbanks and reefs), *Dogger Bank* (1699 km^2; Sandbanks), and *Borkum Reef Ground* (625 km^2; sandbanks and reefs); their designation taking legal effect on publication in January 2008. Germany must now place these sites under the protection of national law and compile management plans. A positive development occurred when Denmark designated a pSCI (*Southern North Sea*) adjoining the German SCI *Sylt Outer Reef;* thus providing a larger coherent protected area for porpoises in this region (see ToR D for further information).

5.3.3 Potential conflicts between harbour porpoise and human habitat use

The importance of various subregions to harbour porpoises within the German EEZ has been acknowledged within the spatial plan. However, it is not specified how this information will impact the planning of anthropogenic activities. Even now, it is obvious that there are potential areas of conflict between marine mammal habitat use and human use within the German EEZ.

The following two studies highlight potential conflicts between harbour porpoise habitat use and emerging, as well as existing, human use: a) offshore wind farms and b) fishing in the German EEZ of the North Sea.

a) Offshore wind farms

Gilles *et al*. (2009) showed that distinct seasonal "hot spots" for harbour porpoises occur in the German EEZ (Figure 8a–c). Important aggregation zones were detected in offshore waters in spring and summer. In spring, two "hot spots", one in the southwest (*Borkum Reef Ground*) and a large hot spot in the northeast (*Sylt Outer Reef* (SOR)), were identified as key foraging areas. In summer, only the large "hot spot" SOR persisted, causing a strong northsouth density gradient in porpoise density, whereas in autumn porpoises were more evenly distributed. Most mother-calf pairs were observed during spring and summer in the SOR, underlining its importance as a foraging area when reproductive costs are high.

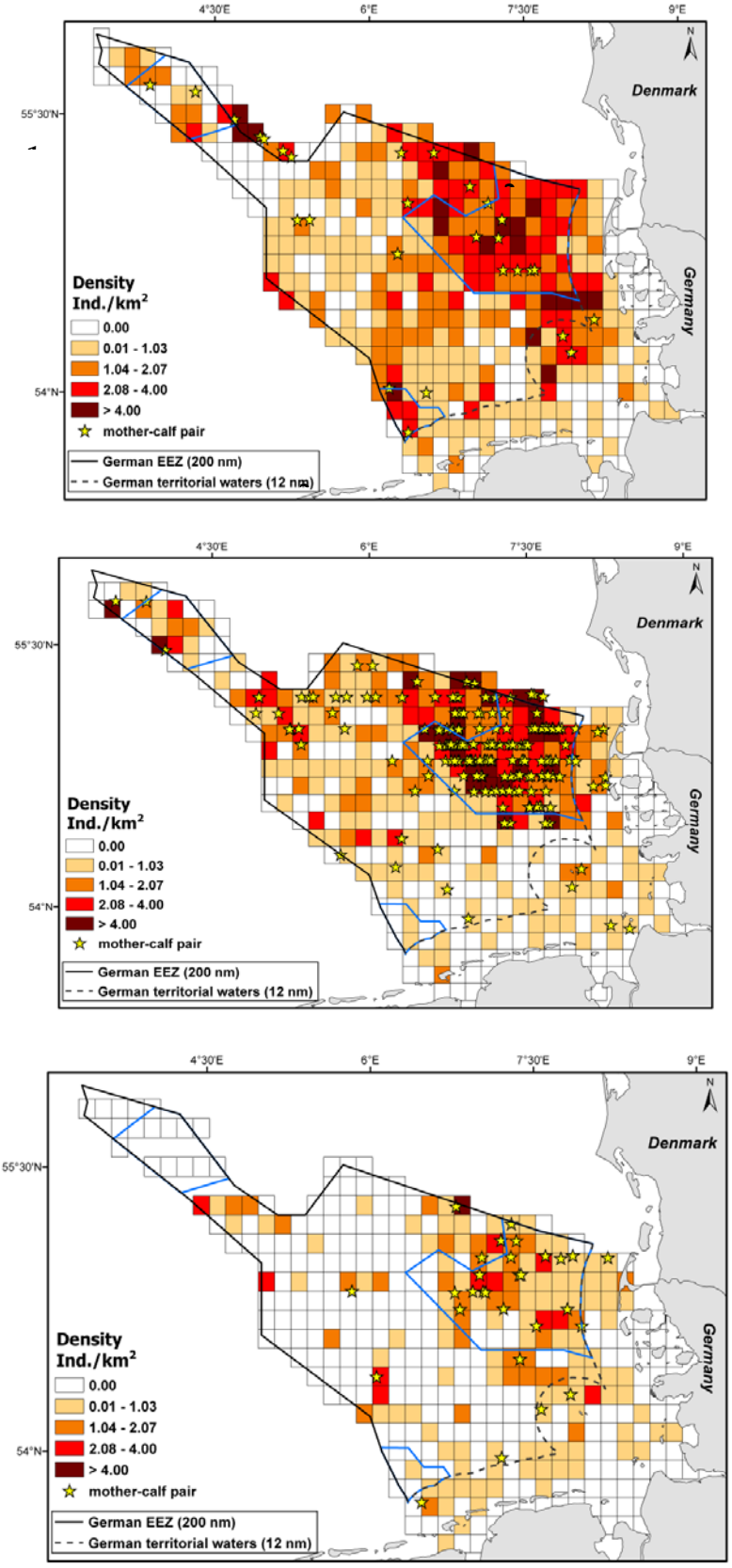


Figure 8. Spatial distribution of harbour porpoise density during a) spring (March–May), b) summer (June–August), c) autumn (September–November). Data from 2002 to 2006 were pooled. Grid cell size: 10×10 km. SACs are indicated by blue contour line: 1-Dogger Bank, 2-Sylt Outer Reef, 3-Borkum Reef Ground (modified after Gilles *et al.*, 2009).

Spatial overlap exists between these 'important areas' for porpoises and areas where offshore wind farms are currently licensed or planned (see Figure 2). The offshore wind industry in Germany has large-scale plans. By June 2008, 18 OWFs were approved and 47 more OWFs are in the approval process. The proportion of harbour porpoises inhabiting the EEZ which would be exposed to construction noise from the 18 licensed wind farms was estimated under different scenarios (see Gilles *et al*., 2009). Within a 20 km zone of responsiveness, described as the worst-case scenario, 39% of the harbour porpoises in the German EEZ could be affected during the construction phases of these OWFs.

Within the German spatial plan for the North Sea, production of wind energy is granted priority over other spatially significant uses in the "priority areas for wind energy" as shown in Figure 7. If other measures and projects are not compatible with the function of OWFs in these "priority areas", they are prohibited.

The development of OWFs in NATURA 2000 areas is not allowed, with the exception of OWFs that were already approved prior to SCI/SAC designation or which had reached an advanced stage in the approval procedure before the Marine Spatial Plan entered into force in 2009. One OWF has been licensed within the borders of the SCI *Sylt Outer Reef* and several approved large OWFs are situated at the prospective borders of the SCIs *Sylt Outer Reef* and *Borkum Reef Ground*.

The marine spatial plan further states that in planning and designing for the construction and operation of energy production facilities, negative impact on the marine environment, in particular its natural functions and the marine ecosystem, shall be avoided and that best environmental practice according to the OSPAR Convention, and use of the state-of-the-art technology, shall be taken into account.

b) Fisheries

In Herr *et al*. (2009), data obtained by a vessel monitoring system (VMS) were used to relate fishing effort to the distribution of harbour porpoise in the German North Sea - in order to assess potential interaction between porpoises and fisheries. These interactions are a major concern for cetacean conservation and fisheries management, as bycatch and resource competition occur as a result. Relationships were analysed in terms of seasonal association and overlap. Results showed that porpoise distribution was positively associated with sandeel fisheries in all seasons, and with gillnet fisheries in summer. Overlaps for sandeel and gillnet fisheries were high in summer, while negligible in spring and autumn. In spring, a high overlap was found for large beam trawlers targeting sole and plaice. In parallel, porpoise distribution was positively linked to fish assemblage components representing sandeel and poor cod in summer and flatfish in spring. The authors suggested that, especially in summer, resource competition between porpoises and industrial sandeel fisheries is likely and the risk of bycatch in gillnets is increased. In spring, interference with sole and plaice fisheries is to be expected (Herr *et al*., 2009).

The identified areas of overlap in the German EEZ may function as a starting point for investigations into the direct effects of fisheries on harbour porpoises (i.e. bycatch) within this region. There are no specific spatial designations for fishery operations included within the German Spatial Plan, as spatial planning for this particular activity is difficult. In addition, Germany has not yet established any dedicated bycatch observer system, as required under the EU Regulation 812/2004 and under Article 12 of the Habitats Directive. As an interim measure in the North Sea, and other EU waters except the Baltic, Germany provided its scientific observers working within the

EU Data Collection Regulation with the additional task of noting the bycatch of marine mammals, assessing carcasses on board and collecting them if necessary (ICES SGBYC 2010).

5.4 Recommendations

The WGMME **recommends** that data on cetacean presence and occurrence should be incorporated at a very early stage of marine spatial planning. Due to the wide ranging nature of cetaceans, the relevance of 'important areas' outside MPAs should be assessed. It is also very important to include any information on seasonal changes in distribution.

ICES, in its advisory capacity, could compile/review information that addresses the question on whether 'areas of importance' for cetaceans can be identified. In addition, it could review existing criteria for the identification process and assess whether the criteria and their interpretations are adequate.

5.5 References

R. Carstensen J, Henriksen OD, Teilmann J. 2006. Impacts of offshore wind farm construction on harbour porpoises: acoustic monitoring of echolocation activity using porpoise detectors (T-PODs). Marine Ecology Progress Series 321:295–308.

Compton R, Goodwin L, Handy R, Abbott V. 2008. A critical examination of worldwide guidelines for minimising the disturbance to marine mammals during seismic surveys. Marine Policy 32:255–262.

Cox TM, Read AJ, Solow A, Tregenza N. 2001.Will harbour porpoises (*Phocoena phocoena*) habituate to pingers? Journal of Cetacean Research and Management 3:81–86.

Curry BE. 1999. Stress in marine mammals: the potential influence of fishery induced stress on dolphins in the Eastern Tropical Pacific ocean. NOAA Technical Memorandum, La Jolla.

DeMaster DP, Fowler CW, Perry SL, Richlen MF. 2001. Predation and competition: the impact of fisheries on marine-mammal populations over the next one hundred years. Journal of Mammalogy 82: 641–651.

Douvere F, Maes F, Vanhulle A, Schrijvers J. 2007. The role of marine spatial planning in sea use management: The Belgian case. Marine Policy 31:182–191.

Douvere F. 2008.The importance of marine spatial planning in advancing ecosystem-based sea use management. Marine Policy 32(5): 762–71.

Engel MH, Marcondes MCC, Martins CCA, Luna FO, Lima RP, Campos A. 2004. Are seismic surveys responsible for cetacean strandings? An unusual mortality of adult humpback whales in Abroholos Bank, northeastern coast of Brazil. International Whaling Commission Doc. SC/56/E28.

Foley MM, Halpern BS, Micheli F, Armsby MH, Caldwell MR, Crain CM, Prahler E, Rohr N, Sivas D, Beck MW, Carr MH, Crowder LB, Emmett Duffy J, Hacker SD, McLeod KL, Palumbi SR, Peterson CH, Regan HM, Ruckelshaus MH, Sandifer PA, Steneck RS. 2010. Guiding ecological principles for marine spatial planning. Marine Policy 34: 955–966.

Gilles A, Scheidat M, Siebert U. 2009. Seasonal distribution of harbour porpoises and possible interference of offshore wind farms in the German North Sea. Marine Ecology Progress Series383:295–307.

Gordon J, Gillespie D, Potter J, Frantzis A, Simmonds MP, Swift R, Thompson D. 2003. A review of the effects of seismic surveys on marine mammals. Marine Technology Society Journal: 37(4): 16–3.

Harwood J. 2001. Marine mammals and their environment in the twenty-first century. Journal of Mammalogy 82: 630–640.

Herr H, Fock H, Siebert U. 2009. Spatio-temporal associations between harbour porpoise *Phocoena phocoena* and specific fisheries in the German Bight. Biological Conservation 142: 2962–2972.

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

ICES SGBYC. 2010. Report of the Study Group on Bycatch of Protected Species, 1–4 February 2010 Copenhagen, Denmark. ICES CM 2010/ACOM:25.

IWC-ACCOBAMS report. 2010. Report of the Joint IWC-ACCOBAMS Workshop on Reducing Risk of Collisions between Vessels and Cetaceans, 21–24 September 2010 Beaulieu-sur-Mer, France.

Jefferson TA, Curry BE. 1994. A global review of porpoise (Cetacea: *Phocoenidae*) mortality in gill nets. Biological Conservation 67: 167–183.

Khalilian S, Froese R, Proelss A, Requate T. 2010. Designed for failure: A critique of the Common Fisheries Policy of the European Union. Marine Policy 34: 1178–1182.

Lewison RL, Crowder LB, Read AJ, Freeman SA. 2004. Understanding impacts of fisheries bycatch on marine megafauna. Trends in Ecology & Evolution 19: 598–604.

Lucke K, Siebert U, Lepper P, Blanchet MA. 2009. Temporary shift in masked hearing thresholds in a harbor porpoise (*Phocoena phocoena*) after exposure to seismic airgun stimuli. Journal of the Acoustical Society of America 125:4060–4070.

National Research Council (NRC). 2005. Marine mammal populations and ocean noise: determining when noise causes biologically significant effects. The National Academies Press, Washington, DC, 126 pp.

Nedwell J, Howell D. 2004. A review of offshore windfarm related underwater noise sources. Cowrie Report 544 R0308.

Nowacek DP, Thorne L, Johnston DW, Tyack PL. 2007. Responses of cetaceans to anthropogenic noise. Mammal Rev 37:81–115.

Miller PJO, Johnson MP, Madsen PT, Biassoni N, Quero M, Tyack PL. 2009.Using at-sea experiments to study the effects of airguns on the foraging behavior of sperm whales in the Gulf of Mexico. Deep-Sea Research I 56: 1168–1181.

Parsons ECM, Dolman SJ, Wright AJ, Rose NA, Burns WCG. 2008. Navy sonar and cetaceans: just how much does the gun need to smoke before we act? Marine Pollution Bulletin 56: 1248–1257.

Pauly D, Christensen V, Dalsgaard J, Froese R, Torres Jr F. 1998. Fishing down marine food webs. Science 279: 860–863.

Richardson WJ, Greene CR, Malme C, Thomson D. 1995. Marine mammals and noise. Academic Press, New York, 567 pp.

Scheidat M, Gilles A, Siebert U. 2006. Evaluating the distribution and density of harbour porpoises (*Phocoena phocoena*) in selected areas in the German waters. In: v Nordheim H, Boedeker D, Krause J (eds). Progress in marine conservation in Europe - NATURA 2000 sites in German offshore waters – Springer Verlag, Hamburg, p 189–208.

Shapiro AD, Tyack PL, Solow AR. 2006. Analysis of sperm whale orientation response to controlled exposure of sonar. Abstract, 20th annual conference of the European Cetacean Society, Gdynia, Poland, 2006.

Shapiro, AD, J Tougaard, PB Jørgensen, LA Kyhn, J Balle, C Bernardez, A Fjälling, JD Karlsen, M Wahlberg. 2009. Transmission loss patterns from acoustic harassment and deterrent de-

vices do not always follow geometrical spreading predictions. Marine Mammal Science 25(1): 53–67.

Stone CJ, Tasker ML. 2006. The effects of seismic airguns on cetaceans in UK waters. Journal of Cetacean Research and Management 8: 255–263.

Tejedor A, Sagaminaga R, De Stephanis R, Cañadas A, Lago R. 2008. Management of MPAs. Options and challenges for the maritime transport sector. Spanish case studies. Proceedings of the ECS/ASCOBANS/ACCOBAMS WORKSHOP on Selection Criteria for Marine Protected Areas for Cetaceans. ECS Special Publications Series no. 48.

Tougaard J, Carstensen J, Teilmann J, Skov H, Rasmussen P. 2009. Pile driving zone of responsiveness extends beyond 20 km for harbor porpoises (*Phocoena phocoena* (L.)). Journal of the Acoustical Society of America 126:11–14.

Vanderlann ASM, Taggart CT, Brown MW. 2008. A practical example of a successful strategic approach to marine spatial analyses and minimizing spatial conflict: How not to kill whales with vessels. ICES CM 2008/E:01 1/8.

Vinther M. 1999. Bycatches of harbour porpoises (*Phocoena phocoena*) in Danish set-net fisheries. Journal of Cetacean Research and Management 1: 123–135.

Weilgart L. 2007. The impacts of anthropogenic ocean noise on cetaceans and implications for management. Canadian Journal of Zoology 85:1091–1116.

Würsig B, Greene CR, Jefferson TA. 2000. Development of an air bubble curtain to reduce underwater noise of percussive piling. Marine Environmental Research 49:79–93.

6 ToR d. Catalogue the Marine Protected Areas for marine mammals in the ICES area and evaluate the efficacy of MPAs for cetaceans

6.1 Introduction

Marine Protected Areas (MPAs) is an umbrella term that embraces a wide diversity of definitions, depending on the jurisdiction (e.g. cetacean sanctuary, marine reserve, national marine sanctuary, nature reserve, Special Areas of Conservation, critical habitat) and rationales for their establishment (Reeves, 2000). MPAs may provide total protection to all species present or a selected list of species, and may or may not permit anthropogenic activities (Reeves, 2000; Hooker and Gerber, 2004; Hooker *et al*., 2011). MPAs may also comprise specific national sites or a protected area network (e.g. the Trilateral Wadden Sea Conservation Area).

In 2004, the WGMME reviewed the usefulness of MPAs as tools to manage human activities that affect marine mammals ("marine mammal management"). The WGMME accepted the following definitions of the US National Center for Ecological Analysis and Synthesis's working group on marine reserves (Lubchenco *et al*., 2003):

MPAs: areas of the ocean designated to enhance conservation of marine resources;

Marine reserves: a category of MPAs which include areas of the ocean completely protected from all extractive and destructive activities;

No-go areas: a category of marine reserves which include areas where human entry is banned subject to permit.

The latter being a stricter categorization than marine reserves. Within this report WGMME will catalogue areas that fall within all three definitions.

6.2 Legal framework

In the ICES area, different legal frameworks for the protection of marine mammals exist in Europe, Canada and the United States. The basic idea behind the designation of MPAs, however, is the same.

6.2.1 Europe

All cetaceans, the Mediterranean monk seal (*Monachus monachus*) and the Saimaa ringed seal (*Phoca hispida saimensis*) are offered strict protection in their entire range under Annex IV of the European Commission's Habitats Directive. The grey (*Halichoerus grypus*), harbour (*Phoca vitulina*) and Baltic ringed (*Phoca hispida botnica*) seal are listed in Annex V "Animal and plant species of Community interest whose taking in the wild and exploitation may be the subject of management measures". In addition, grey, harbour and Baltic ringed seals, harbour porpoises (*Phocoena phocoena*) and bottlenose dolphins (*Tursiops truncatus*) are also listed in Annex II of the Habitat Directive, "Animal and plant species of community interest whose conservation requires the designation of Special Areas of Conservation (SACs)". SACs will form part of a coherent European network of protected areas named the Natura 2000 network (which also includes areas designated under the Bird Directive).

Article 4 of the Habitat Directive describes the process of designating SACs for species listed in Annex II. The process is divided in two Stages as described in Annex III

of the Directive. In Stage 1, the relative importance of sites for each species in Annex II is assessed. On the basis of the criteria listed in Annex III (and below), Member States must classify the sites eligible for identification as Sites of Community Importance (SCI, which is a prerequisite to an SAC) according to their relative value for the conservation of each species in Annex II. For aquatic species which range over wide areas, such sites should only be designated where they constitute a clearly identifiable area which represents the physical and biological factors essential to the species' life and reproduction.

Stage 1 criteria

A. Size and density of the **population** of the species present on the site in relation to the populations present within national territory;
B. Degree of **conservation** of the features of the habitat which are important for the species concerned and restoration possibilities;
C. Degree of **isolation** of the population present on the site in relation to the natural range of the species, and;
D. Global assessment of the **value of the site** for conservation of the species concerned.

Each criterion is graded in three categories (A, B and C), except the **population** criterion which contains the following categories: A = >15% of national population occur in the site; B = 2–15% of national population occur in the site; C = >0%–2% of national population occur in the site; D = non-significant. For species with population categories A-C, the other criteria have to be scored.

The **conservation** criterion comprises two subcriteria , each graded into three categories:

1) The degree of conservation of the features of the habitat important for the species; and
2) Restoration possibilities.

Combination of the grades for the subcriteria renders the overall conservation score: (A) conservation excellent = elements in an excellent condition, independent of the grading of the possibility of restoration; (B) good conservation = elements well conserved independent of the grading of the possibility of restoration, or elements in average or partially degraded condition and restoration easy; (C) average or reduced conservation = all other combinations.

Once draft SCIs are identified for all Annex II species during Stage 1, their combined community importance at national level is assessed according to the Stage 2 criteria.

Stage 2 criteria

A. Relative value of the site at national level;
B. Geographical situation of the site in relation to migration routes of species in Annex II and whether it belongs to a continuous ecosystem situated on both sides of one or more internal Community frontiers;
C. Total area of the site;
D. Number of natural habitat types in Annex I and species in Annex II present on the site; and

E. Global ecological value of the site for the biogeographical regions concerned and/or for the whole of the territory referred to in Article 2, as regards both the characteristic of unique aspect of its features and the way they are combined.

Article 4, paragraph 4 states that once a SCI has been adopted in accordance with the procedures of Stage 1 and 2, the Member State shall designate that site as a Special Area of Conservation (SAC). After a SAC have been designated, the Member State is legally obligated (according to Articles 5 and 6) to establish the necessary conservation measures to protect the species and maintain its status as 'favourable'.

Due to difficulties encountered when trying to identify potential sites for harbour porpoises, EU marine guidelines (EU 2007) were developed which proposed four key criteria that could be used for the assessment of potential SAC sites as being 'essential to the life and reproduction' of the harbour porpoise:

- Continuous or regular presence of the species (subject to seasonal variations);
- Good population density (in relation to neighbouring areas);
- High ratio of young to adults during certain times of the year; and
- Other biological elements that are characteristic, such as very developed social and sexual life.

However, no guidance has been provided on how any of these relate to the grading of site features, nor how they relate to the selection criteria for the relative importance of areas for this species.

Once a site has been submitted to the European Commission as a draft SCI, Member States must take preventive measures to avoid disturbance to the species for which the site is identified, and deterioration of their habitats. Once a site has been designated as a SAC (within six years at most from the site being adopted as SCI), positive conservation measures for the species must be established, which can include, if need be, a site management plan. Priorities for the site to maintain or restore the species at 'Favourable Conservation Status' must be established, and may be achieved by defining conservation objectives for the selected species at the site. Conservation objectives can be specified at different levels: the size of the habitat, the quality of the habitat, and the size of the species' population. Objectives could be qualitative (e.g. maintain quality of the habitat or improve the size of the population), but ideally should be SMART in order to monitor the efficacy of management measures. As part of the management approach associated with MPAs, a commonly used technique for regulating disparate human uses is spatial zoning, where different areas exhibit different levels of protection from human intrusion.

The EU Marine Strategy Framework Directive (MSFD) is a legislative framework for an ecosystem based approach to management of human activities which supports sustainable use of goods and services. Thus, MSFD recommends that Member States prepare national strategies to manage the seas to achieve or maintain Good Environmental Status (GES) by 2020. The MSFD requires that GES will be defined for marine waters by 2012, with a monitoring programme to measure progress towards achieving GES set up by 2014 and to report on progress of establishment of a system of MPAs, contributing to coherent and representative networks, by 2013.

Other examples of the legal frame work used to establish MPAs, and further information on their development, include:

Europe

In Norway, nature reserves were established in the Svalbard Archipelago for the protection of Walrus (*Odobenus rosmarus*), under the jurisdiction of the Norwegian Directorate for Nature Management (http://en.wikipedia.org/wiki/Norwegian_Directorate_for_Nature_Management).

In Iceland, two areas (*Faxaflói Bay*, SW Iceland and *North Icelandic waters*) were specially designated to protect cetaceans by the Ministry of Fisheries and Agriculture through a regulation issued in April 2009. All whaling is prohibited in areas that are designated for whale watching. Whale watching has been a rapidly growing industry since the early 1990s, and the above mentioned two areas are important for this activity. Although, not particularly large, this protection does impose considerable limitations to the small type coastal minke whaling operations, as these areas used to be among the best hunting areas.

There are currently no designated MPAs for marine mammals within the Faroese EEZ (ICES 5a+b).

Within EU waters

In Portugal, a national network of protected areas exists, which includes N2000 areas within their boundaries. All marine mammals in Portugal are managed under the legal transposition of the EU Habitats Directive to the National legislation (DL 140/99); cetacean watching for recreational and commercial purposes is regulated by specific legislation (DL 9/2006); and Parks are managed through the Institute for Nature Conservation and Biodiversity, a division of the Portuguese Ministry of Environment, Spatial Planning and Regional Development.

In France, MPAs can be designated both under national jurisdiction and the EU Habitat Directive framework. Historically, most MPAs relevant to marine mammals designated under national regulation were "Natural Reserves" established in intertidal and coastal habitats - often initially designated for breeding or wintering seabirds. *Baie de Somme*, *Baie des Veys* and *Archipel des Sept Îles* are typical examples of Natural Reserves designated for seabirds which encompass seal haul-out and pupping sites. Management plans generally involve restrictions of human activities, and surface areas considered were often fairly limited and concentrated around well identified biologically essential habitats. More recently, the concept of "Marine Natural Parks" was implemented into law (Law of April 14th, 2006, creating the Agency for Marine Protected Areas) with three general goals: improve knowledge of the marine environment, its protection, and the sustainable development of marine human activities; and one operative objective: creation of a network of ten Marine Natural Parks by 2012. Marine Natural Parks are typically larger than Natural Reserves and are established by means of a decree which defines the limits of the park, the composition of its management committee and a number of strategic management goals. Within the ICES area, one Marine Natural Park was created in 2007 (*Parc Naturel Marin de l'Iroise*) in an area of national importance for grey seals and bottlenose dolphins. Four other Marine Natural Parks are in the consultation phase, prior to their creation and among these, *Parc Naturel Marin de la Côte d'Opale* is of national importance for harbour porpoises and harbour seals and *Parc Naturel Marin du Golfe Normand-Breton* is of national importance for harbour seals and bottlenose dolphins. Beside these national initiatives, as many as 47 SCIs have been proposed in the last decade of which ten list either grey seals, harbour seals, bottlenose dolphins or harbour porpoises as a primary feature (Annex 2). In most of these sites, marine mammals listed in Appendix 2

of the Habitat Directive are only one among many features to conserve. In general, management plans are still in preparation. However, where Natura 2000 marine sites overlap with MPAs established under national regulation, management plans designed for the latter apply.

In the Netherlands, the process for establishing MPAs is gradually expanding from the coastal zone to offshore. The *Wadden Se*a was the first MPA/SAC to be designated, which is linked to German and Danish MPAs in order to provide interconnected MPAs for protection and conservation of the listed species. The management goals for grey and harbour seals in the Dutch part of the Wadden Sea are to "maintain the extent and quality of habitat in order to maintain the population". The Wadden Sea is also designated under the "Bird Directive", and contains a number of smaller areas that are protected under different conservation/legislations schemes. In 2008, two tidal and one coastal area in the southern part of the Netherlands (*Voordelta*, *Oosterschelde*, and *Westerschelde*, respectively) were designated as SACs for both seal species, mainly to an increase in size of the local seal populations. In 2010, two other coastal areas were designated as SACs, *de Vlakte van de Raan* and the *Noordzeekustzone*. Apart from seals, the latter areas were also designated for harbour porpoises, and at the present point in time management plans are been developed and implemented. The conservation objectives for the listed marine mammals in these coastal areas are to "maintain the extent and quality of habitat in order to maintain the population". Further offshore, the *Dogger Bank* and *Cleaver Bank* are the first proposed Dutch offshore SACs with designation due by 2012, and the conservation objectives will likely be similar to those in the above mentioned coastal areas. Because the functions of the proposed and designated areas for harbour porpoises and to a lesser extent seals are virtually unknown, the proposed management measures for the time being will be generic and not tailor made for these species. For the harbour porpoise, measures will be based on the (national) protection plan for this species, which mainly considers reduction of bycatch and disturbance by underwater noise.

In the UK, there are 52 protected sites (SACs) that list cetaceans and/or seals as a feature (Annex 2). On many of these sites, there are specific management measures for marine mammals whereas on others the management measures are specific to the habitat rather than the species itself. Of these, eight list bottlenose dolphins, with three having species-specific management measures (the *Moray Firth* in Scotland and *Lleyn Peninsula/Sarnau* and *Cardigan Bay* in Wales). 27 list harbour porpoises, although none have species-specific management measures. For grey seals, there are 35 sites, of which 13 have species-specific management measures and are based on the largest breeding colonies. Colonies have also been selected to ensure coverage of the geographical range of breeding in the UK. 19 SACs have been established for the harbour seal of which eleven have species-specific management measures. These sites cover areas used for general haul-out, moulting and pupping. Whaling has been prohibited through the waters of the UK since the 1970s. This level of protection is equivalent to that provided by the Irish Whale and Dolphin Sanctuary although the UKs waters have not been designated as an MPA. The process of MPA site identification is ongoing through a variety of projects. These included a continuation of the SAC work (http://jncc.defra.gov.uk/page-1445), as well as the Marine Conservation Zone project (http://jncc.defra.gov.uk/page-2409), Scottish MPAs (http://jncc.defra.gov.uk/page-5269) and MCZ Project Wales (http://jncc.defra.gov.uk/page-4164).

6.2.2 Canada and US

In Canada and the US the term "Critical Habitat" is used to identify important cetacean habitat for endangered species (e.g. North Atlantic right whale and northern bottlenose whale (*Hyperoodon ampullatus*)), and subsequently protecting it (http://www.nmfs.noaa.gov/pr/species/criticalhabitat.htm, http://www.dfo-mpo.gc.ca/species-especes/species-especes/rightwhaleNA-baleinenoireAN-eng.htm, http://www.dfo-mpo.gc.ca/species-especes/species-especes/northernbottlenosewhale-baleinebeccommun-eng.htm). In the US Critical Habitat is defined in Section 3(5)(A) of the Endangered Species Act as 1) the specific areas within the geographical area occupied by the species on which are found those physical or biological features essential to the conservation of the species and which may require special management considerations or protection and 2) specific areas outside the geographical areas occupied by the species that are essential to the conservation of the species (http://www.nmfs.noaa.gov/pr/laws/esa/). In Canada Critical Habitat is defined in the Species At Risk Act (SARA) (http://www.dfo-mpo.gc.ca/species-especes/act-loi/aquaculture-info-eng.htm) as habitat that is vital to the survival or recovery of wildlife species. It may be an identified breeding site, nursery area or feeding ground. For species at risk, such habitats are of the utmost importance, and must be identified, where possible, and included in recovery strategies or action plans.

6.3 Catalogue of MPAs within the ICES area

The WG compiled a list of 344 Marine Protected Areas within the ICES area; including NAFO areas for Canada and the United States (see Annex 2). Creation of the table in Annex 2 took up a considerable amount of time of WG members during the meeting. Preparation of this table relied on published data, particularly Hoyt (2005), contributions from WG members and others. Data available to the WG, however, were insufficient to complete all table cell entries for all countries. The WG plans to complete this table prior to next year's WGMME meeting in 2012.

The table includes both established and candidate MPAs, which vary in terms of size, species, and conservation objectives and management process. Approximately 93% of MPAs listed in the table were established as part of the Natura 2000 network. The earliest MPA was a national park established for seals in 1973 in *Forlandet*, Svalbard. The overarching goals for all these areas are habitat protection and species conservation. The species afforded protection within the MPAs includes both pinnipeds and cetaceans, and sites may be specific to a single or multiple species. Some examples of this diversity are: 1) The *Moffen Island Reserve* (16 km^2) in Svalbard Archipelago was established in 1983 to enhance the walrus population; 2) *Linnansaari* (266 km^2) in Finland was proposed in 1998 to protect the endangered Saimaa ringed seal; 3) The *Voordelta* (900 km^2) in the Netherlands was established in 2008 to conserve habitat and maintain populations of grey and harbour seals; 4)*The Baie du Mont Saint Michel* (387 km^2 – mostly marine) in France was proposed in 2002 for conservation of harbour seals, and secondarily of grey seals and bottlenose dolphins; and 5) *Reserva Natural das Ilhas Desertas* (Desertas Islands; 96.7 km^2) in Portugal aims to protect and improve the status of the colony of Mediterranean monk seals.

The size of the MPAs are highly variable ranging from <0.1 to 55 000 km^2, although most sites can be binned into clusters that are tens or a few hundred km^2. Further, some MPAs include both marine and terrestrial habitat, but the marine component is specified within the table. For example see *Littoral ouest du Cotentin de Bréhal à Pirou* (pSCI FR2500080) in France; *Nordrügensche Boddenlandschaft* (SCI DE-1446302) in

Germany; and *Parque Natural da Ilha de São Miguel,* São Miguel Island in Portugal (Annex 2).

Some countries work jointly to establish equivalent and/or interconnected MPAs to enhance conservation of marine mammals. The establishment of right whale critical habitat in Canada and the US is an example of an equivalent MPA. Whereas, the Wadden Sea Trilateral Agreement among Denmark, the Netherlands and Germany provides interconnected MPAs for protection and conservation of harbour seals, grey seals, and harbour porpoises (http://www.waddensea-secretariat.org/management/Plan.html).

6.4 Efficacy of MPAs for cetaceans

This primarily depends on the species involved and size of the MPA. However, currently, evaluating the efficacy of MPAs for cetaceans is difficult, because monitoring programmes in the EU have not yet begun, and therefore data needed for the assessment of compliance management/conservation objectives are thus non-existent for most MPAs; though general remarks can be made. In addition to this, where data exist, it is difficult to disentangle to which extent trends observed in the MPA result from management practices implemented locally or from general trends affecting the whole region.

As such, we summarize the conclusions of ICES WGMME (2004).

The usefulness of MPAs

ICES WGMME (2004) identified seven characteristics to define the usefulness of MPAs. In synopsis, these included bringing environmental managers and stakeholders together to assess all anthropogenic impacts on a site in question and to maintain the integrity of the marine ecosystem.

Problems with MPAs

Similarly, ICES WGMME (2004) identified problems with MPAs. These include permitted activities and enforcement; they should be designed to enhance the conservation value of the MPA. The time frame for establishing effective management can be long, especially for multinational MPAs. Jurisdictional issues can arise if the MPA extends into waters that permit activities (e.g. fishing), which may be regulated by international agreements. The spatial extent of the MPA may be too restricted to achieve the stated goals, and likely cannot account for shifts in marine mammal habitat use (for an example see Section 3.4.2). Further, finding appropriate boundaries for MPAs, particularly when full spatial and temporal variability of animal distribution needs to be accounted for, can be very costly in research resources. Temporal variability may be on a decadal scale (e.g. porpoises in the North Sea; SCANS 2, 2008). Inadequate data may lead to inappropriate boundaries, with potential disadvantages to the populations being "protected".

The WGMME agrees with the overall conclusions by Agardy *et al.* (2011) on the potential shortcomings of MPAs. These authors categorized potential shortcomings of MPAs in five main types:

1) MPAs that by virtue of their small size or poor design areas are ecologically insufficient;

2) Inappropriately planned or managed MPAs;

3) MPAs that fail due to the degradation of the unprotected surrounding ecosystems;

4) MPAs that do more harm than good due to displacement and unintended consequences of management;

5) MPAs that create a dangerous illusion of protection when in fact no protection is occurring.

Ad 1. Size too small in relation to home ranges of species, or Critical Habitats lying outside the MPA or MPA not designed in connection to other MPAs.

Ad 2. Sufficient involvement of stakeholders is a common omission. Another common failure is meeting the objectives for which they were established is the result of inadequate attention to compliance.

Ad 4. Activities prohibited in MPAs can be displaced to and concentrated in areas where they have more negative impacts. WGMME notes that displacement of fishing activity to less productive areas will lead to greater fishing effort for the same yield and, hence, greater bycatch of, for example, harbour porpoises. Such an SAC would be detrimental to the long-term conservation of this species.

A strategic alternative, which fully utilizes the strengths of the MPA tool while avoiding the pitfalls, can overcome these shortcomings: integrating MPA planning in the broader Marine Spatial Planning (MSP) and ocean zoning efforts (Agardy *et al*., 2001).

Agardy *et al*. (2001) stated that to fully utilize the strengths of the MPA tool while avoiding the pitfalls, MSP should include, at a minimum, five elements:

1) Identification of priority areas, using robust analysis of existing information and databases;

2) Development of scenarios to help decision-makers and multilateral agencies weigh trade-offs and choices in creating various sorts of MPA networks that span both coastal regions and open ocean areas;

3) Analysis and evaluation of current legal and institutional frameworks and potential decision-making governance structures needed for comprehensive ocean zoning;

4) Creation of regional ocean zoning plans that capitalize on existing protected areas and resource management, take into account what is known about priority areas for conservation, and elucidate appropriate areas for the wide range of marine uses;

5) Linking of regional ocean zoning with national and local management efforts in a manner that strengthens all levels of management.

6.4.1 Examples of long-term cetacean MPAs

The Moray Firth SAC and Stellwagen Bank National Marine Sanctuary provide two good examples of long-term cetacean protected areas that have well developed monitoring programmes and highlight some of the issues regarding efficacy of MPAs for mobile species.

Moray Firth SAC, ICES Region IVa

The *inner Moray Firth*, Scotland (Figure 9) was submitted to Europe as a candidate SAC in 1996 and subsequently designated in March 2005 for bottlenose dolphin, which is listed on Annex II of the Habitats Directive, as well as for the Annex I habitat

'Sandbanks which are slightly covered by seawater all the time (http://www.jncc.gov.uk/protectedsites/sacselection/sac.asp?EUCode=UK0019808 and http://www.morayfirth-partnership.org/work-2-sac.html). The boundaries of the *Moray Firth* bottlenose dolphin SAC were derived from ship-based sightings surveys in the 1980s and boat-based photo identification work between 1989 and 1991 (Wilson *et al*., 2004). At the time of submission, the boundaries of the SAC encompassed the populations' core range. The population, which is present year-round within the SAC, is estimated at around 130 animals, and the waters are used for both breeding and feeding.

Since establishment, the resident bottlenose dolphin population extended its distribution on a time-scale similar to that of the implementation of the European Directive designed to protect it. The area used by the dolphins has expanded to include much of the rest of the (south) east coast of Scotland (Wilson *et al*., 2004, see Figure 9). This change appears to be a range expansion rather than a range-shift and has effectively spread the population more widely and into areas considerably outside the SAC (Wilson, 2008). As a result of the range-expansion undertaken by bottlenose dolphins within this region, a decade after designation the SAC no longer covers the core distribution of some of the individuals it was designated to protect (Wilson *et al*., 2004).

Consequently, this and other similar designations, may afford less protection than originally envisioned, and therefore, the potential for long-term mobility should be actively incorporated into such management structures from the outset (Wilson *et al*., 2004). In light of the range expansion, the European Commission requested that boundaries of *Moray Firth* SAC be revised to encompass the entire range of individuals using the site. This has proven impossible as Photo ID studies have indicated that some of these individuals range out of UK waters (including to the west of Ireland).

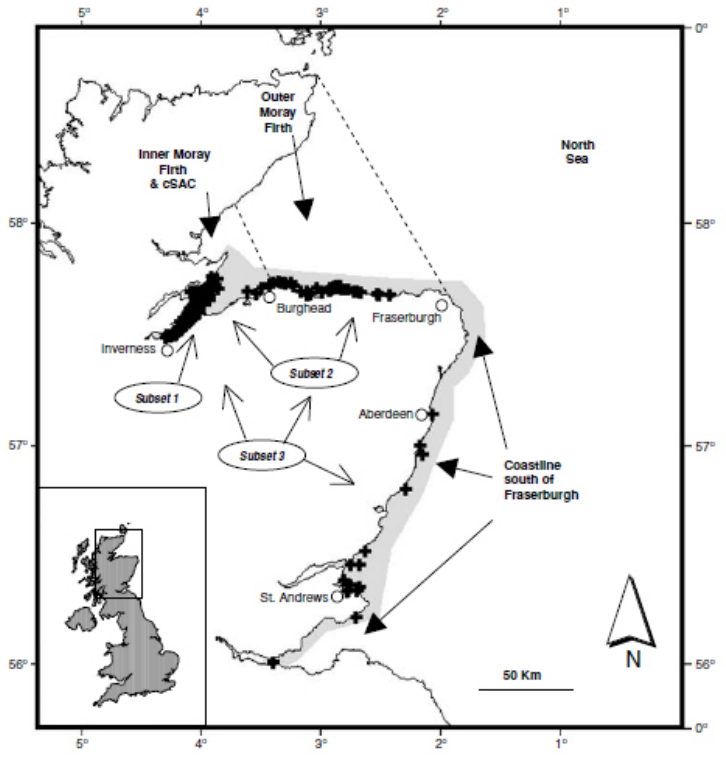


Figure 9. Map of eastern Scotland showing the areas of survey effort (shading), dolphin sightings (crosses) and broad areas used by the three different subsets within the population. The offshore extent of the dolphins' distribution is little known (Taken from Wilson *et al*., 2004).

Stellwagen Bank National Marine Sanctuary

The Stellwagen Bank National Marine Sanctuary (SBNMS; Figure 10) was the culmination of over a decade of effort in the late 1980s and established in 1992 under the US National Marine Sanctuary Act of 1972 (http://sanctuaries.noaa.gov/about/legislation/leg_history.html). The Bank supports important commercial and recreational fisheries, and is an important foraging habitat for marine mammals, fish, and seabirds. Seasonally, humpback, fin and minke whales, and the critically endangered North Atlantic right whale are found there. Smaller cetaceans that also utilize the Bank are the Atlantic white-sided dolphin, harbour porpoise, and long-finned pilot whale.

The Sanctuary management plan contains three marine mammal action plans: Marine Mammal Behavioural Disturbance, Marine Mammal Vessel Strike, and Marine Mammal Entanglement (http://stellwagen.noaa.gov/management/fmp/fmp2010.html).

Each plan has three objectives:

> Behavioural Action Plan: reduce marine mammal behavioural disturbance and harassment by 1) vessels, 2) noise, and 3) aircraft.
>
> Vessel Strike Plan: reduce risk of vessel strike 1) between large commercial ships and whales, 2) through speed restrictions, and 3) support research programmes to reduce the risk of vessel strike.
>
> Marine Mammal Entanglement Plan: reduce marine mammal entanglement by 1) aid disentanglement efforts, 2) reduce interaction with trap/pot fisheries, and 3) reduce interaction with gillnet fisheries.

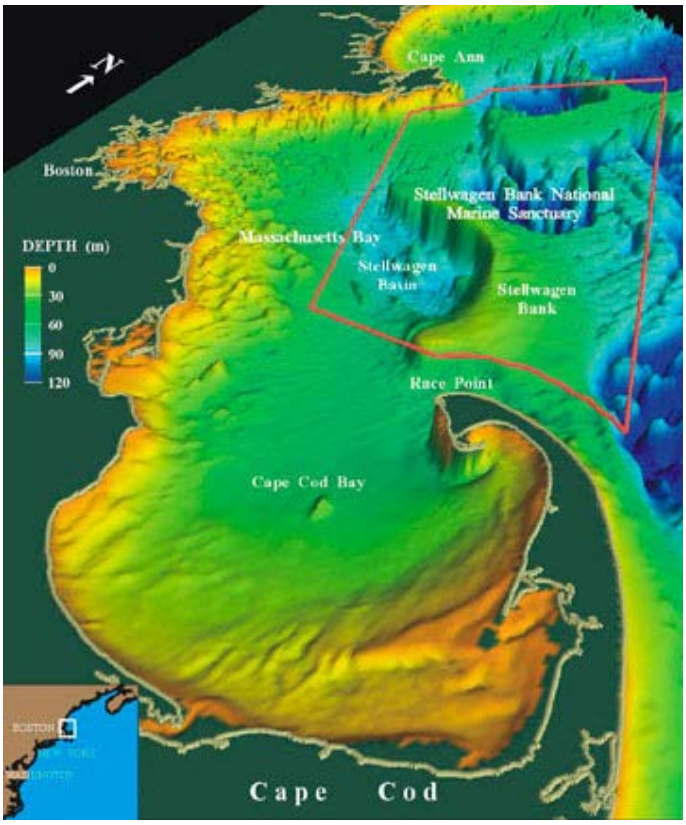


Figure 10. Map of southwestern Gulf of Maine depicting the Stellwagen Bank National Marine Sanctuary (http://stellwagen.noaa.gov/).

Implementation of most of the strategies in the sanctuary management plan requires some input or coordination from partners, particularly other government agencies, research institutions, and NGOs. For example, enforcement activities may involve the US Coast Guard, NOAA law enforcement or Massachusetts state environmental police.

SBNMS has worked with stakeholders to draft a comprehensive management and science plan. They established a process for review and updating the plans, and have an extensive public outreach and education programme. They worked with the shipping industry to move the Boston traffic lanes away from large whale high use sections of the sanctuary. These actions have likely reduced anthropogenic impacts on cetaceans within the sanctuary. It is more difficult to make a direct link between the sanctuary and population changes; but the sanctuary protects high use foraging grounds, which ultimately may translate to animal condition and reproductive success.

6.5 Conclusions and recommendations

National and multinational legislation have resulted in the establishment of MPAs throughout the ICES area. Many of the sites catalogued by the WG have clearly stated conservation objectives to conserve and improve marine mammal habitat and maintain populations. MPAs that were not specifically established for marine mammals should also benefit such populations through more general rules designed to protect wildlife. The group notes that many management plans are in-existent or under preparation (irrespective of the dates of site creation, which may exceed a decade).

With few exceptions, there is no coherent protocol for coordination of management plans among sites for a given species or group of species.

The WG concurs with the MPA evaluations reported in ICES WGMME (2004) and Agardy *et al*. (2001). The group notes that many of the MPAs are small relative to marine mammal movements and habitat used for essential life-history requirements (i.e. foraging, breeding, nursing; Agardy *et al*., 2001; Hooker and Gerber, 2004; Wilson *et al*., 2004; Evans, 2008). Consequently, the value of such sites to the overall conservation of marine mammals, primarily cetaceans, is likely to be limited. In recent years, larger sites have been created through international cooperation (e.g. the Trilateral Wadden Sea Conservation Area).

The efficiency of MPAs is further compounded by the scientific basis on which designations are made. The quality and quantity of data used to designate sites varies considerably, with many utilizing very little scientific data. For example, a number of the SAC sites list one or more species of Annex II (harbour or grey seals, bottlenose dolphin, harbour porpoise) as "C" for population criteria using opportunist sightings or stranding records. Where a site is designated without a thorough understanding of animal movements, it may afford less protection than originally envisioned. It is, therefore, **recommended** that the boundaries of MPAs should only be decided on the basis of a significant long-term dataseries (of at least five years).

If protected areas are created in response to public opinion without the scientific evidence to support their selection, there is a risk that such sites could provide false assurance that space and resources have been set aside for marine mammals, thereby reducing the pressure for targeted action on the most significant threats.

For species that spend the majority of the life outside the MPA, consideration needs to be given to whether protection of a limited part of the population's range, or focus on a site-based protection of a particular life stage, is worthwhile. The key to species protection and recovery is eliminating the threats that have led, could lead, or continue to lead, to the decline of the species. It is therefore **recommended** that the appropriateness of MPAs as a mechanism to controlling or eliminating threats is given significant consideration prior to site designation.

6.6 References

Agardy T, *Notarbartolo di Sciara* G, Christie P. 2011. Mind the gap: Addressing the shortcomings of marine protected areas through large scale marine spatial planning. Marine Policy 35: 226–232.

EU 2007. Guidelines for the establishment of the Natura 2000 network in the marine environment. Application of the habitats and Birds Directives.

Evans PG. 2008. Selection Criteria for marine protected areas for cetaceans. Proceedings of the ECS/ASCOBANS/ACCOBAMS held at the European Cetacean Society's 21st Annual Conference, The Aquarium, San Sebastian, Spain, 22nd April 2007. ECS Special Publication Series No. 48. Available at http://www.service-board.de/ascobans_neu/files/MPA_Workshop2007_final.pdf.

Hooker SK, Cañadas A, Hyrenbach KD, Corrigan C, Polovina JJ, Reeves RR. 2011. Making protected area networks effective for marine top predators. Endangered Species Research 13:203–211.

Hooker SK, Gerber LR. 2004. Marine reserves as a tool for ecosystem-based management: the potential importance of megafauna. Bioscience, 54, 27–39.

Hoyt E. 2005. Marine protected areas for whales, dolphins, and porpoises: a world handbook for cetacean habitat conservation. Cromwell Press Ltd, Trowbridge, UK.499 pp.

ICES WGMME. 2004. Report of the Working Group on Marine Mammal Ecology. 22–25 March 2004, Pasajes, Spain.

Lubchenco J, Palumbi SR, Gaines SD, Andelman S. 2003. Plugging a hole in the ocean: the emerging science of marine reserves. Ecological Applications **13** (1) Suppl., p: S3–S7.

Reeves RR. 2000. The Value of Sanctuaries, Parks, and Reserves (Protected Areas) as Tools for Conserving Marine Mammals. Hudson (Canada): Okapi Wildlife Associates (18 November 2003; *www.mmc.gov/reports/contract/pdf/mpareport.pdf).*

SCANS II. 2008. Small Cetaceans in the European Atlantic and North Sea. Final Report submitted to the European Commission under project LIFE04NAT/GB/000245. Available from http://biology.st-andrews.ac.uk/scans2/inner-finalReport.html.

Wilson B. 2008. Marine protected areas for coastal small cetaceans: the Moray firth bottlenose dolphin experience. In Evans P.G.H (Ed) Selection Criteria for marine protected areas for cetaceans. Proceedings of the ECS/ASCOBANS/ACCOBAMS held at the European Cetacean Society's 21st Annual Conference, The Aquarium, San Sebastian, Spain, 22nd April 2007. ECS Special Publication Series No. 48. Available at http://www.service-board.de/ascobans_neu/files/MPA_Workshop2007_final.pdf.

Wilson B, Reid RJ, Grellier K, Thompson PM, Hammond PS. 2004. Considering the temporal when managing the spatial: a population range expansion impacts protected areas-based management for bottlenose dolphins. Animal Conservation 7:331–338.

7 ToR e. Finalize production of the Cooperative Research Report on the framework for surveillance and monitoring of marine mammals applicable to the ICES area

7.1 Overview

The "Framework for surveillance and monitoring of marine mammals within the ICES area" edited by S. Murphy (UK), G. Pierce (UK), and E. Pinn (UK), will be published in the ICES Cooperative Research Report series. The publication will be based on work undertaken by the WGMME over the last two years and reported in ICES WGMME (2009; 2010). The final draft of the proposed publication will be submitted to ICES by 30th September 2011 and is expected to be around 100 pages in length.

The report is directed at Governments, conservation agencies and relevant NGOs of countries within the European Union, as well as non-EU countries bordering the regional seas shared with the Community. The primary focus will thus be the part of the ICES area that falls within the EU. Clearly, however, the ICES area extends beyond the EU, and the EU also extends beyond the ICES area. Therefore, information for the Arctic and Subarctic areas of the North Atlantic, from the Baltic States to North America, and from the Mediterranean, will also be included.

A draft outline structure is presented here (see Table 3). The intent is to involve the wider scientific community in commenting on and contributing to the material presented, as well as to fill gaps in expertise within the WGMME.

7.2 References

ICES WGMME. 2009. Report of the Working Group on Marine Mammal Ecology. February 2–6 2009, Vigo, Spain.

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

Table 3. Draft outline of the structure for the Cooperative Research Report "Framework for surveillance and monitoring of marine mammals applicable to the ICES area."

Headings	Sub-headings	Content	Associated appendices
Scope	Geographical areas Species groups (Types of monitoring (habitat, species, threat specific) What are appropriate management units (do they match reporting units?)	Scheme for organizing content within subheadings in other chapters, e.g. by area, habitat, species groups, type of monitoring Areas: ICES Europe, other ICES, Mediterranean Species groups: cetaceans, seals, polar bears Distinguish coastal, offshore and ice habitats; resident species (e.g. BND), other small cetaceans, large whales (where appropriate)	
Monitoring objectives	General aims of monitoring (what IS monitoring and surveillance?) Favourable conservation status for species (what it means, e.g. status, trends, allows early conservation decision) Specific threats (check MSFD) Fishery bycatch Renewable energy Boat traffic (collisions, whale watching, disturbance in critical habitats) Deliberate illegal killing (monk seals) Pollution, pathogens Noise (seismic, sonar, elevation of background noise?) Climate change (SST, ice) Habitat loss, damage, barrier to species movement, prey depletion Sustainable hunting (and culling) Good Environmental Status for marine mammal habitats	For each sub-heading: What are the drivers (specific legislation, other perceived needs; forthcoming needs, e.g. MSFD) Where and for which species it applies What kind of monitoring is implied / what data needed (if known – if not, what research is needed to design appropriate monitoring?) What reporting is needed Who is responsible for the monitoring and reporting (Prioritize according to threat severity)	Table of relevant legislation and specific requirements arising Table of species with relevant legislation

Headings	Sub-headings	Content	Associated appendices
Monitoring approaches	Distribution and abundance surveys Large-scale surveys Smaller surveys, platforms of opportunity & JCP Acoustic monitoring Other approaches (e.g. individual based approaches like photo ID, telemetry?) Strandings monitoring Causes of mortality Health, Pollution, Pathogens Life history, Diet Specific threat monitoring Bycatch (on-board, carcass recovery, interviews, strandings) Collision monitoring (ship strikes, corkscrew injuries) Seismic, Naval sonar Renewables (injury, barrier to movements Habitat loss and degradation Deliberate (illegal) killing (e.g. monk seals) Hunting and legal culling Seals Cetaceans (aboriginal, commercial, research) Marine mammal habitats (what is done that is relevant, etc)	What monitoring is needed (what, where, how much of it; operational definition) What is currently done, where and by whom Gaps (e.g. specific activities, geographical areas, coordination, sample banks and databases) Best practice (discussion) Critique and issues to be aware of (e.g. statistical power, good design, data quality and participative science in monitoring practices)	Table of strandings networks Table of organizations and what monitoring they do
Links to action	Link to management Link to research	How it works and if it works (briefly) What is needed to make it work	
Recommendations			

8 ToR f. Update on development of database for seals, status of intersessional work

As there were no further developments on the ICES seal database, this Terms of Reference was deferred until next year's meeting.

9 ToR g. Review the output of the ICES SIBAS Workshop on 'Biodiversity indicators for assessment and management' (available February 2011) and report on: What data, information and marine mammal science are you aware of that would contribute to biodiversity advice, with an emphasis on the trade-offs between fishing and conservation that are relevant to ICES client needs as described in the ICES SIBAS report

9.1 Introduction

A draft version of the WKMARBIO 2011 report "Furthering ICES Engagement in Biodiversity Issues: outcomes of the Workshop on Marine Biodiversity" was made available to the WGMME just prior to meeting. WKMARBIO requested the WGMME to undertake the following actions:

"Table 1 summarizes the types of indicators that might be developed to support the needs of policy and management agencies and applied to the various components (e.g. marine mammals) and pressures (e.g. aggregate extraction, fishing) in marine ecosystems. This table will be used by ICES expert groups that focus on specific ecosystem components to report on:

1) the strengths and weaknesses of these classes of indicators and to identify those that are most suited to supporting the policy drivers identified in Section 2 of this report;

2) to recommend modifications to these indicators if appropriate and to describe the process that would be used for data acquisition, analysis and reporting of the indicators (**Action k**);

3) For the indicators that are selected, the ICES expert groups will then comment on any trade-offs that need to be understood when setting targets for these indicators, the information, data and tools that are available to assess and quantify these trade-offs and how the indicators, targets and trade-offs might be presented as advice;

4) If there are additional data, information and science needs to quantify trade-offs the groups will also seek to identify and report in these.

Table 1 is intentionally comprehensive as the classes of indicators will be considered for many components and pressures. However, it is expected that only a few of these indicators will be relevant and applicable for given ecosystem components."

The WGMME found the terminology used in Table 1 of the WKMARBIO report (reproduced below as Table 4) somewhat confusing; there is need for further explanation and specification. Table 1 of the WKMARBIO report summarizes the types of "indicator classes" that might be developed to support the needs of policy and management agencies and applied to the various components. However, the text within the report requests the WGMME to discuss (and produce) actual "indicators", and discuss "data acquisition, analysis and reporting of the indicators", as well as commenting on "trade-offs that need to be understood when setting targets for these indicators".

Following a review of existing indicators/thresholds, it became apparent to the WGMME that full and unambiguous definitions of "indicator classes", "indicators",

"thresholds", and "trade-offs" etc. will be needed before the WGMME can begin to undertake this task. In addition, the document was received too late to allow WGMME members to prepare responses prior of the meeting, and given the already heavy workload of the other listed ToRs, the production of "actual indicators" was simply not possible at this stage. Realistically, this is a process that will require months of work rather than the small number of hours available during the meeting. In light of this, the WGMME will discuss the strengths and weaknesses of Table 4 for marine mammals, outline current and proposed indicators for marine mammals and discuss possible indicators that could be used for supporting policy drivers.

Table 4. Classes of indicators that would be short-term or medium use to policy and management agencies (take from a draft version of the ICES WKMARBIO 2011 report).

Type	Class	Level/scale	Specification/type of property	Relevance–types of users
State/ structure	Diversity	Community	Structure	All
	Diversity	Community	Functional diversity	All
	Population	Species or stock	Size, Range, Composition	All
	Population	PET species Invasive species Charismatic Highly migratory Bioengineers Forage	Size, Range, Composition	All
	Genetic Diversity	Species (other levels in specific cases)	Structure	Fisheries Management, Conservation
	Habitat	Multiple scales	Size, Range, Composition	All
	Habitat	Multiple scales	Usage – population / community use of available habitat	Conservation & recovery; (All)
	Habitat	Multiple scales	Proportion of suitable conditions where habitat is present	Conservation & recovery, (All)
	Habitat	Species/ Community	Patchiness and connectivity	Conservation, Fisheries
State/ Function	Strategic	Community/ Ecosystem	Marine trophic index (MTI), other trophic indicators from models or community data	Conservation, biodiversity (reporting on state of system - SOS)
	Strategic	Community/ Ecosystem	Ratios of functional groups	Specific to pressure; Reporting SOS
	Strategic	Community/ Ecosystem	Flow/length of food chain, etc	Biodiversity & conservation; Reporting SOS
	Strategic	Community, ecosystem (Population)	Resilience	Reporting on SOS. Indirect back to All

Type	Class	Level/scale	Specification/type of property	Relevance–types of users
Pressure	Magnitude/ extent of activity; trend	Multiple scales/ Ecosystem	Inherently pressure-specific	Fishing, Shipping, Tourism, mining, oil extraction, etc. All
	Accumulated effects	Species/ Community	Pollution, contamination	All
	Environmental forcing	Community/ Ecosystem	Physical and chemical variables; community abundance of characteristic species / groups (southern, calcifiers)	All (accommodate but not manageable)

In 2012, the WGMME can focus on developing biodiversity indicators in support of policy drivers, and develop indicators that are robust to expected uncertainties in data and/or to provide a quantitative analysis of the potential effects of data limitations on indicator performance (**Action d,** WKMARBIO report). In 2012, the WGMME can also discuss a number of other actions listed in the WKMARBIO report:

Action l: In conjunction with the development of indicators and targets for biodiversity, it will be necessary to establish the changes in pressure (and hence in the human activity causing that pressure) that are needed to meet the targets;

Action m: For some activities, pressures have yet to be defined on spatial and temporal scales that are appropriate to research on pressure-state relationships. ICES should describe the spatial and temporal distribution of activities and the resulting pressures in the ICES area;

Action n: It will also be necessary to assess whether the effects of multiple pressures are cumulative or synergistic and how any interactions should be accounted for in management;

Action p: Trade-offs among multiple objectives (for different sectors or among ecological, economic, and social outcomes) are inevitable at national, regional and global scales. Questions that need to be addressed by ICES include

i) Articulating and quantifying the consequences of different policy objectives, and how particular choices for one objective might constrain or create opportunities for other objectives, thus informing societal decisions before they are taken;

ii) providing guidance on the relationships between pressures and impacts, between the scales of activities and the magnitude of the pressures they create, thus informing how allocation of opportunities among sectors changes the aggregate pressures on biodiversity;

iii) providing guidance on how to incorporate externalities such as natural variability of (ii), so they are considered in sustainable allocation of sectoral opportunities;

iv) Conducting periodic high level integrated assessments to evaluate if the allocation scheme adopted has achieved the correct balance between pressures.

It is also necessary to consider the mechanisms for implementing the required changes in human "pressure" activities (i.e. in particular fishing). It is rather unlikely that the EAF and MSFD will result in relaxation of current regulations applied to European marine fisheries (e.g. on catch quotas). Given that excessive fishing effort is still an issue in EU waters, the development of more sophisticated ecosystem and biodiversity indicators needs to be matched by the development of improved implementation of management recommendations (e.g. through co-management measures). In the context of marine mammal indicators, therefore, it may increase acceptance of their use if they are readily understood by stakeholders and the public.

9.2 Current and proposed Indicators

Table 5 outlines the currently used and proposed indicators for marine mammals as developed to meet requirements of specific legislation and agreements. The indicator list is composed of state/structure, state/function and pressure types. The GES4BIO workshop in Utrecht (OSPAR/MSFD Workshop on approaches to determining GES for biodiversity) identified the following indicators currently in operation: (1) OSPAR's list of threatened and declining species, (2) OSPARs Ecological Quality Objectives (EcoQOs), (3) the Habitats Directive Favourable Conservation Status, (4) ASCOBANS Favourable Conservation Status, and (5) ASCOBANS bycatch of harbour porpoise, though the latter is listed as a target. Table 5 also summarizes marine mammal indicators that are proposed (/in consultation) by UK Marine Monitoring and Assessment: Healthy and Biologically Diverse Seas Evidence Group (HBDSEG; Duck, 2010; Pinn, 2010) and the HELCOM marine mammal working team. It became apparent that a number of other working groups are currently preparing indicators for different policy drivers, and are currently at a more advanced stage than the WGMME in their deliberations of useful and appropriate indicators. The WGMME proposed to include participants from these other working groups (e.g. HELCOM marine mammal working team) at next year's WGMME meeting.

The Marine Strategy Framework Directive (MSFD), which came into force on 15 July 2008, is the environmental pillar of the integrated European Maritime Policy. The MSFD outlines a transparent, legislative framework for an ecosystem-based approach to the management of human activities which supports the sustainable use of marine goods and services. The overarching goal of the Directive is to achieve 'Good Environmental Status' (GES) by 2020 across Europe's marine environment. The MSFD can be regarded as a tool for biodiversity protection in European waters but goes well beyond biodiversity by emphasizing ecosystem integrity, structure and function. Therefore, several indicators in the Commission decision of September 1, 2010 concern different elements within the foodwebs. Those with relevance to marine mammals are listed in Table 6.

9.3 Strengths and weaknesses of indicator classes in Table 4

State/structure: Of the listed "indicator classes" outlined in Table 4, the most appropriate class for marine mammals is "**population**", with "**population size**" as the most useful "specification/type of property". To date, detections of trends in abundance (cetaceans, seals), and pup counts (grey seals) have been proposed for a number of currently used marine mammal indicators (see Table 5).

For this marine mammal indicator, assessments units should be based on biological populations or Management Units only, as opposed to Member States political boundaries. Although a mixture of approaches could be used to determine baseline levels, the WG believes that historical data on cetacean abundance in Europe collected prior to the mid-1980s would be insufficient for setting these levels, due to a lack of adequate large-scale surveys undertaken prior to this. Exceptions to this general statement may include small resident coastal populations of cetaceans (e.g. bottlenose dolphins). In addition, good historical estimates of seal population sizes are available for some areas (e.g. UK coasts).

For each individual species "**population size**" indicator, the establishment of "targets" and "quality assurance" arrangements for data collection are required. It should be noted that there is a trade-off between statistical power and cost, such that not all monitoring targets are realistically achievable. Therefore power analysis should be undertaken to determine the ability to detect change and to assess the effectiveness of the existing survey schemes, relative to the specific indicator. In recent years the WGMME has recommended that power analysis should be used to assess the effectiveness of the existing survey schemes for harbour and grey seals, relative to their specific EcoQO (see Table 5). With the continued development of the ICES seal database, the WGMME will have the capacity to undertake this task in future.

In light of future large-scale surveys similar to that of SCANS II (undertaken in 2005), CODA (undertaken in 2007) and T-NASS (undertaken in 2007), new abundance data should become available for a large number of cetacean species, which can be used to detect "**population size**" trend-based targets. Preliminary analyses presented in the WGMME 2009 report demonstrated only a high power to detect trends from these surveys for species such as the harbour porpoise (based on SCANS II data) and bottlenose dolphin (in offshore waters, based on CODA data). In addition, for small-scale surveys, it was suggested that very small trends in population abundance, such as 1% per year, are not detectable in any reasonable time span. Trends of the order of 15–30% per year may be detectable over the six year time-span imposed by the EU Habitats Directive, while smaller per-year trends require a longer time span to detect (Thomas, 2008; ICES WGMME 2009).

Following this, Paxton and Thomas (2010) undertook power analysis using data in the Joint Cetacean Protocol Database and all available data collected to date from the Irish Sea, which were collected by both large- and small-scale surveys. Results showed that, for the harbour porpoise, bottlenose dolphin and common dolphin, quite small declines in modelled population density (0.3–2.2% per year) over a 6-year reporting period could be detected with power of 0.8. For other species only very large changes in modelled population density would be detectable. As the modelled population densities relied on spatial and temporal smoothing, sudden declines would not necessarily be detectable; also the method included variability due only to observation error and ignores process error (random fluctuations in animal numbers from a smooth trend line; Paxton and Thomas, 2010). The results were also based on spatio-temporal models that may not be reliable. The next step for this work is to incorporate data from the west coast of Scotland, enabling a refinement of the methods for cetacean density estimation and spatial/temporal trend analysis. Thereafter, the work will be extended to encompass European waters producing species-specific summary datasets, which will depict distribution and relative abundance at a range of resolutions and determining what power the data resource has to detect trends in distribution and abundance. The WGMME encourages the continue development and usefulness of this work.

In 2009, the WGMME discussed the weaknesses of using "**population range**" as a criterion for marine mammals in Favourable Conservation Status assessments. The presence of a species is far easier to detect than its absence and, as such, it may take a substantial period of time before a change in a species range becomes noticeable (ICES WGMME 2009). In addition, as marine mammals are wide-ranging, with large short-term spatio-temporal variations in their distribution, it is very difficult to detect changes or trends in range, or to know if apparent changes will persist in the longer-term. An exception is resident populations of marine mammals, e.g. bottlenose dolphins, where the range of the population can be relatively easily ascertained and monitored.

Within "state/structure", a specification of "**population distribution**" could be included as a "specification/type of property". Assessing changes in "**population distribution**" (i.e. the pattern of abundance within the range) may be a useful indicator and one that could be easily observed/measured, e.g. the southerly shift detected in the distribution of the harbour porpoise in the North Sea between SCANS 1994 and SCANS II in 2005. Changes in distribution can be informative on population attributes that would be essential to appraising Marine Protected Areas. In addition, distribution changes may highlight changes to areas of importance, or Critical Habitats, of a species, where human activities/pressures would need to be assessed.

"**Population composition"**, which has been taken as group composition i.e. sex ratio, age-sex structure and body size, cannot be easily used for target setting. It should be noted that in marine mammals, body size or body length is not a suitable *a priori* for estimating age of individuals, due to the large overlap in body length ranges at specific ages, especially during the secondary growth spurt (see Murphy and Rogan, 2006; Murphy *et al*., 2005; Murphy *et al*., 2009). Data on group composition, such as sex ratio and age-structure for the majority of marine mammals is obtained from stranding and bycatch schemes. Monitoring programmes which have inherent biases towards particular age–sex classes, i.e. older individuals in the former and in some cases towards juveniles and subadults in the latter; though it should be noted that even biased data can allow detection of trends. The only populations in which group composition may possibly be adequately assessed using genetic and photo-id studies are wild resident populations of marine mammals, e.g. beluga whales, inshore bottlenose dolphins. To date however, the WG is unaware of populations within European waters for which full assessments of population group composition are carried out based on these techniques. Whereas within the US, long-term studies on resident bottlenose dolphin populations, e.g. Sarasota Bay, Florida, have enabled the identification of the "**population composition**" through visual assessment, remote biopsy, and capture–release (biochemical and) health assessment of free-ranging individuals, as well as necropsies of stranded and bycaught animals. The primary aims of these programmes are to provide information on causes of death, endemic diseases, emerging diseases, and toxin exposure (Hall *et al*., 2011).

A specification of "**population condition**" could be included as a "specification/type of property" within "state/structure". Indicators of "**population condition**" such as blubber thickness, age at sexual maturity, pregnancy and birth (fecundity) rates, calf production (e.g. right whales), age-specific (including juvenile) survival/mortality rates, and health status assessment data such as haematology and blood chemistry parameters (collected as part of capture–release programmes) could be used where sufficient information/data are available (and as for age structure, even where biases are present, changes over time can be detected). These indicators can not only be used to infer changes in population condition, but can also be used in conjunction with

pressure indicators such as bycatch and contaminants to assess overall pressure-state relationships. Although largely ignored, an important part of the monitoring requirements under the Habitats Directive is the monitoring of changes/trends in life-history parameters as this can also be used as a measure of conservation status.

Table 5. Currently used and proposed (/in consultation) marine mammal indicators.

Type	Organization	Current/ proposed	Region	Species/Species Group	Indicator	Target
State/ structure	OSPAR	Currently in Operation	NE Atlantic	Bowhead[3] whale, Blue whale[4], Northern right whale[2]	Threatened and declining species Decline: means an observed or indicated significant decline in numbers, extent or quality (quality refers to life-history parameters). The decline may be historical , recent or current. 'Significant' need not be in a statistical sense.	Significantly declined: means a considerable decline in number, extent or quality. For these purposes, "decline" should only be regarded as occurring where the decline goes beyond that which can be expected from what is known about long-term natural variability and resilience in that species, over a time frame appropriate to it.
State/ structure	OSPAR	Current	NE Atlantic	Harbour porpoise[5]	Threatened and declining species Decline: means an observed or indicated significant decline in numbers, extent or quality (quality refers to life-history parameters). The decline may be historical , recent or current. 'Significant' need not be in a statistical sense.	Significantly declined: means a considerable decline in number, extent or quality. For these purposes, "decline" should only be regarded as occurring where the decline goes beyond that which can be expected from what is known about long-term natural variability and resilience in that species, over a time frame appropriate to it.

[3]OSPAR region I
[4]OSPAR ALL regions
[5]OSPAR Regions II and III

Type	Organization	Current/ proposed	Region	Species/Species Group	Indicator	Target
State/ structure	OSPAR EcoQOs	Current	North Sea	Harbour seal	Harbour seal population size	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 eleven subunits of the North Sea.
State/ structure	OSPAR EcoQOs	Current	North Sea	Grey seal	Grey seal pup production	Grey seal pup production: 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), and in breeding sites, within any of nine subunits of the North Sea.
Pressure	OSPAR EcoQOs	Current	North Sea	Harbour porpoise	Bycatch of Harbour porpoise	Annual bycatch levels should be reduced to below 1.7% of the best population estimate
State/ Structure	Habitats Directive	Current	EU waters	Baleen whales, Tooth whales	Favourable Conservation Status (FCS)	Range of the species is stable or increasing and not smaller than the favourable reference range. Population of the species above favourable reference population and reproduction, mortality and age structure not deviating from normal Area of habitat of the species is sufficiently large and habitat quality is suitable for the long-term survival of the species.
State/ Structure	Habitats Directive	Current	EU waters	Seals	Favourable Conservation Status (FCS)	Range of the species is stable or increasing and not smaller than the favourable reference range Population of the species above favourable reference population and reproduction, mortality and age structure not deviating from normal. Area of habitat of the species is sufficiently large and habitat quality is suitable for the long-term survival of the species.

Type	Organization	Current/ proposed	Region	Species/Species Group	Indicator	Target
State/ Structure	ASCOBANS	Current	ASCOBANS Area of NE Atlantic	All toothed whales (except Sperm whales)	Favourable Conservation Status (FCS)	The Conservation and Management Plan requires Parties to: (a) assess the status and seasonal movements of the populations and stocks concerned, (b) locate areas of special importance to their survival, and (c) identify present and potential threats to the different species.
Pressure	ASCOBANS	Current	ASCOBANS Area of NE Atlantic	Toothed whales (except Sperm whales)	Bycatch	Annual bycatch levels (or any anthropogenic removal) should be reduced to below 1% of the best population estimate.
HELCOM Marine Mammal Working Team						
Pressure	HELCOM	Proposed	Baltic Sea	Toothed whales, Grey, Harbour and Ringed seals	Significant decrease in health status or change in biological measurements in marine mammals [Number, per cent of affected animals or measured deviation, time-trend]	Significant change of any observed pathomorphological or biological change (observed change could be further investigated and maybe linked to an environmental change).
Pressure	HELCOM	Proposed	Baltic Sea	Toothed whales, Grey, Harbour and Ringed seals	Bycatch [Number of by-caught marine mammals in fishing gear]	In the Baltic Proper, harbour porpoise bycatch should be reduced to close to zero to allow recovery. For the Belt Sea population, a total allowable anthropogenic removal of 1.7% (or bycatch in the order of 1%) of the total population
Pressure	HELCOM	Proposed	Baltic Sea	Toothed whales, Grey, Harbour and Ringed seals	Contaminants in marine mammals [Concentration of hazardous substances in various tissues (weight/weight)]	There are recorded tissue concentrations and time-trend studies available for some contaminants in marine mammals and fish but rarely for new components. There is also tissue concentrations measured in terrestrial mammals and humans with known effects when tolerable levels are exceeded. These maybe could be extrapolated to marine mammals to prevent a decline in biodiversity or in foodweb integrity. However, very little is known on effects on marine mammals

Type	Organization	Current/ proposed	Region	Species/Species Group	Indicator	Target
Pressure	HELCOM	Proposed	Baltic Sea	Harbour porpoise, Grey, Harbour and Ringed seals	Population status [Population growth rate (% per year)]	The maximum realized rate of increase in seal populations is about 12% per year. Lower rates of increase are indicative of either that the population is reaching its carrying capacity, or that the population is affected by human impacts in form of excessive mortality or impaired fertility.
Pressure	HELCOM	Proposed	Baltic Sea	Harbour porpoise, Grey, Harbour and Ringed seals	Impacts of anthropogenic underwater noise on marine mammals [Single and cumulative impacts on marine life from high-amplitude, low and mid-frequency impulsive sounds and low frequency continuous sound emitted per area and time]	The introduction of impulsive and continuous sounds in the marine environment should be measured and modelled in order to predict for the cumulative impacts on marine life. Abundance and distribution data of marine mammals need to be used for habitat modelling. To establish the species-specific impact as a function of the distribution of noise over time and space the above mentioned steps can be used to create a (threshold) factor as an indicator for the impact of noise. The result of this process would be a three-dimensional map with a grid of related impacts based on the Sound Exposure Level (SEL). High-frequency sounds, e.g. from depth sounders, fish finders and other SONAR should be limited, especially in shallow coastal areas, to the minimum.
UK Marine Monitoring and Assessment Strategy Potential Indicators (HBDSEG)						
Pressure	UKMMAS	possible (based on data collected to date)	Developed for UK waters, though based on biological populations	Common dolphin, harbour porpoise	Removal of non-target species	<1.7% of best population estimate
Pressure	UKMMAS	possible (based on data collected to date)	Developed for UK waters	harbour porpoise, common dolphin	Non-synthetic compound contaminants: heavy metals and organotoxins	Not determined
Pressure	UKMMAS	possible (based on data collected to date)	Developed for UK waters	harbour porpoise, common dolphin	Synthetic compound contaminants: organochlorine, pesticides, PCBs, brominated flame retardants	Blubber PCB toxicity threshold concentration of 13mg/kg lipid wt (for summed ICES7 CB congeners) Others - Not determined

Type	Organization	Current/ proposed	Region	Species/Species Group	Indicator	Target
Pressure	UKMMAS	possible (based on data collected to date)	Developed for UK waters	harbour porpoise, common dolphin	Radionuclide contamination	Not determined
Pressure	UKMMAS		Developed for UK waters	All	Underwater noise	Not determined
Pressure	UKMMAS	possible (based on data collected to date)	Developed for UK waters	Common dolphin and White-beaked dolphin	Climate change: Ratio of Common Dolphin To White-beaked Dolphin Records on the continental shelf In Summer	Not determined
Structure/ Function	UKMMAS	possible (based on data collected to date)	Developed for UK waters	Bottlenose dolphins	Abundance and usage of core areas by bottlenose dolphins	Not determined
Structure/ Function	UKMMAS	possible (based on data collected to date)	Developed for UK waters, though based on biological populations	Harbour porpoise	Harbour porpoise abundance	Not determined
Structure/ Function	UKMMAS	possible (based on data collected to date)	Developed for UK waters, though based on biological populations	Common dolphins and Harbour porpoises	Assessing temporal changes in reproductive parameters using post-mortem data	Not determined
Structure/ Function	UKMMAS	possible (based on data collected	Developed for UK waters, though based on biological populations	Grey seals	Annual estimates of pup production (changes in)	Not determined

Type	Organization	Current/ proposed	Region	Species/Species Group	Indicator	Target
Structure/ Function	UKMMAS	possible (based on data collected	Developed for UK waters, though based on biological populations	Harbour seals	Regional counts during annual moult and breeding seasons (changes in)	Not determined
Structure/ Function	UKMMAS	possible (based on data collected	Developed for UK waters, though based on biological populations	Grey seals	Grey seal demography (at two breeding colonies)	Not determined
Pressure	UKMMAS	possible (based on data collected to date)	Developed for UK waters	Grey and Harbour Seals	Diet	Not Determined
Pressure	UKMMAS	possible (based on data collected to date)	Developed for UK waters	Grey and Harbour seals	Contaminants and toxins	Not determined
Pressure	UKMMAS	possible (based on data collected to date)	Developed for UK waters, though based on biological populations	Grey and Harbour seals	Bycatch	Not determined
OSPAR'S Good Environmental Status state and pressure targets						
State	OSPAR	Proposed	European waters	Cetaceans		Directional/trends based targets (specific direction of change) using a mixture of approaches to set a baseline (Current state, past state, expert judgment, historical data).
State	OSPAR	Proposed	European waters	Cetaceans		Modelling carrying capacity for common marine species, based on assumptions or measurements of life history and setting a target as a deviation from the total carrying capacity to allow for "sustainability" (for example, 80%).

Type	Organization	Current/ proposed	Region	Species/Species Group	Indicator	Target
Pressure	OSPAR	Proposed	European waters	Cetaceans		Using the EIA/SEA process to regulate licensed activities that may introduce (new) pressures believed to cause an impact on marine mammals (unless mitigation measures are introduced).
Pressure	OSPAR	Proposed	European waters	Cetaceans		Setting levels of pressure in line with agreed deviations from modelling carrying capacity (e.g. harbour porpoise EcoQO) so that a target population of at least 80% of K is maintained.
Pressure	OSPAR	Proposed	European waters	Cetaceans		Reducing pressures on marine mammals at crucial points during their life cycle. E.g. preventing visual/noise disturbance at seal haul out/pupping areas during relevant times of the year.
Pressure	OSPAR	Proposed	European waters	Cetaceans		Reducing or eliminating impacts on endangered/threatened species.

It is also a requirement of ASCOBANS monitoring. The regular monitoring of reproductive rates in marine mammals would contribute significantly to assessments of conservation status (ICES WGMME 2010).

Levels of genetic diversity (genetic variation within and between populations/species) can be evaluated in marine mammals and can provide information on current, recent or historical demographic parameters (e.g. population expansion, bottlenecking, effective population size). However, "changes in genetic diversity" within a marine mammal population can only be observed if a significant demographic event occurs (e.g. high mortality in a short period of time) or if data are extensively collected from multiple generations (both overlapping and non-overlapping). Hence, considering a limited time frame (e.g. a six year reporting time frame), genetic diversity is not an appropriate "indicator class" due to the long generation time of most marine mammal species, a cohort generation time of 12.94 years was calculated for the common dolphin (Murphy *et al*., 2007), though for some marine mammal species such as the harbour porpoise and seals the generation time will be somewhat shorter as they attain sexual maturity at a much lower age. In addition, the potential for acquisition of appropriate inter- and intra-generational genetic data depends on ease of tissue collection and availability of life-history parameters (e.g. age), which in turn depend on the nature of samples collected (e.g. single or groups, dead-stranded, live-stranded or free-ranging). "Structure" was listed as a "specification/type of property" within the genetic diversity indicator class. Population structure, as defined by genetic markers, provides you with an estimate of genetic differentiation between putative populations. This not only allows the identification of discrete populations (that may be reproductively isolated), but also informs on the levels of past or ongoing gene flow among different populations. In general, changes in population structure are not only difficult to detect but they may take a long time to occur (generations) for species such as marine mammals - and only if non-assortative mating, genetic drift or selection occurs.

As cetacean (important areas/critical) "**habitats**" (e.g. feeding and breeding areas) vary temporally and spatially and are influenced by natural and anthropogenic factors, it difficult to determine what features characterize cetacean habitats and, thus, to determine their extent (ICES WGMME 2009). Consequently, the surface area of cetacean habitat is impossible to quantify and can vary significantly on a seasonal and annual basis. The situation is, however, slightly different for seals. Seals have three broad habitat requirements: breeding areas, haul out areas and feeding areas. The spatial distributions of the breeding and haul out areas for both harbour and grey seals are reasonably well known throughout the Marine-Atlantic region but feeding areas are not. Although, modelled density maps derived from telemetry data can give some indication of where seals are most likely to spend their time at sea. Despite current knowledge, however, the surface area of seal habitat is still impossible to quantify, and can vary significantly on a seasonal basis (ICES WGMME 2009).

More recently, the at-sea foraging distribution of UK seals was evaluated by HBDSEG as an indicator for seals, though not proposed (Duck, 2010). At-sea foraging of seals can be determined through the use of telemetry devices attached to seals. When combined with data on commercial fishing effort, areas of overlap would be identifiable.

State/Function: The WG would like further clarification of the term "**strategic**" prior to fully rejecting the usefulness of this indicator class; though as top predators, marine mammals should be incorporated within indicator classes focusing on the community/ecosystem structure level.

Pressure: Possible "**pressure**" type indicators include bycatch, contaminants, and noise. Considerable investment of funding is required to adequately monitor bycatch rates (to obtain a bycatch estimate with a coefficient of variation of less than 0.3, for example, as required by EU Regulation 812/2004), body contaminant levels from stranded and bycaught animals and noise levels in the marine environment. In addition, in order to decipher the effects of the above listed "pressure" types, it is necessary to obtain knowledge of genetic diversity and population structure.

Unless there is knowledge and continued assessment of population diversity, structure and biological parameters, as well as an understanding of the pressure-state relationships, the usefulness of other indicators such as "population size" (detections of trends in abundance) is questionable, as understanding the root cause of a significant decline in population abundance is necessary for successfully managing that population, and achieving 'Good Environmental Status'.

"**Pressure**" type indicators should be monitored at the population level, or Management Unit level. Those indicators currently in operation primarily focus on bycatch; OSPARs EcoQO on bycatch of harbour porpoise and ASCOBANS bycatch target. The current target set by OSPAR is as follows "*annual bycatch levels should be reduced to below 1.7% of the best population estimate*. ASCOBANS have lowered this target/threshold level "*total anthropogenic removal is reduced by the Parties to below the threshold of "unacceptable interactions" with the precautionary objective to reduce bycatch to less than 1% of the best available abundance estimate and the general aim to minimize bycatch (i.e. to ultimately reduce to zero)*".

In 2008, the WGMME evaluated the status of harbour porpoises in relation to the OSPAR EcoQO. While undertaking this task, the WG reviewed the methods for incorporating uncertainties in abundance and bycatch estimation in the evaluation of population level effects of incidental capture.

Recommendations from the WG were as follows:

In all estimation of biological quantities there are statistical uncertainties inherited from the empirical data used in the estimation procedure. Using the best estimate of abundance and point estimates for bycatches will not take this uncertainty into account when evaluating the EcoQO on harbour porpoise bycatch in the North Sea. Therefore the WGMME recommends that an alternative approach should be considered. The WGMME noted that the two approaches (a Potential Biological Removal (PBR) type procedure and a Catch Limit Algorithm (CLA) type procedure) tested in SCANS II (and CODA) explicitly include uncertainties. The WGMME agreed with the advice from SCANS II (and CODA) and recommended that ICES consider the CLA approach for future evaluation of bycatch levels and advice on conservation objectives management actions.

The WG noted in 2008 that before a management procedure can be implemented for a particular species in a particular region, several steps need to be taken including decisions by policy-makers on the exact conservation/management objective(s) and consideration by scientists of any sub-areas that may be considered to contain sub-populations. In addition, most of the EU gillnet fisheries in the North Sea (and other regions) are conducted without bycatch monitoring programmes and there are no recent estimates of porpoise or other marine mammal bycatch (ICES WGMME 2008).

Contaminants (including pollution by hazardous substances such as heavy metals, organotins, organochlorines including PCBs, brominated flame-retardants and ra-

dionuclides) represent a type of "**pressure**" not addressed by any indicator currently in use. It is recommended that the biological effects from contaminants are kept within safe limits, so that there are no significant impacts on, or risks to, marine mammals. The cause-and-effect relationships need to be established and monitored, as well as the impacts of accumulated effects. In order to undertake these tasks, knowledge of information on population growth rates, population structure, (life-history) biological parameters and density-dependent changes in these parameters are required.

To date only a threshold level for PCBs, i.e. blubber PCB toxicity threshold concentration of 13 mg/kg lipid weight (for summed ICES7 CB congeners), has been determined/proposed (Pinn, 2010). Although effects of PCB bioaccumulation on reproduction and immune responses are known in marine mammals, and there is empirical evidence of association between high contaminant burdens and poor health in some marine mammal species (e.g. porpoises), there have (for obvious ethical reasons) been very few experimental studies (exceptions being work on captive seals; Reijnders, 1986; Hall *et al*., 2006; Jepson *et al*., 2005). Much more work is needed to determine thresholds for these various effects for different contaminants in different species of marine mammals.

Noise was proposed as a "**pressure**" type indicator by the HELCOM marine mammal working group The suggested indicator: "Single and cumulative impacts on marine life from high-amplitude, low and mid-frequency impulsive sounds and low frequency continuous sound emitted per area and time" jointly accounts for the two source-based indicators under D 11 of the Commission Decision of September 1, 2010 (see Table 6). There is a broad range of physiological or behavioural reactions by marine mammals to noise. Noise presents, at least, the following threats: diversion of attention and disruption of behaviour, masking of important signals, temporary and permanent effects of hearing and injury to other organs, sometimes leading to death. The introduction of impulsive and continuous sounds in the marine environment could be measured and modelled in order to predict for the cumulative impacts on marine life. In combination with this, marine mammal habitat modelling would be undertaken using data on distribution and abundance. To establish the species-specific impact as a function of the distribution of noise over time and space the above mentioned steps can be used to create a (threshold) factor as an indicator for the impact of noise. The result of this process would be a two ideally three-dimensional map (produced on a species by species basis) with a grid of related impacts based on the sound exposure level. Such impact maps were already produced for example by TNO for different sound sources in the North Sea (TNO-DV 2009 C085 2009; assessment of natural and anthropogenic sound sources and acoustic propagation in the North Sea) and the project "Listening to the deep-ocean environment" currently operating in different parts of the world's oceans, including the Mediterranean Sea (Lido - http://listentothedeep.com/). It should be noted that it is not known if the adaptive responses of marine mammals to an environmental stressor, such as noise, lead to any negative impacts on vital functions and rates. However, if this were the case, it could ultimately also have adverse consequences at the population level.

Table 6. Proposed MSFD indicators that may have relevance for marine mammals.

Type	Organization	Current/ proposed	Region	Species/Species Group	Indicator	Target
State/ structure	EU [Commission decision MSFD]	Current	EU waters	Species according to Table 1 of Annex III to Directive 2008/56/EC	D 1 Biodiversity: Species distribution	Distributional range (1.1.1)
State/ structure	EU [Commission decision MSFD]	Current	EU waters	Species according to Table 1 of Annex III to Directive 2008/56/EC	D 1 Biodiversity: Species distribution	Distributional pattern within the latter, where appropriate (1.1.2)
State/ structure	EU [Commission decision MSFD]	Current	EU waters	Species according to Table 1 of Annex III to Directive 2008/56/EC	D 1 Biodiversity: Population size	Population abundance and/or biomass, as appropriate (1.2.1)
State/ structure	EU [Commission decision MSFD]	Current	EU waters	Species according to Table 1 of Annex III to Directive 2008/56/EC	D 1 Biodiversity: Population condition	Population demographic characteristics (e.g. body size or age-class structure, sex ratio, fecundity rates, survival/mortality rates) (1.3.1)
State/ structure	EU [Commission decision MSFD]	Current	EU waters	Species according to Table 1 of Annex III to Directive 2008/56/EC	D 1 Biodiversity: Population condition	Population genetic structure, where appropriate (1.3.2)
State/ Structure	EU [Commission decision MSFD]	Current	EU Waters	Functional habitats (such as breeding and feeding areas and migration routes)	D 1 Biodiversity: Habitat condition	Condition of the typical species and communities (1.6.1)
State/ Structure	EU [Commission decision MSFD]	Current	EU waters	Functional habitats (such as breeding and feeding areas and migration routes)	D 1 Biodiversity: Habitat condition	Relative abundance and/or biomass , as appropriate (1.6.2)
State/ Structure	EU [Commission decision MSFD]	Current	EU Waters	Ecosystem components (habitats and species)	D 1 Biodiversity: Ecosystem structure	Composition and relative proportions of ecosystem components (habitats and species) (1.7.1)
Structure/ functions	EU [Commission decision MSFD]	Current	EU waters	Appropriate species (e.g. mammals) of the main predator–prey processes	D 4 Foodweb: Productivity of key species or trophic groups	Performance of key predator species using their production per unit biomass (productivity) (4.1.1)

Type	Organization	Current/ proposed	Region	Species/Species Group	Indicator	Target
Structure/ functions	EU [Commission decision MSFD]	Current	EU waters	[further development and specification of criteria and potentially useful indicators is required]	D 4 Foodweb: Abundance/distribution of key trophic groups/species	Abundance trends of functionally important selected groups/species (4.3.1)
State/ structure	EU [Commission decision MSFD]	Current	EU waters	[further development and specification of criteria and potentially useful indicators is required]	D 4 Foodweb: Abundance/distribution of key trophic groups/species	Changes in status of groups/species that are indirectly affected by human activities (in particular, bycatch and discards) (4.3.3)
State/ Structure	EU [Commission decision MSFD]	Current	EU waters	[further development and specification of criteria and potentially useful indicators is required]	D 4 Foodweb: Abundance/distribution of key trophic groups/species	Changes in status of habitat-defining groups/species (4.3.4)
State/ structure	EU [Commission decision MSFD]	Current	EU waters	[further development of criteria and potentially useful indicators is required]	D 4 Foodweb: Abundance/distribution of key trophic groups/species	Changes in status of groups/species at the top of the foodweb (4.3.5)
Pressure	EU [Commission decision MSFD]	Current	EU waters	Fish, birds and mammals	D 7 Hydrographical conditions: Impact of permanent hydrographical changes	Changes in habitats, in particular the functions provided (e.g. breeding and feeding areas and migration routes of mammals), due to altered hydrographical conditions (7.2.2)
Pressure	EU [Commission decision MSFD]	Current	EU waters	Biota	D 8 Contaminants: Concentration of contaminants	Concentration of certain contaminants measured in relevant matrix (such as biota) in a way that ensures comparability with the assessments under Directive 2000/60/EC (8.1.1)
Pressure	EU [Commission decision MSFD]	Current	EU waters	Selected taxonomic groups	D 8 Contaminants: Effects of contaminants	Levels of pollution effects on the ecosystem components concerned, having regard to the selected biological processes and taxonomic groups where a cause/effect relationship has been established and needs to be monitored (8.2.1)
Pressure	EU [Commission decision MSFD]	Current	EU Waters	Biota	D 8 Contaminants: Effects of contaminants	Occurrence, origin (where possible), extent of significant acute pollution events (e.g. oil slicks from oil and oil products) and their impact on biota physically affected by this pollution (8.2.2)

Type	Organization	Current/ proposed	Region	Species/Species Group	Indicator	Target
Pressure	EU [Commission decision MSFD]	Current	North Sea	[there is a need for further development of several indicators]	D 10 Litter: Characteristics of litter in the marine and coastal environments	Trends in the amount of litter in the water column (including floating at the surface) and deposited on the seabed (10.1.2)
Pressure	EU [Commission decision MSFD]	Current	North Sea	Marine animals	D 10 Litter: Impacts of litter on marine life („There is still a need for further development of several indicators, notably those relating to biological impacts…“)	Trends in the amount and composition of litter ingested by marine animals (e.g. stomach analysis) (10.2.1)
Pressure	EU [Commission decision MSFD]	Current	EU waters	Marine animals	D 11 Energy: Distribution in time and place of loud, low and mid frequency impulsive sounds	Proportion of days and their distribution within a calendar year over areas of a determined surface, as well as their spatial distribution, in which anthropogenic sound sources exceed levels that are likely to entail significant impact on marine animals measured as SEL or as peak SPL at one metre, measured over the frequency band 10 Hz to 10kHz (11.1.1)
Pressure	EU [Commission decision MSFD]	Current	EU waters	Marine life	D 11 Energy: Continuous low frequency sound (Additional scientific and technical progress is required to support the further development of criteria in relation to impacts on marine life and relevant noise and frequency level, including in relation to mapping.)	Trends in the ambient noise level within the 1/3 octave bands 63 and 125 Hz (centre frequency; average noise level in these octave bands over a year) measured by observation stations and/or with the use of models if appropriate (11.2.1)

9.4 References

Duck C. 2010. Healthy and Biologically Diverse Seas Evidence Group Technical Report Series: Evaluation and gap analysis of current and potential indicators for seals.

Hall AJ, Hugunin K, Deaville R, Law RJ, Allchin CR, Jepson PD. 2006. The Risk of Infection from Polychlorinated Biphenyl Exposure in the Harbor Porpoise (*Phocoena phocoena*): A Case–Control Approach Environmental Health Perspectives 114(5): 704–711.

Hall AJ, Gulland FMD, Hammond JA, Schwacke LH. 2010. Epidemiology, disease and health assessment. In: Boyd IL, Bowen WD, Iverson SJ (eds). Marine Mammal Ecology and Conservation, a handbook of techniques. Oxford University Press, Oxford.

ICES WGMME. 2008. Report of the Working group on marine mammal ecology. February 25–29 2008, St Andrews, UK.

ICES WGMME. 2009. Report of the Working Group on Marine Mammal Ecology. February 2–6 2009, Vigo, Spain.

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

Jepson P, Bennett PM, Deaville R, Allchin CR, Baker JR, Law RJ. 2005. Relationships between polychlorinated biphenyls and health status in harbour porpoises (*Phocoena phocoena*) stranded in the United Kingdom Environmental Toxicology and Chemistry 24(1): 238–248.

Murphy S, Collet A, Rogan E. 2005. Mating strategy in the male common dolphin *Delphinus delphis*: what gonadal analysis tells us. Journal of Mammalogy 86(6):1247–1258.

Murphy S, Rogan E: External morphology of the short-beaked common dolphin, *Delphinus delphis*: growth, allometric relationships and sexual dimorphism. ActaZoologica2006, 87(4):315–329.

Murphy S, Dabin W, Ridoux V, Morizur Y, Larsen F, Rogan E. 2007. Estimation of Rmax for the common dolphin in the Northeast Atlantic. NECESSITY Contract 501605 Periodic Activity Report No 2. Annex 8.4.

Murphy S, Winship A, Dabin W, Jepson PD, Deaville R, Reid RJ, Spurrier C, Rogan E, López A, González AF *et al*. 2009. Importance of biological parameters in assessing the status of *Delphinus delphis*. Marine Ecology Progress Series388:273–291.

Paxman CGM, Thomas L. 2010. Phase One Data Analysis of Joint Cetacean Protocol Data. Report to Joint Nature Conservation Committee on JNCC Contract No: C09-0207-0216. Centre for Research into Ecological and Environmental Modelling, University of St Andrews.

Pinn EH. 2010. Healthy and Biologically Diverse Seas Evidence Group Technical Report Series: Evaluation and gap analysis of current and potential indicators for Cetaceans.

Reijnders PJH. 1986. Reproductive failure in common seals feeding on fish from polluted coastal waters. Nature 324: 456–457.

Thomas L. 2008. Potential Use of Joint Cetacean Protocol Data for Determining Changes in Species' Range and Abundance: Exploratory Analysis of Southern Irish Sea Data. Report to Joint Nature Conservation Committee on JNCC Contract No: F90–01–1208. Centre for Research into Ecological and Environmental Modelling, University of St Andrews.

10 Future work and recommendations

10.1 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 6 of this document.

Recommendation I

The WGMME strongly recommends that an international survey be undertaken, funded by the Governments of Denmark, Sweden and Germany, to determine the abundance of harbour porpoises in the Belt Sea region.

Recommendation II

The WGMME recommends that data on cetacean presence and occurrence should be incorporated at a very early stage of marine spatial planning. Due to the wide ranging nature of cetaceans, the relevance of 'important areas' outside MPAs should be assessed. It is also very important to include any information on seasonal changes in distribution.

Recommendation III

The WGMME recommends that the boundaries of MPAs should only be decided on the basis of a significant long-term dataseries (of at least five years).

Recommendation IV

For marine mammal species that spend the majority of the life outside the MPA, consideration needs to be given to whether protection of a limited part of the population's range, or focus on a site-based protection of a particular life stage, is worthwhile. The key to species protection and recovery is eliminating the threats that have led, could lead, or continue to lead, to the decline of the species. It is therefore recommended that the appropriateness of MPAs as a mechanism to controlling or eliminating threats is given significant consideration prior to site designation.

Recommendation V

The WGMME recommends the development of an appropriate precautionary management framework for wet renewables.

Recommendation VI

WGMME recommends that independent research be carried out into the nature of close range interactions between marine mammals and tidal devices and the potential population consequences of these.

Recommendation VII

The WGMME recommends that our understanding of ambient underwater noise in tidal-sites is improved and that the noise associated with construction and mainte-

nance of tidal devices be assessed so that impacts on marine mammals can be minimized.

Recommendation VIII

To understand the perception range available to marine mammals in the vicinity of operating tidal turbines, WGMME recommends that the sound output of operating devices is quantified along with the surrounding ambient underwater sound of the sites.

Recommendation IX

The WGMME recommends that current methods used to quantify marine mammal distribution, activity and abundance are adapted or improved so that they can be appropriately applied to studies in and around fast moving water.

Recommendation X

ICES WGMME recommends that appropriate metrics be developed to regulate any population level deleterious effects of marine renewable developments. To achieve this, target population size should be explicitly chosen and all appropriate data should be used to assess allowable impacts.

Recommendation XI

The WGMME recommends that additional coordinated monitoring is carried out at scales greater than the footprints of a demonstrator or commercial-scale arrays to determine population scale changes in distribution and abundance.

Recommendation XII

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.

Recommendation XIII

WGMME recommends a strategic approach to identify sites of low marine mammal risk for early stage deployments before consenting to tidal device or array developments in more sensitive sites.

Recommendation XIV

In recognition that animal-tidal turbine interactions are likely to be both species and device (or device-type) specific, WGMME recommends that extreme care be taken when extrapolating environmental impacts between species and device types.

Recommendation XV

WGMME recommends that extreme care is taken when scaling up environmental lessons learned from studies of single tidal turbine devices up to arrays as the nature of any impact relationships (linear or otherwise) between one and many devices is currently unknown. In light of this, a stepwise approach should be taken for array development.

Recommendation XVI

WGMME recommends that the sensitivity of marine mammals to environmental perturbations from electromagnetic fields, possibly generated by cables, should be investigated and the potential displacement implications considered.

Annex 1: Working paper 1

T-NASS: a cast of many[1,2]

Geneviève Desportes, T-NASS coordinator, on the behalf of the T-NASS participants[1], Faroese Museum of Natural History and GDnatur.

Introduction

The **Trans North Atlantic Sightings Survey (T-NASS)** is the latest in a series of internationally coordinated North Atlantic Sightings Surveys (NASS) that were conducted in 1987, 1989, 1995, 2001, and 2007. The target species of the NASS surveys have been fin whales (*Balaenoptera physalus*)(Iceland and Faroes), minke whales (*B. acutorostrata*)(Iceland, Norway, Greenland and Faroes), sei whales (*B. borealis*)(Iceland 1989), humpback whales (*Megaptera novaeangliae*)(Iceland, Greenland, Faroes), pilot whales (*Globicephala melas*; Faroes), and harbour porpoise (*Phocoena phocoena*; Iceland, Faroes, Greenland). However, sightings of all species were recorded. The choice of target species has influenced the temporal and spatial extent of the surveys, and to some extent the survey methods used. Ships have been used in most areas, however the coastal areas of Iceland and Greenland have been covered by aircraft. Iceland, the Faroes, and Norway have participated in all of the NASS surveys.

The **Trans North Atlantic Sightings Survey** (**T-NASS**), planned under the auspices of the Scientific Committee of NAMMCO in 2006 and 2007 (NAMMCO 2006ab, 2007), was designed to generate summer distribution and abundance estimates of cetacean populations in the Northern North Atlantic from visual survey data collected during summer 2007. With the participation of Greenland, and for the first time Canada and Russia, T-NASS covered areas to the west of Greenland and the entire east coast of Canada that had not been covered in earlier NASS surveys. The T-NASS covered the primary areas of summer distribution for the main target species, minke, fin, humpback, and blue whales, and to a lesser extent that of sei and pilot whales.

Adding to the series of North Atlantic Sightings Surveys 1987-2001 (Lockyer and Pike, 2009), T-NASS contributes to a 20-year time-series, which provide a realistic opportunity for detecting changes in abundance over time.

Coordination with other surveys

Dedicated whale surveys: CODA and SNESSA

Ideally a survey should cover the full distribution range of the species of interest at the time of the survey. This is not always feasible for species with very large ranges, such as the T-NASS target species, mainly because of the prohibitive costs of survey aircraft and ships. Previous NASS have therefore concentrated on the main areas of summer distribution, and T-NASS did the same.

In 2007, concurrent with the T-NASS, the waters southeast of the T-NASS survey area were surveyed as part of the Cetacean Offshore Distribution and Abundance in the European Atlantic (European CODA project, coordinated by the Sea Mammal research Unit, University of St Andrews), while the waters to the southwest were covered by the Southern New England to Scotian Shelf Abundance survey (American SNESSA project, conducted by the National Marine Fisheries Service, Woods Hole, NMFS).

The coordination between the T-NASS, CODA and SNESSA surveys offered an absolutely unique opportunity to get nearly complete coverage of the northern North Atlantic, an opportunity that has never arisen before. This reduces tremendously the bias/doubt that might arise from the possible movements of the whales between surveyed and non-surveyed areas, in particular when the survey area does not cover the distribution ranges of the target species.

Other non-dedicated whale surveys: T-NASS extension

Although the T-NASS covered the main summer distribution for the target species, it is known that these species do occur outside the survey area during summer. This was demonstrated by the NASS-89 survey, which extended farther south than the other NASS (Sigurjónsson *et al.*, 1991), and more recently by cetacean observations made along the mid-Atlantic Ridge during MAR-ECO surveys (Nøttestad *et al.*, 2005). It is also known that the distribution of cetaceans does vary from year to year within the survey area (*e.g.* Pike *et al.*, 2005). If the proportion of the summer populations inside and outside the main survey area also varies, this could confound the interpretation of apparent trends in abundance. For this reason, obtaining information on the distribution and relative abundance of cetaceans outside the main survey area is important in interpreting the results.

Making use of research vessels that were in areas adjacent to the main survey areas for other purposes would extend, at very low cost, the T-NASS into "ancillary" areas that would not otherwise be surveyed. This would enhance the value of the main survey by providing information to interpret abundance estimates and any observed trends, and by providing information on cetacean distribution and relative abundance in areas that have seldom or never been surveyed by dedicated whale surveys.

Because these ancillary surveys would not be designed explicitly for enumerating cetaceans, and because the level of observational effort would be lower than in the main survey, these data could likely not be used to estimate absolute abundance. Nevertheless the ancillary data would be extremely valuable in putting the T-NASS estimates into the context of the summer distribution of cetaceans in other parts of the North Atlantic. This would reduce the bias/doubt that might arise from the possible movements of the whales between surveyed and non-surveyed areas, thus leading to stronger scientific basis for a risk assessment, and a management programme aiming to sustain cetacean populations subject to direct and indirect catches.

Three ancillary survey efforts covered areas adjacent to, and to the south of, the main T-NASS survey area in 2007, at approximately the same time that the T-NASS was in progress. Incorporation of cetacean observations from these ancillary surveys provided a substantial extension of the T-NASS coverage area.

- The MAR-ECO research programme had one vessel (from the UK) which travelled along the North Atlantic Ridge north of the Azores, and particularly around the Charlie Gibbs Fracture Zone (one observer).
- The international Redfish survey, coordinated by ICES, was covering the Denmark Strait and the Irminger Sea, with three vessels from Iceland, Russia, and Germany. The Icelandic vessel was used as a full cetacean survey platform, as was done successfully in 2001 (two observers on each of the Russian and German vessels; because of engine issues, the German vessel cancelled its participation to the survey and never reached the survey area).

- The pelagic Norwegian/Russian fish survey had two Norwegian vessels operating in the Norwegian Sea. The Russian vessel participated in the Redfish survey and also surveyed in the Barents Sea and in the Norwegian Sea on its way to the Irminger Sea (two observers on each vessel).

Methodology and target species

T-NASS international context

T-NASS was coordinated in timing, coverage (spatial contiguity), and methodology; both with the European CODA survey and the American SNESSA survey, conducted respectively to the Southeast and Southwest of the TNASS core area. The coordinators of CODA and SNESSA were members of the T-NASS Planning Committee, and are members of the NAMMCO Working Group on Abundance Estimates, which coordinates and supervises the analysis of the data.

The Scientific Committee of the International Whaling Commission endorsed T-NASS at its 2006 meeting, and played an advisory role in the project. T-NASS was a component project of the International Polar Year (#1136), as a sub-project of the umbrella project ESSAR - Ecosystem Studies of Subarctic and Arctic Regions (#155).

Methodology

Line transect methods and/or cue counting were used to collect visual data. When possible, a double platform setup was used both in the aerial and shipboard surveys. Passive acoustic data were also collected from five of the vessels (the three Icelandic, the Faroese, and the MarEco vessels), with emphasis on recording sperm whale acoustic signals.

Dedicated cetacean shipboard sightings surveys were conducted from seven vessels (one Faroese, three Icelandic, two Norwegian) from June 25 to August 6, while dedicated aerial survey were conducted from five aircraft (three Canadian, one Greenlandic, one Icelandic) between June 20 and October 1, with a total in all 79 observer positions.

In addition, nine observers were placed on fishery surveys occurring simultaneously to T-NASS in adjacent areas, the ICES Redfish survey in the Irminger Sea (one Russian and one German vessels), MarEco survey on the Mid Atlantic Ridge (one UK vessel), and Norwegian Pelagic survey in the Norwegian sea (two Norwegian vessels). Russia participated also by sending observers both to the shipboard and the shipboard extension surveys. In total, 90 observers from 14 different countries participated in the T-NASS.

Target species

The target species of T-NASS were fin whales (*Balaenoptera physalus*; Iceland and Faroes), minke whales (*B. acutorostrata*; Iceland, Norway, Greenland, and Faroes), humpback whales (*Megaptera novaeangliae*; Iceland, Greenland, Faroes), pilot whales (*Globicephala melas*; Faroes) and harbour porpoise (*Phocoena phocoena*; Iceland, Greenland). Sightings of all species were, however, recorded.

Results

For the first time, a trans North Atlantic survey was achieved, adding to the NASS coverage, in areas to the west of Greenland and along the east coast of Canada. The twelve platforms of the core survey covered over 58 000 nm of transects of effort in an

area of about 1.5 million nm², spanning from the Eastern Barents Sea, along the East coast of Canada to the U.S border, and from 78º N in the north to 52ºN in the east and 42 ºN in the west to the south (Table 1, Figure 1). This represents one of the largest coordinated whale surveys today.

T-NASS observers placed on opportunistic surveys (MarEco, ICES Redfish and Norwegian pelagic) added a supplementary effort of 5253 nm, in the Irminger Sea, the Norwegian Sea, and along the Mid-Atlantic Ridge (Table 1, Figure 2).

Cetacean sightings numbered close to 4000 (Table 2), with an apparent variation in frequency between blocks and areas (Figure 1, Figures 3–9). Nineteen cetacean species were observed, with fin, common minke, and humpback whales, and white beaked dolphins and harbour porpoises as the top five species in numbers of sightings (Table 2). Other marine megafauna like sea turtles, seals, and large shark and fish species were also recorded.

Analyses

The analyses of the data have been carried out by the different institutes participating in T-NASS, with some of them as coordinated efforts.

Abundance estimates have been calculated for many areas and species, although several remain to be calculated. Table 3 presents the abundance estimates, which have been endorsed by the NAMMCO Scientific Committee on recommendation of the NAMMCO Scientific Committee Working Groups on Abundance Estimates (AEWG; NAMMCO 2009, 2011a) and Assessment (ASWG; NAMMCO 2010, 2011b). Each working group report details the list of analyses submitted and their authors.

The WGs also recommended that supplementary analyses be performed for different areas and species. The ones not implemented yet are summarized in Table 4 (NAMMCO 2011a). Many of these supplementary analyses will be presented to the AEWG, which will meet in Copenhagen, March 7–9, 2011. This meeting will be followed by a meeting of the Survey Planning WG, which will review the NASS series and start planning the next NASS survey, which is anticipated to be also a T-NASS survey, which should take place in the period 2013–2015. More detailed purposes of the two coming meetings are:

AEWG will continue the evaluation and validation of abundance estimates from the Trans North Atlantic Sightings Survey completed in 2007:

Several estimates have been completed to date, including ones for fin, humpback, and minke whales from the shipboard surveys, and several species from aerial surveys in Greenland and Canada. In addition to further refining these estimates, we will be concentrating on the following tasks:

1) Completing estimates of minke whale abundance from the 2007 and 2009 aerial surveys around Iceland, incorporating correction for perception bias;
2) Developing or re-doing estimates of pilot whale abundance from all NASS (1987–2007) and developing an index of relative abundance for trend analysis;
3) Developing estimates of harbour porpoise abundance from Icelandic and Faroese aerial surveys;
4) Developing estimates of abundance for sei whales from the 2007 and earlier surveys;

5) Developing estimates of abundance for sperm whales, beaked whales and dolphins from Icelandic and Faroese shipboard survey;

6) Developing estimates of abundance for large cetacean species, but minke whales, from the Norwegian mosaic survey 2002–2007.

At the conclusion of the meeting we hope that all abundance estimates that can be obtained from TNASS will have been reviewed and that this meeting will conclude the TNASS survey (Unfortunately, we know by now that this will not happen).

SPWG will define the objectives of the next survey and produce a general scope of the resources that will be needed and available:

7) A major task of the WG will be to undertake a general review of all previous NASS, in order to ascertain if the survey series is meeting its objectives in a cost-effective way, and to look for ways in which it could be improved.

8) A general examination of some of the methodologies used will be carried out to determine where improvements can be made.

At the conclusion of the meeting we would expect to have a general plan for the next (T-) NASS. Practical details and the specifics of survey design and field protocols will be developed at later meetings.

Some of the analyses emanating from T-NASS have been presented to conferences and workshop and some have already been published (Heide-Jørgensen, 2010a, b)

Conclusion

Together, T-NASS, CODA, and SNESSA provide the most complete synoptic coverage yet of the northern North Atlantic. The ultimate dream is that these surveys be able to provide combined estimates for several species, and thus enhance our understanding of the dynamics of cetacean populations in the entire North Atlantic.

Estimates will be incorporated into the management framework of NAMMCO and the IWC, as well as national plans.

[1]T-NASS International Planning Group

Canada, Department of Fisheries and Oceans, St John's, NL & Mont-Joli, PQ: J.W. Lawson & J-F. Gosselin;
Faroes, Museum of Natural History, Tórshavn: G. Desportes, and B. Mikkelsen;
Greenland, Institute for Natural Resources, Nuuk: L. Witting, M. Simon & M.P. Heide-Jørgensen;
Iceland, Marine Research Institute, Reykjavík: G. Vikingsson, T. Gunnlaugsson, D. Ólafsdóttir, and S.D. Halldórsson;
Norway, Institute of Marine Research, Bergen: N. Øien;
Russia, PINRO, Murmansk: V. Zabavnikov, and I. Golyak;
NAMMCO Secretariat, Tromsø, Norway: D. Pike, G. Desportes, M. Acquarone, and C. Lockyer.

[2]Thanks to

A large degree of appreciation is expressed for all of the observers and the survey crews. We thank the staff at Sea Mammal Research Unit for help and support before and during the survey. Appreciation is extended to those involved in the planning

and in particular P. Simon, who helped get Canada involved in the project. P. Hammond, G. Donovan, D. Palka, and R. Williams, as well as numerous others who could not resist being dragged in. Mario Acquarone (NAMMCO) produced the maps. The last, but not the least, many thanks to J. Lawson for commenting on and editing the MS.

Funding sources

Institutes, National programmes, Special funds from Ministries (Faroes, Greenland, Iceland), the Danish Navy, Hvalur HF, FOÍB/Atlanticon, IWC, the Arctic Programme from the Nordic Council of Ministers, and not the least, NAMMCO.

References

Heide-Jørgensen, M.P., Laidre, K.L., Simon, M.L., Burt, D.L., Borchers, D. and Rasmussen, M. 2010. Abundance of fin whales in West Greenland in 2007. *J. Cetacean Res. Manage.* 11(2): 83–88.

Heide-Jørgensen, M.P., Witting, L., Laidre, K.L., Hansen, R.G. and Rasmussen, M. 2010. Fully corrected estimates of common minke whale abundance in West Greenland in 2007. *J. Cetacean Res. Manage.* 11(2): 75–82.

Lockyer, C. and Pike, D. eds. 2009. North Atlantic Sightings Surveys. Counting whales in the North Atlantic 1987-2001. NAMMCO Scientific Publications, vol. 7. 244pp.

NAMMCO. North Atlantic Marine Mammal Commission. 2006a. Report of the Scientific Committee Planning Committee on the Trans North Atlantic Sightings Survey. First meeting, Reykjavík March 2006. In: *NAMMCO Annual Report 2007-2008*, NAMMCO, Tromsø, Norway, 186–210.

NAMMCO. North Atlantic Marine Mammal Commission. 2006b. Report of the Scientific Committee Planning Committee on the Trans North Atlantic Sightings Survey. Second meeting, Reykjavík November 2006. In: *NAMMCO Annual Report 2007-2008*, NAMMCO, Tromsø, Norway, 186–210.

NAMMCO. North Atlantic Marine Mammal Commission. 2007. Report of the Scientific Committee Planning Committee on the Trans North Atlantic Sightings Survey. Third meeting, St Andrews, March 2007. In: *NAMMCO Annual Report 2007-2008*, NAMMCO, Tromsø, Norway, 219–251.

NAMMCO. North Atlantic Marine Mammal Commission. 2009. Report of the Scientific Committee Working Group on Abundance Estimates. In: *NAMMCO Annual Report 2007-2008*, NAMMCO, Tromsø, Norway, 252–272.

NAMMCO. North Atlantic Marine Mammal Commission. 2010. Report of the Scientific Committee Working Group on Large Whale assessment. In: *NAMMCO Annual Report 2009*, NAMMCO, Tromsø, Norway, 411–421.

NAMMCO. North Atlantic Marine Mammal Commission. In press a. Report of the Scientific Committee Working Group on Abundance Estimates. In: *NAMMCO Annual Report 2010*, NAMMCO, Tromsø, Norway, 30pp.

NAMMCO. North Atlantic Marine Mammal Commission. In press b. Report of the Scientific Committee Working Group on Assessment. In: *NAMMCO Annual Report 2010*, NAMMCO, Tromsø, Norway. 37pp.

Nøttestad, L., Olsen, E., Skov, H., Falkenhaug, T. Søiland, H., Gislason, A., Horne, J. Anderson, C., Piatkowski, U., Waring, G. and Víkingsson, G. 2005. Marine mammal hot spots in the open ocean: Why do we find aggregations of large baleen and toothed whales along the mid-Atlantic Ridge between Iceland and the Azores. Poster to the 16th Biennial Conference on the Biology of Marine Mammals, San Diego, California.

Pike, D.G., Gunnlaugsson, Th., Øien, N., Desportes, G., Víkingsson, G.A., Paxton, C.G.M and Bloch, D. 2005. Distribution, abundance and trends in abundance of fin and humpback whales in the North Atlantic. ICES CM 2005/R12.

Sigurjónsson, J., Gunnlaugsson. Th., Ensor, P. Newcomer, M. and Víkingsson, G. 1991. North Atlantic Sightings Survey 1989 (NASS-89): Shipboard surveys in Icelandic and adjacent waters July–August 1989. *Rep. Int. Whal. Commn* 41: 559–572.

Table 1. T-NASS 2007: summary of the effort realized per area and type of survey.

Survey Effort		Northern North Atlantic	Trackline, nm			Area
			planned	on effort	%	nm^2
MAIN TOTAL		**12**	**69.928**	**57.781**	**83**	**1.474.530**
SHIPBOARD	ICELAND	Irminger sea	3.700	2.027	55	246.363
		North Iceland	3.021	891	29	117.344
		South centre Iceland	2.711	2.500	92	119.116
	FAROES	East-Southeast Iceland	2.761	1.520	55	128.740
	GREENLAND	West Greenland	2.129	814	38	57.771
	NORWAY	Barents Sea east of 28E	4.008	2.230	56	264.939
	TOTAL	**7**	**18.330**	**9.982**	**54**	**934.273**
AERIAL	ICELAND	Iceland coastal shelf	6447	5080	79	85.546
	CANADA	Newfoundland and Labrador	27.205	26.063	96	214.555
		St. Lawrence Gulf	6643	6.643	100	68.523
		Scotian Shelf	4935	4.919	100	52.344
		Canadian offshore	cancelled			0
	GREENLAND	West Greenlandic shelf	6368	5.094	80	119.289
	TOTAL	**5**	**51.598**	**47.799**	**93**	**540.257**
EXTENSION TOTAL		**5**		**5.253**		
EXTENSION	Pre - ICES Redfish, RU	Barents & Norwegian Sea	3.710	198	0	38.600
	ICES Redfish, D	Irminger sea	cancelled			0
	ICES Redfish, RU	Irminger sea	8.600	755	0	90.000
	Post - ICES Redfish, RU	Labrador, Norwegian & Barents Seas	19.010	540	0	198.600
	Norwegian Pelagic, NO	Norwegian Sea	NA	1.152	NA	NA
	Norwegian Pelagic, NO	Norwegian Sea	NA	1.568	NA	NA
	MAR-ECO, UK	Mid Atlantic ridge	NA	1.040	NA	NA

Table 2. T-NASS 2007: list of primary, unique, sightings recorded on effort, per species and per area.

	SHIPBOARD						AERIAL					SHIPBOARD EXTENSION						TOTAL
T-NASS 2007	Iminger Sea	South Centre Iceland	North Iceland	East - Southeast Iceland	West Greenland	Eastern Barents Sea	Iceland coastal	N. Foundland Labrador	St Lawrence Gulf	Scotian Shelf	West Greenland	Iminger Sea	Mid atlantic Ridge	Norwegian Sea	Norwegian Sea	Barents Sea	Norwegian Sea	
Bowhead whale											1							1
Blue whale	1	4	8					4	6	5		4						32
Fin whale	237	69	20	5	2	15	7	73	4	44	25	10		3	6			520
Seiwhale+like	13	31		1	1			1		2	5	7		2				63
Common minkewhale	5	2	19	9	35	88	70	53	24	86	27			8	13	2	5	446
Humpbackwhale	10	1	66	4	8	11	58	144	32	51	21	1			3		1	411
Spermwhale	31	27	4	9			4	11		11			9	10	17			133
Kogiasp (Pygmy?)										1								1
Narwhal											2							2
Beluga								5	203									208
Northern bottlenosewhale	2	9	2	13	2		1	10		3		4	1	2	1			50
Sowerby's beaked whale		1											1					2
Cuvier's beaked whale										1								1
Unid.beaked whale	1	10			1		3			13			1					29
Killerwhale	6		3	5	0		11	1		7		2		8	11		5	59
Long-finned pilotwhale	45	12		14	1		9	10	7	37	15	10	11					171
White sided dolphin	8	15		3			3	92	13	15		4	6	1				160
White beaked dolphin	6		25			35	105	68	16	2	58	2		6	13	7	2	345
Lagenorhynchus sp.						64												64
Bottlenose dolphin				2			1			8								11
Common dolphin								28	2	201			35					266
Striped dolphin										1			4					5
Risso's dolphin									1	6								7
Harbour porpoise		9		10	3	37	119	36	25	4	46					1		290
Allunidentified	79	9	26	33	4	4	40	48	125	283	21	20	16	7	4	0	1	720
TOTAL	444	199	173	108	57	254	431	584	458	781	221	64	84	47	68	10	14	3997

Table 3. T-NASS abundance estimates endorsed by the NAMMCO SC for assessment purposes.

Survey Areas	West Greenland	Iceland Coastal	Iceland–Faroes	Canada GSS	Canada NL	Norwegian mosaïc 2002–2007
Species / Survey	Aerial	Aerial	Shipboard	Aerial	Aerial	Shipboard
Fin whale	*4,359 n*** *(1879–10 114)*	-	20 613 n** (14 819–25 466) 26 117 p** (17 401–39 199)	462 n** (270–791)	1254 p** (765–2059)	To be done
Minke whale	16 609 pa[1]** (7172–38 461) 22 952 pa[2]** (7815–67 403)	15 055[3] * (6357–27 278) 10 680[4] * (5873–17 121)	10 782 n*** (4733–19 262)	1927 ** (1196–2799)	3748 p** (2214–6345)	IWC
Humpback whale	3272 pa** (1.230–8.710)	1242 p** (632–2445)	11 572 n** (4502–23 807)	653 ** (385–1032)	3712 p** (2536–5428)	To be done
Pilot whale	**2976 n** (1178–7515)**	-	**Not accepted**	6134 n** (2774–10 573)	-	To be done
Sperm whale	-	-	To be done	To be done?	To be done?	To be done
Bottlenose whale	-	-	To be done	-	To be done?	To be done
Harbour porpoise	**33 271 pa** (15 939–69 450)**	To be done	-	3667 n** (1565–6566)	958 n** (470–1954)	To be done
White-beaked dolphin	**9827 p** (6723–14 365)**	To be done	To be done			To be done
White-sided dolphin	-	-	To be done	4289 n** (cv = 0.210)	3086 p** (1781–5357)	To be done
Common dolphin	-	-	-	53 049 n** (34 865–80 717)	613 p** (278–1355)	-

Estimates in bold are first estimates for the species in the area, estimates in *italic* have been endorsed but need further work. Further work is needed before acceptance in a few cases. For detail of the recommended supplementary analysis see Table 2.

n, uncorrected for bias; p, corrected for perception bias; a, corrected for availability bias.

[1] Availability bias is adjusted using aerial photographic images taken in Iceland.

[2] Availability bias is adjusted using satellite tagging data from three different areas.

[3] Using both primary observers

[4] Using only the most effective primary observer (much higher sighting rate)

*** Endorsed at the NAMMCO WG on Abundance estimate, Copenhagen, April 2008, and subsequent Scientific Committee Meeting (NAMMCO, 2009)**

**** Endorsed at the NAMMCO WG on Abundance Estimates, Quebec City, October 2009, and subsequent Scientific Committee Meeting (NAMMCO, 2011)**

***** Endorsed at the NAMMCO WG on Assessment, Copenhagen, March 2010, and subsequent Scientific Committee Meeting (NAMMCO, 2011)**

Table 4. T-NASS 2007: Summary per species and areas of: (1) the T-NASS analyses remaining to be done, (2) the supplementary analyses recommended by the NAMMCO Scientific Committee Working Group on Abundance Estimates, Quebec City, October 2009.

Species	Areas	Recommendations
All species	Norway	No abundance has been provided to the AEWG from Norway.
	Iceland	Elucidating whether there is a problem in using the last distance estimation for each sighting instead of the first, which is standard practice for line transect surveys of cetaceans.
	Canada	Should correct for availability bias in all areas and correct for perception in the NL area.
Fin whale	Greenland aerial	1. Post-stratification of blocks 4 (which includes much of the estimate) and 7 to only include areas actually surveyed (MRDS&CDS estimates); 2. Examination of the effect of the level of pooling of expected group size on stratum and total estimates (MRDS&CDS estimates); 3. Examination of the effect of right truncation on the MRDS estimate, particularly truncation to the same degree as the CDS estimate. An alternative would be to truncate the CDS model equivalently to the MRDS model. 4. Detailed trend analysis
Minke	Canada aerial – GSS	Investigate possibility of correcting for availability bias using the methods employed in Greenland (SC/17/AE/08).
	Iceland/Faroes + Extension	1. Re-write paper with correction of errors and adding necessary information for allowing interpretation. 2. Provide a CDS estimate, consistent with earlier surveys
	Greenland shipboard	Provide documentation for the estimate.
Humpback	Iceland-Faroese shipboard	Investigate for the possible presence of responsive movement. If such evidence is found then a MRDS model assuming full independence should be used.
	Iceland-Faroese shipboard and Iceland costal	Combine Iceland-Faroese shipboard and Iceland costal surveys by employing abundance estimates from the shipboard surveys in the overlapping areas and to use the post-stratified aerial survey for the rest.
	Greenland shipboard	To be done
Pilot whales	Iceland-Faroes	1. Provide a CDS estimate 2. Complete the present analysis looking in particular at: a) "edge effects" showed by the MRDS model, b) the actual distribution of sightings used (Figure 5 and 6 are different) 3. Provide an index of relative abundance for areas common to all surveys
	Greenland aerial	Reconsider correction for availability
Harbour porpoise	Iceland aerial	Analysis remains to be done

Species	Areas	Recommendations
Sperm whales	Iceland-Faroes	The analysis should be prepared for both areas and both for the acoustic and the visual data
Bottlenose whales	Iceland-Faroese	Analysis of shipboard sightings data remains to be done
Lagenorhynchus	Iceland-Faroese shipboard and Iceland costal	Analysis remains to be done

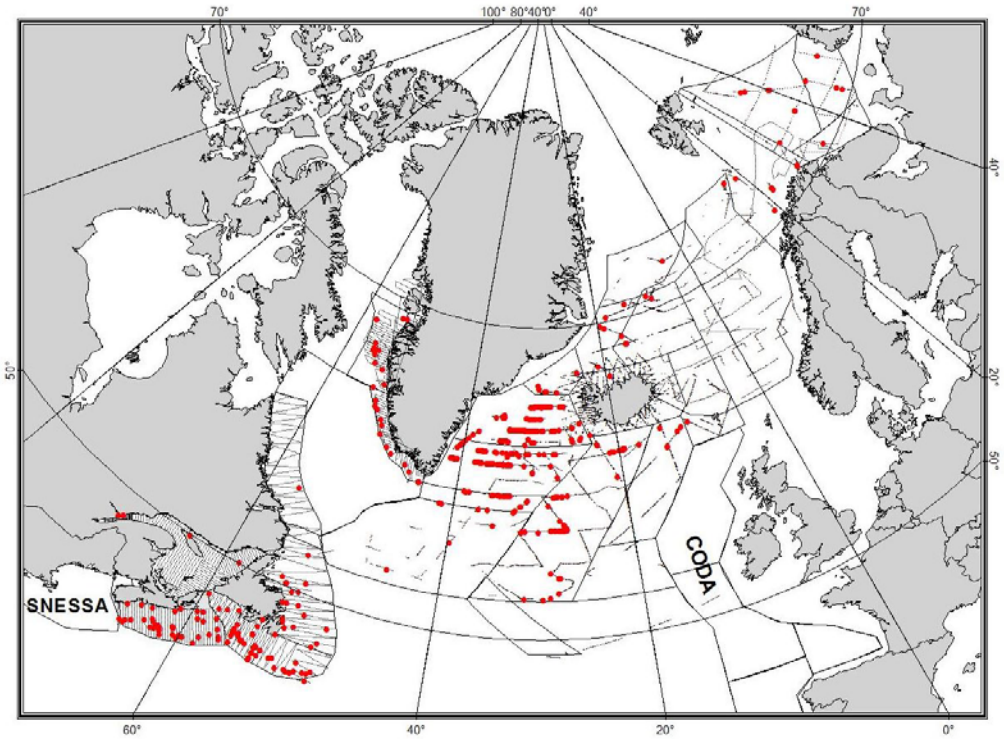


Figure 1. T-NASS 2007: Effort accomplished by the main and extensions surveys and distribution of fin whale on-effort sightings. The areas covered by the CODA and SNESSA surveys are indicated.

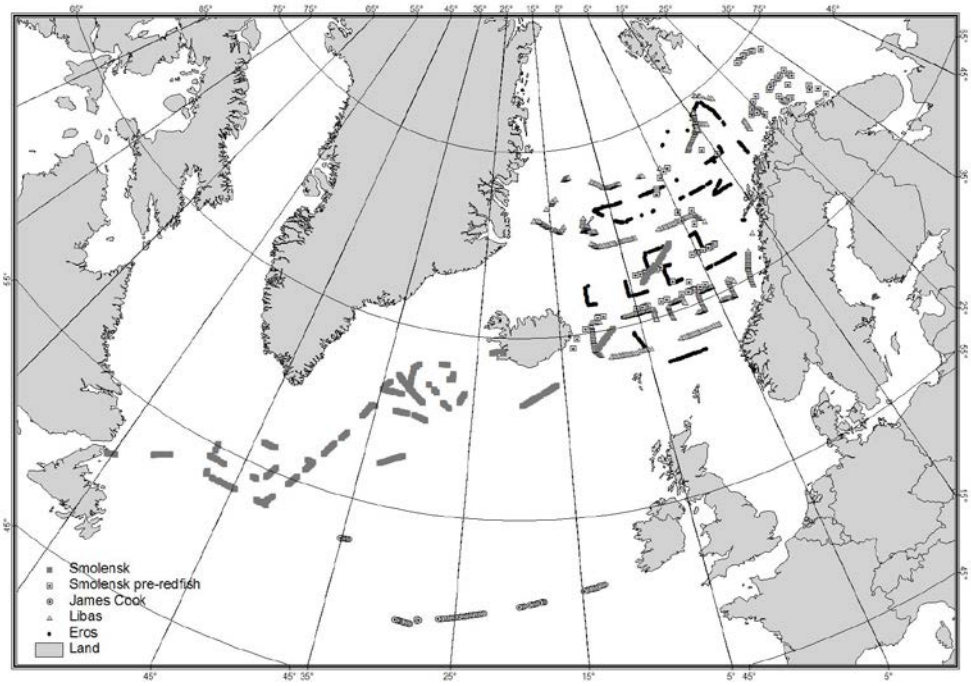


Figure 2. T-NASS 2007: Effort realized by the 'Extension' vessels.

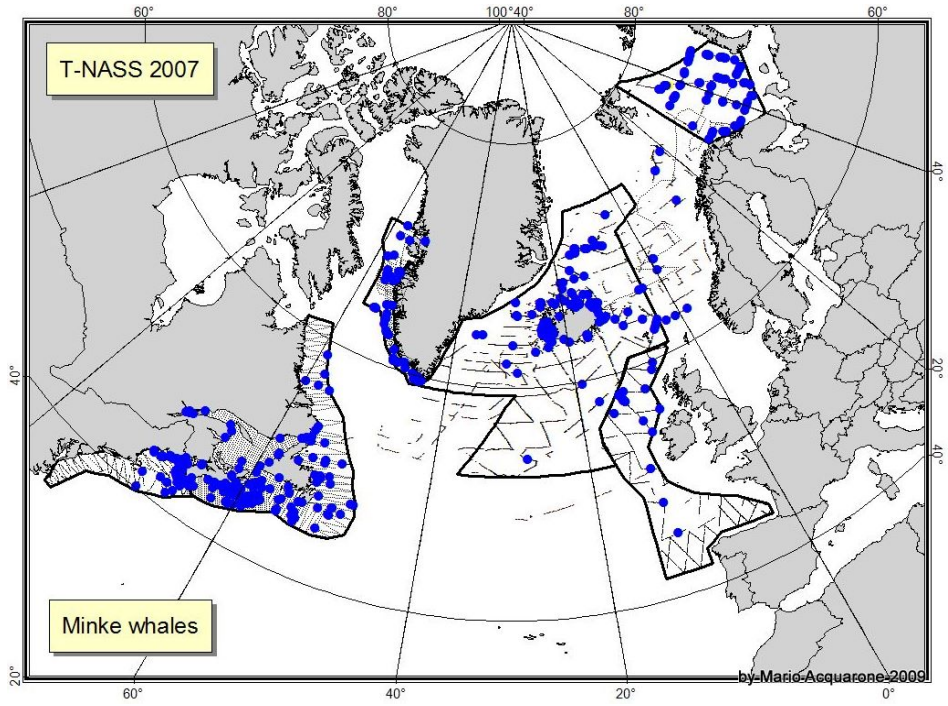


Figure 3. T-NASS 2007: On-effort sightings of minke whales. (please note that the sightings of CODA and SNESSA are also indicated).

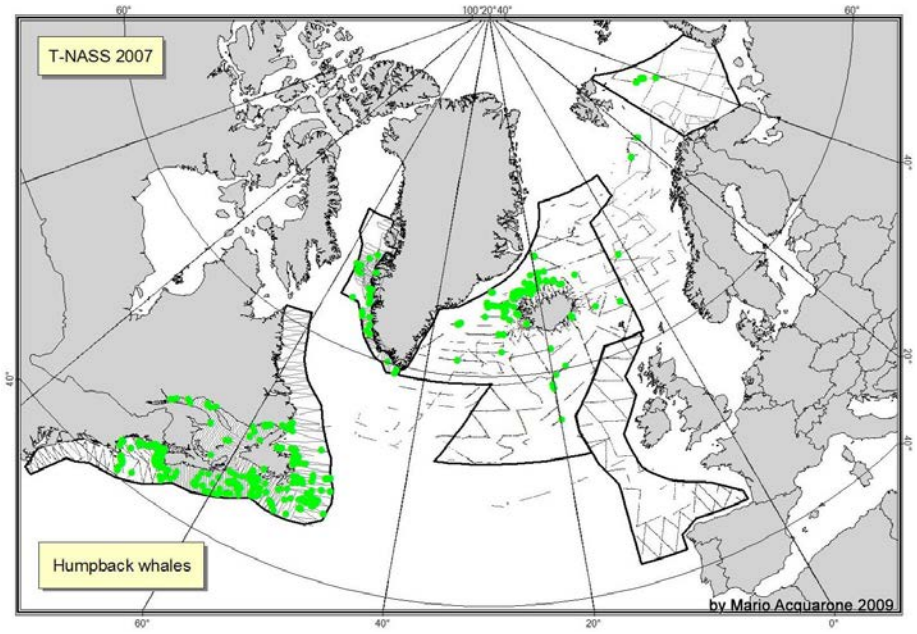


Figure 4. T-NASS 2007: On-effort sightings of humpback whales. (please note that the sightings of CODA and SNESSA are also indicated).

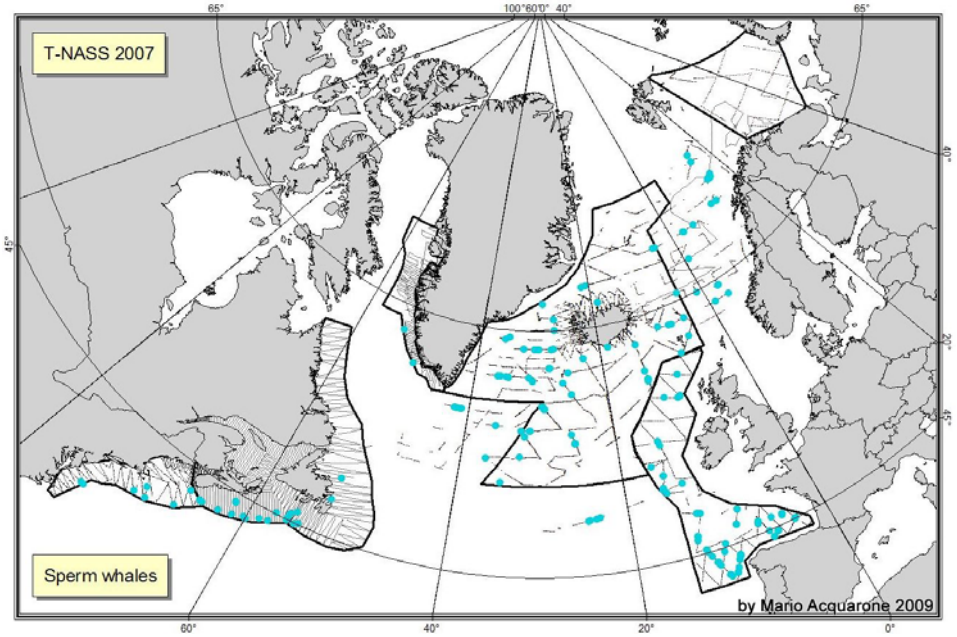


Figure 5. T-NASS 2007: On-effort sightings of sperm whales. (please note that the sightings of CODA and SNESSA are also indicated).

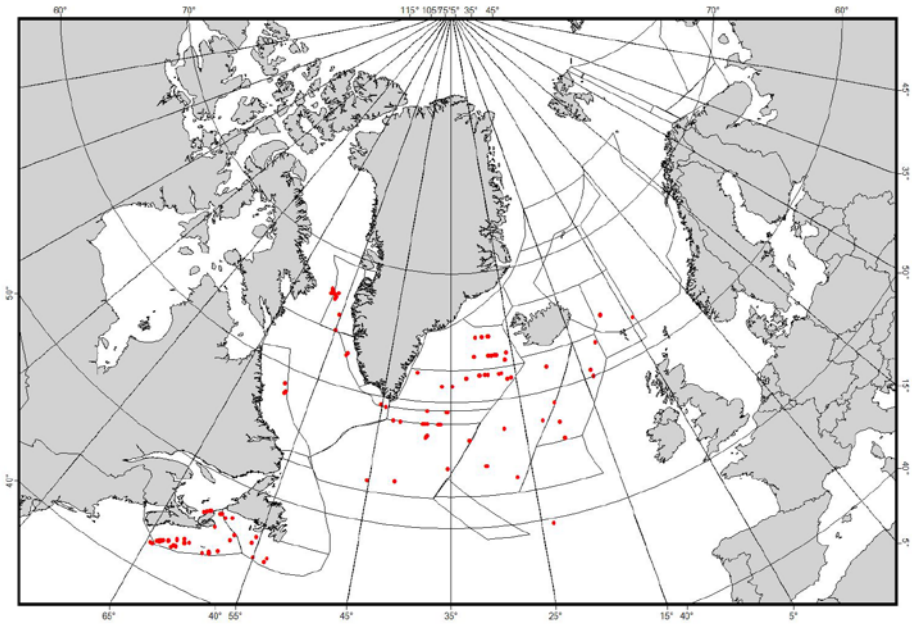


Figure 6. T-NASS 2007: On-effort sightings of pilot, beaked, and bottlenose whales.

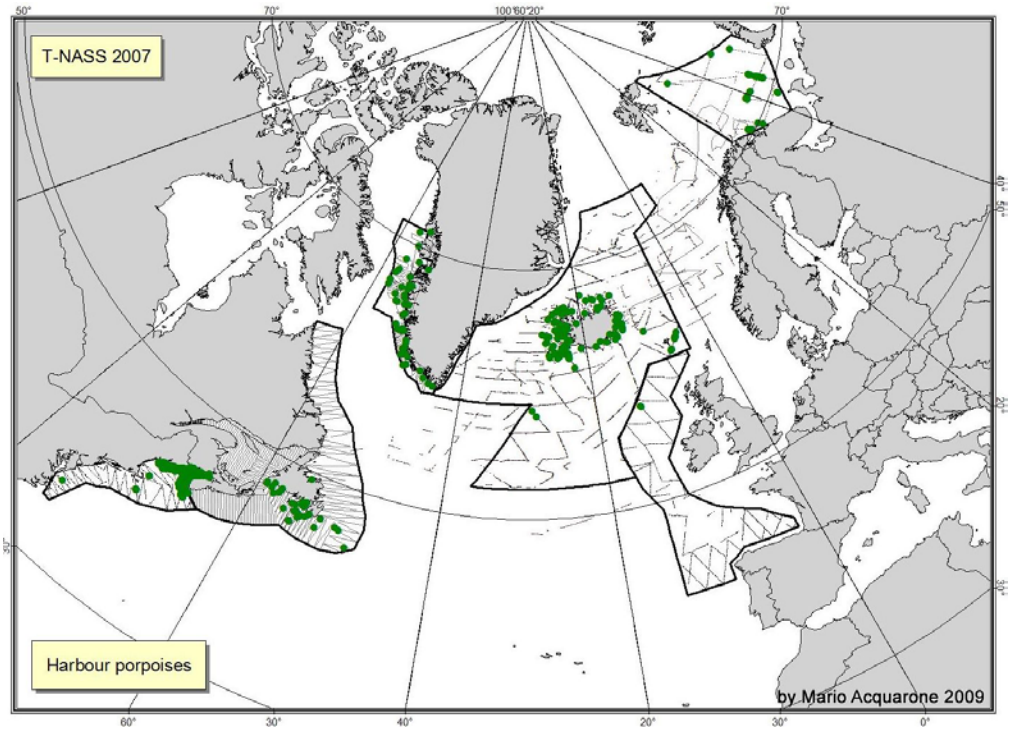


Figure 7. T-NASS 2007: On-effort sightings of harbour porpoises. (please note that the sightings of CODA and SNESSA are also indicated).

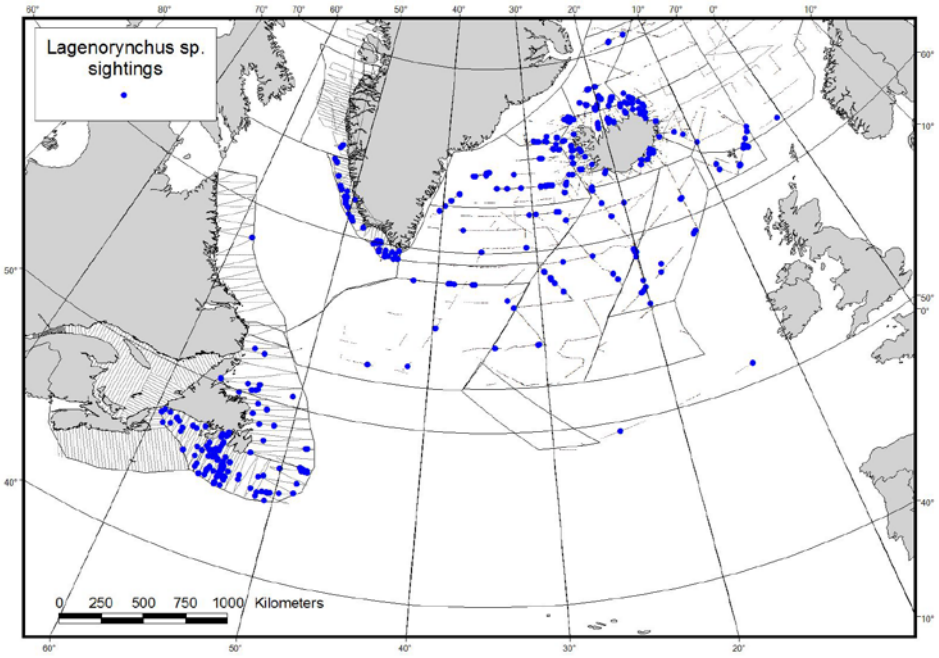


Figure 8. T-NASS 2007: On-effort sightings of *Lagenorhynchus* sp.

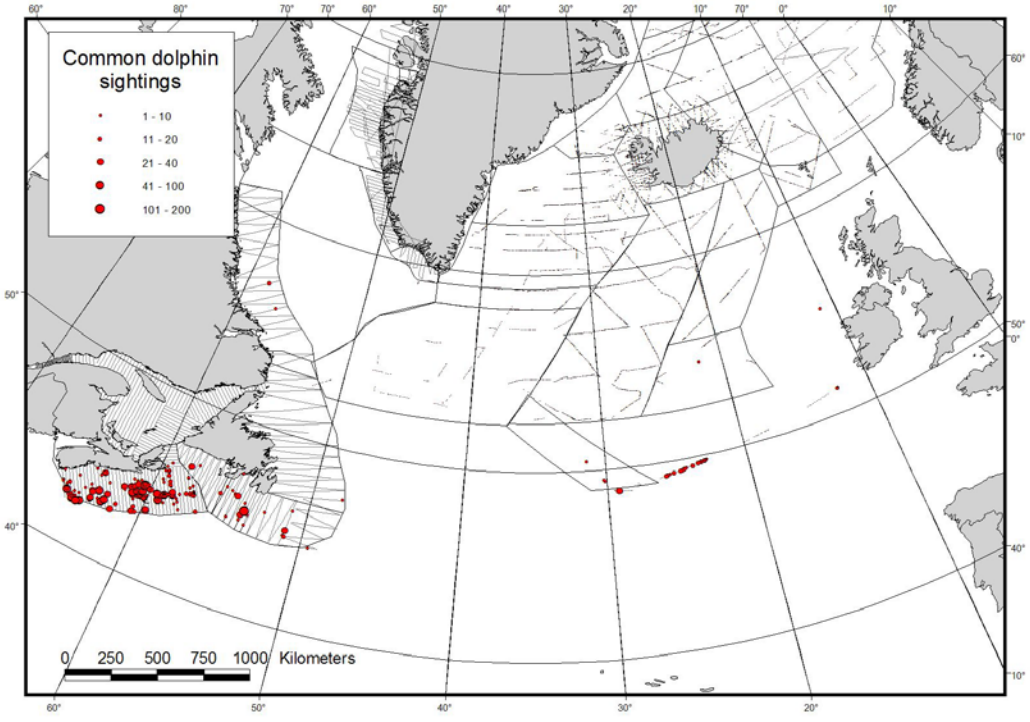


Figure 9. T-NASS 2007: On-effort sightings of common dolphins.

Annex 2: Catalogue of MPAs in the ICES area

NA = Not Available, NS = Not Specified, N.D. = No data

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
NAFO 4w	Canada	The Gully	DFO Oceans Act	2004	Northern bottlenose whale	Managed under Canadian Fisheries Act / Species at Risk	Protection of critical habitat	2364	Endangered under the Species at Risk Act	Northern bottlenose whale=E	Five MPAs have been established in Atlantic Canada, but only one, "The Gully" was designed to protect cetacean habitat. In 1994, Fisheries and Oceans Canada (DFO) identified part of the area as a Whale Sanctuary to reduce noise disturbance and ship collisions with whales. In 1999, DFO identified the Gully as an Area of Interest (AOI) under its national Marine Protected Area (MPA) Program. In 2004 it was designated a MPA. The MPA regulations prohibit the disturbance, damage, destruction or removal of any living marine organism or habitat within the Gully.	(http://www.dfo-mpo.gc.ca/oceans/marineareas-zonesmarines/mpa-zpm/index-eng.htm), http://www.dfo-mpo.gc.ca/species-especes/species-especes/northernbottlenosewhale-baleinebeccommun-eng.htm	
NAFO 4t	Canada	Saguenay-St. Lawrence Marine Park	DFO Oceans Act	1997	Beluga whales (P); fin whales, blue whales, minke whales, harbor seals, and grey seals (S)	Managed under Canadian Fisheries Act / Species at Risk	Recovery plan in place to reduce contamination and disturbance of beluga habitat	1245	Beluga whales are listed as endangered	(Beluga whale, Fin whale, Blue whale)=E	The Saguenay-St. Lawrence Marine Park was established in 1997 to conserve and manage its marine resources.	(http://www.pc.gc.ca/eng/amnc-nmca/qc/saguenay/plan.aspx), (http://www.dfo-mpo.gc.ca/science/publications/uww-msm/articles/beluga-eng.htm)	
NAFO 4x	Canada	Grand Manan Basin and Roseway Basin	DFO Oceans Act	1993	Rght whales (P); fin whale, humpback whale, minke whale (S)	Managed under Canadian Fisheries Act / Species at Risk	Recovery plan in place to reduce ship strikes and protect critical habitat	NA	Right whales are listed as endangered	(Right whale, Humpback whale, and Fin whale)=E	DFO established two right whale conservation zones: 1) Grand Manan Basin in the Bay of Fundy is a right whale conservation area and critical habitat. Vessels are advised to use caution when transiting the area. Roseway Basin on southwest Scotian Shelf is an area to be avoided for ships of 300 gross tonnage and upwards during the period 1 June through 31 December.	http://www.gmwsrs.org/conserv.htm#Zone, http://www.dfo-mpo.gc.ca/oceans/marineareas-zonesmarines/loma-zego/atlantic-atlantique/gsl/1/1271-eng.htm, http://www.tc.gc.ca/eng/mediaroom/backgrounders-b07-m017-5145.htm	

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
NAFO 5y	USA	Stellwagen National Marine Sanctuary	NOAA National Marine Sanctuary Act	1992	Right whales, humpback whales, fin whales, minke whales, harbour porpoise, white-sided dolphins, long-finned pilot whales, harbour seals, and grey seals	National Marine Sanctuary Program	Endangered Species Act (ESA), Marine Mammal Protection Acts (MMPA) and National Marine Sanctuary Research Plans	2181	Right, humpback and fin whales are listed as endangered under ESA. Harbour porpoise, Atlantic white-sided dolphin listed as strategic stocks under MMPA	(Right whale, Humpback whale, and Fin whale)=E	This sanctuary protects important cetacean feeding and nursing habitat.	http://stellwagen.noaa.gov/about/welcome.html	
NAFO 5y & 5 Z	USA	Great South Channel critical habitat	Endangered Species Act	1994	Right whales	Endangered Species Act	Recovery Plan	8371	Endangered	Right whale=E	Important spring feeding grounds - high *Calanus* sp. production	http://www.nmfs.noaa.gov/pr/species/criticalhabitat.htm	
NAFO 5y	USA	Cape Cod Bay critical habitat	Endangered Species Act	1994	Right whales	Endangered Species Act	Recovery Plan	1666	Endangered	Right whale=E	Important spring feeding grounds - high *Calanus* sp. production	http://www.nmfs.noaa.gov/pr/species/criticalhabitat.htm	
IVc	Belgium	Uitbreiding Trapegeer-Stroombank BEMNZ0001	N2000	P. 2010	S: harbour porpoise, grey seal, harbour seal			1010	Harbour porpoise= D; Grey seal= D; Harbour seal= D	NA	Offshore extension of 'old' N2000-area. Nominated for habitats	Degraer et al. 2009	
	Denmark	pSCI - DK00VA171 (Hab. No. 171 Gilleleje Flak og Tragten)	N2000	P. 2009	Harbour porpoise			150.3	Harbour porpoise=C	Harbour porpoise=C	Resident	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	
	Denmark	pSCI - DK00VA258 (Hab. No. 258	N2000	P. 2009	Harbour porpoise			108.92	Harbour porpoise=C	Harbour porpoise=C	Resident	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm.. Miljøministeriet,	

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
		Store Rev)										Naturstyrelsen	
	Denmark	pSCI - DK00VA259 (Hab. No. 259 Gule Rev)	N2000	P. 2009	Harbour porpoise			470.59	Harbour porpoise=C	Harbour porpoise=C	Resident	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	
	Denmark	pSCI - DK00VA260 (Hab. No. 260 Fermern Bælt)	N2000	P. 2009	Harbour porpoise			114.56	Harbour porpoise=C	Harbour porpoise=C	Resident	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	
	Denmark	SCI - DK00DX155 (Hab. No. 51 Stavns Fjord, Samsø Østerflak og Nordby Hede)	N2000	2005	Harbour seal, Harbour porpoise			156.63	Harbour seal=B; Harbour porpoise=D	Harbour seal=A	HS: Resident: 413i, HP: Resident - P	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	
	Denmark	SCI - DK002X110 (Hab. No. 126 Saltholm og omliggende hav)	N2000	2005	Grey seal, Harbour seal			72.18	Grey seal=B; Harbour seal=C	Grey seal=C; Harbour seal=B	GS: Resident (V), HS: Resident: 36i	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	
	Denmark	SCI - DK003X202 (Hab. No. 112 Hesselø med omliggende stenrev)	N2000	2005	Grey seal, Harbour seal, Harbour porpoise			41.93	Grey seal=B; Harbour seal=B; Harbour porpoise=D	Grey seal=B; Harbour seal=A	GS: Resident - V, HS: Resident: 824i, HP - P	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	
	Denmark	SCI - DK005X276 (Hab. No. 195 Røsnæs, Røsnæs Rev og Kalundborg Fjord)	N2000	2005	Harbour seal, Harbour porpoise			56.64	Harbour seal=C; Harbour porpoise=C	Harbour seal=B; Harbour porpoise=C	HP: Resident - P, HS: Resident - C	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
	Denmark	SCI - DK006X233 (Hab. No. 147 Havet og kysten mellem Præstø Fjord og Grønsund)	N2000	2005	Harbour seal			319.49	Harbour seal=C	Harbour seal=B	Resident: 32i	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	
	Denmark	SCI - DK008X047 (Hab. No. 96 Lillebælt)	N2000	2005	Harbour porpoise			350.43	Harbour porpoise=C	Harbour porpoise=B	Resident - P	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	
	Denmark	SCI - DK008X183 (Hab. No. 91 Fyns Hoved, Lillegrund og Lillestrand)	N2000	2005	Harbour porpoise, harbour seal			21.82	Harbour porpoise=C; Harbour seal=D	Harbour porpoise=B	HP: Resident - C	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	
	Denmark	SCI - DK008X184 (Hab. No. 92 Ærø, havet syd for og Nærå)	N2000	2005	Harbour seal, Harbour porpoise			112.83	Harbour seal=C; Harbour porpoise=C	Harbour seal=C; Harbour porpoise=B	HP and HS: Resident - P	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	
	Denmark	SCI - DK008X185 (Hab. No. 93 Havet mellem Romsø og Hindsholm samt Romsø)	N2000	2005	Harbour porpoise			42.15	Harbour porpoise=C	Harbour porpoise=B	Resident - P	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	
	Denmark	SCI - DK008X190 (Hab. No. 100 Centrale Storebælt og Vresen)	N2000	2009	Harbour porpoise			370.05	Harbour porpoise=C	Harbour porpoise=C	Resident - C	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
	Denmark	SCI - DK00AY176 (Hab. No. 78 Vadehavet med Ribe Å, Tved Å og Varde Å vest for Varde)	N2000	2004	Grey seal, Harbour seal, Harbour porpoise			1347.32	Grey seal=A; Harbour seal=A; Harbour porpoise=C	Grey seal=C; Harbour seal=A; Harbour porpoise=C	GS: Resident - 5M, HS: Resident - 2145i, HP: Resident - P	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	
	Denmark	SCI - DK00CY040 (Hab. No. 55 Venø, Venø Sund)	N2000	2004	Harbour seal, Harbour porpoise			29.26	Harbour seal=B; Harbour porpoise=D	Harbour seal=B		http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	
	Denmark	SCI - DK00DX146 (Hab. No. 42 Anholt og havet nord for)	N2000	2005	Grey seal, Harbour seal			133.57	Grey seal=A; Harbour seal=B	Grey seal=C; Harbour seal=A	GS: Resident - P, HS: Resident: 912i. Anholt Seal colony have a seal santuary since 1982 and the public are not allowed to enter. Important breeding and resting area.	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	
	Denmark	SCI - DK00DY156 (Hab. No. 52 Horsens Fjord, havet øst for og Endelave)	N2000	2005	Grey seal, Harbour seal, Harbour porpoise			458.23	Grey seal=B; Harbour seal=C; Harbour porpoise=D	Grey seal=C; Harbour seal=B	GS: Resident - V, HS: Resident: 600i, HP - P	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	
	Denmark	SCI - DK00EX026 (Hab. No. 29 Dråby Vig)	N2000	2004	Harbour seal			16.78	Harbour seal=C	Harbour seal=A	HS: Resident - C	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	
	Denmark	SCI - DK00EY124 (Hab. No. 16 Løgstør Bredning, Vejlerne og Bulbjerg)	N2000	2004	Harbour seal			447.68	Harbour seal=B	Harbour seal=A	Resident - 781i. The seal colony on the Island of Livø is a national seal santuary and the colony area is forbidden to enter all year.	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
	Denmark	SCI - DK00EY133 (Hab. No. 28 Agger Tange, Nissum Bredning, Skibsted Fjord og Agerø)	N2000	2004	Harbour seal			255.83	Harbour seal=C	Harbour seal=A	HS: Resident - 88i	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	
	Denmark	SCI - DK00EY134 (Hab. No. 30 Lovns Bredning, Hjarbæk Fjord og Skals, Simested og Nørre Ådal, samt Skravad Bæk)	N2000	2005	Harbour seal			235.13	Harbour seal=C	Harbour seal=B	Resident - P	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	
	Denmark	SCI - DK00FX010 (Hab. No. 9 Strandenge på Læsø og havet syd herfor)	N2000	2005	Grey seal, Harbour seal, Harbour porpoise			669.86	Grey seal=C; Harbour seal=B; Harbour porpoise=D	Grey seal=C; Harbour seal=B	GS: Resident - P, HS: Resident: 654i, HP: Resident - P	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	
	Denmark	SCI - DK00FX112 (Hab. No. 1 Skagens Gren og Skagerrak)	N2000	2009	Harbour porpoise			2690.79	Harbour porpoise=B	Harbour porpoise=C	Resident - C	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	
	Denmark	SCI - DK00FX113 (Hab. No. 4 Hirsholmene, havet vest herfor og Ellinge Å's udløb)	N2000	2005	Grey seal, Harbour seal, Harbour porpoise			94.6	Grey seal=B; Harbour seal=C; Harbour porpoise=D	Grey seal=B; Harbour seal=B	GS: Resident - V, HS: Resident - P, HP: resident - P	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
	Denmark	SCI - DK00FX122 (Hab. No. 14 Ålborg Bugt, Randers Fjord og Mariager Fjord)	N2000	2005	Harbour seal, Harbour porpoise			685.83	Harbour seal=C; Harbour porpoise=D	Harbour seal=C	HS: Resident=C, HP: Resident - P	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	
	Denmark	SCI - DK00FX123 (Hab. No. 15 Nibe Bredning, Halkær Ådal ogSønderup Ådal)	N2000	2005	Harbour seal			189.07	Harbour seal=C	Harbour seal=A	Resident - C	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	
	Denmark	SCI - DK00FX257 (Hab. No. 176 Havet omkring Nordre Rønner)	N2000	2005	Harbour seal			185.35	Harbour seal=B	Harbour seal=B	Resident: 243i	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	
	Denmark	SCI - DK00VA250 (Hab. No. 169 Store Middelgrund)	N2000	2005	Harbour porpoise			21.37	Harbour seal=C	Harbour seal=C	Resident - C	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	
	Denmark	SCI - DK00VA347 (Hab. No. 255 Sydlige Nordsø)	N2000	2009	Harbour seal, Grey seal, Harbour porpoise			2462.96	Grey seal=B; Harbour seal=B; Harbour porpoise=B	Grey seal=B; Harbour seal=B; Harbour porpoise=C	GS: Resident - R, HS: Resident - P, HP: Resident - C	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	
	Denmark	SCI - DK008X198 (Hab. No. 108 Maden på Helnæs og havet vest for)	N2000	2005	Harbour porpoise			20.45	Harbour porpoise=B	Harbour porpoise=B	Resident - P	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
	Denmark	SCI (Hab. No. 148 Havet og kysten mellem Karrebæk Fjord og Knudshoved Odde)	N2000	2005	Harbour seal, Harbour porpoise			169.05	Harbour seal=C; Harbour porpoise=D	Harbour seal=B	HS: Resident: 74i	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	
	Denmark	SCI (Hab. No. 152 Smålandsfarvandet nord for Lolland, Guldborg Sund, Bøtø Nor og Hyllekrog-Rødsand)	N2000	2009	Grey seal, Harbour seal			778.48	Harbour seal=B; Grey seal=A	Harbour seal=B; Grey seal=B	HS: Resident: 167i, GS: Resident 5-15i. The Western tip of Rødsand has been a seal santuary since 1978. Access is forbidden from March 1. to September 30. Very important breeding colony for the Harbour seal in the Baltic Sea.	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	
	Denmark	SCI (Hab. No. 173 Flensborg Fjord, Bredgrund og farvand)	N2000	2009	Harbour porpoise			649.22	Harbour porpoise=B	Harbour porpoise=C	Resident - C	http://natura2000.eea.europa.eu/# and Lone Reersø Hansen, pers. comm., Miljøministeriet, Naturstyrelsen	
	Estonia	pSCI - EE0040141 Klaasrahu	N2000	2009	Grey seal	SCI P. 2004, confirmed in 2020		26.74	Grey seal=C	Grey seal=C	Resident: 10-160	http://natura2000.eea.europa.eu/#	
	Estonia	SCI - EE0010154 Krassi	N2000	2009	Grey seal	SCI P. 2004, confirmed in 2016		0.80	Grey seal=C	Grey seal=D	Resident: >20	http://natura2000.eea.europa.eu/#	
	Estonia	SCI - EE0010171 Kolga lahe	N2000	2009	Grey seal	SCI P. 2004, confirmed in 2009		24.35	Grey seal=B	Grey seal=B	Breeding area: 6-10i	http://natura2000.eea.europa.eu/#	
	Estonia	SCI - EE0040002 Väinamere	N2000	2009	Grey seal, Ringed seal	SCI P. 2004, confirmed in 2018		2521.38	Grey seal=A; Ringed seal=C	Grey seal=B; Ringed seal=A	GS: Resident: 10-1000, RS: Resident: 6-50	http://natura2000.eea.europa.eu/#	

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
	Estonia	SCI - EE0040313 Kihnu	N2000	2009	Grey seal, Ringed seal	SCI P. 2004, confirmed in 2012		91.36	Grey seal=B; Ringed seal=A	Grey seal=A; Ringed seal=A	GS: Resident: 51-100i, RS: 101-205i	http://natura2000.eea.europa.eu/#	
	Estonia	SCI - EE0040402 Allirahu	N2000	2009	Grey seal	SCI P. 2004, confirmed in 2015		19.60	Harbor seal=B	Harbor seal=A	Resident: 501-1000i	http://natura2000.eea.europa.eu/#	
	Estonia	SCI - EE0040421 Kerju	N2000	2009	Grey seal	SCI P. 2004, confirmed in 2017		0.79	Grey seal=A	Grey seal=A	Resident (P), Breeding area: 10-300p	http://natura2000.eea.europa.eu/#	
	Estonia	SCI - EE0040476 Tagamõisa	N2000	2009	Grey seal	SCI P. 2004, confirmed in 2010		134.82	Grey seal=B	Grey seal=A	Resident: 101-250i	http://natura2000.eea.europa.eu/#	
	Estonia	SCI - EE0040490 Vesitükimaa	N2000	2009	Grey seal	SCI P. 2004, confirmed in 2019		12.61	Grey seal=A	Grey seal=C	Breeding area: 1-70p	http://natura2000.eea.europa.eu/#	
	Estonia	SCI - EE0040496 Vilsandi	N2000	2009	Grey seal	SCI P. 2004, confirmed in 2011		182.34	Grey seal=C	Grey seal=A	Resident (P), Breeding area: 300p	http://natura2000.eea.europa.eu/#	
	Estonia	SCI - EE0040499 Raudrahu	N2000	2009	Grey seal	SCI P. 2004, confirmed in 2014		9.79	Grey seal=A	Grey seal=B	Resident: 10-100	http://natura2000.eea.europa.eu/#	
	Estonia	SCI - EE0060220 Uhtju	N2000	2009	Grey seal, Ringed seal	SCI P. 2004, confirmed in 2013		24.29	Grey seal=B; Ringed seal=B	Grey seal=B; Ringed seal=C	GS: Resident: 11-50i, RS: Resident: 1-6i	http://natura2000.eea.europa.eu/#	
	Finland	Rahjan saaristo (SCI FI1000005)	N2000	P. 1998	Grey Seal, Ringed Seal			83.8	Grey Seal: Pop = C (Breed 1-5 p); Ringed Seal: Pop = C (Breed 1 p)	Grey seal= A; Ringed seal= A			
	Finland	Merenkurkun saaristo (SCI	N2000	P. 1998	Grey Seal, Ringed Seal			1,281.6	Grey Seal: Pop = A (resident 200 -	Grey seal=B; Ringed seal=A			

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
		FI0800130)							300); Ringed Seal: Pop = C (resident p)				
	Finland	Kristiinankaupungin saaristo (SCI FI0800134)	N2000	P. 1998	Grey Seal, Ringed Seal			80.6	Grey Seal: Pop = C (resident p); Ringed Seal: Pop = C (migratory stage 5)	Grey seal=A; Ringed seal=A			
	Finland	Uudenkaupungin saaristo (DE FI0200072)	N2000	P. 1998	Grey Seal, Ringed Seal			569.9	Grey Seal: Pop = C (resident R); Ringed Seal: Pop = C (resident P)	Grey seal=A; Ringed seal=A			
	Finland	Seksmiilarin saaristo (SCI FI0200152)	N2000	no data for SCI SPA p. 1998	Grey Seal, Ringed Seal			172.3	Grey Seal: Pop = C (resident P); Ringed Seal: Pop = C (resident P)	Grey seal=A; Ringed seal=A			
	Finland	Björkör (SCI FI1400006)	N2000	P. 1998	Grey Seal			52.9	Grey Seal: Pop = B (resident 10; migratory stage 10)	A			
	Finland	Saaristomeri (SCI FI0200090)	N2000	P. 1998	Grey Seal, Ringed Seal			497.4	Grey Seal: Pop = B (resident 101-250); Ringed Seal: Pop = B (resident 11-50)	Grey seal=A; Ringed seal=A			

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
	Finland	Luonteri (SCI FI0500021)	N2000	P. 1998	Saimaa Ringed Seal			84.4	Saimaa Ringed Seal: Pop = B (resident 2-4 i)	Ringed seal=B			
	Finland	Lietvesi (SCI FI0500024)	N2000	P. 1998	Saimaa Ringed Seal			192.7	Saimaa Ringed Seal: Pop = B (resident 5-14 i)	Ringed seal=B			
	Finland	Ilkonselkä (FI0422001)	N2000	P. 1998	Saimaa Ringed Seal			74.2	Saimaa Ringed Seal: Pop = C (resident 2-3 i)	Ringed seal=C			
	Finland	Katosselkä - Tolvanselkä (SCI FI0500026)	N2000	P. 1998	Saimaa Ringed Seal			132.9	Saimaa Ringed Seal: Pop = B (resident 16-22 i)	Ringed seal=B			
	Finland	Pihlajavesi (SCI FI0500013)	N2000	P. 1998	Saimaa Ringed Seal			367.4	Saimaa Ringed Seal: Pop = A (resident 50-60 i)	Ringed seal=B			
	Finland	Hevonniemi (SCI FI0500171)	N2000	P. 1998	Saimaa Ringed Seal			65.1	Saimaa Ringed Seal: Pop = B (resident 5-10 i)	Ringed seal=B			
	Finland	Linnansaari (SCI FI0500002)	N2000	P. 1998	Saimaa Ringed Seal			265.5	Saimaa Ringed Seal: Pop = A (resident 45-50 i)	Ringed seal=B			

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
	Finland	Joutenvesi - Pyyvesi (SCI FI0500031)	N2000	P. 1998	Saimaa Ringed Seal			152.9	Saimaa Ringed Seal: Pop = B (resident 25-30 i)	Ringed seal=B			
	Finland	Kolovesi - Vaaluvirta - Pyttyselkä (SCI FI0500001)	N2000	P. 1998	Saimaa Ringed Seal			79.9	Saimaa Ringed Seal: Pop = B (resident 13-15 i)	Ringed seal=B			
	Finland	Oriveden-Pyhäselän saaristot (SCI FI0700018)	N2000	P. 1998	Saimaa Ringed Seal			159.4	Saimaa Ringed Seal: Pop = B (resident 16-30 i)	Ringed seal=C			
	Finland	Luvian saaristo (SCI FI0200074)	N2000	P. 1998	Grey Seal			76	Grey Seal: Pop = C (resident R)	Grey seal=A			
	Finland	Rauman saaristo (SCI FI0200073)	N2000	P. 1998	Grey Seal			53.5	Grey Seal: Pop = C (resident R)	Grey seal=A			
	Finland	Gadden (SCI FI1400029)	N2000	No data for SCI SPA P. 1997	Grey Seal			0.04	Grey Seal: Pop = B (resident 10 i)	Grey seal=A			
	Finland	Ytterstberg (SCI FI1400031)	N2000	P. 1997	Grey Seal			2.7	Grey Seal: Pop = B (resident 100 i)	Grey seal=C			
	Finland	Länsmansgrund (SCI FI1400011)	N2000	no data for SCI SPA P. 1995	Grey Seal			1.6	Grey Seal: Pop = C (resident 5)	Grey seal=A			

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
	Finland	Boxö (SCI FI1400021)	N2000	P. 1995	Grey Seal			12.5	Grey Seal: Pop = C (migratory stage 10 i)	Grey seal=A			
	Finland	Läggningsbådan (SCI FI1400048)	N2000	no data for SCI SPA P. 1997	Grey Seal			2.8	Grey Seal: Pop = C (migratory stage 10 i)	Grey seal=A			
	Finland	Märrkallarna - Åbergsgrynnan - Mjölskärskallen (SCI FI1400035)	N2000	P. 1997	Grey Seal			7.6	Grey Seal: Pop = B (resident 700 i)	Grey seal=C			
	Finland	Signilskär - Märket (SCI FI1400047)	N2000	P. 1998	Grey Seal			210.3	Grey Seal: Pop = A (resident >200 i)	Grey seal=B			
	Finland	Stora Lökskär (SCI FI1400013)	N2000	no data for SCI SPA P. 1997	Grey Seal			0.65	Grey Seal: Pop = C (resident 3)	Grey seal=A			
	Finland	Lågskär (SCI FI1400058)	N2000	P. 1998	Grey Seal			10.6	Grey Seal: Pop = C (migratory stage >5i)	Grey seal=C			
	Finland	Klåvskär (SCI FI1400040)	N2000	no data for SCI SPA P. 1997	Grey Seal			24.6	Grey Seal: Pop = C (resident 10i)	Grey seal=A			
	Finland	Karlbybådar (SCI FI1400055)	N2000	P. 1997	Grey Seal			7.2	Grey Seal: Pop = B (resident 251-500)	Grey seal=B			
	Finland	Sandskär (SCI FI1400007)	N2000	P. 1995	Grey Seal			1.3	Grey Seal: Pop = C (migratory	Grey seal=B			

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
									stage 2)				
	Finland	Blåskären - Salungarna - Stora Bredgrundet (SCI FI1400012)	N2000	P. 1998	Grey Seal			3.3	Grey Seal: Pop = C (resident 10)	Grey seal=A			
	Finland	Mörskär (SCI FI1400054)	N2000	P. 1997	Grey Seal			8	Grey Seal: Pop = B (resident C)	Grey seal=B			
	Finland	Söderskärin ja Långörenin saaristo (SCI FI0100077)	N2000	P. 1998	Grey Seal			182.2	Grey Seal: Pop = C (resident <40 i)	Grey seal=A			
	Finland	Pernajanlahtien ja Pernajan saariston merensuojelualue (SCI FI0100078)	N2000	P. 1998	Grey Seal			657.8	Grey Seal: Pop = C (migratory stage 10-20)	Grey seal=A			
	Finland	Kallbådanin luodot ja vesialue (SCI FI0100089)	N2000	P. 1998	Grey Seal			15.2	Grey Seal: Pop = B (migratory stage 40)	Grey seal=B			
	Finland	Itäisen Suomenlahden saaristo ja vedet (SCI FI0408001)	N2000	P. 1998	Grey Seal			956,3	Grey Seal: Pop = C (migratory stage 0- 20 i)	Grey seal=B			
	Finland	Södra Sandbäck (SCI FI1400030)	N2000										
	Finland	Örskär - Fjällskär (SCI FI1400057)	N2000	P. 1997	Grey Seal			0.06	Grey Seal: Pop = C (resident < 5 i)	Grey seal=B			

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
VIIe,h	France	Parc Naturel Marin de l'Iroise	French national jurisdiction	2007	Bottlenose dolphin (P), grey seal (P), harbour porpoise (S), common dolphin (S)	Recently created MPA in the process of designing its management plan. Monitoring bottlenose dolphin and grey seal populations is in place since the early 1990's.	General goals include: 1- monitoring habitats and species and dissemination of knowledge; 2- maintain or improve population and habitat of protected species; improve water quality. Operational management plan due in 2012.	3550	Coastal resident groups of bottlenose dolphin fairly stable over last 20 years (c. 60-70 ind.); grey seal numbers currently at about 100 ind. increasing at a 7% yearly rate but local births limited to a few per year.	Bottlenose dolphin = A; grey seal = A	Highly energetic coastal area at the western end of Brittany characterized by major tidal currents, with 3 inhabited islands, many uninhabited islets and rocks and an extended plateau covered with *Laminaria* spp. Key human activities in the area include fisheries (including sea-weed extraction), tourism, military base and shipping.	Harkonen et al. 2007; Vincent et al. 2005; Liret et al. 2006	
VIIe	France	Réserve Naturelle des 7 Îles	French national jurisdiction	Created in 1912 by *Ligue pour la Protection des Oiseaux*, recognized as a National Reserve in 1976; listed as Natura 2000 site in 2002;	Grey seal (S)	National Reserve, no go area on terrestrial and tidal part; no hunting in a 1 nautical mile area around the reserve. Monitoring grey seal populations is in place since the early 1990's.	Conservation objectives for breeding seabirds, no explicit marine mammal objectives	no go area: 2.4 at sea, 0.4 on land; no hunting in surrounding area 40	Seal counts within the reserve increased from sporadic visits in the 80's to a permanent group of 20-30 individuals in 2009, producing up to 15 pups (2009). *Les Triagoz*, an adjacent series of tidal rocks located out of the reserve is also haul-out site to an additional 15-20 seals.	Grey seal = A	Rocky islands home to 12 breeding seabird species, including one of the biggest gannet colony in Europe. Together with grey seals, the majority of these species are at the southern limit of their European distribution. Extensive *Laminaria* spp beds and associated fauna from the tidal zone to the 25m isobath also of regional ecological interest.	Harkonen et al. 2007; Vincent et al. 2005	

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
VIIe	France	SCI FR2500077 Baie du Mont Saint Michel	N2000	Bird Directive site in 1990, Ramsar Convention site in 1994, UNESCO World Heritage site in 1979; Habitats Directive site in 2002	Migrating waterfowl (P); harbour seals (P); grey seal (S); harbour porpoise (S); bottlenose dolphin (S);	Hunting prohibited; monitoring bottlenose and harbour seal populations is in place since the early 1990's.	Conservation objectives for breeding, migrating and wintering birds, no explicit marine mammal objectives	477 (mostly in 83% zone)	Harbour seal count at haul-out and number of pups increasing rapidly, from 5-10 individuals/0 pup in 1990 to 40-50 ind../ 10 pups in 2010. Bottlenose dolphin=B; Harbour porpoise=D; Harbour seal=B; Grey seal=D	Bottlenose dolphin=A; Harbour seal=A	Complex system of small estuaries merging into an extensive intertidal bay composed of numerous sand banks and mud flats separated by channels (maximum tidal height 13m). Harbour seals at southern limit of their European distribution in the Channel.	Hassani et al., in press.	
VIId	France	Réserve Naturelle de la Baie de Somme	French national jurisdiction	1994, RAMSAR convention site in 1998	Migrating waterfowl (P); harbour seals (P); grey seal (S); harbour porpoise (S)	No go area within the Natural Reserve; information to the public provided. Monitoring of harbour seal populations is in place since the early 1990's.	Maintain population and habitat of protected species	31	Harbour seal count at haul-out and number of pups increasing rapidly, from 10-15 individuals/1 pup in 1990 to 180-200 ind./ 30 pups in 2010.	Harbour seal = A	Estuaries merging into an intertidal bay composed of sand banks and mud flats separated by channels. Harbour seals at southern limit of their European distribution in the Channel.	Hassani et al., in press.	

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
VIId	France	Réserve Naturelle de la baie des Veys	French national jurisdiction	1980	Migrating and wintering waterfowl (P); harbour seals (P); harbour porpoise (S)	No go area within the Natural Reserve.	maintain population and habitat of protected species		Harbour seal count at haul-out and number of pups increasing rapidly, from 0-5 individuals/1 pup in 1990 to 60-70 ind./13 pups in 2010.	Harbour seal = A	Harbour seals at southern limit of their European distribution in the Channel.	Hassani et al., in press.	
VIId	France	Parc Naturel Marin de la Mer d'Opale et des Estuaires Picards	for future designation under French national jurisdiction	2011	Harbour porpoise (P); harbour seal (P); grey seal (S)	NA	Maintain population and habitat of protected species	To be determined; will encompass Réserve Naturelle de la Baie de Somme	Harbour seal count at haul-out and number of pups increasing rapidly, from 10-15 individuals/1 pup in 1990 to 180-200 ind./ 30 pups in 2010. Harbour porpoise densities have increased rapidly in the area between 1994 and 2005.	ND	Region of shallow water with extensive tide movement, connecting the North Sea with the Channel. Heavily anthropized (major shipping route, fishing areas, recreational activities). Harbour seals at southern limit of their European distribution in the Channel.	SCANS-II 2008	

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
VIIe	France	Parc Naturel Marin du Golfe Normand-Breton	for future designation under French national jurisdiction	Under study and consultation; expected date of creation 2012-13.	Harbour seal (P), grey seal (S), bottlenose dolphin (P), harbour porpoise (S)	to be defined	Maintain population and habitat of protected species	To be determined; will encompass Réserve Naturelle de la Baie du Mont Saint Michel and all EU Natura 2000 site within its remits.	Presence of inshore bottlenose dolphins estimated at 41-127 individuals, but up to 600 different individuals catalogued to date, suggesting extensive exchanges with other populations. Harbour seal count at haul-out and number of pups increasing rapidly, from 5-10 individuals/0 pup in 1990 to 40-50 ind./ 10 pups in 2010.	ND	Region of shallow water with extensive tide movement (tide height of up to 13 m) and strong current, located between western coasts of Normandy, north-eastern coasts of Brittany and the Channel Islands. Important human activities in the area include fishery, oyster and mussel farms, tourism, shipping, nuclear power plant. Harbour seals at southern limit of their European distribution in the Channel.		

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
VIIIa, b	France	Parc Naturel Marin de l'estuaire de la Gironde et des Pertuis Charentais		Under study and consultation; expected date of creation 2012-13	Bottlenose dolphin (S), harbour porpoise (S), common dolphin (S)	NA	Maintain population and habitat of protected species	To be determined; will encompass all EU Natura 2000 site within its remits.	A resident group of up to 5 bottlenose dolphins used to be at this site in the 1980-90's, now gone. Pods of up to 100-150 long-finned pilot whales visit the area for brief visits in the summer, possibly in relation with calving; site fidelity established by photo-identification. Common dolphin is abundant in the 50-80 depth range.	ND	Region of shallow water under the influence of the Gironde estuary with extensive mud flats along both sides of the estuary, sandy beaches and sea bed on the ocean side of the islands and mud flats between the islands and the mainland. Key human activities are oyster and mussel farms, tourism (including sailing), shipping and fisheries.		
VIIIb	France	Parc Naturel Marin du Bassin d'Arcachon	For future designation under French national jurisdiction	Under study and consultation; expected date of creation 2012-13	Bottlenose dolphin (S), harbour porpoise (S), common dolphin (S)	To be defined	maintain population and habitat of protected species	To be determined; will encompass all EU Natura 2000 site within its remits.	A resident group of up to 10 bottlenose dolphins used to be at this site in the 1980-90's, now gone. Frequent entanglements in ropes of leisure boat moorings, sometime	ND	Main coast line oriented north-south, forming a continuous sandy coastline from the Gironde estuary to the Basque country, over *c.* 300km. Bassin d'Arcachon is a semi enclosed tidal laguna. Key human activities are oyster farms, tourism (including sailing) and fisheries.		

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
									fatal.				
VIId	France	pSCI FR3100474 Dunes de la Plaine Maritime Flamande	N2000	p. 2003	Harbour seal (S)	Management plan in preparation	Maintain population and habitat of protected species	4.4 (86% marine)	5-10 harbour seals, 1-5 grey seals use the area as a haul-out site.	ND	Extensive system of sand dunes, characteristics of southern North sea.		
VIId	France	pSCI FR3102003 Récifs gris-nez blanc-nez	N2000	p. 2008	Harbour porpoise (P); grey seal (S); harbour seal (S)	NA	Maintain population and habitat of protected species	292	5-15 grey seals use the area as a haul-out site. Highest density of harbour porpoise in France.	ND	Strong current and hard substrate shape the area.		
VIId	France	pSCI FR3100478 Falaises du Cran aux oeufs et du Cap gris-nez, dunes du Chatelet, marais de Tardinghen et dunes de Wissant	N2000	p. 2002	Harbour porpoise (P); grey seal (S), harbour seal (S)	Management plan in preparation, but see also Parc Naturel Marin de la Côte d'Opale et des Trois Estuaires	Maintain population and habitat of protected species	10 (75% marine)	5-15 grey seals use the area as a haul-out site. Highest density of harbour porpoise in France.	ND	Strong current and hard substrate shape the area; high cliffs.		

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
VIId	France	pSCI FR3100480 Estuaires de la Canche, Dunes Picardes plaquées sur l'ancienne falaise, forêt d'Hardelot et falaise d'Equihen	N2000	p. 2007	Harbour seal (S)	NA, but see also Parc Naturel Marin de la Côte d'Opale et des Trois Estuaires	Maintain population and habitat of protected species	17 (3% marine)	Harbour and grey seals visit the area.	ND	Restricted maritime domain constituted of a small estuary with limited alteration.		
VIId	France	pSCI FR3102005 Baie de Canche et couloirs des Trois Estuaires	N2000	p. 2008, but see also National Reserve of Baie de Somme	harbour seal (P); grey seal (S); harbour porpoise (S)	NA, but see also Réserve Nurelle de la Baie de Somme and Parc Naturel Marin de la Côte d'Opale et des Trois Estuaires	Maintain population and habitat of protected species	333	Major foraging grounds for harbour seals hauling out and breeding in the Baie de Somme and other smaller estuaries, as shown by telemetry.	ND	Coastal waters in front of estuaries that are home to the largest colonies of harbour seals in France. Important fish nurseries. Site of international importance for migrating and wintering waterfowl. Key human activities are fisheries and bivalve farms; development of wind farms is envisaged in the vicinity.	Vincent et al. in press.	
VIId	France	pSCI FR2200346 Estuaires et Littoral Picards (baies de Somme et d-Authie)	N2000	p. 1999, but see also National Reserve of Baie de Somme	Harbour seal (P); grey seal (S)	Management plan in preparation, but see also Réserve Nurelle de la Baie de Somme and Parc Naturel Marin de la Côte d'Opale et des Trois Estuaires	Maintain population and habitat of protected species	157 (64% marine), encompasses National Reserve of Baie de Somme	Harbour seal count at haul-out and number of pups increasing rapidly, from 10-15 individuals/1 pup in 1990 to 180-200 ind./ 30 pups in 2010.	ND	Estuaries and intertidal bay composed of sand banks and mud flats separated by channels. Harbour seals at southern limit of their European distribution in the Channel.	Vincent et al. in press.	
VIId	France	pSCI FR2300121 Estuaire de la Seine	N2000	p. 2003	Harbour seal (S)	Management plan in preparation	Maintain population and habitat of protected species	109 (69% marine)	Harbour seals present in small number.	ND	In spite of being heavily anthropized, the Seine estuary is a fish nursery of regional importance as well as an important area for migrating fish.		

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
VIId	France	pSCI FR2300139 Littoral Cauchois	N2000	p. 2008		Management plan in preparation	Maintain population and habitat of protected species	46 (79% marine)	No data other than occasional visits of grey and harbour seals, or of harbour porpoise.	ND	Elevated cray cliffs. Development of wind farms is envisaged in the vicinity.		
VIId	France	pSCI R2502021 Baie de Seine orientale	N2000	p. 2009	Harbour (S) and grey seals (S), bottlenose dolphins (S) and harbour porpoise (S)	NA	Maintain population and habitat of protected species	445	Harbour and grey seals, bottlenose dolphins and harbour porpoise visitors	ND	NA		
VIId	France	pSCI FR2502020 Baie de Seine occidentale	N2000	p. 2008	Harbour seal (P); bottlenose dolphin (S)	NA	Maintain population and habitat of protected species	456	Harbour seals resting and breeding in Baie des Veys use the area for foraging, as shown by telemetry.	ND	Shallow water with sandy bottom forming extensive system of hydraulic dunes. Important area for fish and foraging zone for harbour seals, harbour porpoise and, occasionally, bottlenose dolphins. Key human activities are fisheries and bivalve farms; development of wind farms is envisaged in the vicinity.	Vincent et al. in press.	
VIId	France	pSCI FR2500088 Marais du Cotentin et du Bessin-Baie des Veys	N2000	p. 1999, but see also National Reserve of Baie des Veys	Harbour seal (P)	Management plan in preparation, but see also National Reserve of Baie des Veys	Maintain population and habitat of protected species	293 (9% marine), encompasses National Reserve of Baie des Veys	Harbour seal count at haul-out and number of pups increasing rapidly, from 0-5 individuals/1 pup in 1990 to 60-70 ind./13 pups in 2010.	ND	Baie des Veys and adjacent wetlands are a site of international importance for migrating and wintering waterfowl. Home to the second biggest colony of harbour seals in France.	Vincent et al. in press.	

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
VIId	France	pSCI FR2500085 Récifs et marais arrière-littoraux du Cap Lévi à la Pointe de Saire	N2000	p. 1997	Harbour seal (S); bottlenose dolphin (S); harbour porpoise (S)	Management plan in preparation	Maintain population and habitat of protected species	154 (96% marine)	Site visited by harbour and grey seals, harbour porpoise and bottlenose dolphin. No quantitative data available.	ND	Strong current and hard substrate shapes the area. Seabed made of rocks, gravels and sand.		
VIIe	France	pSCI FR2500084 Récifs et Landes de la Hague	N2000	. 1997	Bottlenose dolphin (S); harbour porpoise (S); grey seal (S); harbour seal (S)	Management plan in preparation, but see also Parc Naturel Marin du Golfe Normand-Breton	Maintain population and habitat of protected species	92 (83% marine)	Site visited by harbour and grey seals, harbour porpoise and bottlenose dolphin. No quantitative data available.	ND	Very strong current (up to 12 knot at Raz-Blanchard) and hard substrate shape the area. Seabed made of rocks, gravels and sand.		
VIId	France	pSCI FR2502019 Anse de Vauville	N2000	p. 2008	bottlenose dolphin (S)	NA, but see also Parc Naturel Marin du Golfe Normand-Breton	Maintain population and habitat of protected species	131	mite visited by harbour and grey seals, harbour porpoise and bottlenose dolphin. No quantitative data available.	ND	Shallow water on sandy bottom.		
VIId	France	pSCI FR2502018 Banc et Récifs de Surtainville	N2000	p. 2008	Bottlenose dolphin (S); harbour porpoise (S); grey seal (S); harbour seal (S)	NA, but see also Parc Naturel Marin du Golfe Normand-Breton	Maintain population and habitat of protected species	141	Site visited by harbour and grey seals, harbour porpoise and bottlenose dolphin. No quantitative data available.	ND	Shallow water on sandy bottom.		

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
VIIe	France	pSCI FR2500080 Littoral ouest du Cotentin de Bréhal à Pirou	N2000	p. 1997		Management plan in preparation, but see also Parc Naturel Marin du Golfe Normand-Breton	Maintain population and habitat of protected species	33 (76% marine)	site visited by harbour and grey seals, harbour porpoise and bottlenose dolphin. No quantitative data available.	ND	Marine part of this site composed of estuaries and sandy bottom.		
VIIe	France	pSCI FR2500077 Baie du Mont Saint-Michel	N2000	p. 2002, overlaps with Réserve de la Baie du Mont Saint Michel and Parc Naturel Marin Normand-Breton	Harbour seal (P); grey seal (S); bottlenose dolphin (S)	Management plan in preparation, but see also Parc Naturel Marin du Golfe Normand-Breton	Maintain population and habitat of protected species	387 (97% marine)	Harbour seal count at haul-out and number of pups increasing rapidly, from 5-10 individuals/0 pup in 1990 to 40-50 ind./ 10 pups in 2010.	ND	Complex system of small estuaries merging into an extensive intertidal bay composed of numerous sand banks and mud flats separated by channels (maximum tidal height 13m). Harbour seals at southern limit of their European distribution in the Channel.		
VIIe	France	pSCI FR2500079 Les Iles Chausey	N2000	p. 2003, overlaps with Parc Naturel Marin Normand-Breton	Harbour seal (S); grey seal (S); bottlenose dolphin (S)	Management plan in preparation, but see also Parc Naturel Marin du Golfe Normand-Breton	Maintain population and habitat of protected species	829 (99% marine)	Site visited by harbour and grey seals, harbour porpoise and bottlenose dolphin. Presence in the divinity of an extended population of inshore bottlenose dolphins (see Parc Naturel Marin du Golfe Normand Breton). No quantitative	ND	Extensive area of shallow water on sandy bottom, with an archipelago of small granitic islands.		

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
									data available.				
VIIe	France	pSCI FR5300052 Côtes de Cancale à Paramé	N2000	p. 2002, overlaps with Parc Naturel Marin Normand-Breton	Bottlenose dolphin (S); Risso's dolphins (S).	NA, but see also Parc Naturel Marin du Golfe Normand-Breton	Maintain population and habitat of protected species	18 (61% marine)	No data other than occasional visits of grey and harbour seals, or of bottlenose dolphin and harbour porpoise.	ND	Rocky shore line, with cliffs and sandy bottom in the depressions.		
VIIe	France	pSCI FR5300012 Baie de Lancieu, baie de l'Arguenon, archipel de StMalo et Dinard	N2000	p. 2002, overlaps Parc Naturel Marin Normand-Breton	Bottlenose dolphin (S)	NA, but see also Parc Naturel Marin du Golfe Normand-Breton	Maintain population and habitat of protected species	51 (75% marine)	No data other than occasional visits of grey and harbour seals, or of bottlenose dolphin and harbour porpoise.	ND	Rocky shore line, with cliffs and sandy bottom in the depressions, small estuaries and coastal archipelagos.		
VIIe	France	pSCI FR5300011 Cap d'Erquy-Cap Fréhel	N2000	p. 2002	Bottlenose dolphin (S); harbour porpoise (S)	Management plan in preparation	Maintain population and habitat of protected species	559 (97% marine)	No data other than occasional visits of grey and harbour seals, or of bottlenose dolphin and harbour porpoise.	ND	Strong current and hard substrate shapes the area. Seabed made of rocks, gravels and sand.		

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
VIIe	France	pSCI FR5300066 Baie de Saint-Brieuc-est	N2000	p. 2002		Management plan in preparation	Maintain population and habitat of protected species	144 (97% marine)	No data other than occasional visits of grey and harbour seals, or of bottlenose dolphin and harbour porpoise.	ND	The site listed as a N2000 area is representative of the Baie de St Brieuc complex characterised by a more sheltered hydrodynamic regime and therefore finer sediment than in nearby Channel regions. Key human activities are fisheries and bivalve farms; development of wind farms is envisaged in the vicinity.		
VIIe	France	pSCI FR5300010 Trégor Goëlo	N2000	p. 2002	Grey seal (S); bottlenose dolphin (S); harbour porpoise (S)	Management plan in preparation	Maintain population and habitat of protected species	912 (97% marine)	No data other than occasional visits of grey and harbour seals, or of bottlenose dolphin and harbour porpoise.	ND	Rocky reefs and sandy bottom in shallow waters are characteristic of this site.		

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
VIIe	France	pSCI FR5300009 Côte de Granit Rose-Sept-Iles	N2000	p. 2002, but see also National Reserve of 7 Îles	Grey seal (P); bottlenose dolphin (S); harbour porpoise (S)	Management plan in preparation, but see also Réserve Naturelle des Sept Îles	Maintain population and habitat of protected species	722 (99 % marine), encompasses National Reserve of 7 Îles	Seal counts at Les 7 Îles increased from sporadic visits in the 80's to a permanent group of 20-30 individuals in 2009, producing up to 15 pups (2009). *Les Triagoz*, an adjacent series of tidal rocks located to the west of Les 7 Îles is also haul-out site for an additional 15-20 seals.	ND	The site is a complex mosaic of habitat including cliffs, shallower rocky shore, sandy beaches, reefs, sandy bottom, and uninhabited islands, submitted to a strong hydrodynamism due to tidal currents, waves and swell.		
VIIe	France	pSCI FR5300015 Baie de Morlaix	N2000	p. 2003	Grey seal (S); harbour porpoise (S)	NA	Maintain population and habitat of protected species	266 (97% marine)	No data other than occasional visits of grey seals, or of bottlenose dolphin, common dolphin and harbour porpoise.	ND	Compared to nearby sites, Baie de Morlaix is characterised by a more sheltered hydrodynamic regime and finer sediment.		

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
VIIe	France	pSCI FR5300017 Abers-Côte des légendes	N2000	p. 2002	Grey seal (S); harbour porpoise (S); bottlenose dolphin (s)	Management plan in preparation, but see also Parc Naturel Marin de l'Iroise	Maintain population and habitat of protected species	227 (94% marine), partly included in Parc Naturel Marin de l'Iroise	No data other than regular visits of grey seals or of bottlenose dolphin, common dolphin and harbour porpoise. Foraging habitat for some of the grey seals using Molène archipelago as a resting site as shown by telemetry.	ND	The site is made cliffs, shallower rocky shore, sandy beaches, deep estuaries forming rias (aber), reefs, sandy bottom, and uninhabited islets and coastal rocks, submitted to a very strong hydrodynamism due to tidal currents, waves and swell. The cold water plume of the Ushant tidal front extents its influence in the area.		
VIIe	France	pSCI FR5300018 Ouessant-Molène	N2000	p. 2002, but see also Iroise Marine Natural Park	Grey seal (P); bottlenose dolphin (P); harbour porpoise (S)	NA, but see also Parc Naturel Marin de l'Iroise	maintain population and habitat of protected species	772 (99% marine), included in Parc Naturel Marin de l'Iroise	Coastal resident groups of bottlenose dolphin fairly stable over last 20 years (c. 35-45 ind.); grey seal numbers currently at about 100 ind. increasing at a 7% yearly rate but local births limited to a few per year.	ND	Highly energetic coastal area at the western end of Brittany characterized by major tidal currents, with 2 inhabited islands, many uninhabited islets and rocks and an extended plateau covered with Laminaria spp. The high hydrodynamism is mostly driven by tidal current and is responsible for the establishment of a cold water plume in the summer that is delimited by the Ushant tidal front. Key human activities in the area include fisheries (including sea-weed extraction), tourism and in the vicinity military base and major shipping route.		

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
VIIe	France	pSCI FR5300019 Presqu'île de Crozon	N2000	p. 2002, but see also Iroise Marine Natural Park	grey seal (S)	Management plan in preparation, but see also Parc Naturel Marin de l'Iroise	Maintain population and habitat of protected species	44 (24% marine), included in Parc Naturel Marin de l'Iroise	No data other than occasional visits of grey, or of bottlenose dolphin, common dolphin and harbour porpoise. Foraging habitat for some of the grey seals using Molène archipelago as a resting site as shown by telemetry.	ND	The site is made high granitic cliffs, rocky reefs, gravel and sandy bottom, submitted to a very strong hydrodynamism due to tidal currents, waves and swell. The cold water plume the Ushant tidal front extents its influence in the area.		
VIIe	France	pSCI FR5302006Côtes de Crozon	N2000	p. 2008, but see also Iroise Marine Natural Park	Grey seal (S); bottlenose dolphin (S); harbour porpoise (S)	NA, but see also Parc Naturel Marin de l'Iroise	Maintain population and habitat of protected species	102, included in Parc Naturel Marin de l'Iroise	No data other than occasional visits of grey, or of bottlenose dolphin, common dolphin and harbour porpoise. Foraging habitat for some of the grey seals using Molène archipelago as a resting site as shown by telemetry.	ND	The site is made high granitic cliffs, rocky reefs, gravel and sandy bottom, submitted to a very strong hydrodynamism due to tidal currents, waves and swell. The cold water plume the Ushant tidal front extents its influence in the area.		

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
VIIe	France	pSCI FR5300020 Cap Sizun	N2000	p. 2002	Grey seal (S); bottlenose dolphin (S)	NA	Maintain population and habitat of protected species	28 (22% marine)	No data other than occasional visits of grey, or of bottlenose dolphin, common dolphin and harbour porpoise.	ND	The site is made high cliffs, rocky reefs, gravel and sandy bottom, submitted to a very strong hydrodynamism due to tidal currents, waves and swell on their W-SW side, more sheltered with finer sediment along the North side		
VIIe	France	pSCI FR5302007 Chaussée de Sein	N2000	p. 2008, but see also Iroise Marine Natural Park	Bottlenose dolphin (P); grey seal (S); harbour porpoise (S)	NA, but see also Parc Naturel Marin de l'Iroise	Maintain population and habitat of protected species	416 (99% marine), included in Parc Naturel Marin de l'Iroise	Resident group of 20-25 bottlenose dolphins very resident (fully photo-identified), around and west of Sein Island. Common dolphins abundant on the 50-80 m depth range, nearby. Harbour porpoise and long-finned pilot whale are visitors. Increasing number of grey seals haul-out in the area but no birth reported.	ND	Highly energetic coastal area at the western end of Brittany characterized by major tidal currents, with 1 inhabited islands, many rocks and an submarine reefs covered with Laminaria spp. Chaussée de Sein is made of a series of rocks and reefs extending westward from Sein Island. The high hydrodynamism is driven by tidal current and is responsible for the establishment of a cold water plume in the summer that is delimited by the Ushant tidal front. Key human activities include fisheries, gravel/sand extraction and tourism.	Liret 2001	

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
VIIIa	France	pSCI FR5302008 Roches de Penmarc'h	N2000	p. 2008	Bottlenose dolphin (S); common dolphin (S); harbour porpoise (S); grey seal (S)	NA	Maintain population and habitat of protected species	457	Common dolphins abundant on the 50-80 m depth range, nearby. Harbour porpoise, bottlenose dolphins and long-finned pilot whales are visitors. Haul-out site for a few grey seals.	ND	Mosaic of rocky and sandy substrates, some emerged rocks.		
VIIIa	France	pSCI FR5300023 Archipel des Glénan	N2000	p. 2002	Grey seal (S); bottlenose dolphin (S); common dolphin (S)	Management plan in preparation	Maintain population and habitat of protected species	587 (99% marine)	Common dolphins abundant on the 50-80 m depth range, nearby. Harbour porpoise, bottlenose dolphins and long-finned pilot whales are visitors.	ND	Mosaic of rocky and sandy substrates, some emerged rocks and an archipelago of small islands mostly frequented by tourists.		

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
VIIIa	France	pSCI FR5300031 Ile de Groix	N2000	p. 2002	Bottlenose dolphin (S)	Management plan in preparation	Maintain population and habitat of protected species	284 (97% marine)	Common dolphins abundant on the 50-80 m depth range, nearby. Harbour porpoise, bottlenose dolphins and long-finned pilot whales are visitors.	ND	Rocky island surrounded by a mosaic of sandy and rocky bottom. Area exposed to heavy swell and wave action and strong tidal current.		
VIIIa	France	pSCI FR5300029 Golfe du Morbihan, côte ouest de Rhuys	N2000	p. 2002	Bottlenose dolphin (S)	Management plan in preparation	Maintain population and habitat of protected species	206 (77% marine)	No data other than occasional visits of grey, or of bottlenose dolphin, common dolphin and harbour porpoise.	ND	Golfe du Morbihan is a semi-enclosed bay with extensive mud flats and numerous islands. The ocean side of this N2000 site is characterised by sandy bottom.		
VIIIa	France	pSCI FR5300032 Belle-Ile en Mer	N2000	p. 2002	Bottlenose dolphin (S)	NA	Maintain population and habitat of protected species	174 (76% marine)	Common dolphins abundant on the 50-80 m depth range, nearby. Harbour porpoise, bottlenose dolphins and long-finned pilot whales are visitors	ND	Rocky island surrounded by a mosaic of sandy and rocky bottom. Area exposed to heavy swell and wave action and strong tidal current		

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
VIIIa	France	pSCI FR5300033 Iles Houat-Hoëdic	N2000	p. 2002	Bottlenose dolphin (S)	NA	Maintain population and habitat of protected species	178 (97% marine)	Common dolphins abundant on the 50-80 m depth range, nearby. Harbour porpoise, bottlenose dolphins and long-finned pilot whales are visitors	ND	Shallow islands surrounded by a mosaic of sandy and rocky bottom. Area exposed to heavy swell and wave action and strong tidal current		
VIIIa	France	pSCI FR5202010 Plateau du Four	N2000	p. 2008	Bottlenose dolphin (S); harbour porpoise (S)	NA	Maintain population and habitat of protected species	42	No data other than occasional visits of bottlenose dolphin, common dolphin and harbour porpoise.	ND	Shallow rocky sea bed under the influence of the Loire and Vilaine estuaries. Development of wind farms envisaged in the vicinity.		
VIIIa	France	pSCI FR5202011 Estuaire de la Loire Nord	N2000	p. 2009	Bottlenose dolphin (S); harbour porpoise (S)	NA	Maintain population and habitat of protected species	190	No data other than occasional visits of bottlenose dolphin, common dolphin and harbour porpoise.	ND	Shallow rocky sea bed under the influence of the Loire estuary. Development of wind farms envisaged in the vicinity.		

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
VIIIa	France	pSCI FR5202012 Estuaire de la loire sud et baie de Bourgneuf	N2000	p. 2009	Bottlenose dolphin (S); harbour porpoise (S)	NA	Maintain population and habitat of protected species	494	No data other than occasional visits of bottlenose dolphin, common dolphin and harbour porpoise.	ND	Shallow rocky sea bed under the influence of the Loire estuary and extensive mud flats and sand banks.		
VIIIa	France	pSCI FR5202013 Plateau rocheux de l'île d'Yeu	N2000	P. 2008	Bottlenose dolphin (S)	NA	Maintain population and habitat of protected species	120	No data other than occasional visits of bottlenose dolphin, common dolphin and harbour porpoise.	ND	Shallow rocky sea bed.		

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
VIIIa, b	France	pSCI FR5400469 Pertuis Charentais	N2000	P. 1999	Bottlenose dolphin (S); long-finned pilot whale (S)	NA, but see also Parc Naturel Marin de l'Estuaire de la Gironde et des Pertuis Charentais	Maintain population and habitat of protected species	456	A resident group of up to 5 bottlenose dolphins used to be at this site in the 1980-90's, now gone. Pods of up to 100-150 long-finned pilot whales visit the area for brief visits in the summer, possibly in relation with calving; site fidelity established by photo-identification.	ND	Region of shallow water under the influence of the Gironde and Charente estuaries with extensive mud flats between the islands and the mainland, together with calcareous cliffs and sea bed. Key human activities are oyster and mussel farms, tourism (including sailing), shipping and fisheries. Site of international importance for migrating and wintering waterfowl.		
VIIIa	France	pSCI FR5402012 Plateau de Rochebonne	N2000	P. 2008	Bottlenose dolphin (S); common dolphin (P)	NA	Maintain population and habitat of protected species	97	Common dolphins abundant on the 50-80 m depth range, nearby. Harbour porpoise, bottlenose dolphins and long-finned pilot whales are visitors.	ND	Isolated granitic plateau submerged at -20 m below the surface, constituting the southern limit of sub-tidal benthic systems found in abundance around Brittany, further north.		

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
VIIIb	France	pSCI FR7200811 Panache de la Gironde et plateau rocheux de Cordouan (Système Pertuis-Gironde)	N2000	P. 2008		NA, but see also Parc Naturel Marin de l'Estuaire de la Gironde et des Pertuis Charentais	Maintain population and habitat of protected species	953	Common dolphins abundant on the 50-80 m depth range, nearby. Harbour porpoise, bottlenose dolphins and long-finned pilot whales are visitors.	ND	Region of shallow water under the influence of the Gironde estuary with extensive mud flats along both sides of the estuary and sandy beaches and sea bed on the ocean side of the islands. Key human activities are oyster and mussel farms, tourism (including sailing), shipping and fisheries.		
VIIIb	France	pSCI FR7200812 Portion du littoral sableux de la côte aquitaine	N2000	P. 2008	Bottlenose dolphin (S); common dolphin (S); harbour porpoise (S)	NA	Maintain population and habitat of protected species	507	Common dolphins abundant on the 50-80 m depth range, nearby. Harbour porpoise, bottlenose dolphins and long-finned pilot whales are visitors.	ND	Main coast line oriented north-south, forming a continuous sandy coastline from the Gironde estuary to the Basque country, over *c.* 300km. Bassin d'Arcachon is a semi enclosed tidal laguna. Key human activities are oyster farms, tourism (including sailing) and fisheries.		
VIIIb	France	pSCI FR7200679 Bassin d'Arcachon	N2000	P. 2003	Bottlenose dolphin (S)	NA, but see also Parc Naturel Marin du Bassin d'Arcachon	Maintain population and habitat of protected species	227 (93% marine)	Common dolphins abundant on the 50-80 m depth range, nearby. Harbour porpoise, bottlenose dolphins and long-finned pilot whales are visitors.	ND	Main coast line oriented north-south; forming a continuous sandy coastline from the Gironde estuary to the Basque country, over *c.* 300km. Bassin d'Arcachon is a semi enclosed tidal laguna. Key human activities are oyster farms, tourism (including sailing) and fisheries.		

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
VIIIb	France	pSCI FR7200813 Côte Basque Rocheuse et Extension au large	N2000	P. 2008	Bottlenose dolphin (S); common dolphin (S); harbour porpoise (S)	NA	Maintain population and habitat of protected species	78	Common dolphins abundant on the 50-80 m depth range, nearby. Harbour porpoise, bottlenose dolphins and long-finned pilot whales are visitors.	ND	Rocky coast submitted to heavy wave and swell action.		
22	Germany (Baltic Sea) EEZ	Fehmarnbelt (SCI DE-1332-301)	N2000	2008	Harbour porpoise; Harbour seal	developing management plan	Maintenance and restoration at favourable conservation status of the following Habitats Directive species and their natural habitats: Harbour porpoise (among other things under the ASCOBANS Recovery Plan for Harbour Porpoise in the Central Baltic) and Harbour seal.	280	Harbour porpoise: Pop=C (> 100); Harbour seal: foraging visitor (no current population statistics)		Harbour porpoise migrate across Fehmarn Belt on a regular basis, and very frequently for Baltic Sea standards. They are found both within the designated site area and in neighbouring waters around Fehmarn. The site appears to be important to the species, notably in resting periods. Calves have also been sighted. Harbour porpoise regularly recorded over course of year; 'Vulnerable' behaviour common in summer (e.g. resting)	www.habitatmare.de	http://natura2000.eea.europa.eu/#

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
	Germany (Baltic Sea) EEZ	Kadet Trench; (Baltic Sea, main shipping lane north-west of the Fischland-Darss peninsula) (SCI DE-1339-301)	N2000	2008	Harbour porpoise	Developing management plan	Maintenance and restoration at favourable conservation status of the harbour porpoise, a Habitats Directive Annex II species, and its natural habitats (among other things under the ASCOBANS Recovery Plan for Harbour Porpoise in the Central Baltic).	100	Harbour porpoise: Pop=C (> 10);		Harbour porpoise present throughout the survey period; The trench is presumably used as a migration corridor	www.habitatmare.de	http://natura2000.eea.europa.eu/#
	Germany (Baltic Sea) EEZ	Adler Ground (SCI DE-1251-301)	N2000	2007	Harbour porpoise; Grey seal	Developing management plan	Habitats Directive Annex II species recorded are harbour porpoise and grey seal, which are therefore included in the area's conservation objectives.	234	Harbour porpoise: Pop=C (> 10); Grey seal (recorded; no current population statistics)	??	These species migrate through the area and presumably use it as a foraging ground.	www.habitatmare.de	http://natura2000.eea.europa.eu/#

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
	Germany (Baltic Sea) EEZ	Western Rønne Bank (SCI DE-1249-301)	N2000	2007	Harbour porpoise;	Developing management plan	Maintenance and restoration at favourable conservation status of the harbour porpoise, a Habitats Directive Annex II species, and its natural habitats (among other things under the ASCOBANS Recovery Plan for Harbour Porpoise in the Central Baltic).	86	Harbour porpoise: Pop=C (11 - 50);		The harbour porpoise so far recorded in the protected area are presumably individuals from the severely endangered subpopulation of the eastern Baltic Sea using the area as a migration or living and foraging habitat. A mother-calf pair has also been sighted. As harbour porpoise are very rarely seen in this area of sea, the sightings made to date are particularly important. - Probably part of the severely endangered eastern harbour porpoise population (western range limit roughly marked by Darss Sill); Notable gathering first observed in May and July 2002; may be a seasonal or population ecology phenomenon; Very low density in all survey years (2003-2005)	www.habitatmare.de	http://natura2000.eea.europa.eu/#
	Germany (Baltic Sea) EEZ	Pommersche Bucht mit Oderbank (Sci DE-1652-301)	N2000	2007	Harbour porpoise	Developing management plan	Maintenance and restoration at favourable conservation status of the harbour porpoise, a Habitats Directive Annex II species, and its natural habitats (among other things under the ASCOBANS Recovery Plan for Harbour Porpoise in the Central Baltic).	1,101	Harbour porpoise: Pop=B (251 - 500) ;		As regards marine mammals, harbour porpoise have been recorded on the Odra Bank, in some cases with seasonal hot spot concentrations. They are presumably part of the eastern Baltic Sea subpopulation, which is down to an estimated 600 individuals and is classified as severely endangered.	www.habitatmare.de	http://natura2000.eea.europa.eu/#
	Germany Baltic Sea within 12nm	Küstenbereiche Flensburger Förde von Flensburg bis Geltinger Birk (SCI DE-1123-	N2000	no data	Harbour porpoise			110 (86.6 marine areas, sea inlets)	Harbour Porpoise: Pop=C (resident i V)			http://natura2000.eea.europa.eu/#	

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
		393)											
	Germany Baltic Sea within 12nm	Schlei incl. Schleimünde und vorgelagerter Flachgründe (SCI DE-1423-394)	N2000	no data	Harbour porpoise			87.5 (73.5 marine areas, sea inlets)	Harbour Porpoise: Pop=C (resident i V)			http://natura2000.eea.europa.eu/#	
	Germany Baltic Sea within 12nm	Südküste der Eckernförder Bucht und vorgelagerte Flachgründe (SCI DE-1526-391)	N2000	P. 2004	Harbour porpoise			82.4 (49.4 marine areas, sea inlets)	Harbour Porpoise: Pop=C (resident i V)			http://natura2000.eea.europa.eu/#	
	Germany Baltic Sea within 12nm	Küstenlandschaft Bottsand - Marzkamp u. vorgelagerte Flachgründe (SCI DE-1528-391)	N2000	P. 2004	Harbour porpoise			54.8 (52.6 marine areas, sea inlets)	Harbour Porpoise: Pop=C (resident i V)			http://natura2000.eea.europa.eu/#	
	Germany Baltic Sea within 12nm	Staberhuk (SCI DE-1533-301)	N2000	P. 2000	Harbour porpoise			16.6 (15.1 marine areas, sea inlets)	Harbour Porpoise: C (resident i V)				http://natura2000.eea.europa.eu/#
22	Germany Baltic Sea within 12nm	Meeresgebiet der östlichen Kieler Bucht (SCI DE-1631-392)	N2000	P. 2004	Harbour porpoise			618.3	Harbour Porpoise: Pop=C (resident i V)				http://natura2000.eea.europa.eu/#

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
	Germany Baltic Sea within 12nm	Küstenlandschaft vor Großenbrode und vorgelagerte Meeresbereiche (SCI DE-1632-392)	N2000	no data	Harbour porpoise			17.4 (16.2 marine areas, sea inlets)	Harbour Porpoise: Pop=C (resident i V)				http://natura2000.eea.europa.eu/#
	Germany Baltic Sea within 12nm	Sagas-Bank (SCI DE-1733-301)	N2000	2004	Harbour porpoise			32.4	Harbour Porpoise: Pop=C (resident i V)				http://natura2000.eea.europa.eu/#
	Germany Baltic Sea within 12nm	Küste Klützer Winkel und Ufer von Dassower See und Trave (SCI DE-2031-301)	N2000	no data	Harbour porpoise; Grey Seal; Harbour seal			35.5 (28.4 marine areas, sea inlets)	Harbour porpoise: Pop=D (resident i P); Grey Seal: Pop=C; Harbour seal: Pop=C				http://natura2000.eea.europa.eu/#
	Germany Baltic Sea within 12nm	Wismarer Bucht (SCI DE-1934-302)	N2000	no data	Harbour porpoise; Grey Seal; Harbour seal			238.3 (221.6 marine areas, sea inlets)	Harbour porpoise: Pop=D (resident i P); Grey Seal: Pop=C; Harbour seal: Pop=C				http://natura2000.eea.europa.eu/#
	Germany Baltic Sea within 12nm	Erweiterung Wismarer Bucht (SCI DE-1934-303)	N2000	no data	Harbour porpoise; Grey Seal; Harbour seal			35.2	Harbour porpoise: Pop=C (migratory stage i P); Grey Seal: Pop=C (migratory stage i P); Harbour seal: Pop=C (				http://natura2000.eea.europa.eu/#

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
									migratory stage i P)				
	Germany Baltic Sea within 12nm	Darßer Schwelle (SCI DE-1540-302)	N2000	no data	Harbour porpoise; Grey Seal; Harbour seal			384.2	Harbour porpoise: Pop=D (resident i P); Grey Seal: Pop=C (migratory stage i P); Harbour seal: Pop=C (migratory stage i P)				http://natura2000.eea.europa.eu/#
	Germany Baltic Sea within 12nm	Darß (SCI DE-1541-301)	N2000	no data	Harbour porpoise; Grey Seal; Harbour seal			42 (7.1 marine areas, sea inlets)	Harbour porpoise: Pop=C (resident i P); Grey Seal: Pop=C (migratory stage i V); Harbour seal: Pop=C (migratory stage i V)				http://natura2000.eea.europa.eu/#

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
	Germany Baltic Sea within 12nm	Recknitz-Ästuar und Halbinsel Zingst (SCi DE DE-1542-302)	N2000	no data	Harbour porpoise; Grey Seal; Harbour seal			278.9 (241.8 marine areas, sea inlets)	Harbour porpoise: Pop=C (resident i P); Grey Seal: Pop=B (resident i 1-5); Harbour seal: Pop=C (migratory stage i V)				http://natura2000.eea.europa.eu/#
	Germany Baltic Sea within 12nm	Plantagenetgrund (SCI DE-1343-301)	N2000	no data	Harbour porpoise; Grey Seal; Harbour seal			149.1	Harbour porpoise: C (resident i P); Grey Seal: C; Harbour seal: C				http://natura2000.eea.europa.eu/#
	Germany Baltic Sea within 12nm	Westrügensche Boddenlandschaft mit Hiddensee (SCI DE-1544-302)	N2000	no data	Harbour porpoise; Grey Seal; Harbour seal			232.8 (204.8 marine areas, sea inlets)	Harbour porpoise: Pop=C (resident i P); Grey Seal: Pop=C; Harbour Seal: Pop=C				http://natura2000.eea.europa.eu/#
	Germany Baltic Sea within 12nm	Steilküste und Blockgründe Wittow (SCI DE-1346-301)	N2000	no data	Harbour porpoise; Grey Seal			18.5 (16.28 marine areas, sea inlets)	Harbour porpoise: Pop = D (resident i P); Grey Seal: Pop = C (migratory stage i V);				http://natura2000.eea.europa.eu/#

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
	Germany Baltic Sea within 12nm	Greifswalder Boddenrandschwelle und Teile der Pommerschen Bucht (SCI DE-1749-302)	N2000	no data	Harbour porpoise; Grey Seal; Harbour seal			404	Harbour porpoise: Pop = C (migratory stage i P); Grey Seal: Pop = C (migratory stage i P); Harbour Seal: Pop = C (migratory stage i P)				http://natura2000.eea.europa.eu/#
IVb	Germany (North Sea) EEZ	Dogger Bank (SCI DE-1003-301)	N2000	2008	Harbour porpoise; Harbour seal	Developing management plan	Maintenance and restoration at favourable conservation status of the following Habitats Directive species and their natural habitats: Harbour porpoise and Harbour seal.	1,624	Harbour porpoise: Pop = B (resident i 501 – 1,000); Harbour Seal: Pop = C (migratory stage i P) - Foraging visitor, no current population statistics	Harbour porpoise B; Grey seal B; Harbour seal B	Harbour porpoise and Harbour seals have been sighted at Dogger Bank, although because of lacking data the latter can currently only be considered a visiting species. The harbour porpoise sighted in airborne censuses – some of them even with calves – may be part of the British subpopulation.	www.habitatmare.de	http://natura2000.eea.europa.eu/#

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
IVb	Germany (North Sea) EEZ	Sylt Outer Reef (SCI DE-1209-301)	N2000	2008	Harbour porpoise; Harbour seal; Grey Seal	Developing management plan	Maintenance and restoration at favourable conservation status of the following Habitats Directive species and their natural habitats: Harbour porpoise, grey seal and Harbour seal.	5,314	Harbour porpoise: Pop = A (resident i 1,001 – 10,000); Harbour Seal: Pop = A (resident i 1,001 – 10,000); Grey Seal: Pop = A (resident i 11 - 50)		The protected area is especially important for harbour porpoise. The densest concentrations of harbour porpoise in the entire German North Sea have been recorded here, making it a key site for conservation of the species. Regular sightings of mother-calf pairs and hot spots with up to 50 porpoise spotted in a ten-minute watching period show the site to be a major calving and mating habitat. The Sylt Outer Reef directly borders the harbour porpoise conservation area west of Sylt. This is so far the only cetacean conservation area in the North Sea. The high density of harbour porpoise also suggests large numbers of potential prey fish.	www.habitatmare.de	http://natura2000.eea.europa.eu/#
IVb	Germany (North Sea) EEZ										Harbour seal and grey seal also use the site as a feeding habitat or traverse it as they move between feeding sites and resting and reproduction sites. Grey seals currently only reproduce on the Knobsände off Amrum and Heligoland. Strong seasonal fluctuations in population suggest a large amount of movement between these locations and other resting sites and colonies around the North Sea, for example on the British coast. This makes conserving suitable migration corridors a key priority.		
IVb	Germany (North Sea) EEZ	Borkum Reef Ground (SCI DE-2104-301)	N2000	2008	Harbour porpoise; Harbour seal; Grey Seal	Developing management plan	Maintenance and restoration at favourable conservation status of the following Habitats Directive species and their natural habitats: Harbour porpoise, Harbour seal, grey seal	625	Harbour porpoise: Pop = C (resident i 51 - 100); Harbour seal: Pop = B (resident i 251 - 500); Grey Seal: Pop = C (i P - Recorded, no current population	Harbour porpoise=B; Grey seal B; Harbour seal B	Habitats Directive Annex II species found here are harbour porpoise, grey seals and Harbour seals. These are consequently included in the conservation objectives. Harbour porpoise are spotted with low average frequency but on an ongoing basis, sometimes with calves. They are thought to be part of the fairly small, endangered subpopulation of the southern North Sea whose distribution centre is off the Dutch coast. The Borkum Reef Ground serves the two seal species mainly as a feeding habitat, but partly also as a corridor for migration, for example to feeding sites and other resting sites.	www.habitatmare.de	http://natura2000.eea.europa.eu/#

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
									statistics)				
IVb	Germany (North Sea within 12nm)	Nationalpark Niedersächsisches Wattenmeer (SCI DE-2306-301	N2000	2004	Harbour porpoise; Harbour seal;			2,769.6 (941.7 marine areas, Sea inlets)	Harbour porpoise: Pop = B (resident i P); Harbour seal: Pop = A (resident i~4,300);	Harbour porpoise=B; Harbour seal= B			http://natura2000.eea.europa.eu/#
IVb	Germany (North Sea within 12nm)	Helgoland mit Helgoländer Felssockel (SCI DE-1813-391)	N2000	P. 2004	Harbour porpoise; Harbour seal; Grey Seal			55.1 (53.4 marine areas, Sea inlets)	Harbour porpoise: Pop = C (resident i 51-100); Harbour seal: Pop = C (resident C); Grey Seal: Pop = A (resident 11-50)	Harbour porpoise=A; Harbour seal=A; Grey seal=A			http://natura2000.eea.europa.eu/#
IVb	Germany (North Sea within 12nm)	Hamburgisches Wattenmeer (SCI DE-2016-301)	N2000	2008	Harbour porpoise; Harbour seal;			137.5 (132 marine areas, Sea inlets, Tidal	Harbour porpoise: Pop = C (resident i R); Harbour seal: Pop = B (resident i 501	Harbour porpoise=C; Harbour seal=A			http://natura2000.eea.europa.eu/#

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
								rivers and Estuaries)	– 1,000);				
IVb	Germany (North Sea within 12nm)	Unterelbe (SCI DE-2018-331)	N2000	P. 2005	Harbour porpoise; Harbour seal;			186.8 (155 Tidal rivers, Estuaries , Mud flats, Sand flats, Lagoons)	Harbour porpoise: Pop = C (resident 11-51); Harbour seal: Pop = C (resident i 51 - 100);				http://natura2000.eea.europa.eu/#
IVb	Germany (North Sea within 12nm)	Steingrund (SCI DE-1714-391)	N2000	2004	Harbour porpoise; Harbour seal; Grey Seal			174.5	Harbour porpoise: Pop = C (resident i 11 - 50); Harbour seal: Pop = C (resident i 11 - 50); Grey Seal: Pop = A(resident i 11-50)	Harbour porpoise=B; Harbour seal==A; Grey seal=A			http://natura2000.eea.europa.eu/#
IVb	Germany (North Sea within 12nm)	NTP S-H Wattenmeer und angrenzende Küstengebiete (SCI DE-0916-391)	N2000	2007	Harbour porpoise; Harbour seal; Grey Seal			4,524.6 (4,253.1 marine areas, Sea inlets, Tidal rivers and Estuaries)	Harbour porpoise: Pop = A (resident i ~1,000); Harbour seal: Pop = A (resident i >8.000); Grey Seal: Pop = A (resident i ~40)	Harbour porpoise=B; Harbour seal==B; Grey seal=B			http://natura2000.eea.europa.eu/#

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
IVb	Germany (North Sea within 12nm)	Unterems und Außenems (SCI DE-2507-331)	N2000	P. 2006	Harbour seal;			73.77 (67.1 Tidal rivers, Estuaries, Mud flats, Sand flats, Lagoons)	Harbour seal: Pop = C (resident i V)	Harbour seal=C			http://natura2000.eea.europa.eu/#
IVb	Germany (North Sea within 12nm)	Hund und Paapsand (SCI De-2507301)	N2000	2004	Harbour seal;			25.6	Harbour seal: Pop = C (resident i 101 - 250)	Harbour seal=B			http://natura2000.eea.europa.eu/#
	Germany (North Sea within 12nm)	Erweiterung Libben, Steilküste und Blockgründe Wittow und Arkona (SCI DE-1345301)	N2000	no data	Harbour seal; Grey Seal			75.8	Harbour seal: = C (migratory stage i P); Grey Seal = C (migratory stage i P)	Harbour seal=NS; Grey seal=NS			http://natura2000.eea.europa.eu/#
	Germany (North Sea within 12nm)	Nordrügensche Boddenlandschaft (SCI DE-1446302)	N2000	no data	Harbour seal;			111.4 (92.5 Marine areas, Sea inlets)	Harbour seal: Pop = C (migratory stage i V)	Harbour seal=A			http://natura2000.eea.europa.eu/#
	Germany (North Sea within 12nm)	Greifswalder Bodden, Teile des Strelasundes und Nordspitze Usedom (SCI DE-1747301)	N2000	no data	Harbour seal;			599.7 (563.7 Marine areas, Sea inlets)	Harbour seal: Pop = C (migratory stagei V); Grey Seal: Pop = C (migratory stage iV)	Harbour seal=B; Grey seal=B			http://natura2000.eea.europa.eu/#

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
	Germany (North Sea within 12nm)	Greifswalder Oie (SCI DE-1749301)	N2000	2004	Harbour seal; Grey Seal			2.2 (1.76 Marine areas, Sea inlets and Shingle, Sea cliffs, Islets)	Harbour seal: Pop = C (migratory stage i V); Grey Seal: Con = C (migratory stage i V)	Harbour seal=A; Grey seal=A			
Va2	Iceland	Faxaflói Bay, SW Iceland and North Icelandic waters	Established by the Ministry of Fisheries and Agriculture by a regulation issued in April 2009	2009	Minke whale (P); white beaked dolphin, harbour porpoise, humpback whale and blue whale (S)	Minke whales are protected from whaling operations in these areas	minke whale protection	NA	No special status	No special status	All whaling is prohibited in these areas that are designated for whale watching. Whale watching has expanded rapidly since the early 1990s. Although the areas are not large they provide protection from coastal minke whaling operations, as these areas use to be among the best hunting grounds.	Víkingsson, pers. comm., MRI, Reykavik, Iceland	
VIIa, VIIb, VIIg, VIIj2	Ireland	Irish whale and dolphin sanctuary	No new legislation enacted, declaration under existing Wildlife Act (1976) and Whale Fisheries Act (1937).	1991	24 cetacean species, 11 regularly seen	Minke whale, fin whale, humpback whale, bottlenose dolphin, striped dolphin, short-beaked common dolphin, Atlantic white-sided dolphin, Risso's dolphin, long-finned pilot whale, orca, harbour porpoise	Refuge or sanctuary from hunting	380,300	No special status	No special status		Hoyt 2005, Rogan and Berrow 1996, http://www.bfn.de/habitatmare/de/downloads/vortraege-yod/10-	

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
VIIj2	Ireland	cSAC Blasket Islands	N2000	2000	Harbour porpoise (P); grey seal (S)	All cetacean species in Irish waters are listed Annex IV, which require strict protection, but not the designation of protected sites. cSAC proposed under Annex 1 habitat criteria	Protected habitat for harbour porpoise ecological requirements	227	Harbour porpoise=C	Harbour porpoise=B	Blasket Islands is one of only two SAC designated for harbour porpoise	(Berrow *et al*. 2008, Anon. 2009, http://www.bfn.de/habitatmare/de/downloads/vortraege-yod/10-Simon_Berrow.pdf)	
VIIj2	Ireland	cSAC Roaringwater Bay	N2000	2000	Harbour porpoise	All cetacean species in Irish waters are listed Annex IV, which require strict protection, but not the designation of protected sites. cSAC proposed under Annex 1 habitat criteria	Protected habitat for harbour porpoise ecological requirements		Harbour porpoise=C; Grey seal=C	Harbour porpoise=B; Grey seal=A	Roaringwater Bay is one of only two SAC designated for harbour porpoise	(Berrow et al. 2009, Anon. 2009, http://www.bfn.de/habitatmare/de/downloads/vortraege-yod/10-Simon_Berrow.pdf)	
VIIj2	Ireland	cSAC lower River Shannon SC2165	N2000	2000	P: bottlenose dolphin, S: short-beaked common dolphin, harbour porpoise, minke whale, harbour seals	All cetacean species in Irish waters are listed Annex IV, which require strict protection, but not the designation of protected sites. cSAC proposed under Annex 1 habitat criteria	Prime area with an estuarine ecosystem which serves as a mating, breeding and feeding ground for resident population of bottlenose dolphins	641.8	Bottlenose dolphin=C	Bottlenose dolphin=B	The lower River Shannon is the only cSAC in Ireland designated for the bottlenose dolphin.	(Berrow et al. 1996; Ingram 2000; Berrow et al. 2009; Anon. 2009, http://www.bfn.de/habitatmare/de/downloads/vortraege-yod/10-Simon_Berrow.pdf)	

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
	Latvia	No designated areas for marine mammals						0			7 MPAs are designated in Latvia but Marine Mammals are not included in the protection and management	Source: Valdis Pilats, pers. comm., Gauja National Park	
	Lithuania	No information						0					
IVb	The Netherlands	Waddensea NL1000001	N2000		P: grey seal, harbour seal		Grey seal: conservation of size and quality of habitat in order to maintain population. Harbour seal: conservation of size and quality of habitat in order to increase the population	2592	Grey seal= A; harbour seal= A	Grey seal= A; harbour seal= A	feeding , resting and reproduction area		http://www.synbiosys.alterra.nl/natura2000/googlemapsgebied.aspx?id=n2k1&groep=2
IVb	The Netherlands	Dogger Bank NL2008001	N2000	P. 2008	P: harbour porpoise, grey seal, harbour seal	Definitive designation before 2012; management process not started	Conservation of size and quality of habitat in order to maintain the population	4715	Harbour porpoise= C; Grey seal= C; Harbour seal= C	Harbour porpoise= B; Grey seal= B; Harbour seal= B	Offshore. Harbour porpoise: unknown. Grey and harbour seal: feeding and resting area		
IVb	The Netherlands	Cleaver Bank NL2008002	N2000	P. 2008	P: harbour porpoise, grey seal, harbour seal	Definitive designation before 2012 management process not started	Conservation of size and quality of habitat in order to maintain the population	1235	Harbour porpoise=C; Grey seal=C; Harbour seal=C	Harbour porpoise= B; Grey seal= B; Harbour seal= B	Offshore, partly UK. Harbour porpoise: unknown. Grey and harbour seal: feeding and resting area		
Ivb/c	The Netherlands	Noordzeekustzone II NL2008004	N2000	2010	P: harbour porpoise, grey seal, harbour seal	Designation 2010; management process started	Conservation of size and quality of habitat in order to maintain the population	1500	Harbour porpoise=C; Grey seal= A; Harbour seal= B	Harbour porpoise= B; Grey seal= B; Harbour seal= B	Coastal zone. Harbour porpoise: unknown. Grey and harbour seal: feeding and resting area	Jak et al. 2010	http://www.synbiosys.alterra.nl/natura2000/googlemapsgebied.aspx?id=n2k7&groep=2

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
IVc	The Netherlands	Vlakte van de Raan NL2008003	N2000	2010	Harbour porpoise, grey seal, harbour seal	Designation 2010; management process not started	All species: conservation of size and quality of habitat in order to maintain population	190	Harbour porpoise=C; Grey seal=C Harbour seal=C	Harbour porpoise= B; Grey seal= B; Harbour seal= B	Coastal zone. Harbour porpoise: unknown. Grey and harbour seal: feeding and resting area		http://www.synbiosys.alterra.nl/natura2000/googlemapsgebied.aspx?id=n2k163&groep=9
Ivc	The Netherlands	Voordelta NL4000017	N2000	2008	Grey seal, harbour seal	Designation 2008, management operational	Grey seal: conservation of size and quality of habitat in order to maintain the population. Harbour seal: maintain size of habitat, improve quality of habitat and increase population	900	Grey seal B; harbour seal=C	NS	Coastal zone. Feeding and resting area.		http://www.synbiosys.alterra.nl/natura2000/googlemapsgebied.aspx?id=n2k113&groep=10
IVc	The Netherlands	Oosterschelde NL1000018	N2000	2009	S: harbour seal	Designation 2009; management process started	Harbour seal: maintain size of habitat, improve quality of habitat and increase local population (in order to get Delta population of 200 individuals)	365.8	Harbour seal=C	Harbour seal=C	Estuary. Feeding and resting area		http://www.synbiosys.alterra.nl/natura2000/googlemapsgebied.aspx?id=n2k118&groep=10
IVc	The Netherlands	Westerschelde NL9803061	N2000	2009	S: harbour seal	Designation 2009; management process started	Harbour seal: maintain size of habitat, improve quality of habitat and increase population (in order to get Delta population of 200 individuals)	428.4	Harbour seal=C	Harbour seal=C	Estuary		http://www.synbiosys.alterra.nl/natura2000/googlemapsgebied.aspx?id=n2k122&groep=10

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
Vb1b	Norway	Forlandet, Svalbard	National Park	1973	seals	Seals are 100% protected inside the area	Protection of Svalbard's ecology and outstanding wildlife populations.	4626.9				Source: Nilssen Kjell Tormod, pers. comm., Institute of Marine Research, Bergen, Norway.	
Vb1b	Norway	Svalbard Archipelago (Moffen Nature Reserve)	Nature Reserve	1983	P: Walrus	It is a no-go area from 15 May to 15 September, people cannot approach with 300m of the shoreline, and aircraft are prohibited from altitudes lower than 500m.	Provide a sanctuary for resting walrus and nesting birds.	8.8			The reserve is an important resting area for walrus. Walrus are recolonizing the island after three centuries of exploitation and animals exhibit strong site fidelity.	Source: Nilssen Kjell Tormod, pers. comm., Institute of Marine Research, Bergen, Norway.	
Vb1b	Norway	Søraust-Svalbard	Nature Reserve	1973	Walrus		Protection of Svalbard's ecology and outstanding wildlife populations.	21,825.90				Source: Nilssen Kjell Tormod, pers. comm., Institute of Marine Research, Bergen, Norway.	
Vb1b	Norway	Noraust-Svalbard	Nature Reserve	1973	Walrus		Protection of Svalbard's ecology and outstanding wildlife populations.	55,354.30				Source: Nilssen Kjell Tormod, pers. comm., Institute of Marine Research, Bergen, Norway.	

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
	Norway	Froan landskapsvernområde, Sør-Trøndelag County			Harbour seal, Grey seal	Harbour and grey seals are protected during breeding seasons, but hunt can be used in order to regulate population sizes, but has not been done yet		~400				Source: Nilssen Kjell Tormod, pers. comm., Institute of Marine Research, Bergen, Norway.	
	Norway	Aldgården (NT) nature reserve	Nature reserve		seals	Some level of protection for seals						Source: Nilssen Kjell Tormod, pers. comm., Institute of Marine Research, Bergen, Norway.	
	Norway	Kjørholmane (RO) nature reserve	Nature reserve		seals	Some level of protection for seals						Source: Nilssen Kjell Tormod, pers. comm., Institute of Marine Research, Bergen, Norway.	
	Norway	Bliksvær (NO) nature reserve	Nature reserve		seals	All seal species are protected within this area						Source: Nilssen Kjell Tormod, pers. comm., Institute of Marine Research, Bergen, Norway.	
	Poland	PLH220044 Ostoja w Ujœciu Wis³y	N2000	2008	Grey seal			8.835	Grey seal=A	Grey seal=A	Resident – P	http://natura2000.eea.europa.eu/# and Iwona Pawliczka, pers. comm., University of Gdansk	
	Poland	pSCI - PLH220072 Kaszubskie Klify	N2000	2009	Grey seal			2.276	Grey seal=C	Grey seal=B	Migratory stage P	http://natura2000.eea.europa.eu/# and Iwona Pawliczka, pers. comm., University of Gdansk	
	Poland	SCI - PLH220023 Ostoja S³owiñska	N2000	2007	Grey Seal, Harbour Porpoise			321.505	Harbour porpoise=B; Grey seal=C	Harbour porpoise=B; Grey seal=B	Both: Migratory stage – P	http://natura2000.eea.europa.eu/# and Iwona Pawliczka, pers. comm., University of Gdansk	

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
	Poland	SCI - PLH220032 Zatoka Pucka i Pó³wysep Helski	N2000	2007	Harbour porpoise, Grey seal			268.443	Harbour porpoise=A; Grey seal=B	Harbour porpoise=B; Grey seal=B	Both: Migratory stage P	http://natura2000.eea.europa.eu/# and Iwona Pawliczka, pers. comm., University of Gdansk	
	Poland	SCI - PLH280007 Zalew Wiœlany i Mierzeja Wiœlana	N2000	2007	Grey seal			408.626	Grey seal=C	Grey seal=B	Migratory stage P	http://natura2000.eea.europa.eu/# and Iwona Pawliczka, pers. comm., University of Gdansk	
	Poland	SCI - PLH320019 Wolin i Uznam	N2000	2007	grey seal, Harbour porpoise			307.92	Grey seal=C; Harbour porpoise=D	Grey seal=B	No data	http://natura2000.eea.europa.eu/# and Iwona Pawliczka, pers. comm., University of Gdansk	
	Poland	SCI - PLH990002 Ostoja na Zatoce Pomorskiej	N2000	2008	Harbour porpoise			2431.327	Harbour porpoise=B	Harbour porpoise=B	No data	http://natura2000.eea.europa.eu/# and Iwona Pawliczka, pers. comm., University of Gdansk	

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
Ixa	Portugal	Parque Natural do Litoral Norte (includes SCI PTCON0017)	National Network of Protected Areas; includes N2000 area within its boundaries	1987	bottlenose dolphin, harbour porpoise, short-beaked common dolphin, stripped dolphin; Risso's dolphin, long-finned pilot whales, and minke whales (S)	All marine mammals in Portugal are managed under the legal transposition of the EU Habitats Directive to the National legislation (DL 140/99); cetacean watching for recreational and commercial purposes is regulated by specific legislation (DL 9/2006); the Park is managed through the Institute for Nature Conservation and Biodiversity, a division of the Portuguese Ministry of Environment, Spatial Planning and Regional Development	To preserve biodiversity; recover habitats and promote sustainable activities: No specific goal for marine mammals	5.0 (approx. marine area0	There are no references to cetaceans either in the Park documentation or the SCI	NS			

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
Ixa	Portugal	Parque Natural da Arrábida (includes SCI PTCON10)	National Network of Protected Areas; includes N2000 area within its boundaries	1980	Bottlenose dolphin, harbour porpoise (P); short-beaked common dolphin, Risso's dolphin, long-finned pilot whales, and minke whales (S)	See Parque Natural Litoral Norte above	To preserve marine biodiversity; recover habitats and promote sustainable activities: No specific goal for marine mammals	52.7 (approx. marine area)	Annex II of Directive 92/43/EEC;	Harbour porpoise B; Bottlenose dolphin B	Goals are to preserve marine biodiversity; recover habitats and promote sustainable activities: No specific goal for marine mammals. Marine mammals are strictly protected, but no Action Plan is in place. The area is probably too small to be efficient in protecting any of the cetacean species that are known to occur there.	http://portal.icnb.pt/ICNPortal/vEN2007/	http://portal.icnb.pt/ICNPortal/vEN2007/
	Portugal	Reserva Natural do Estuário do Sado (includes SCI PTCON0034)	National Network of Protected Areas; includes N2000 area within its boundaries	1976	Bottlenose dolphin (P); harbour porpoise and common dolphin (S)	See Parque Natural Litoral Norte above	To preserve marine biodiversity; recover habitats and promote sustainable activities. The resident population of bottlenose dolphins is referred as one of the invaluable natural resources to be protected.	116 (approx. marine area)	Annex II of Directive 92/43/EEC; Bottlenose dolphin B	Bottlenose dolphin C	The park encompasses estuarine and terrestrial habitat and was established for habitat protection and spatial management. A resident population of bottlenose dolphins has its core distribution within the estuary. It is not likely that other cetacean species use the estuary frequently, although some species such as the harbour porpoise and the common dolphin may enter the area occasionally. The goals are to preserve marine biodiversity; recover habitats and promote sustainable activities. The resident population of bottlenose dolphins is referred as one of the invaluable natural resources to be protected. An Action Plan specific for bottlenose dolphin management was implemented in 2009.	http://portal.icnb.pt/ICNPortal/vEN2007/	http://portal.icnb.pt/ICNPortal/vEN2007/

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
	Portugal	Parque Natural do Sudoeste Alentejano e Costa Vicentina (includes SCI PTCON0012)	National Network of Protected Areas; includes N2000 area within its boundaries	1988	Harbour porpoise, short-beaked common dolphin, stripped dolphin, bottlenose dolphin, Risso's dolphin, long-finned pilot whale, minke whale (S)	See Parque Natural Litoral Norte above	To preserve biodiversity; recover habitats and promote sustainable activities: No specific goal for marine mammals	275 (approx. marine area)	There are no references to cetaceans either in the Park documentation or the SCI	NS		http://portal.icnb.pt/ICNPortal/vEN2007/	http://portal.icnb.pt/ICNPortal/vEN2007/
	Portugal	PTCON0056 Peniche-Santa Cruz	National Network of Protected Areas; includes N2000 area within its boundaries	1997	Harbour porpoise, short-beaked common dolphin, stripped dolphin, bottlenose dolphin, Risso's dolphin, long-finned pilot whale, minke whale (S)	See Parque Natural Litoral Norte above	To preserve marine biodiversity; recover habitats and promote sustainable activities: No specific goal for marine mammals	49 (approx. marine area)	The SCI does not mention cetaceans	NS		http://portal.icnb.pt/ICNPortal/vEN2007/	http://portal.icnb.pt/ICNPortal/vEN2007/
	Portugal	PTCON0008 Sintra-Cascais	N2000	1997	Harbour porpoise, short-beaked common dolphin, stripped dolphin, bottlenose dolphin, Risso's dolphin, long-finned pilot	See Parque Natural Litoral Norte above	To preserve marine biodiversity; recover habitats and promote sustainable activities: No specific goal for marine mammals	65 (approx. marine area)	The SCI does not mention cetaceans	NS		http://portal.icnb.pt/ICNPortal/vEN2007/	http://portal.icnb.pt/ICNPortal/vEN2007/

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
					whale, minke whale (S)								
Xa2	Portugal-Azores	Parque Natural da Ilha do Corvo – Corvo Island (includes PTCOR0001)	National Network of Protected Areas; includes N2000 area within its boundaries	2008	Bottlenose dolphin (P); see Overview for discussion on other species	All marine mammals in Portugal are managed under the legal transposition of the EU Habitats Directive to the National legislation (DL 140/99); cetacean watching for recreational and commercial purposes is regulated by specific legislation (DLR 10/2003A); the Park is managed through the Regional Secretariat for the Environment and the Sea	To preserve marine biodiversity; recover habitats and promote sustainable activities. No specific goal for marine mammals.	257.4 (marine area)	Annex II of Directive 92/43/EEC	NS	Several species of cetaceans occur in the archipelago and due to the absence of a continental shelf all can occur within the limits of any of the MPAs. The species that are known to occur with some degree of frequency in the Azores are: minke whale, blue whale, fin whale, sei whale, humpback whale, short-beaked common dolphin, short-finned pilot whale, long-finned pilot whale, Risso's dolphin, orca, false killer whale, stripped dolphin, Atlantic spotted dolphin, bottlenose dolphin, sperm whale, Northern bottlenose whale, Sowerby's beaked whale, Cuvier's beaked whale). Other species have been recorded but their occurrence pattern in the region is considered rare, incidental or unknown.	Prieto and Silva, pers. comm., University of the Azores // http://www.azores.gov.pt/Portal/pt/entidades/sram-dra/livres/pnicorvo.htm; http://www.eea.europa.eu/themes/biodiversity/interactive/natura2000gis/index_html	

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
Xa2	Portugal-Azores	Parque Natural da Ilha do Faial – Faial Island (includes PTFAI0004; PTFAI0005; PTFAI0007; PTFAI0008)	National Network of Protected Areas; includes N2000 area within its boundaries	2008	Bottlenose dolphin (P); see Overview for discussion on other species	See Covo Island, above	To preserve marine biodiversity; recover habitats and promote sustainable activities. No specific goal for marine mammals.	189.1 (marine area)	Annex II of Directive 92/43/EEC	NS	Several species of cetaceans occur in the archipelago and due to the absence of a continental shelf all can occur within the limits of any of the MPAs. The species that are known to occur with some degree of frequency in the Azores are: minke whale, blue whale, fin whale, sei whale, humpback whale, short-beaked common dolphin, short-finned pilot whale, long-finned pilot whale, Risso's dolphin, orca, false killer whale, stripped dolphin, Atlantic spotted dolphin, bottlenose dolphin, sperm whale, Northern bottlenose whale, Sowerby's beaked whale, Cuvier's beaked whale). Other species have been recorded but their occurrence pattern in the region is considered rare, incidental or unknown.	Prieto and Silva, pers. comm., University of the Azores // http://www.azores.gov.pt/Portal/pt/entidades/sram-dra/livres/PNIFAIAL.htm; http://www.eea.europa.eu/themes/biodiversity/interactive/natura2000gis/index_html	
Xa2	Portugal-Azores	Parque Natural da Ilha do Pico – Pico Island (includes PTPIC0010; PTPIC0012)	National Network of Protected Areas; includes N2000 area within its boundaries	2008	Bottlenose dolphin (P); see Overview for discussion on other species	See Covo Island, above	See Covo Island, above	74.4 (marine area)	Annex II of Directive 92/43/EEC	NS	See Corvo Island above	Prieto and Silva, pers. comm., University of the Azores // http://www.azores.gov.pt/Portal/pt/entidades/sram-dra/livres/pnicorvo.htm; http://www.eea.europa.eu/themes/biodiversity/interactive/natura2000gis/index_html	
Xa2	Portugal-Azores	Parque Natural da Ilha Graciosa – Graciosa Island (includes PTGRA0015)	National Network of Protected Areas; includes N2000 area within its boundaries	2008	Bottlenose dolphin (P); see Overview for discussion on other species	See Covo Island, above	See Covo Island, above	7.8 (marine area)	Annex II of Directive 92/43/EEC	NS	See Corvo Island above	Prieto and Silva, pers. comm., University of the Azores // http://www.azores.gov.pt/Portal/pt/entidades/sram-dra/livres/PNIGRA.htm;http://www.eea.europa.eu/themes/biodiversity/interactive/natura2000gis/index_html; http://www.eea.europa.eu/themes/biodiversity/interactive/natura2000gis/index_html	

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
Xa2	Portugal-Azores	Parque Natural da Ilha de São Miguel – São Miguel Island	National Network of Protected Areas; includes N2000 area within its boundaries	2008	Bottlenose dolphin (P); see Overview for discussion on other species	See Covo Island, above	See Covo Island, above	74.7 (marine area)	Annex II of Directive 92/43/EEC	NS	See Corvo Island above	Prieto and Silva, pers. comm., University of the Azores // http://www.azores.gov.pt/Portal/pt/entidades/sram-dra/livres/PNISMG.htm; http://www.eea.europa.eu/themes/biodiversity/interactive/natura2000gis/index_html	
Xa2	Portugal-Azores	Parque Natural da Ilha de Santa Maria – Santa Maria Island (includes PTSMA0022; PTSMA0023)	National Network of Protected Areas; includes N2000 area within its boundaries	2008	Bottlenose dolphin (P); see Overview for discussion on other species	See Covo Island, above	See Covo Island, above	571.9 (marine area)	Annex II of Directive 92/43/EEC	NS	See Corvo Island above	Prieto and Silva, pers. comm., University of the Azores // http://www.azores.gov.pt/Portal/pt/entidades/sram-dra/livres/PNISMA.htm; http://www.eea.europa.eu/themes/biodiversity/interactive/natura2000gis/index_html	
Xa2	Portugal-Azores	PTMIG0021 - Banco D. João de Castro	N2000	1997	Bottlenose dolphin (P); see Overview for discussion on other species	See Covo Island, above	See Covo Island, above	16.4 (exclusively marine)	Annex II of Directive 92/43/EEC	NS		http://www.eea.europa.eu/themes/biodiversity/interactive/natura2000gis/index_html	
NA	Portugal-Madeira										Only a relatively small part of the northernmost Madeira EEZ intersects with the ICES area and presently there are no MPAs in that area. Nevertheless, for national coherence, MPAs in the Madeira Autonomous Region are presented here.	http://www.ices.dk/aboutus/icesareas.asp	

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
NA	Portugal-Madeira	Rede de Áreas Marinhas Protegidas do Porto Santo – Porto Santo Island (includes PTPOR0001)	National Network of Protected Areas; includes N2000 area within its boundaries	2008	Mediterranean monk seal, bottlenose dolphin (P); see Overview for discussion on other cetacean species	All marine mammals are strictly protected in the Madeira Autonomous Region since 1986 through specific legislation (DLR 6/86/M); Marine mammals are managed under the legal transposition of the EU Habitats and Birds Directives to the National legislation (DL 140/99), adapted to Madeira through specific legislation (DLR 5/2006/M); in Madeira all protected areas are managed by the Natural Park of Madeira, a division of the Regional Secretariat for the Environment and Natural Resources	Implement the protection and monitoring of species with high conservation value. No specific goal for marine mammals	No data	Annex II of Directive 92/43/EEC	NS	Several species of cetaceans occur in the archipelago and due to the absence of a continental shelf all can occur within the limits of any of the MPAs. The cetacean species that are known to occur with some degree of frequency in the Madeira are: fin whale, Bryde's whale, short-beaked common dolphin, short-finned pilot whale, Risso's dolphin, orca, false killer whale, stripped dolphin, Atlantic spotted dolphin, bottlenose dolphin, sperm whale. Other species have been recorded but their occurrence pattern in the region is considered either rare or unknown.	http://www.pnm.pt/	

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
NA	Portugal-Madeira	Reserva Natural da Ponta de São Lourenço – Madeira Island (includes PTMAD0003)	National Network of Protected Areas; includes N2000 area within its boundaries	1982	Mediterranean monk seal (P); bottlenose dolphin (S)	See Porto Santo Island above	To preserve marine biodiversity; recover habitats and promote sustainable activities. No specific goal for marine mammals.	18.6	Annex II of Directive 92/43/EEC	NS	The site held the last known colony of monk seals in Madeira Island. Today the regular presence of monk seals in the waters of the MPA may be related to fish farming operations in the area. 15% of the MPA is land area.	Prieto and Silva, pers. comm., University of the Azores // http://www.pnm.pt/	
	Portugal-Madeira	*Reserva Natural do Sítio da Rocha do Navio* – Madeira Island (includes PTMAD0004)	National Network of Protected Areas; includes N2000 area within its boundaries	1997	Mediterranean monk seal, bottlenose dolphin (P); see Overview for discussion on other cetacean species	See Porto Santo Island above	Protect the marine and terrestrial habitats and species. Keep the sustainability of the marine resources. No specific goals for marine mammals.	18.2	Annex II of Directive 92/43/EEC	NS	Several species of cetaceans occur in the archipelago and due to the absence of a continental shelf all can occur within the limits of any of the MPAs. The cetacean species that are known to occur with some degree of frequency in the Madeira are: fin whale, Bryde's whale, short-beaked common dolphin, short-finned pilot whale, Risso's dolphin, orca, false killer whale, stripped dolphin, Atlantic spotted dolphin, bottlenose dolphin, sperm whale. Other species have been recorded but their occurrence pattern in the region is considered either rare or unknown.	http://www.pnm.pt/	
NA	Portugal-Madeira	Reserva Natural das Ilhas Desertas – Desertas Islands (includes PTDES0001)	National Network of Protected Areas; includes N2000 area within its boundaries	1990	Mediterranean monk seal; bottlenose dolphin (P); see Overview for discussion on other cetacean species	See Porto Santo Island above	Protect and improve the status of the colony of Mediterranean monk seals	96.7	Annex II of Directive 92/43/EEC	NS	See Porto Santo Island above for discussion on cetacean species present. The Desertas MPA hosts the only known remaining colony of monk seals in Portugal. The Protected Area was created in 1990. In 1978 the colony of the Desertas had an estimated 50 individuals but the population was declining chiefly due to by-catches in gillnets. In the 1980's the colony had declined to an estimated 6-8 individuals, leading to the creation of the Protected Area. In 1997 a rehabilitation centre was created in the Protected Area. Presently the colony size is estimated at 30 individuals. 15% of the MPA is land area.	http://www.pnm.pt/	

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
NA	Portugal-Madeira	Reserva Natural das Ilhas Selvagens – Selvagens Islands (includes PTSEL0001)	National Network of Protected Areas; includes N2000 area within its boundaries	1971	T. Truncatus (P); see Overview for discussion on other cetacean species	See Porto Santo Island above	Protect the marine and terrestrial habitats and species. Keep the sustainability of the marine resources. No specific goals for marine mammals.	no data	Annex II of Directive 92/43/EEC	NS	See Porto Santo Island above for discussion on cetacean species present.	http://www.pnm.pt/	
	Russia	No information											
IXa	Spain	Illas Cíes	N2000	1997	Bottlenose dolphin	SAC designated under Marine Habitats Directive and National law 42/2007	Maintain or restore the habitat at a favourable conservation status	5.4	Bottlenose dolphin=C	Bottlenose dolphin=B		Santiago Lens, pers. comm., IEO, Vigo, Spain	
VIIIc	Spain	Costa da Morte	N2000	1997	Bottlenose dolphin, harbour porpoise;	SAC designated under Marine Habitats Directive and National law 42/2007	Maintain or restore the habitat at a favourable conservation status	49.7	Bottlenose dolphin=B; Harbour porpoise=B	Bottlenose dolphin=A; Harbour porpoise=A		Santiago Lens, pers. comm., IEO, Vigo, Spain	
IXa	Spain	Complexo húmido de Corrubedo	N2000	1999	Bottlenose dolphin, harbour porpoise;	SAC designated under Marine Habitats Directive and National law 42/2007	Maintain or restore the habitat at a favourable conservation status	74.0	Bottlenose dolphin=C; Harbour porpoise=C	Bottlenose dolphin=A; Harbour porpoise=A		Santiago Lens, pers. comm., IEO, Vigo, Spain	
IXa	Spain	Complexo Ons - O Grove	N2000	2000	Bottlenose dolphin, harbour porpoise;	SAC designated under Marine Habitats Directive and National law 42/2007	Maintain or restore the habitat at a favourable conservation	53.8	Bottlenose dolphin=B; Harbour porpoise=B	Bottlenose dolphin=B; Harbour porpoise=B		Santiago Lens, pers. comm., IEO, Vigo, Spain	

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
							status						
IXa	Spain	Costa da Vela	N2000	1999	Bottlenose dolphin, harbour porpoise;	SAC designated under Marine Habitats Directive and National law 42/2007	Maintain or restore the habitat at a favourable conservation status	9.9	Bottlenose dolphin=C; Harbour porpoise=C	Bottlenose dolphin=B; Harbour porpoise=B		Santiago Lens, pers. comm., IEO, Vigo, Spain	
VIIIc	Spain	Penarronda-Barayo	N2000	2004	Bottlenose dolphin, harbour porpoise;	SAC designated under Marine Habitats Directive and National law 42/2007	Maintain or restore the habitat at a favourable conservation status	33.4	Bottlenose dolphin=C; Harbour porpoise=C	Bottlenose dolphin=B; Harbour porpoise=B		Santiago Lens, pers. comm., IEO, Vigo, Spain	
VIIIc	Spain	Cabo Busto-Luanco	N2000	2004	Bottlenose dolphin, harbour porpoise;	SAC designated under Marine Habitats Directive and National law 42/2007	Maintain or restore the habitat at a favourable conservation status	76.6	Bottlenose dolphin=C; Harbour porpoise=C	Bottlenose dolphin=B; Harbour porpoise=B		Santiago Lens, pers. comm., IEO, Vigo, Spain	
VIIIc	Spain	Ría de Ribadesella -Ría de Tinamayor	N2000	2004	Bottlenose dolphin	SAC designated under Marine Habitats Directive and National law 42/2007	Maintain or restore the habitat at a favourable conservation status	49.4	Bottlenose dolphin=C	Bottlenose dolphin=B		Santiago Lens, pers. comm., IEO, Vigo, Spain	
VIIIc	Spain	Yacimientos de Icnitas	N2000	2004	Bottlenose dolphin, harbour porpoise;	SAC designated under Marine Habitats Directive and National law 42/2007	Maintain or restore the habitat at a favourable conservation status	32.2	Bottlenose dolphin=C; Harbour porpoise=C	Bottlenose dolphin=B; Harbour porpoise=B		Santiago Lens, pers. comm., IEO, Vigo, Spain	

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
IXa	Spain	El Cachucho	N2000	2009	Bottlenose dolphin	SAC designated under Marine Habitats Directive and National law 42/2007	Maintain or restore the habitat at a favourable conservation status	2349.5				Santiago Lens, pers. comm., IEO, Vigo, Spain	
IXa	Spain	Estrecho	N2000	2003	Bottlenose dolphin, harbour porpoise;	SAC designated under Marine Habitats Directive and National law 42/2007	Maintain or restore the habitat at a favourable conservation status	93.9	Bottlenose dolphin=D; Harbour porpoise=D	NS		Santiago Lens, pers. comm., IEO, Vigo, Spain	
IXa	Spain	Punta de Trafalgar	N2000	1999	Bottlenose dolphin	SAC designated under Marine Habitats Directive and National law 42/2007	Maintain or restore the habitat at a favourable conservation status	5.5				Santiago Lens, pers. comm., IEO, Vigo, Spain	
	Sweden	SCI - SE0110088 Bullerö-Bytta	N2000	2005	Grey seal			143.145	Grey seal=C	Grey seal=B	Migratory stage 30	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0110092 Stora Nassa	N2000	2005	Grey seal			29.487	Grey seal=C	Grey seal=B	Migratory stage P	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0110096 Svenska Högarna	N2000	2005	Grey seal			26.671	Grey seal=C	Grey seal=B	Migratory stage P	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0110111 Huvudskär	N2000	2005	Grey seal			20.765	Grey seal=C	Grey seal=C	Resident V	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0110124 Svenska Björn	N2000	2005	Grey seal			39.802	Grey seal=A	Grey seal=A	Migratory stage 1300	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0220028 Hävringe-Källskären	N2000	2005	Grey seal			111.887	Grey seal=C	Grey seal=B	Breeding area - 250i	http://natura2000.eea.europa.eu/#	

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
	Sweden	SCI - SE0220129 Skärgårdsreservaten	N2000	2005	Grey seal			92.18	Grey seal=C	Grey seal=A	Resident P	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0230055 Sankt Anna och Gryts skärgårdar	N2000	2005	Harbour seal, grey seal			128.841	Grey sealB; Harbour seal=? Cons=B, HS: ?	Grey seal=B; Harbour seal=?	St Anna sälskyddsområde has been a national seal santuary since 1987	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0230090 Bråviken yttre	N2000	2005	Grey seal			87.526	Grey seal=C	Grey seal=A	Resident 1-5i	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0330109 Eckelsudde	N2000	2004	Harbour seal, Grey seal			4.248	Grey seal=C; Harbour seal=C	Grey seal=A; Harbour seal=A	GS: Breeding 9i, HS: Breeding 75i	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0330123 Värnanäs skärgård	N2000	2005	Harbour seal, Grey seal			15.519	Grey seal=C; Harbour seal=B	Grey seal=A; Harbour seal=A	GS: Breeding 10i, HS: Breeding 142i	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0330159 Örö Sankor	N2000	2005	Grey seal			10.767	Grey seal=C	Grey seal=A	Breeding 50-100i	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0330174 Sydöstra Ölands sjömarker	N2000	2005	Harbour seal, Grey seal			87.929	Grey seal=C; Harbour seal=C	Grey seal=B; Harbour seal=B	Resident P	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0330187 Jutskär	N2000	2005	Grey seal			3.546	Grey seal=C	Grey seal=B	Resident P	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0330189 Stora Grindö	N2000	2005	Grey seal			7.796	Harbour seal=C	Harbour seal=B	Resident P	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0330190 Städsholmen	N2000	2005	Grey seal			12.61	Grey seal=C	Grey seal=B	Resident P	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0340010 Näsrevet	N2000	2005	Grey seal			0.95	Harbour seal=C	Harbour seal=B	Resident ca 10	http://natura2000.eea.europa.eu/#	

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
	Sweden	SCI - SE0340097 Gotska Sandön-Salvorev	N2000	2005	Grey seal			604.947	Grey seal=C	Grey seal=B	Resident ca 50	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0410040 Utklippan	N2000	2004	Grey seal			1.176	Grey seal=C	Grey seal=A	Resident P	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0410113 Isaks kläpp	N2000	2005	Harbour seal			1.247	Harbour seal=C	Harbour seal=A	Resident 50	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0420002 Hallands Väderö	N2000	2004	Harbour seal			18.344	Harbour seal=B	Harbour seal=A	Resident 400, Migratory stage 400	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0430095 Falsterbohalvön	N2000	2004	Harbour seal, Grey seal			423.422	Grey seal=C; Harbour seal=C	Grey seal=C; Harbour seal=C	GS: Resident 60i, HS: Breeding 80i	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0510050 Balgö	N2000	2004	Harbour seal, Grey seal			21.433	Harbour seal=C; Grey seal=D	Harbour seal=A	Resident P	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0510058 Kungsbackafjorden	N2000	2004	Harbour seal			78.629	Harbour seal=C	Harbour seal=A	Resident P	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0510084 Nidingen	N2000	2004	Harbour seal			7.26	Harbour seal=C	Harbour seal=A	Breeding P	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0510186 (Stora Middelgrund och Röde bank)	N2000	2009	Harbour porpoise				Harbour porpoise=B	Harbour porpoise=A	Resident P	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0520001 (Vrångöskärgården)	N2000	2004	Harbour porpoise, harbour seal				Harbour seal=B; Harbour porpoise=C	Harbour seal=B; Harbour porpoise=A	HS: Resident R, HP: Resident 11-50	http://natura2000.eea.europa.eu/#	

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
	Sweden	SCI - SE0520036 Sälöfjorden	N2000	2004	Harbour seal			28.69	Harbour seal=C	Harbour seal=A	Resident C	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0520043 Nordre älvs estuarium	N2000	2004	Harbour seal			70.853	Harbour seal=C	Harbour seal=A	Breeding 100i	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0520057 Malmöfjord	N2000	2009	Harbour seal			6.992	Harbour seal=C	Harbour seal=A	Resident 101-250i	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0520058 Måseskär	N2000	2009	Harbour seal			17.976	Harbour seal=C	Harbour seal=A	Resident 251-500i	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0520170 (Kosterfjorden-Väderöfjorden)	N2000	2005	Harbour porpoise, harbour seal				Harbour porpoise=C; Harbour seal=C	Harbour porpoise=C; Harbour seal=A	HS: Resident C, HP: Resident P	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0520171 Gullmarsfjorden	N2000	2004	Harbour seal			113.889	Harbour seal=C	Harbour seal=A	Resident C	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0520176 Pater Noster-skärgården	N2000	2004	Harbour seal			24.158	Harbour seal=C	Harbour seal=B	Resident C	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0520188 Soteskär	N2000	2009	Harbour seal			2.994	Harbour seal=C	Harbour seal=A	Resident 51-100i	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0630069 Drakön-Tihällan	N2000	2005	Grey seal			15.608	Grey seal=B	Grey seal=B	Resident <500i	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0630166 Axmar-Gåsholma	N2000	2005	Grey seal			56.094	Grey seal=C	Grey seal=B	Resident P	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0630173 Gran	N2000	2005	Grey seal			4.738	Grey seal=C	Grey seal=A	Resident C	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0810002	N2000	2005	Grey seal			3.961	Grey seal=C	Grey seal=A	Migratory stage P	http://natura2000.eea.europa.e	

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
		Bonden										u/#	
	Sweden	SCI - SE0810010 Holmöarna	N2000	2005	Grey seal, Ringed seal			242.096	Grey seal=D; Ringed sealB	Ringed seal=A	Resident R	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0820003 Stenskär	N2000	2005	Grey seal			2.082	Grey seal=C	Grey seal=C	Migratory stage P	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0820004 Stor-Rebben	N2000	2005	Grey seal			27.165	Grey seal=C	Grey seal=C	Migratory stage P	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0820035 Rödkallen-SörÄspen	N2000	2005	Grey seal, Ringed seal			70.878	Grey seal=C; Ringed seal=B	Grey seal=C; Ringed seal=C	Migratory stage P	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0820049 Lappön	N2000	2005	Grey seal, Ringed seal			0.55	Grey seal=C; Ringed seal=C	Grey seal=C; Ringed seal=C	Migratory stage P	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0820108 Haparanda skärgård	N2000	2005	Grey seal, Ringed seal			74.305	Grey seal=C; Ringed seal=B	Grey seal=C; Ringed seal=C	Migratory stage P	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0820751 Marakallen	N2000	2009	Grey seal			59.84	Grey seal=C	Grey seal=B	Resident – P	http://natura2000.eea.europa.eu/#	
	Sweden	SCI - SE0340097 Biogenetic reserves Gotska Sandön	N2000	2005	Grey seal			604.95	Grey seal=C	Grey seal=B	Resident ca 50	http://natura2000.eea.europa.eu/#	

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
VIa	UK: Scotland	Ascrib, Islay and Dunvegan	N2000	P. 2001*	P: harbour seal, S: harbour porpoise	No management group/management scheme	To maintain the habitat of the qualifying species and avoid disturbance of the qualifying species	25.8	Harbour seal=B, harbour porpoise= D	Harbour seal= A	Designated as a key haul out site for harbour seal.		http://www.jncc.defra.gov.uk/page-5201
IVb	UK: England/Scotland	Berwickshire and North Northumberland Coast	N2000	P. 1996 , updated 2001*	P: grey seal	Management Plan (see literature cited)	To maintain the habitat of the qualifying species and avoid disturbance of the qualifying species	650.5	Grey seal=B	Grey seal=B	Site designated as a key pupping site for grey seals.	http://www.xbordercurrents.com/docs/schemewebversion.pdf	http://www.jncc.defra.gov.uk/page-5201
VIIf	UK: Wales	Cardigan Bay SAC	N2000	P. 1996, updated 2003*	P: bottlenose dolphin, grey seal, S: harbour porpoise; occasionally short-beaked common dolphin	Management Plan (see literature cited)	The overall objective for the site is to maintain the Cardigan Bay Bottlenose Dolphin population at Favourable Conservation Status, as defined in the Habitats Directive.	958.6	Harbour porpoise=D; Bottlenose dolphin=A; Grey seal=C	Bottlenose dolphin=B; Grey seal=B	Site designated for bottlenose dolphins. Grey seals also have a significant presence.	http://www.cardiganbaysac.org.uk/	http://www.jncc.defra.gov.uk/page-5201
	UK: Wales	Dee Estuary / Aber Dyfrdwy SAC	N2000	P. 2007, updates 2009*	S: grey seal	NA		158.1	Grey Seal = D		Site designated for habitat features.		http://www.jncc.defra.gov.uk/page-5201

* = requirement for management begins at date of submission to EC

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
IVa	UK: Scotland	Dornoch Firth and Morrich More	N2000	P. 1996, updated 2004*	P: harbour seal	No management group/management scheme	To maintain the habitat of the qualifying species and avoid disturbance of the qualifying species	87	Harbour seal=C	Harbour seal=B	Designated as a key haul out site for harbour seal.		http://www.jncc.defra.gov.uk/page-5201
VIa	UK: Scotland	Eileannan agus Sgeiran Lios mor	N2000	P. 2001*	P: harbour seal	No management group/management scheme	To maintain the habitat of the qualifying species and avoid disturbance of the qualifying species	11.4	Harbour seal=B	Harbour seal=B	Designated as a key haul out site for harbour seal.		http://www.jncc.defra.gov.uk/page-5201
VIIe	UK:England	Essex Estuaries	N2000	P. 1996, updated 2001*	S: harbour seal	NA		461.4	Harbour seal = D		Site designated for habitat features.		http://www.jncc.defra.gov.uk/page-5201
VIIe	UK: England	Fal and Helford	N2000	P. 1996, updated 2001*	S: Bottlenose dolphin, harbour porpoise, grey seal	NA		63.9	Bottlenose dolphin= D, harbour porpoise= D, grey seal= D		Site designated for habitat features.		http://www.jncc.defra.gov.uk/page-5201
IVa	UK: Scotland	Faray and Holm of Faray	N2000	P. 1998, updated 2000*	P: grey seal	No management group/management scheme	To maintain the habitat of the qualifying species and avoid disturbance of the qualifying species	7.85	Grey seal=B	Grey seal=A	Site designated as a key pupping site for grey seals.		http://www.jncc.defra.gov.uk/page-5201
VIa	UK: Scotland	Firth of Lorn	N2000	P. 1999, updated 20018	S: harbour porpoise	NA		209.8	Harbour porpoise= D		Site designated for habitat features.		http://www.jncc.defra.gov.uk/page-5201
IVb	UK:Scotland	Firth of Tay & Eden Estuary	N2000	P. 2002, updated 2003*	P: harbour seal, S: grey seal	No management group/management scheme	To maintain the habitat of the qualifying species and avoid disturbance of the	154.1	Harbour seal=B, grey seal= D	Harbour seal=B	Designated as a key haul out site for harbour seal.		http://www.jncc.defra.gov.uk/page-5201

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
							qualifying species						
	UK: England	Flamborough Head	N2000	P. 1996, updated 2003*	S: grey seal	NA		63.1	grey seal = D		Site designated for habitat features.		http://www.jncc.defra.gov.uk/page-5201
IVc	UK: England/offshore	Haisborough, Hammond and Winterton	N2000	P. 2010*	S: Harbour porpoise, Grey seal	NA		1467.6	Harbour porpoise= D; Grey seal= D	NA	Site designated for habitat features.		http://www.jncc.defra.gov.uk/page-5201
	UK: Wales	Holy Island coast/ Glannau Ynys Gybi	N2000	P. 1995, updated 2002*	S: grey seal	NA		4.6	Grey seal = D		Site designated for habitat features.		http://www.jncc.defra.gov.uk/page-5201
IVb/IVc	UK: England	Humber Estuary	N2000	P. 2007*	P: grey seal	Management scheme (see literature cited)		366.6	Grey seal = C	Grey seal = B	Site designated for habitat features. Grey seals have a significant presence.	http://www.humberems.co.uk/	http://www.jncc.defra.gov.uk/page-5201
IVc	UK: England/offshore	Inner Dowsing, Race Bank and North Ridge	N2000	P. 2010 *	S: Harbour porpoise, Grey seal	NA		845.1	Harbour porpoise= D; Grey seal= D		Site designated for habitat features.		http://www.jncc.defra.gov.uk/page-5201
IVb	UK: Scotland	Isle of May	N2000	P. 2001*	P: grey seal	No management group/management scheme	To maintain the habitat of the qualifying species and avoid disturbance of the qualifying species	3.6	Grey seal=B	Grey seal=B	Site designated as a key pupping site for grey seals.		http://www.jncc.defra.gov.uk/page-5201
VIIb	UK: England	Isles of Scilly Complex	N2000	P. 1996, updated 2001*	P: grey seal, D: bottlenose dolphin, harbour porpoise	There is a management group but no management scheme		268.5	grey seal= C, bottlenose dolphin= D, harbour porpoise = D	grey seal= A	Site designated for habitat features. Grey seals have a significant presence.		http://www.jncc.defra.gov.uk/page-5201

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
	UK: Wales	Limestone coast of south Wales	N2000	P. 1995, updated 2002*	S: grey seal	NA		15.9	grey seal = D		Site designated for habitat features.		http://www.jncc.defra.gov.uk/page-5201
	UK: Scotland	Loch Crenan	N2000	P. 2001*	S: harbour seal	NA		12.3	harbour seal = D		Site designated for habitat features.		http://www.jncc.defra.gov.uk/page-5201
VIa	UK: Scotland	Loch nam Madadh	N2000	P. 1996, updated 2001*	S: Harbour porpoise, Grey seal, Harbour seal	NA		23.2	Harbour porpoise= D, Grey seal= D, Harbour seal= D		Site designated for habitat features.		http://www.jncc.defra.gov.uk/page-5201
VIa	UK: Scotland	Lochs Diuch, Long and Alsh Reefs	N2000	P. 1999, updated 2000*	S: Harbour porpoise, Grey seal, Harbour seal	NA		23.8	Harbour porpoise= D, Grey seal= D, Harbour seal= D		Site designated for habitat features.		http://www.jncc.defra.gov.uk/page-5201
	UK: Scotland	Luce Bay and Sands	N2000	P. 1996, updated 2003*	s: grey seal	NA		487.6	grey seal = D		Site designated for habitat features.		http://www.jncc.defra.gov.uk/page-5201
VIIf	UK: England	Lundy	N2000	P. 1996, updated 2001*	P: grey seal, S: bottlenose dolphin, harbour porpoise	Management scheme		30.6	Grey seal=C, bottlenose dolphin= D, harbour porpoise= D	grey seal = B	Site designated for habitat features. Grey seals have a significant presence.		http://www.jncc.defra.gov.uk/page-5201
	UK:Wales	Menai Strait and Conwy Bay	N2000	P. 2001, updated 2004*	S: grey seal	NA		264.8	Grey seal = D		Site designated for habitat features.		http://www.jncc.defra.gov.uk/page-5201
VIa	UK: Scotland	Monach Islands	N2000	P. 1996, updated 2003*	P: grey seal, S: harbour porpoise	No management group/management scheme	To maintain the habitat of the qualifying species and avoid disturbance of the qualifying species	36.5	Grey seal=A, harbour porpoise= D	Grey seal=A	Site designated as a key pupping site for grey seals.		http://www.jncc.defra.gov.uk/page-5201

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
Iva	UK: Scotland	Moray Firth	N2000	P. 1996, updated 2009*	P: Bottlenose dolphins: harbour porpoise, grey seal, Harbour seal	Management scheme (see literature cited)	To maintain the habitat of the qualifying species and avoid disturbance of the qualifying species	1513.4	Bottlenose dolphin= A, harbour porpoise= D, grey seal= D, Harbour seal= D	Bottlenose dolphin= B	The boundaries of the SAC were intended to include the main Scottish populations' core range, based on research conducted in the 1980s and early 1990s. The resident bottlenose dolphin population changed distribution on a timescale similar to that of the implementation of the European Directive designed to protect it. There was little understanding of the underlying oceanographic, biological or anthropogenic factors affecting the distribution patterns of dolphins. Prey availability is the most likely cause of the change in distribution. The potential for long-term mobility of dolphins should be incorporated in management framework from the outset. Population of photo-identified animals in the inner Moray Firth declined throughout the 1990s.	Wilson *et al.* 2004, Hoyt 2005, http://www.morayfirth-partnership.org/assets/files/SAC%20REV%202/Rev2%20MF%20SAC%20MS&AP-final--first%20annual%20review%202010-amended%20online.pdfhttp://www.invernessharbour.co.uk/public/downloads/mfsacmgmtscheme.jsphttp://www.invernessharbour.co.uk/public/downloads/mfsacmgmtscheme.jsp	http://www.jncc.defra.gov.uk/page-5201
	UK: England	Morcambe Bay	N2000	P. 1996, updated 2003*	S: grey seal	NA		615.1	grey seal = D		Site designated for habitat features.		http://www.jncc.defra.gov.uk/page-5201
IVa	UK: Scotland	Mousa	N2000	P. 1996, updated 2001*	P: harbour seal, S: harbour porpoise	Management scheme	To maintain the habitat of the qualifying species and avoid disturbance of the qualifying species	5.3	Harbour seal=B, harbour porpoise= D	Harbour seal=B	Designated as a key haul out site for harbour seal.		http://www.jncc.defra.gov.uk/page-5201
VIIa	UK: Northern Ireland	Murlough	N2000	P. 1996, updated 2000*	P: harbour seal	No management group/management scheme	The objective is to encourage the effective management of activities which could cause disturbance, for example, through the provision of seal refuges, the adoption of good practice by different user	119	Harbour seal=B	Harbour seal=B	Designated as a key haul out site for harbour seal.		http://www.jncc.defra.gov.uk/page-5201

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
							groups, and through education.						
VIa	UK: Scotland	North Rona	N2000	P. 1996, updated 2001*	P: grey seal	No management group/management scheme	To maintain the habitat of the qualifying species and avoid disturbance of the qualifying species	6.3	Grey seal=B	Grey seal=B	Site designated as a key pupping site for grey seals.		http://www.jncc.defra.gov.uk/page-5201
VIb2/VIb1	UK: offshore	North West Rockall Bank	N2000	P. 2010*	S: Harbour porpoise	NA		4365.3	Harbour porpoise= D		Site designated for habitat features.		http://www.jncc.defra.gov.uk/page-5201
	UK: Scotland	North Usit Machair	N2000	P. 1996, updated 2003*	S: grey seal, S: harbour seal	NA		30.5	Grey seal = D; harbour seal = D		Site designated for habitat features.		http://www.jncc.defra.gov.uk/page-5201
IVa	UK: Scotland	Papa Stour	N2000	P. 1996, updated 2001*	S: Harbour porpoise	NA		20.8	Harbour porpoise= D		Site designated for habitat features.		http://www.jncc.defra.gov.uk/page-5201
VIIg/VIIf	UK: Wales	Pembrokeshire Marine	N2000	P. 1997, updated 2003*	P: grey seal, S: bottlenose dolphin, harbour porpoise	Management scheme (see literature cited)	To maintain the population and supporting habitat of the qualifying species	1380.7	Grey seal=B, harbour porpoise= D, bottlenose dolphin= D	Grey seal=A	Site designated for habitat features. Significant presence of grey seals.	http://www.pembrokeshiremarinesac.org.uk/english/manage/man_c.htm	http://www.jncc.defra.gov.uk/page-5201
VIIa	UK:Wales	Pen Llyn a'r Sarnau / Lleyn Peninsula and the Sarnau SAC	N2000	P. 1996, updated 2003*	P: bottlenose dolphin, grey seal, S: harbour porpoise	Management scheme (see literature cited)	To maintain the population and supporting habitat of the qualifying species	1460.2	Harbour porpoise=D; Bottlenose dolphin=C; Grey seal=C	Bottlenose dolphin=B; Grey seal=B	Site designated for habitat features. Significant presence of grey seals and bottlenose dolphins.	http://www.penllynarsarnau.co.uk/sac_publications.aspx	http://www.jncc.defra.gov.uk/page-5201
VIIe	UK: England	Plymouth Sound and Estuaries	N2000	P. 1996, updated 2001*	S: Bottlenose dolphin, harbour porpoise, grey	NA		64	Bottlenose dolphin= D, harbour porpoise=D,		Site designated for habitat features.		http://www.jncc.defra.gov.uk/page-5201

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
					seal				grey seal= D				
	UK: Northern Ireland	Rathlin Island	N2000	P. 1998, updated 2001 *	S: grey seal; S : harbour seal	NA		33.4	grey seal = D, harbour seal = D		Site designated for habitat features.		http://www.jncc.defra.gov.uk/page-5201
IVa	UK: Scotland	Sanday	N2000	P. 1999, updated 2001*	P: harbour seal, S: harbour porpoise	No management group/management scheme	To maintain the habitat of the qualifying species and avoid disturbance of the qualifying species	109.7	Harbour seal=B, harbour porpoise= D	Harbour seal=A	Designated as a key haul out site for harbour seal.		http://www.jncc.defra.gov.uk/page-5201
	UK: England	Solent Maritime	N2000	P. 1998, updated 2001*	S: harbour seal	NA		113.3	Harbour seal = D		Site designated for habitat features.		http://www.jncc.defra.gov.uk/page-5201
VIIa	UK: England/Scotland	Solway Firth	N2000	P. 1996, updated 2001*	S: Harbour porpoise	NA	To maintain the habitat of the qualifying species and avoid disturbance of the qualifying species	436.9	Harbour porpoise= D		Site designated for habitat features.		http://www.jncc.defra.gov.uk/page-5201
VIa	UK: Scotland	South-East Islay Skerries	N2000	P. 2001*	P: harbour seal	No management group/management scheme	To maintain the habitat of the qualifying species and avoid disturbance of the qualifying species	15	Harbour seal=C	Harbour seal = A	Designated as a key haul out site for harbour seal.		http://www.jncc.defra.gov.uk/page-5201
	UK: Scotland	South Uist Machair	N2000	P. year 1996, updated 2003*	S: grey seal	NA		34.3	grey seal = D		Site designated for habitat features.		http://www.jncc.defra.gov.uk/page-5201
VIa	UK: Scotland	Sound of Arisaig (Loch Ailot to	N2000	P. 1996, updated	S: Harbour porpoise, Grey	NA		45.6	Harbour porpoise= D,		Site designated for habitat features.		http://www.jncc.defra.gov.uk/pa

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
		Loch Ceann Traigh)		2002*	seal, Harbour seal				Grey seal= D, Harbour seal= D				ge-5201
VIa	UK: Scotland	St Kilda	N2000	P. 1996, updated 2003*	S: Bottlenose dolphin, Harbour porpoise, Grey seal	NA		254.7	Bottlenose dolphin= D, Harbour porpoise= D, Grey seal= D		Site designated for habitat features.		http://www.jncc.defra.gov.uk/page-5201
VIIa	UK: Northern Ireland	Strangford Lough	N2000	P. 1996, updated 2001*	P: harbour seal, S: grey seal	Management scheme (see literature cited)	To maintain the population of harbour seal in favourable condition, allowing for natural change.	154	Harbour seal=C, grey seal = D	Harbour seal = C	Site designated for habitat features.	http://www.doeni.gov.uk/niea/txt/strangfordloughpubinfobooklet_web.pdf	http://www.jncc.defra.gov.uk/page-5201
IVa	UK: Scotland	Sullom Voe	N2000	P. 2001*	S: Harbour porpoise	NA		27	Harbour porpoise= D		Site designated for habitat features.		http://www.jncc.defra.gov.uk/page-5201
VIa	UK: Scotland	Sunart	N2000	P. 1996, updated 2003*	S: Grey seal, harbour seal	NA		102.5	Grey seal= D, harbour seal= D		Site designated for habitat features.		http://www.jncc.defra.gov.uk/page-5201
IVc	UK: England	The Wash and North Norfolk Coast	N2000	P. 1996, updated 2001 *	P: harbour seal, S: grey seal	Management scheme (see literature cited)	Subject to natural change, maintain in favourable condition the habitats of Common seals, in particular: Intertidal mudflats and sand flats	1077.6	Harbour seal=B, grey seal = D	Harbour seal=B	Designated as a key haul out site for harbour seal.	http://www.esfjc.co.uk/ems/downloads/PDF/col-management-scheme.pdf	http://www.jncc.defra.gov.uk/page-5201

ICES Region	Country	MPA	Type	Year (P. = proposed)	Species (Primary (P), Secondary (S))	Management process	Conservation objectives	Size km2	Species status population	Species status conservation	Overview - specific points (e.g., breeding, resting area etc.)	Literature cited	(interactive) map
VIa	UK: Scotland	Treshnish Isles	N2000	P. 2001*	P: grey seal, S: harbour porpoise	NA	To maintain the habitat of the qualifying species and avoid disturbance of the qualifying species	19.6	Grey seal=B, harbour porpoise= D	Grey seal=A	Site designated as a key pupping site for grey seals.		http://www.jncc.defra.gov.uk/page-5201
Vb1b/VIa	UK: offshore	Wyville Thomson Ridge	N2000	P. 2010*	S: Bottlenose dolphin	NA		1740	Bottlenose dolphin= D		Site designated for habitat features.		http://www.jncc.defra.gov.uk/page-5201
IVa	UK: Scotland	Yell Sound Coast	N2000	P. 1998, updated 2000*	P: Harbour seal	No management group/management scheme	To maintain the habitat of the qualifying species and avoid disturbance of the qualifying species	15.4	Harbour seal=C. Assessed as favourable in 2006.	Harbour seal=B	Designated as a key haul out site for harbour seal.		http://www.jncc.defra.gov.uk/page-5201

References

Berrow SD, Holmes B, Kiely OR. 1996. Distribution and abundance of Bottle-nose dolphins *Tursiops truncatus* (*montagu*) in the Shannon estuary. Proceedings of the Royal Irish Academy, 96B 1: 1–9.

Berrow S, O'Brien J, O'Connor I, McGrath D. 2009. Abundance estimate and acoustic monitoring of harbour porpoises (*Phocoena phocoena*(L.)) in the Blasket Islands' candidate Special Area of Conservation. Biology and Environment: Proceedings of the Royal Irish Academy 109B, 35–46.

Degraer S, Braeckman U, Haelters J, Hostens K, Jacques T, Kerckhof F, Merckx B, Rabaut M, Stienen E, Van Hoey G, Van Lancker V, Vincx M. 2009. Studie betreffende het opstellen van een lijst met potentiële Habitatrichtlijn gebieden in het Belgische deel van de Noordzee. Eindrapport in opdracht van de Federale Overheidsdienst Volksgezondheid, Veiligheid van de Voedselketen en Leefmilieu, Directoraat-generaal Leefmilieu. Brussel, België.

Härkönen T, Brasseur S, Teilmann J, Vincent C, Dietz R, Abt K, Reijnders P. 2007. Status of grey seals along mainland Europe from the Southwestern Baltic to France. In : Grey seals in the North Atlantic and the Baltic (eds. T. Haug, M. Hammill and D. Olafsdottir). NAMMCO Scientific Publications 6: 57–68

Hassani S, Dupuis L, Elder J-F, Caillot E, Gautier G, Hemon A, Lair J-M, Haelters J. in press. Common seals (*Phoca vitulina*) in France and Belgium. NAMMCO Special Publication.

Hoyt E. 2005. Marine protected areas for whales, dolphins, and porpoises: a world handbook for cetacean habitat conservation. Cromwell Press Ltd, Trowbridge, UK.499 pp.

Ingram SN. 2000. The ecology and conservation of bottlenose dolphins in the Shannon Estuary, Ireland [PhD.]: University College Cork. Ireland.

Jak RG, Tamis JE. 2010. Natura 2000-doelen in de Noordzeekustzone. Van doelen naar opgaven voor natuurbescherming. IMARES Rapport 164/10.

Liret C. 2001. Domaine vital, utilisation de l'espace et des ressources : les grands dauphins, Tursiops truncatus, de l'île de Sein. Thèse de doctorat de l'Université de Bretagne Occidentale, Brest.155 p.

Liret C, Baines M, Evans P, Gourmelon F, Le Berre, I, Hammond P, Wilson, B. 2006.*Tursiops* : European network of bottlenose dolphin study, framework of INTERREG IIC, programme « Atlantic area », 61p.

Reeves RR. 2000. The Value of Sanctuaries, Parks, and Reserves (Protected Areas) as Tools for Conserving Marine Mammals. Hudson (Canada): Okapi Wildlife Associates (18 November 2003; *www.mmc.gov/reports/contract/pdf/mpareport.pdf).*

Rogan E, Berrow SD. 1996. Review of harbor porpoises *Phocoena phocoena* L. in Irish waters. Report of the International Whaling Commission 46:595–605.

Vincent C, Fedak MA, McConnell BJ, Meynier L, Saint-Jean C, Ridoux V. 2005. Status and conservation of the grey seal, *Halichoerus grypus*, in France. Biological Conservation 126(1): 62–73.

Vincent C, McConnell BJ, Delayat S, Elder J-F, Gautier G, Ridoux V. in press. Winter habitat use of harbour seals fitted with fastlocTM GPS/GSM tags in two tidal bays in France. NAMMCO Special Publication.

http://ec.europa.eu/environment/nature/natura2000/db_gis/index_en.htm

http://natura2000.ecologie.gouv.fr/

http://airesmarines.org/

Annex 3: List of participants

Name	Address	Phone/Fax	E-mail
Stefan Bräger	Deutsches Meeresmuseum Katharinenberg 14/20 D-18439 Stralsund Germany	Phone +49 3831 2650 303 Fax +49 3831 2650 209	stefan.braeger@meeresmuseum.de stefan.braeger@gmx.net
Ian M. Davies Invited Expert By correspondence	Marine Scotland FRS Marine Laboratory Aberdeen PO Box 101 AB11 9DB Aberdeen United Kingdom	Phone +44 1224 876544 Fax +44 1224 295511	I.M.davies@marlab.ac.uk
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
Anita Gilles Invited Expert	Research and Technology Centre Hafentörn 1 D-25761 Büsum Germany	Phone +49 4834-604105 Fax +49 4834-604199	gilles@ftz-west.uni-kiel.de
Kai-Uwe Graw Invited Expert	Dresden Technical University Dresden Germany		Kai-uwe.graw@tu-dresden.de
Ilka Hasselmeier	Christian-Albrechts-Universität zu Kiel Research and Technology Centre Hafentörn 1 D-25761 Büsum Germany	Phone +49 4834 604 103 Fax +49 4834 604 199	ih@ftz-west.uni-kiel.de

Name	Address	Phone/Fax	E-mail
Gordon Hastie By correspondence	SMRU Limited, Scottish Oceans Institute, New Technology Centre, North Haugh St Andrews KY16 9SR United Kingdom	Phone: +44 (0)1334 479100 Fax: +44 (0)1334 477878	gdh@smru.co.uk
George Lees Invited Expert By correspondence	Coastal and Marine Ecosystems Unit Scottish Natural Heritage Battleby 2 Perth PH1 3EW United Kingdom	Phone +44 1786 458621	George.lees@snh.gov.uk
Alexander Liebschner	Federal Agency for Nature Conservation Federal Agency for Nature Conservation, Insel Vilm D-18581 Putbus Germany	Phone +49 Fax +49	alexander.liebschner@bfn-vilm.de
Sónia Mendes By correspondence	Joint Nature Conservation Committee Inverdee House Baxter Street AB11 9QA Aberdeen Scotland United Kingdom	Phone: +44 (0)1224 266 558 Fax: +44 (0)1224 896 170	sonia.mendes@jncc.gov.uk
Sinéad Murphy Chair	Sea Mammal Research Unit, Scottish Oceans Institute, University of St Andrews East Sands KY16 8LB St Andrews Fife, Scotland United Kingdom	Phone +44 (0) 1334 463472 Fax +44 1334 463443	snm4@st-andrews.ac.uk
Graham Pierce	Oceanlab, Newburgh, Aberdeenshire AB41 6AA United Kingdom	Phone +44 1224 272459	g.j.pierce@abdn.ac.uk

Name	Address	Phone/Fax	E-mail
Eunice Pinn	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 Invited Expert	University of La Rochelle 23 avenue Albert Einstein 17071 La Rochelle Cedex 9 France	Phone +33546449910 Fax +33546449945	vincent.ridoux@univ-lr.fr
Signe Sveegaard	National Environmental Research Institute Aarhus University Frederiksborgvej 399 4000 Roskilde Denmark	Phone +45 46301961	sign@dmu.dk
David Thompson By correspondence	Sea Mammal Research Unit, Scottish Oceans Institute, University of St Andrews East Sands KY16 8LB St Andrews Fife, Scotland United Kingdom	Phone +44 (0) 1334 463472 Fax +44 1334 463443	dt2@st-andrews.ac.uk
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

Name	Address	Phone/Fax	E-mail
Stefanie Werner	Federal Environment Agency Woerlitzer Platz 1 06844 Dessau-Rosslau Germany	Phone +49 340-2103-2221 Fax +49 340-2104-2221	stefanie.werner@uba.de
Ben Wilson Invited Expert	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 4: Agenda

Monday, 21st February 2011

09:30 Meeting room open, set up of Internet connections

10:30 Coffee break

11:00 Plenary session, adoption of agenda

12:00 Forming of subgroups, setting up of work plan

13.30 Lunch break

14.30 Work in subgroups

15:00 Presentation by Ben Wilson on tidal turbines

15.45 Work in subgroups

16.30 Coffee break

16.45 Work in subgroups

19:00 Dinner (optional) place to be announced

Tuesday, 22nd February 2011

09:00 Plenary session, update from leads of ToRs

11:00 Coffee break

11:30 Presentation by Signe Sveegaard on (1) Harbour porpoise distribution and its correlation with prey in high density areas, and (2) MPAs in Danish waters

12.00 Work in subgroups

13.00 Lunch break

14.00 Work in subgroups

16:00 Conference call for ToR B subgroup (tidal turbine ToR) 3pm UK time

16.30 Coffee break

19:30 WGMME dinner (optional); Restaurant "Die Zwölf Apostel"

Wednesday, 23rd February 2011

10:00 Plenary session; review of material from ToRs (Meeting room booked by another group from 9–10)

11:30 Coffee break Presentation by Signe Sveegaard on defining boundaries between the three harbour porpoise populations inhabiting 1) the North Sea/Skagerrak, 2) Kattegat, Belt Sea, the Sound and the Western Baltic and 3) the inner Baltic Sea

11:45 Coffee break

12.00 Work in subgroups

13.00 Lunch break

14.30 Work in subgroups

16.30 Coffee break

16.45 Plenary session; review print outs of available first drafts

19:00 Dinner (optional) place to be announced

Thursday, 24th February 2011

10:00 Plenary session; review of material from ToRs (Meeting room booked by another group from 9–10)

11:30 Coffee break

12:00 Work in subgroups; finalizing reports

12.30 Plenary session; review of material from ToRs

13.30 Lunch break

14.30 Plenary session; review of material from ToRs

16.30 Coffee break

16.45 Plenary session; review material from all ToRs

19:00 Dinner (optional) place to be announced

Annex 5: WGMME Terms of Reference for the next meeting

The **Working Group on Marine Mammal Ecology** [WGMME] (Chair: Eunice Pinn, UK) will meet at ICES headquarters in Copenhagen, Denmark from xx month to xx month 2012 to:

a. Review and report on any new information on population sizes, population/stock structure and management frameworks for marine mammals;

b. Develop biodiversity indicators in support of policy drivers, and develop indicators that are robust to expected uncertainties in data and/or to provide a quantitative analysis of the potential effects of data limitations on indicator performance;

c. Outline and review the effects of wave energy devices on marine mammals and provide recommendations on research needs, monitoring and mitigation schemes;

d. Update on development of database for seals, status of intersessional work.

WGMME will report to the attention of the Advisory Committee (ACOM) by XX month 2012.

Supporting information

Priority:	**High, as only group that can support requirements in ToR a.**
Scientific justification and relation to action plan:	a) This work is required under MoU between the European Commission and ICES; to review the status of small cetaceans in European waters b) Fulfills a recommendation for action from WKMARBIO c) This is completion of the revew of the effects of renewable energy on marine mammals within the ICES Area. It addresses 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 d) This will facilitate future work of the WG
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:	

Annex 6: Recommendations

Recommendation	For follow up by:
1. The WGMME strongly recommend that an international survey be undertaken, funded by the Governments of Denmark, Sweden and Germany, to determine the abundance of harbour porpoises in the Belt Sea region.	ACOM, SCICOM
2. The WGMME recommends that data on cetacean presence and occurrence should be incorporated at a very early stage of marine spatial planning. Due to the wide ranging nature of cetaceans, the relevance of 'important areas' outside MPAs should be assessed. It is also very important to include any information on seasonal changes in distribution.	ACOM, SCICOM
3. The WGMME recommends that the boundaries of MPAs should only be decided on the basis of a significant long-term dataseries (of at least 5 years).	ACOM, SCICOM
4. For marine mammal species that spend the majority of the life outside the MPA, consideration needs to be given to whether protection of a limited part of the population's range, or focus on a site-based protection of a particular life stage, is worthwhile. The key to species protection and recovery is eliminating the threats that have led, could lead, or continue to lead, to the decline of the species. It is therefore recommended that the appropriateness of MPAs as a mechanism to controlling or eliminating threats is given significant consideration prior to site designation.	ACOM, SCICOM
5. The WGMME recommends the development of an appropriate precautionary management framework for wet renewables (including tidal-stream technologies).	ACOM
6. WGMME recommends that independent research be carried out into the nature of close-range interactions between marine mammals and tidal devices and the potential population consequences of these.	SCICOM
7. The WGMME recommends that our understanding of ambient underwater noise in tidal-sites is improved and that the noise associated with construction and maintenance of tidal devices be assessed so that impacts on marine mammals can be minimized.	SCICOM
8. To understand the perception range available to marine mammals in the vicinity of operating tidal turbines, WGMME recommends that the sound output of operating devices is quantified along with the surrounding ambient underwater sound of the sites.	SCICOM
9. The WGMME recommends that current methods used to quantify marine mammal distribution, activity and abundance are adapted or improved so that they can be appropriately applied to studies in and around fast moving water.	SCICOM
10. ICES WGMME recommends that appropriate metrics be developed to regulate any population level deleterious effects of marine renewable developments. To achieve this, target population size should be explicitly chosen and all appropriate data should be used to assess allowable impacts.	ACOM
11. The WGMME recommends that additional coordinated monitoring is carried out at scales greater than the footprints of a demonstrator or commercial-scale arrays to determine population scale changes in distribution and abundance.	ACOM
12. 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.	ACOM
13. WGMME recommends a strategic approach to identify sites of low marine mammal risk for early stage deployments before consenting to tidal device or array developments in more sensitive sites.	ACOM

Recommendation	For follow up by:
14. In recognition that animal-tidal turbine interactions are likely to be both species and device (or device-type) specific, WGMME recommends that extreme care be taken when extrapolating environmental impacts between species and device types.	ACOM
15. WGMME recommends that extreme care is taken when scaling-up environmental lessons learned from studies of single tidal turbine devices up to arrays as the nature of any impact relationships (linear or otherwise) between one and many devices is currently unknown. In light of this, a stepwise approach should be taken for array development.	ACOM
16. WGMME recommends that the sensitivity of marine mammals to environmental perturbations from electromagnetic fields, possibly generated by cables, should be investigated and the potential displacement implications considered.	SCICOM