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

February 2–6 2009

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Executive summary

The Working Group on Marine Mammal Ecology (WGMME) met at the Instituto Español de Oceanografía in Vigo, Spain, from 2 February to 6 February 2009. Sinéad Murphy chaired the meeting of 17 participants, representing nine countries.

Seven different ToRs were assessed, covering a wide range of conservation issues, including: reviewing various aspects of OSPAR's EcoQOs for seals, management procedures for estimating bycatch limits for small cetaceans, assessing population and stock structure in small cetaceans, suggesting recommendations for improvements in the procedure for reporting on Favourable Conservation status (FCS) under the EU Habitats Directive, and developing a framework for monitoring and surveillance of European marine mammal populations.

The WG discussed extensively the development of OSPAR's EcoQOs for seals. Although the group acknowledged the necessity for such a measure, in light of a lack of recent genetic data questions still arose regarding to the subunit boundaries, especially as a consequence of recent seal telemetry studies. The EcoQOs subunits were created and selected in the first place according to survey effort, comparability of data, geographical separation and reliability of interpreting observed trends. On the whole, these are still the main criteria for selecting subunits of harbour and grey seals. Although a recent genetic study suggested a division of the harbour seal Kattegat, Skagerrak and Oslofjord subunit.

Furthermore it was noted by the WGMME that, although the EcoQO for harbour seals was triggered in a number of subunits in 2006, the WG is unaware of actions taken or advice provided by OSPAR in response to this. The WG recommended provision of feedback by OSPAR to ICES, in an appropriate time frame, when EcoQOs are triggered. In addition, the WG would appreciate OSPAR and ICES to encourage and support the responsible entity (e.g. *governments)* to take appropriate action. The WG would be prepared to assist in making specific recommendations (e.g. research to be carried out, management measures to be taken).

The creation of the ICES North-east Atlantic and North Sea seal database will allow the working group to undertake assessments of local seal population trends. Further development work on the database was undertaken prior to, and during, the course of the meeting, including input of data from Denmark, Germany, the Netherlands, Belgium and the UK.

A review of the ASCOBANS/HELCOM Working Group report on common dolphin population structure in the Northeast Atlantic, and available information on population structure in harbour porpoise in the Northeast Atlantic, was carried out. The WGMME concurred with the ASCOBANS/HELCOM recommendation that only one common dolphin population inhabits the Northeast Atlantic, although the distributional range of the population is unknown, as sampling of individuals for genetic analysis was confined to continental shelf and slope waters and oceanic waters of the Bay of Biscay. A separate Iberian harbour porpoise population has recently been identified using genetic analysis, and the WGMME strongly recommended that this population should be given a high priority for conservation, as a consequence of its presumed small population size, low genetic diversity and likely susceptibility to habitat degradation. The WGMME also strongly recommended immediate action by the Spanish and Portuguese governments in monitoring and conserving the Iberian harbour porpoise population.

During this year's meeting, new data from the SCANS II and CODA projects were reviewed by the WG and presented in the current report. WGMME concurs with the recommendation in these reports to use the CLA approach for estimating bycatch limits for small cetaceans. Given the nature of the data available, WGMME believes it is appropriate to use the most conservative measure (i.e. *in a worst-case situation*) for both harbour porpoises and common dolphins in the Northeast Atlantic. It was noted by the WG that the continuation, and estab-

lishment in some cases, of national observer bycatch programmes is extremely important, in order to obtain current estimates of incidental capture for all marine mammal species. Furthermore, the bycatch management procedures developed under SCANS-II and CODA projects should be taken into consideration by DG MARE when reviewing the EU Regulation 812/2004. The WG also noted the need for the continuation of surveys of the type of SCANS II and CODA to estimate absolute abundance, at least every 5–10 years.

All marine mammal reports on FCS (to fulfil requirements of the Habitats Directive) were reviewed by the WGMME at this year's meeting. The WG reviewed the whole reporting procedure, and suggested recommendations for improvements. WGMME strongly recommended that the European Commission (ETC/BD) reconsiders the data requirements for FCS reporting with respect to highly mobile, wide ranging, species and, most notably, considers allowing reporting at an appropriate biological scale where possible. This would allow ETC/BD to produce accurate and biologically meaningful assessments, relevant to the conservation of the species and would aid instigation of appropriate management measures where necessary. Furthermore, as part of the above guidance, WGMME strongly recommended that all future FCS assessments should be evidence based rather than allowing expert judgements of the various parameters used to assess conservation status. This would lead to biologically accurate assessments relevant to the conservation of the species. WGMME also recommended that Member States develop international collaborative monitoring strategies for marine mammals, in order to meet the surveillance requirements of the Habitats Directive.

Initial development of a European framework for surveillance and monitoring of marine mammals was undertaken during the course of the meeting. The WG noted that, while it seems clear that monitoring of abundance, bycatch and health status (through stranding programmes) may reasonably form the core of surveillance for cetaceans, the importance of other types of information (e.g. life-history data) and monitoring of specific threats (e.g. offshore construction) should also be recognized when designing a surveillance strategy. Further, monitoring programme design should take account of new findings on the stock structure, for example the identification of an isolated Iberian stock for harbour porpoise.

1 Opening of the meeting

The Working Group on Marine Mammal Ecology (WGMME) met at the Instituto Español de Oceanografía from 2 February to 6 February 2009. The list of participants and contact details are given in Annex 6.

The Working Group thanks the Instituto Español de Oceanografía for their invitation to conduct the meeting in Vigo. 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.

2 Acknowledgements

The Working Group also gratefully acknowledges the support given to us by Phil Hammond, Arliss Winship, Doug Gillespie, who kindly provided unpublished data, text and/or reports for use by WGMME. We also thank Mark Tasker, Sonia Mendes and Tero Härkönen who contributed support, text and/or unpublished papers by e-mail.

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.

3 Adoption of the agenda

The following Terms of Reference and the work schedule were adopted on February 2nd.

a) Review the quality assurance arrangements for the following ecological quality objectives as set out in the EcoQO Handbook (OSPAR publication 2007/307) and make suggestions for their further development and/or improvement: (i) harbour seal population trends (ii) grey seal pup production (OSPAR request no. 5, 2009)

b) Review any further information on population structure of small cetaceans in the ICES areas and provide an assessment of consequences for management for these species.

c) Review the geographical subunits for EcoQOs for ICES areas for harbour and grey seals based on the most appropriate available data (e.g. genetic data) and make recommendations.

d) Review any further information/analyses from SCANS II/CODA and make recommendations.

e) Review available EU Habitats Directive FCS reports for marine mammals submitted by Member States, including a summary of any issues identified and solutions utilized. Suggest any appropriate conservation assessment criteria that can be used within the ICES area and quantitative measures against which these assessments could realistically be measured.

f) Develop a framework for surveillance and monitoring of marine mammals applicable to the ICES area that is realistically achievable by contracting parties.

g) Update on development of database for seals, and report on the status of any intersessional work.

WGMME will report by 16 February 2009 to the attention of ACOM.

Supporting Information

Scientific Justification and relation to Action Plan:

a) Response to OSPAR request no. 5 (2009), Action Plan No: 1.

b) This is important in understanding biologically appropriate management units for small cetaceans.

c) This is important in understanding biologically appropriate management units for seals in the North Sea.

d) SCANS II developed and tested potential methods for monitoring harbour porpoises and made a series of recommendations so that trends in abundance in time and space can be better determined between major decadal surveys. This ToR would extend this work to other species where sufficient information is available for such an analysis.

e) Recommendations on quantitative monitoring objectives and quantitative assessment approaches will contribute to developing strategies for the long-term maintenance of cetacean populations within the ICES area.

f) 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.

4 ToR a. Review the quality assurance arrangements for the following ecological quality objectives as set out in the EcoQO Handbook (OSPAR publication 2007/307)

Make suggestions for their further development and/or improvement: (i) harbour seal population trends (ii) grey seal pup production (OSPAR request no. 5, 2009)

4.1 Introduction

Contracting parties (countries) have in place established monitoring procedures or programmes for harbour and grey seal populations in the North Sea. Surveys have been designed to effectively assess the distribution and numbers of seals in different areas/countries (Lonergan *et al.*, 2007; Thompson *et al.*, 2005; Reijnders *et al.*, 2003). The results of these monitoring programmes were used by OSPAR to develop Ecological Quality Objectives for each species.

The EcoQO for harbour seals is:

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. These subunits are: Shetland; Orkney; North and East Scotland; South-East Scotland; the Greater Wash/Scroby Sands; the Netherlands Delta area; the Wadden Sea; Helgoland; Limfjord; the Kattegat, the Skagerrak and the Oslofjord; the west coast of Norway south of 62°N.

The EcoQO for grey seals is:

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. These subunits are: Orkney; Fast Castle/Isle of May; the Farne Islands; Donna Nook; the French North Sea and Channel coasts; the Netherlands coast; the Schleswig-Holstein Wadden Sea; Helgoland; Kjørholmane (Rogaland).

4.2 Quality assurance

Quality assurance guidelines have not previously been established for harbour and grey seal EcoQOs. However, the WG noted that the EcoQO trigger levels were specified to detect declines in harbour and grey seal populations (OSPAR 2007/307). There is a wide range of survey methods used by different contracting parties although each method attempts to achieve the same result-where are seals distributed and how many are there?

At this meeting the participants have proposed the following quality assurance statement, in order to adequately assess trends in harbour seal population size and grey seal pup production:

Seal monitoring surveys should conform to established methodologies:

For harbour seals:

- survey at key times during the annual cycle
- undertake moult surveys to provide information on population size
- undertake breeding season surveys to inform on numbers of pups born and on population size
- undertake replicate surveys to provide confidence intervals

- annual surveys can more accurately detect smaller changes
- area surveyed should be consistent between years
- for larger areas, aerial surveys are recommended
- to determine population trends, the timing of surveys should be consistent
- environmental covariates (e.g. state of tide, time of day and weather) should be considered

For grey seals, which range over considerably larger areas than harbour seals, it should be noted that depending on the parameter measured, coordination between survey cycles in different areas could be affected by the apparent variation in timing of breeding. Also, grey seal numbers on shore during summer can vary considerably from day to day:

- undertake breeding season surveys to inform on numbers of pups born, which is the most cost-effective method for monitoring this species
- use pup production data to estimate the total population size
- undertake moult surveys to provide information on population size in areas where pup counts are less reliable (i.e. in the Wadden Sea and Dutch Delta), although the grey seal moult can extend over a number of months
- undertake replicate surveys to provide confidence intervals
- annual surveys can more accurately detect smaller changes
- area surveyed should be consistent between years
- for larger areas, aerial surveys are recommended
- to determine population trends, the timing of surveys should be consistent
- environmental covariates (e.g. state of tide, time of day and weather) should be considered

The WG noted that contracting parties should develop or sustain survey programmes to ensure that the status of North Sea seal populations can be evaluated for each subunit. Further, survey frequency and scale should be adjusted to account for changes in species range, epizootics or other significant events. Power analysis should be used to assess the effectiveness of the existing survey schemes (Meesters *et al.*, 2007), relative to the specific EcoQO.

The WG also recommends that subunit names should better coincide with the geographic regions that are surveyed by national monitoring programmes. Therefore, the WG made several changes to Tables 2.1.1 and 2.1.2 contained in OSPAR publication 2007/3007 (see Tables 1–2), which are further outlined in ToR C.

Table 1. Current and known plans for monitoring harbour seals by Contracting Parties.

Country	Subunit	Current monitoring	Monitoring method	Comments
UK	Shetland	Population monitoring: Moult	Single aerial survey on approximate 5 yearly schedule	Minimum required
UK	Orkney	Population monitoring: Moult	Single aerial survey on approximate 5 yearly schedule	Minimum required
United Kingdom	North and East Scotland [1,2]	Population monitoring: Moult	Single aerial survey on approximate 5 yearly schedule	Minimum required
United Kingdom	North-east Scotland (Moray Firth)	Population monitoring: breeding and moult	Repeat aerial survey, annual	
United Kingdom	South-east Scotland (Firth of Tay)	Population monitoring: Moult	Single aerial survey, annual	Minimum required
United Kingdom	East England (Greater Wash, Scroby Sands)	Population monitoring: breeding and moult	Repeat aerial survey, annual	
Netherlands	Delta	Extension of bird surveys	Aerial survey, monthly	No formal assessment yet
Netherlands/ Germany/ Denmark	Wadden Sea	Population monitoring: breeding and moult	Repeat aerial survey annual	
Germany	Helgoland	Population monitoring	Daily land counts	
Denmark	Limfjord	Population monitoring: pupping and moult	Repeat aerial survey annual	
Denmark/Sweden	Kattegat/Skagerrak	Population monitoring: breeding and moult	Repeat aerial survey Annual	
Norway	Skagerrak and Oslo Fjord	Population monitoring: Moult	Aerial survey, every 5 years	
Norway	West coast, south of 62°N	Population monitoring: Moult	Aerial survey, every 5 years	
France	Baie du Mont [1,3] Saint Michel	Population monitoring: breeding and moult	Aerial surveys 18/year + 15 census (boat and land)	
France	Baie de Somme [1,3]	Population monitoring: breeding and moult	Land census every 10 days (January–June). Daily from June to September	

COUNTRY	SUBUNIT	CURRENT MONITORING	MONITORING METHOD	COMMENTS
France	Baie des Veys [1,2]	Population monitoring: breeding and moult	Land and aerial surveys (1/week)	

[1] Not included as an OSPAR EcoQO subunit for assessing trends

[2] Includes both North-east and South-east Scotland subunits

[3] Outside the North Sea

Table 2. Current and known plans for monitoring grey seals by Contracting Parties.

Country	Subunit	Current monitoring	Monitoring method	Comments
United Kingdom	Shetland [1]	Pup production Monitoring	Ground count, annual since 2004	Difficult area to monitor
United Kingdom	Orkney	Pup production Monitoring	Aerial survey, annual	
United Kingdom	Fast Castle, Isle of May and adjacent colonies	Pup production Monitoring	Aerial survey, annual	
United Kingdom	Farne Islands	Pup production Monitoring	Ground count, annual	
United Kingdom	Donna Nook and adjacent colonies	Pup production Monitoring	Ground count, annual	
Netherlands	Wadden Sea	Moult and pup production	Aerial survey	Pup counts are unreliable and not appropriate to population estimates
Netherlands	Delta	Extension of bird surveys	Aerial survey, monthly	No formal assessment yet
Germany	Schleswig-Holstein Wadden Sea	Moult and pup production	Aerial, boat and land survey, annual	Pup counts are unreliable and not appropriate to population estimates
Germany	Helgoland	Pup production Monitoring	Ground count, annual	
Denmark	Limfjord	Moult and pup production	Repeat aerial survey; annual	
Norway	Rogaland	Pup production	Ground count, every 5 years at least	
France	Archipelago of Molene [1,2]	Pup production and population Monitoring	Regular (monthly) census and Photo identification	
France	Archipelago of Sept Îles [1,2]	Pup production and population Monitoring	Regular (monthly) census	

[1] Not included as an OSPAR EcoQO subunit for assessing trends, [2] Outside the North Sea.

4.2.1 Harbour seal trends

The WG reviewed recent count data available for several locations around the North Sea to document ongoing monitoring of several EcoQO subunits and to highlight trends in a number of subunits. In the Wadden Sea, coordinated surveys are conducted along the coast of the Netherlands, Germany and Denmark, and where over a 5-year period, between 2003 and 2008, counts increased in all areas surveyed; 67% for the whole Wadden Sea. In contrast, numbers of harbour seals off the North Sea coast of the UK (Shetland, Orkney, Moray Firth, Firth of Tay and the Greater Wash) declined significantly between 2000 and 2006. For instance, harbour seal numbers in Orkney declined by 40% between 2001 and 2006 and by 21% between 2006 and 2007 (single counts). In east Scotland, numbers declined by 11% between 2005 and 2007. The total moult count in The Wash in August 2007 (2162; Figure 1) was 21.6 %

higher than the single count in 2006; although 27.4% lower than the mean pre-epidemic 2002 count (2976; SCOS 2008).

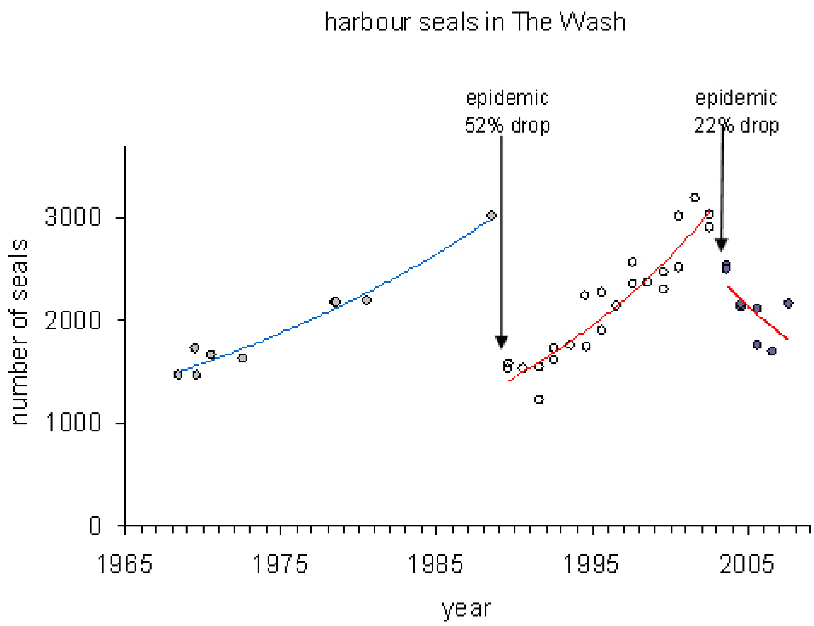

Figure 1. Declines in harbour seal numbers in The Wash following the phocine distemper virus outbreaks in 1998 and 2002 (Duck *et al.*, 2008).

In response to the observed (unexplained) UK declines, extra funding (from the Scottish Government and Scottish Natural Heritage) allowed surveys to be carried out in the worst affected area (Orkney) in successive years (2006 and 2007). To further investigate the cause of the decline, the SMRU undertook a study which compared harbour seal pup mortality in areas with (Orkney) and without (Scottish west coast) a decline. Results from this study will be presented to SCOS (Special Committee on Seals) in 2009.

It should be re-iterated that the observed declines in the UK has triggered the EcoQO. Further, it demonstrates that the existing UK North Sea monitoring programme is capable of detecting population declines at least of this magnitude (11%–40%); though single surveys are not likely to be sufficient to detect more gradual declines within a 5 year interval. The results to date clearly highlight the importance in continuing long-term monitoring programmes.

4.2.2 Grey seal pup production

Monitoring programmes throughout the North Sea provide annual or less frequent estimates or counts of grey seal pup production. Overall, these programmes have documented an increasing or stable trend in pup production. Long-term monitoring programmes, particularly at UK colonies, have also allowed scientists to examine trends in pup production over discrete periods. For example, pup production in Orkney in 2007 (18 952) was 1.97% lower than in 2006 (SCOS 2008b). The overall annual change in pup production in Orkney over successive 5-year intervals revealed a progressive decline in the rate of increase: +8.5% between 1992 and 1997; +4.53% between 1997 and 2002; and +0.85% between 2002 and 2007 (Duck and Mackey, 2008).

Though attempts are made to carry out pup counts in the Wadden Sea area, they are not adequate for estimating population size as a consequence of the following factors: a) pups are born on sandbanks which occasionally flood, causing mother-pup pairs to scatter away from breeding sites; b) as a result of the relatively small number of pups (200–300) born in a 10 week period during mid-winter, survey intensity cannot be raised to correctly estimate number of new born animals; and c) grey seal pups are subject to intensive rescuing by rehabilitation centres, thus affecting survey count data. In this case, the WG recommends that the annual moult count be used to monitor the grey seal population in the Wadden Sea and Delta areas.

The WG has noted that in future, new stocks/groups should be included in the assessment of seal status, where monitoring surveys appear to be sufficient to meet the EcoQO quality objectives.

4.3 Remarks and recommendations

- The WG **recommends** that power analysis should be used to assess the effectiveness of the existing survey schemes, relative to the specific EcoQO.
- For grey seals, the EcoQO should be changed for the Wadden Sea as circumstances make it impossible to meet the proposed requirements to survey pup numbers. It is recommended to use moult counts instead; though the importance to continue efforts in obtaining pup count data was noted, in order to compare with available data from the UK.
- It should be noted, OSPAR (2007) outlined that harbour and grey seal EcoQOs are alerting EcoQOs, rather than ones based on strict targets for the seal sub-units. If the EcoQOs are not met, then it is unlikely that immediate management action would be taken, instead it is intended that this event should trigger research into the causes of this change. If the cause is related to a human activity, then suitable management measures might then be taken (OSPAR 2007).
- The WG noted that although the EcoQO for harbour seals was triggered in a number of subunits in 2007, the WG is unaware of actions taken or advice provided by OSPAR in response to this.
- The WG **recommends** feedback from OSPAR, in an appropriate time frame, when EcoQOs are triggered. In addition, the WG would appreciate OSPAR and ICES to encourage and support the responsible entity (e.g. *governments)* to take appropriate action. The WG would be prepared to assist in making specific recommendations (e.g. research to be carried out, management measures to be taken).

4.4 References

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5 ToR b. Review any further information on population structure of small cetaceans in the ICES area and provide an assessment of consequences for management for these species

5.1 Introduction

When dealing with population structure, it is important to define what we mean by a population. Definitions are numerous in the scientific literature, but they can be grouped in two main paradigms (see Waples and Gaggiotti, 2006):

> *Ecological paradigm:* A group of individuals of the same species that co-occur in space and time and have an equal opportunity to **interact** with each other.
>
> *Evolutionary paradigm:* A group of individuals of the same species living in close enough proximity that any member of the group can potentially **mate** with any other member.

These two paradigms reflect the two distinct, but complementary, approaches that currently exist for assessing population structure: the *ecological* and *evolutionary approaches*. Frequently, confusion or misunderstanding surrounds what these approaches tell us about population structure and dispersal pattern of animals, thus preventing the production of clear recommendations for efficient management.

The "*ecological/direct approaches*" are based on: field observations, measurements of natural history parameters including morphology, and measurements of non-heritable traits such as the "elemental" profiles determined by pollutants, fatty acids, stable isotopes, and also on satellite tagging studies. These measurements[1] are mostly informative on the demography of natural populations, their habitat use, and feeding habits and preferences, over time-scales spanning between days to the lifespan of the animal. Some of these measurements (such as pollutants, stable isotopes and fatty acids) are very sensitive to the physiological and health status of the animal (Aguilar *et al*., 1999; Das *et. al*., 2004; Pierce *et al*., 2008). Therefore, these confounding effects have to be considered before being able to address the ecological structure, i.e. ecological stocks.

"***Evolutionary approaches***" are based on the analysis of the genetic polymorphism at molecular markers. These approaches allow (by analyse of spatial variation in the genetic polymorphism) us to infer the population structure, breeding behaviours, pattern of gene flows (or dispersal), and the population demographic history (i.e. over several generations; Avise 2000; Hartl and Clark 2007; Hedrick 2005).

These two approaches do not necessarily provide equivalent information, even for similar types of parameters. For example, estimations of the population size using direct ecological approaches can greatly differ from the effective population size that could be estimated from genetic approaches. A direct survey would record the number of animals present in a study area, while genetic estimates would measure roughly the number of animals that breed successfully in that area. In a similar way, gene flow corresponds to an individual's movements, which may have reproduced successfully outside its own habitat range, but not necessarily to the movements that could be recorded by satellite tracking. The time-scale on which these estimates are made can also greatly differ; field surveys for example will provide punctual information on population density, but only for the time at which the survey was conducted, while genetic estimates will be more integrative in time (over a few generations), depending

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[1] Named sometimes "demographic" estimates to contrast with "genetic" estimates.

on the geographic scale, the kind of markers analysed, and most importantly, its evolutionary rate (e.g. Frankham *et al*., 2002).

Knowledge on the population structure is a prerequisite to any assessment of population abundance, the impact of the anthropogenic pressures, and the development of management strategies. Management strategies are based on the definition of intraspecific units on which surveys and conservation efforts are conducted. Different levels of units have been proposed in order to capture and conserve different aspects of the biological diversity (Moritz, 2002): *Evolutionary Significant Units* (ESUs) and *Management Units* (MUs). The goal of ESUs, as proposed by Moritz, is to ensure that major historical lineages within recognized species are protected and the evolutionary potential inherent across the set of these units is maintained. Emphasis was placed on delineating sets of populations that are historically isolated from others, rather than on current adaptive diversity. The second category, MUs, was suggested to recognize demographically distinct populations that should be managed to ensure the viability of the larger ESU. Later Dizon, 2002 suggested replacing the term of MUs by the term demographically significant units (DSUs) in order to avoid any confusion; both ESUs and DSUs are management units, but at a different level and with different purposes. The criteria for recognition of these conservation units were that: (1) ESUs should be reciprocally monophyletic for mitochondrial (mtDNA) alleles and demonstrate significant divergence of allele frequencies at nuclear loci; and (2) DSUs (formerly MUs) should have a significant divergence of allele frequencies at either nuclear or mitochondrial loci, regardless of the phylogenetic distinctiveness of the alleles (for useful critiques of the use of genetic data to define MUs, see also Palsboll *et al*., 2007; Schwartz *et al*., 2007; Taylor *et al*., 2000; Taylor and Dizon, 1999).

Defining and understanding genetic and demographic population structure are highly challenging for small cetaceans. They are distributed over continuous habitat without obvious evidence of what could restrict their dispersal. Furthermore, sampling strategies are difficult to control. Beyond field-based approaches of sampling live animals, most of the samples available to conduct genetic or ecological analyses in small cetaceans are obtained from stranded or bycaught animals; which is the case for most studies in western European waters. This results in a patchy sampling distribution of species such as the harbour porpoise and common dolphin, which are potentially continuously distributed over their habitat, and can therefore be problematic and misleading in identification of population structure and understanding the biological processes and factors that shape it (Schwartz and McKelvey, in press). One can wonder whether the sampling used is representative of the distribution of natural populations, and also, when significant differences are found, do these groups constitute truly distinct natural populations, or, do these differences reflect a gradual change in genetic and/or ecological properties, without any sharp delimitations.

In this report we focused on Northeast (NE) Atlantic harbour porpoises and common dolphins.

5.2 Update on the harbour porpoise (*Phocoena phocoena)* in Northeast Atlantic

5.2.1 Sampling issue

For species like the harbour porpoise, which is widely and potentially continuously distributed over a large geographical scale, a large-scale continuously distributed sampling scheme is required. Such a kind of study has been recently conducted for harbour porpoises in the NE Atlantic within the framework of the VIPHOGEN project (Belgian Scientific Policy EV/12/46A) and the PhD thesis of Michael Fontaine (2008). The goals of the thesis were (1) to characterize the population structure of harbour porpoises in Western Palearctic waters (i.e. NE Atlantic and in the Black Sea – outside the ICES area), and (2) to understand its origin and its evolution in space and time. With these aims, both indirect genetic and ecological approaches have been used with special emphasis on the understanding of the processes involved.

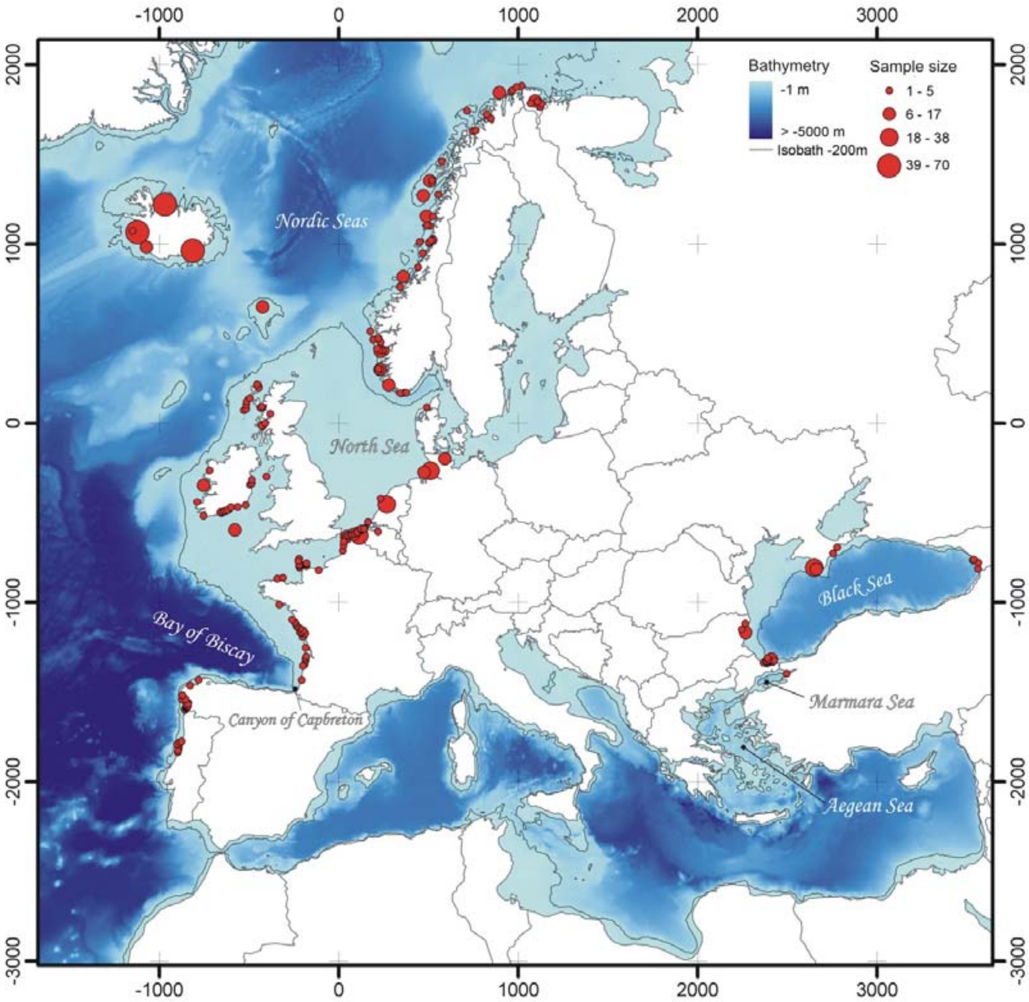

Figure 2. Bathymetric map of the eastern North Atlantic showing the approximate geographic sampled locations and sample sizes per location. Geographic locations are based on GPS coordinates or reported discovery location (from Fontaine *et al*., 2007a).

5.3 Population structure in harbour porpoises

5.3.1 Genetic structure

Fontaine *et al*., 2007a investigated the population genetic structure of the harbour porpoise in Western Palearctic waters using a combination of recent individual-based landscape genetic approaches. Analyses of highly polymorphic nuclear microsatellite loci for 752 individuals (Figure 2) revealed that most of the sampled range in the NE Atlantic behaves as a 'continuous' system that widely extends over thousands of kilometres from the French coasts of the Bay of Biscay to the Arctic waters off Norway and Iceland. However, this continuous system is not a random mating unit. Significant isolation by distance (IBD) among individuals was detected with local habitat-related variation in its strength. Such kind of structure is consistent with previous results obtained in the North Sea, where significant, but generally weak differences were observed at similar kinds of genetic markers when comparing groups artificially defined (Andersen *et al*., 2001).

Evidence of strong barriers to gene flow was observed at both microsatellite and mtDNA loci in the south and eastern parts of the range (Fontaine *et al*., 2007a; Tolley and Rosel, 2006). Such barriers isolate, on a relatively small-scale porpoises from Iberian waters and, on a larger scale porpoises from the Black Sea and coincide with profound changes in environmental characteristics (i.e. depth, surface water temperature and primary biomass; Fontaine *et al*., 2007a). These results provided strong evidence that physical processes, and especially the factors determining food availability for the species, have a major impact on the demographic and genetic structures of porpoises. Authors argued that such strong links between habitat and population genetic structure could be likely related to the high energetic constraints this small cetacean has to balance, in order to survive (Fontaine, 2008; Fontaine *et al*., 2007a; Lockyer, 2007; MacLeod *et al*., 2007; Read and Hohn, 1995).

Regarding porpoises from the Baltic Sea and adjacent waters, their status is still highly debated (see Berggren and Wang, 2008; Palmé *et al*., 2008a; Palmé *et al*., 2008b). Most of the genetic differences, although significant were rather weak (Wang *et al*., 1997; Andersen *et al*., 2001) and within the range of values observed within the continuous NE Atlantic system (Fontaine *et al*., 2007a). A recent study analysed mtDNA and microsatellites in several hundred porpoises from the Baltic Sea. Results suggested evidence of a separate population inhabiting the Inner Danish Waters, with a transition to North Sea population occurring within in the Kattegat Sea. In addition, subtle-but consistently significant-genetic differences were observed between porpoises from the Baltic Sea and the Inner Danish waters (Tiedemann, pers. comm.). No consensus has been reached to date, and the question remains regarding the biological process underlying such subtle population structure. Are the subtle differences large enough to really recognize them as distinct populations or instead are they part of the genetic continuum observed at a larger scale? These questions remain to be addressed, and require further collaborative works between the European teams.

5.3.2 Ecological structure

Measurements of time-integrative ecological tracers (i.e. stable isotopes, fatty acids, PCBs loads and trace elements concentrations) have been conducted to assess the feeding preferences and habitat use of harbour porpoise in the NE Atlantic, mainly within the genetic continuum (Das *et al*., 2004; Fontaine *et al*., 2007b; Lahaye *et al*., 2007; Pierce *et al*., 2008; Tolley and Heldal, 2002). Comparisons of sampled localities revealed regional variation in elemental profiles of harbour porpoises. Although part of this geographic variation originated from variation in intrinsic physiological and health status, the results also suggested that harbour porpoises adapted their feeding habits gradually to local oceanographic conditions during the year, without performing an extensive migration. These results were consistent with stomach contents analysis (Santos and Pierce, 2003) and results from telemetry studies (Teilmann, ref). Morphological variations have also been observed and are congruent with ecological variations (Read, 1999; Viaud-Martinez, 2007). No sharp discontinuities in the elemental profiles have been observed. Thus to some extent this ecological variation seems consistent with the continuous genetic structure observed. However, individual-based and spatially explicit statistical analyses are required to determine whether there are continuous or discrete variations in the ecological structure. Such a study combining both genetic and ecological tracers is currently underway at a local scale within UK waters (Fontaine, Bull, Fenton, Deaville, Law, Allchin, Jepson and Goodman, unpublished results). A similar large-scale NE Atlantic study would be of great value.

5.3.3 Population demographic trends

At the NE Atlantic scale, the pattern of population genetic structure depicted for harbour porpoises suggests an ongoing habitat-related fragmentation of the species' range (Fontaine *et al*., 2007a). Fontaine *et al*., under review addressed this issue in a submitted paper. Such evolution for cold temperate species, like harbour porpoises, is probably related to past and recent changes in its habitat feature and thus to climate change. We can expect that contemporaneous climate warming has contributed to this fragmentation process. An increasing number of studies report profound climate change impact on the distribution of marine assemblages from plankton to fish. Assessing the repercussions on apex predators remains a challenging issue. Fontaine *et al.*, under review inferred the population demographic history of the harbour porpoises in Western Palearctic waters. These authors compared genetic inferences with historical records on fisheries and paleoceanographic data. Together, these complementary approaches provided compelling evidence that porpoise populations have responded markedly to the recent climate-induced reorganization in NE Atlantic ecosystems. The suggested fragmentation began with the retreat of porpoises from the Mediterranean Sea during the postglacial water warming of the Mediterranean Sea, and the reorganization in marine assemblages. This response then included the isolation of Iberian porpoises from those inhabitating waters further north in tandem with the contemporaneous warming trend underway since the "Little Ice Age" period (≈ 300 years ago), and the retreat of cold water species from the Bay of Biscay.

5.3.3.1 Implication for management issue

This climate-driven fragmentation of porpoises' habitat cumulates with overexploitation of their food resources by commercial fisheries and the high mortality rate through incidental catches in gillnet. Combined together, these factors are of serious concern for the sustainability of regional populations.

5.3.4 Management units

Demographically independent units

Fontaine, 2008 has identified two critic populations in the southern part of the range: the recently isolated population along the Iberian coast and the relict population in the Black Sea (outside the ICES area). Both display very small effective population sizes. They are demographically isolated from the rest of the distribution, and persist in marginal areas characterized by special oceanographic conditions: an *upwelling* process along the Iberian coasts and a meromictic system in the Black Sea. These populations are therefore highly sensitive to genetic, demographic and environmental stochasticity. Singular morphological differences they display, compared with other populations, suggest they may present adaptations to these marginal habitats. For example, harbour porpoises off the Iberian coast are larger than the majority of porpoises in the continuous NE Atlantic population. Therefore, it is not only necessary to draw a management plan for porpoises, but also for the habitat they inhabit. Their conservation status is unequivocal. Both are clearly independent management units. Furthermore, porpoises from the Black Sea display a unique genetic heritage accumulated through a long history of isolation. As a result, this population can be further qualified as an Evolutionary Significant Unit, independent from that of the Northeast Atlantic Ocean.

The WGMME **strong recommends** that the Iberian harbour porpoise population and the NE Atlantic harbour porpoise continuous system population (France to Norway) are managed separately. Only one abundance estimate of 2600 (CV = 0.80) porpoises exists for the Iberian population, which was obtained by the SCANS II project. Although, this only provides a snap-shot of summer (July) abundance of porpoises in this regions in 2005, the extremely low abundance estimate is a cause for concern; and is in marked contrast to an approx. estimate of 358 800 porpoise for the North-east Atlantic population (SCANS-II, combining abundance data from different survey blocks).

The northern continuous systems

North of the Bay of Biscay, both genetic and ecological approaches converged toward a similar conclusion: harbour porpoises form a continuous system under IBD displaying regional habitat-related variation in genetic, demographic and ecologic properties. Such a continuous structure under IBD complicates markedly the assessment of conservation status and the design of management strategies, because it challenges classic concepts of "population" and "management unit" (Rousset, 1997). The controversy is embedded within a more profound debate surrounding the recognition of species and populations. In particular, the dilemma lies in the wish to categorize continuous process for management and conservation purposes. Regional variation in genetic and ecological properties has been observed across the distribution range of harbour porpoises and can be used to define management units. This strategy supports to some extent that used formerly by the International Whaling Commission (IWC) to define population structure for management purposes. However, whether or not these management units really constitute demographically independent units and whether or not categorizing a continuous system into a management unit constitutes the best practice for efficient management of a system remains a critical issue, which requires further theoretical and conceptual attention. The debate surrounding the status of Baltic porpoises is probably the best example of that dilemma.

5.4 Remarks and recommendations for harbour porpoises

- Critical isolated populations unambiguously identified:
  - **Iberian population**: an independent DSU, although belonging to the Atlantic ESU
  - **Black Sea population:** DSU(/MU) and ESU independent from the Atlantic populations
  - **Immediate action required for both populations**
    - Efforts to better characterize their dynamics, demography, and temporal trends
    - High priority for conservation as a consequence of their small population size, their low genetic diversity, and their strong susceptibility to habitat variation
- The issue of the **continuous system** north of the Bay of Biscay
  - Gradual habitat-related variation observed at genetic loci and suspected at ecologic tracers as well, though requires further work to be tested formally:
    - large-scale meta-analyses of published data required,
    - distinguishing explicitly between clinal and cluster geographic variation (spatial statistical analyses required)
  - Classic definitions of population and management units not applicable from the biological point of view, but the only tool available to date for conservation policy
  - Conceptual works required to better understand the dynamics of such a continuous system and its resilience to anthropogenic pressures
  - What to conserve? Demographically independent units?
- WGMME **strongly recommends** that Iberian harbour porpoise population and the NE Atlantic harbour porpoise population (continuous system-France to Norway) are managed separately. For further separation of the NE Atlantic porpoises, we will wait until recommendations come from the ASCOBANS/HELCOM working group on small cetacean stock structure. The ASCOBANS/HELCOM harbour por-

poise stock structure report was unavailable to the WG, as it is currently in preparation.

- WGMME **strongly recommends** that the Iberian population should be given a high priority for conservation, as a consequence of its presumed small population size, low genetic diversity and likely susceptibility to habitat degradation.
- The WGMME also **strongly recommends** immediate action by the Spanish and Portuguese governments in monitoring and conserving the Iberian harbour porpoise population.
- The WGMME **recommends** a large-scale Northeast Atlantic study which combines both genetic and ecological tracers.

5.5 Update on the common dolphin (*Delphinus delphis*) in Northeast Atlantic

A draft version of the ASCOBANS/HELCOM working group report by Murphy *et al*., in review on population and stock structure in common dolphins in the Northeast Atlantic was made available to, and was reviewed by, the WGMME. It is used as the basis for this report, along with a recent published study by Mirimin *et al*., in press.

The short-beaked common dolphin is the only *Delphinus* species recognized in the North Atlantic. The common dolphin has a widespread distribution in the NE Atlantic, ranging from waters off Portugal to 65°N latitude, west of Norway (Collet, 1981; Syvertsen *et al*., 1999; Silva and Sequeira, 2003; López *et al*., 2004; Murphy, 2004). Their presence along the mid-Atlantic Ridge was documented during a summer expedition in 2004 (Doksæter *et al*., 2008), though their distribution and relative abundance in mid-Atlantic area remains largely unknown. In the Northwest (NW) Atlantic, common dolphins are found along the east coast of North America, from Florida to as far north as Sable Island, Canada (Selzer and Payne, 1988; Gaskin, 1992; Lucas and Hooker, 2000), and are rarely sighted in the Gulf of Mexico.

Figure 3a presents all the available *D. delphis* sightings data from the North Atlantic Ocean, complied for the ASCOBANS/HELCOM common dolphin population structure report. The data were obtained between 1963 and 2007, although the majority of sightings were obtained after 1980, and predominately during summertime. It appears that *D. delphis* are distributed, at least during summertime, from coastal waters in the NE Atlantic to the mid Atlantic ridge, and as far south as the Azores. In fact, *D. delphis* may be distributed across the whole North Atlantic, between 35 and 55°N (partially covering a region heavily influenced by the Gulf Stream/North Atlantic drift). However, as a consequence of a lack of observer effort, beyond the mid Atlantic ridge (approx. 30–40°W, see Figure 3b), the full distributional range of common dolphins in the North Atlantic Ocean is not known. Further, the actual distributional boundary of the Northeast Atlantic population is also not known.

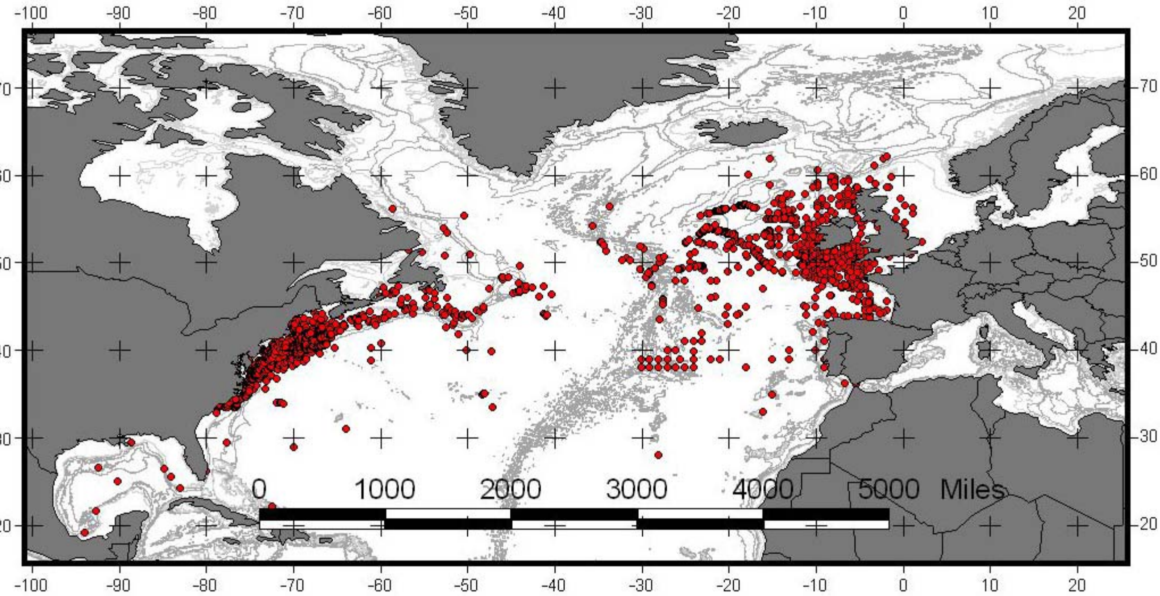

Figure 3a. Distribution of common dolphin sightings in the North Atlantic, data obtained between 1963 and 2007 by a large number of observer sighting schemes (see acknowledgements in Murphy *et al.*, in review).

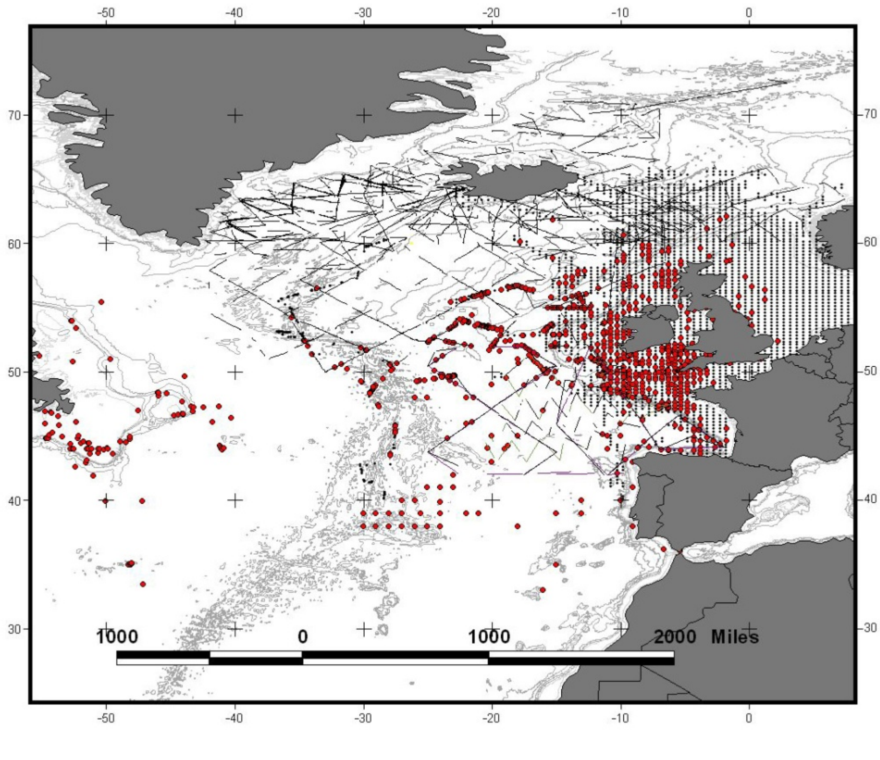

Figure 3b. Outline of available information on track lines and areas covered (black dots) by various surveys in the Northeast Atlantic (obtained from Murphy *et al.*, in review).

Although common dolphins are regarded as highly mobile animals, their movements in the open-ocean habitat are poorly understood. Seasonal-based shifts in distribution and abundance have been reported in higher latitudes of both the Northwest (Gowans and Whitehead, 1995; Waring *et al.*, 2007) and NE Atlantic (Pollock *et al.*, 1997; Kiszka *et al.*, 2004; Northridge *et al*., 2004; O'Cadhla *et al*., 2004; WGMME 2005), indicating possible migratory patterns, which may be correlated with prey availability and distribution (WGMME 2005). Recently, genetic analysis of a mass live stranding in France has reported, confirming results from previous studies, that the social structure of common dolphin is likely fluid, with some age and sex segregation (Viricel *et al*., 2008).

5.6 Population structure in common dolphins

The situation regarding population structure is much less clear than that of harbour porpoises, mainly because of sampling limitations. Indeed, the availability of samples constitutes to date the most important limiting factor for assessing common dolphin population structure in the North Atlantic Ocean. Most samples available for genetic analyses were obtained from aggregated coastal areas, without easy access to samples from offshore waters (Mirimin *et al*., in press).

5.6.1 Genetic structure

Natoli *et al*., 2006 investigated levels of genetic variation within the North Atlantic (using 9 microsatellite loci and mtDNA control region sequence data) and focused on variations across the species' range and alpha taxonomy. Results revealed significant genetic differentiation between the NE and NW Atlantic, although these results were based on a limited sample size (n=13) from the NW Atlantic. Following this, Mirimin et al. (in press) conducted further investigations on the genetic structure in the North Atlantic using samples from stranded and bycaught common dolphins, and analysing the genetic polymorphism at the mtDNA control region, and 14 microsatellite loci. Samples were obtained from continental shelf and slope waters of the NE and NW Atlantic. Significant genetic differences were found between both regions; the level of genetic differentiation was very weak at nuclear microsatellite loci (F_{ST}: 0.005, $p < 0.05$) and slightly higher at mtDNA locus (F_{ST}: 0.018, $p<0.001$). The authors suggested the difference in the level of genetic markers could be as a consequence of sex-biased dispersal, with females dispersing less than males (Mirimin *et al*., 2009). However, such claims would require standardizing the estimates of genetic differentiation, as the possible range of values that different kinds of markers can have, depending on their polymorphism properties (see Hedrick, 2005, Meirmans, 2006). In any case, such a low level genetic differentiation between both sides of the North Atlantic Ocean suggest common dolphins in these two regions are highly connected, i.e. with a level of high level of gene flow. However, this is not a random mating (panmictic) unit. Knowing whether these two regions belong to the same continuous system or to two separate but highly connected stocks would require a better sampling coverage of the distributional range of this species.

Within the NE Atlantic, a few studies have investigated population genetic structure of common dolphins within the NE Atlantic (Natoli *et al*., 2006; Viricel, 2006; Amaral *et al*., 2007; Mirimin, 2007; Mirimin *et al*., 2007). In this region, some evidence of genetic structure was identified between the northern (i.e. Scotland) and southern (i.e. Portugal and the eastern central Atlantic) limits of the study area using microsatellite loci, mtDNA control region (Natoli *et al*., 2006) and mtDNA cytochrome b sequence data (Amaral *et al*., 2007). As part of the recent EC NECESSITY project, Mirimin *et al*., 2007 analysed samples (mtDNA control region and microsatellite loci) from the NE Atlantic (Scotland, Ireland, SW UK/western English Channel, France and Portugal). The Scottish sample demonstrated a unimodal distribution but not a significant negative Fs value, which may suggest that its marginal position in the distributional range may have led to smaller exchange rates of migrants to neighbouring aggregations (Mirimin *et al*., 2007). A separate Mediterranean Sea population has been proposed, with directional movement of females from the western Mediterranean Sea into the Northeast Atlantic Ocean (Natoli *et al*., 2008; Murphy *et al*., in review). This confirms a previous skull morphometric study, where results suggested that female Portuguese common dolphins may not interbreed with common dolphins from other areas in the NE Atlantic, and/or common dolphins off the Portuguese coast are mixing with common dolphins in the Mediterranean Sea, and/or common dolphins inhabitating waters further south of the sampled region (Murphy *et al*., 2006).

Common dolphin population structure within the NW Atlantic has been assumed to consist of a single-stock (Waring *et al*., 2007) and recent mtDNA control region and cranial morphometric studies supported this hypothesis (Westgate, 2005; Westgate and Read, 2007).

As part of the ASCOBANS/HELCOM workshop on small cetacean stock structure, a common dolphin database has been created outlining all the nuclear microsatellite loci, mtDNA control region and cytochrome *b* sequences that have been analysed to date in the NE Atlantic. Information on sample code, sampling location and sex and body length of individual was also included, where data were available. The WGMME **recommends** that the next step would be to conduct a meta-analysis in order to improve the knowledge of the population structure and to understand better the process underlying such a low population structure.

Interestingly, results from a cytochrome *b* study demonstrated the possible existence of a divergent evolutionary lineage within the genus *Delphinus* in the NE Atlantic (though the percentage of sampled individuals was small). Thus raises questions regarding to the taxonomic status of common dolphins in this region. Further analysis needs to be undertaken prior to establishing and implementing the existence of a separate evolutionary stock/species into a Northeast Atlantic common dolphin management plan (Murphy *et al*., in review). The ASCOBANS/HELCOM working group recommended increasing the sample size of the cytochrome *b* study in order to investigate the further.

5.6.2 Ecological structure

Some studies have been conducted to assess ecological variation in common dolphins using fatty acids (Learmonth *et al*., 2004), stable isotopes (Das *et al*., 2003), and contaminants loads (Lahaye *et al*., 2005, Pierce *et al*., 2008). Geographic variation has been observed using fatty acids, stable isotopes and pollutants load such as cadmium. For example, Lahaye *et al*., 2005 suggested the existence of two ecological stocks in the neritic and oceanic waters of the Bay of Biscay. This study was based on analysis of cadmium levels in common dolphins caught in summertime French tuna driftnet fishery in the mid 1990s (the oceanic stock) and from bycaught and stranded animals from French neritic waters, that died between 2001 and 2005 (Lahaye *et al*., 2005). However this study (and most other studies using ecological markers) was based on a small sample size from the proposed oceanic stock (n=10), and it was concluded that further analysis is needed to verify the existence of ecological stocks in the NE Atlantic.

Pierce *et al*., 2008 reported clear regional differences in polychlorinated biphenyls (PCB) levels in the NE Atlantic, using data obtained by the EC-BIOCET project. Analysis of samples, obtained between 2001 and 2003, reported that female *D. delphis* off France (a large proportion from the Pleubian 2002 mass stranding event) and Galicia (northwest Spain) had significantly higher PCB concentrations in their blubber than female *D. delphis* off Ireland, although the model also included a significant and generally negative effect of ''maturation'', i.e. lower POP concentrations at higher ovary weights (or increased ovarian activity). These results indicate clearly the occurrence of spatial ecological variation, however the transfer of PCB's from mothers to offspring during pregnancy and lactation may confound the use of these markers for assessing ecological stocks.

It is therefore necessary to widen the geographic scale, select the most appropriate markers, and improve sampling in order to determine the ecological structure, and whether ecological stocks can be identified or not, i.e. whether ecological variation is continuous or if clearly delimited boundaries between stocks can be identified.

5.6.3 Management units

Based on current data in the North Atlantic, *D. delphis* from the NE Atlantic can be considered as genetically distinct from the NW Atlantic, though high levels of gene flow exist between both regions. Only one *D. delphis* population exists in the NE Atlantic ranging from waters off Scotland to Portugal. All samples analysed for genetic analysis in the NE Atlantic were obtained from continental shelf and slope waters, and the oceanic waters of the Bay of Biscay, and therefore the management unit/area for *D. delphis* is confined to this region. A separate population has been reported in the Mediterranean Sea.

For both genetic and ecological structure, further investigations are required to determine whether variation is continuous between the NE and NW Atlantic, or if clear boundaries can be identified. To date, the main limitation that precludes any firm conclusions to be made is the lack of sampling of common dolphins in offshore habitats.

5.7 Remarks and recommendations

The WGMME confers with the main conclusions from the ASCOBANS/HELCOM report which are as follows:

- Only one *D. delphis* population exists in the Northeast Atlantic ranging from waters off Scotland to Portugal, and separate populations have been reported in the Northwest Atlantic and the Mediterranean Sea; suggesting one management unit in the NE Atlantic, based on genetic data.
- All samples analysed for genetic analysis in the NE Atlantic were obtained from continental shelf and slope waters, and the oceanic waters of the Bay of Biscay, and therefore the management unit/area for *D. delphis* in the NE Atlantic is confined to this region.
- The actual distributional range of the population is not known. In order to assess what the distributional range of the population is, samples need to be obtained from offshore common dolphins, and analysed using both genetic and ecological markers. This can only be undertaken by obtaining samples of skin and blubber from biopsies.
- The high haplotype diversity of control region suggests a large effective population size of common dolphins living in the NE Atlantic.
- As a consequence of the low genetic differentiation in this species on a whole, it is proposed that common dolphins in the NE Atlantic should be managed using an ecological time-scale, i.e. managing ecological stocks. However, as a consequence of small sample sizes, data obtained to date using ecological markers are not adequate for describing the existence of ecological stocks in the Northeast Atlantic.
- Therefore, directed studies should be undertaken on assessing the existence of ecological stocks in this region-using a large number of samples, obtained from all age/sex classes, and sampling animals over a large geographical area. A number of ecological markers such as heavy metals, stable isotopes, fatty acids etc should be used.
- A genetically divergent lineage within the genus *Delphinus* has been identified in the NE Atlantic. This raises questions regarding to the taxonomic status of common dolphins in this region. Further analysis needs to be undertaken prior to establishing and implementing the existence of a separate evolutionary stock/species into a Northeast Atlantic common dolphin management plan.
- As a consequence of a lack of sampling of offshore common dolphins for genetic (and ecological) analysis, the **WGMME recommends** that the management

unit/area for the *D. delphis* population in the NE Atlantic be confined to the continental shelf and slope waters, and the oceanic waters of the Bay of Biscay.

- The WGMME highly **recommends** that all the samples and data available (genetic and ecological) in the ICES area are analysed together, in order to get the most comprehensive picture of the population structure. Special emphasis has to be put on the understanding of the process underlying such a low genetic structure. In this respect, a paramount aspect is to determine whether the population structure consists in continuous gradation, with local habitat related variation, or if clearly delimited stocks can be identified. This requires a large-scale study, incorporating samples from offshore waters, conducted at the level of individual, and using spatially explicit analysis.

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6 ToR c. Review the geographical subunits for EcoQOs for ICES areas for harbour and grey seals based on the most appropriate available data (e.g. genetic data) and make recommendations

6.1 North Sea seals

Table 3 outlines the EcoQO subunits described for harbour and grey seals in the OSPAR EcoQO handbook (OSPAR 2007). See ToR A for further information on the specific EcoQO indicators for these species. The current ToR will review available information in order to propose biologically appropriate management units for seals in the North Sea.

6.1.1 Harbour seals

A NAMMCO working group reviewed the most comprehensive genetic studies on population structure in harbour seals in the North Atlantic (Stanley *et al.*, 1996; Goodman, 1998). Results from genetic studies in the North Sea and UK suggested the following three populations: Northern Ireland and Scotland; East England; and the Wadden Sea (NAMMCO 2006). In a new study, where samples from 259 individuals from 12 haul-out sites within southern Scandinavia were analysed for genetic variation at 15 microsatellite loci, strong genetic differentiation was observed between haul-out sites in the Skagerrak-Kattegat-western Baltic and the Limfjord-Wadden Sea regions respectively, indicating distinct historical origins (Olsen *et al.*, in press). The results support the delineation of four management units within southern Scandinavia waters in the North Sea area, corresponding to the Skagerrak, the Kattegat, the central Limfjord and the Wadden Sea; although their precise boundaries should be allowed some plasticity (Olsen *et al.*, in prep.).

Harbour seals on the Norwegian west coast, south of 62°N, are divided into two management units by the Norwegian Government based on their distribution: the counties of Rogaland (south) and Sogn and Fjordane (north). Although there have been no studies to determine whether these two management subunits are genetically distinct, the geographic distance between the subareas and the presence of two small colonies (each with 50+ seals) in the inner part of the Sognefjord in Sogn and Fjordane County, and in the Lysefjord in Rogaland County, suggest they may be discrete subunits. To date though, only one OSPAR EcoQO subunit has been proposed for western Norwegian waters (south of 62°N, see Table 3).

Stanley *et al.*, 1996 and Goodman, 1998 reported that genetic differentiation increases with geographic distance and where distribution is discontinuous; philopatry in harbour seals operates over 300–500 km. Similar findings have been reported by O'Corry-Crowe *et al.*, 2003 for Alaskan harbour seals. Although outside the EcoQO area, this structure seems to be supported by preliminary results from a genetic study of harbour seals from four different subareas (selection based on geographical distance) along mid and northern Norway. Genetic differentiation was observed between the areas, which included large differences in haplotype frequencies between seals from two neighboring areas in Finnmark County, the inner part of the Porsangerfjord and the western part of the county (A.K. Frie, Institute of Marine Research, Norway, pers. comm.).

The NAMMCO working group (2006) also reviewed results from satellite telemetry studies undertaken in several areas of the North Atlantic. Results from such experiments were generally consistent with respect to stock delineation:

- Harbour seals usually undertake relatively short excursions from their favoured haul-out sites, often less than 50 km; they may however range over much larger distances.

- Excursions vary between a few hours to 9 days and there is little evidence of extensive seasonal migrations.
- Harbour seals often tend to return to the same haul-out site, though they may make excursions to other haul-out sites. In areas with more or less continuous haul out possibilities, such as the Wadden Sea, individual harbour seals are seen to change haul-out sites regularly within a tag period (3–6 months), even moving more than 100 km (i.e. Dutch Delta to Helgoland; Texel to France and Schleswig Holstein).
- Behaviour may vary strongly between individuals, as some seals tend to undertake longer trips than others.
- There is little evidence of sexual differentiation in behaviour, but there may be variation in behaviour between age groups; younger seals are more prone to longer excursions and exchange between areas. Recaptures of tagged pups support such conclusions. Younger seals have been observed to move away from natal sites, but tended to return when they approach sexual maturity.

Satellite tagging of harbour seals in Denmark reveals movement patterns that were consistent with the stock structure suggested by genetic studies (NAMMCO 2006). Harbour seals tagged with satellite transmitters in the Netherlands were seen to move between Dutch, German, and even the Danish Wadden Sea. On several occasions seals were also observed off British, Belgian and French coasts.

6.1.2 Grey seal

The grey seal was a common species along mainland Europe and the UK during the Stone Age. Along mainland Europe numbers started to decline in the 11th century as a result of excessive hunting. The last local breeding population disappeared in the 16th century in the Wadden Sea and before 1900 in the Kattegat-Skagerrak Seas (Härkönen *et al.*, 2007). The Norwegian grey seal local population was reduced to very low levels during the 1950s as a consequence of overhunting. The largest colony in Froan (mid Norway) was reduced from 5–600 animals in the 1870s, to about 60 seals in the 1950s (Øynes, 1964). In 1953, grey seals were given a protected status in the Froan area, and since then, the population size has increased to approx. 1500–1700 seals in 2003 (Nilssen and Haug, 2003). Along the Norwegian North Sea coast, a few pups were born on the Kjør islands in Rogaland County in the 1960s (Øynes, 1964) and in the 1980s (Wiig, 1986). Over the last 25 years the number has increased to approx. 35–40 pups/year.

No regular pupping occurred further south, along the North Sea coast of mainland Europe, until the end of the 1970s when a breeding colony was established in the German Wadden Sea. In the 1980s, new breeding sites were established in the Dutch Wadden Sea, Helgoland, and off Brittany in France (Härkönen *et al.*, 2007). The re-sighting of marked seals and tracking of movements using telemetry indicate these seal groups are linked to the larger local populations in the UK.

Stock delineation

In 2003, a NAMMCO scientific working group recommended that a North Atlantic wide genetic study on the population structure of grey seals should be carried out to improve the basis for delineation of management units, and evaluation of the effects of removals (NAMMCO 2003). Boskovic *et al.*, 1996 reported significant large-scale differentiation between localities in Canada (NW), the Baltic Sea and Norway using mtDNA analysis. In addition, genetic differentiation between North Rona and the Isle of May in Scotland has been found using microsatellite analysis (Allen *et al.*, 1995).

Telemetric studies are very useful for studying various aspects of grey seal ecology, such as determining foraging areas, potential interactions between grey seals and fisheries, and providing information on the overlap in the distributional ranges of grey seal populations/stocks. Such studies have successfully been carried out in the UK.

Mainland Europe

In the Netherlands, grey seal numbers have grown from virtually zero in the 1970s, to the current estimate of almost 2000 animals counted during the moult. As pups cannot be appropriately counted (see ToR a), estimates of population size comparable with the UK have until present not been possible. Both in the Wadden Sea and the Delta area, grey seals employ tidal haulouts; although they do demonstrate a preference for haulouts that are less often submerged during moult and pupping seasons. Human interference makes it unlikely for seals to haulout on the mainland.

As a consequence of increasing numbers, the distributional range of the grey seal has expanded in the Wadden Sea. There is no information available on possible competition with harbour seals, or other top predators in the area.

Norway

Grey seals in Norwegian waters have been divided in three management subareas (Lista-Stad, Stad-Lofoten, Vesterålen-Finnmark); based on variations in the timing of pupping and geographic distance. Recent mtDNA analysis has verified genetic differentiation between these three management subunits (A.K. Frie, Institute of Marine Research, Norway, pers. comm.) and suggested a further demographically significant subdivision within the current management areas. Genetic analysis also suggested that the increase in grey seal numbers in Rogaland County is partly as a consequence of recruitment of seals from Scottish waters (Isle of May); although the genetic samples from Rogaland also include one unique haplotype and five haplotypes from other Norwegian and Russian local populations on the Murmansk coast (A.K. Frie, Institute of Marine Research, Norway, pers. comm.).

UK North Sea

As mentioned earlier, genetic differentiation between North Rona and the Isle of May in Scotland was reported using microsatellite analysis. Grey seal pup production in UK colonies bordering the North Sea is monitored annually. Details of the monitoring programme, including numbers of pups born in different areas, are provided annually (e.g. Duck and Mackey, 2008). While there are no formally established management units in the UK, pup production is reported regionally. EcoQO subunits have been defined according to these regional groups of breeding colonies (Table 3). While all major breeding colonies are included in the monitoring programme, a number of smaller colonies are not - such as seals breeding in caves along the northeast coast of Scotland. The EcoQO subunits recognized in the UK are: Shetland, Orkney, Isle of May and Fast Castle, Farne Islands, and Donna Nook.

Grey seal pup production in the UK North Sea is increasing at a reduced rate compared with previous years, with the exception of Shetland - where breeding success may be limited by the small number of suitable breeding locations and by wave action on exposed beaches. New colonies are incorporated into the monitoring programme as they become established and when requested, EcoQO subunits will be adjusted accordingly.

Long-term studies on reproductive performance are carried out on grey seals breeding on the Isle of May in the Firth of Forth and North Rona (Allen *et al*., 1995; Pomeroy *et al*., 2001).

6.2 EcoQO subunits

To date, it is possible to derive trends in local areas, but not to sum the North Sea totals of harbour and grey seals, as the frequency of counts varies between regions. To derive an overall North Sea trend, only the time-scales of the least frequent counts can be included, as a consequence of differences in data collection techniques (OSPARR biodiversity committee 2004). These local trends may not represent "real" populations. "Real" population boundaries are not known, so practicality dictates that population trends should be assessed in relation to boundaries of count techniques (OSPAR biodiversity committee 2004). Furthermore it is much more representative/informative to report on local trends. The current harbour and grey seal EcoQO subunits are presented in Table 3. The different subunits were selected according to survey effort, comparability of data, geographical separation and reliability of interpreting observed trends.

The WG was requested to review the geographical subunits for EcoQOs, taking into account biologically appropriate management units for seals in the North Sea.

Table 3. Current EcoQO subunit boundaries for North Sea populations. Superscripts indicate the counting technique (OSPAR, 2007).

	Harbour seal		Grey seal
UK	Shetland [1]	UK	Orkney
	Orkney [1]		Fast Castle/Isle of May
	North and East Scotland [1,2,3]		Farne Islands
	Southeast Scotland [2]		Donna Nook
	Greater Wash/Scroby Sands [2]	France	North Sea and channel coasts
Netherlands	Delta area [2]	Netherlands	Coast
Netherlands, Denmark and Germany	Wadden Sea [2]	Germany	Schleswig-Holstein Wadden Sea
Germany	Helgoland [3]		Helgoland
Denmark	Limfjord [2]	Denmark	Limfjord
Denmark, Sweden and Norway	Kattegat, Skagerrak and Oslofjord [2]	Norway	Kjørholmane (Rogaland)
Norway	West coast, South of 62oN [2,3]		

[1] Aerial surveys using thermal imaging, [2] Aerial surveys using oblique photography, [3] Land-based counts.

For harbour seals, as a result of the genetic study by Olsen *et al*., in prep., the WG **recommends** the use of these four management units within southern Scandinavia waters in the North Sea area: (1) Skagerrak, (2) Kattegat, (3) central Limfjord and (4) the Wadden Sea; therefore splitting the current EcoQO subunit Kattegat, Skagerrak and Oslofjord (see Tables 3 and 4). Furthermore, slight alterations to the UK EcoQO subunit names were proposed; North-east Scotland (Moray Firth), South-east Scotland (Firth of Tay), and Greater Wash

(Humber Estuary to Scroby Sands). These definitions more accurately describe the areas that are monitored most frequently.

Table 4. New proposed subunit boundaries for the North Sea seal populations. Superscripts indicate the counting technique.

Harbour seal		Grey seal	
UK	Shetland [1]	UK	Orkney
	Orkney [1]		Firth of Forth colonies (Fast Castle, Isle of May)
	North-east Scotland (Moray Firth) [1,2,3]		Farne Islands
	South-east Scotland (Firth of Tay) [2]		Greater Wash (Donna Nook and adjacent colonies)
	Greater Wash (Humber Estuary to Scroby Sands)		
Netherlands	Delta area [?]	Netherlands	Coast
Netherlands, Denmark and Germany	Wadden Sea [2]	Germany	Wadden Sea
Germany	Helgoland [3]		Helgoland3
Denmark	Limfjord [2]	Norway	Rogaland
Denmark and Sweden	Kattegat [2]		
Denmark, Sweden and Norway	Skagerrak & Oslofjord [2]		
Norway	South of 62oN Rogaland - *Sogn-fjordane* [2,3]		

[1] Aerial surveys using thermal imaging, [2] Aerial surveys using oblique photography, [3] Land-based counts.

For grey seals, the WG **recommends** using the current OSPAR EcoQO grey seal subunits, as outlined in 2007 OSPAR handbook. Again, slight alterations to the UK EcoQO subunit names were proposed; Firth of Forth colonies (Fast Castle, Isle of May), Greater Wash (Donna Nook and adjacent colonies) in order to include two recently established colonies from Norfolk. The German subunit was renamed the German Wadden Sea. Further the removal of the grey seal "French North Sea and Channel coast" subunit was proposed, as we questioned whether they were geographically within the boundary of the North Sea. There have been no recent genetic studies undertaken on grey seals in the North Sea.

6.3 Remarks and recommendations

- The level of differentiation required between harbour and grey seal stocks will depend on the general objectives of the management programme. A finer level of stock delineation will be required for objectives related to harvest management than for objectives related to conservation of viable populations without hunting.
- The WG **recommends** that genetic studies of harbour seals should be carried out in areas where such information is lacking, in particular for populations were hunting is conducted. Samples for genetic analyses should be obtained from breeding sites whenever possible. Genetic studies should use a standard set of markers, including those used in previous studies.
- Based on results from a recent genetic study, the WG **recommends** the use of four management units within southern Scandinavia waters in the North Sea area: (1)

Skagerrak, (2) Kattegat, (3) central Limfjord and (4) the Wadden Sea; therefore splitting the current EcoQO subunit Kattegat, Skagerrak and Oslofjord.

- The WG **recommends** using the current OSPAR EcoQO grey seal subunit boundaries, as outlined in the 2007 OSPAR handbook.
- A Northeast Atlantic wide genetic study of grey seal population structure should be initiated. The study should be carried out by coordinating the activities already ongoing in the distribution area of the species. The study should be standardized and use the same genetic markers.
- Regular surveys are required to determine trends for all harbour and grey seal management subunits.
- Removals of harbour and grey seals, catch and bycatch, should be recorded for all subunits.

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7 ToR d. Review any further information/analyses from SCANS II/CODA and make recommendations

7.1 CODA survey

During summer of 2007, four countries participated in a coordinated international survey to estimate marine mammal abundance in the offshore waters of the Northeast Atlantic as part of the *Cetacean Offshore Distribution and Abundance in the European Atlantic* (CODA) project. The specific objectives of CODA were:

- to map summer distribution of the main cetacean species found in offshore waters of the Northeast Atlantic (common and striped dolphins, bottlenose dolphins, fin, sei and minke whales), and deep diving whale species such as sperm, beaked and pilot whales
- to generate unbiased abundance estimates for these species
- to investigate their habitat use and
- to continue the development of the management framework developed during SCANS-II in order to assess the impact of bycatch on common dolphins and to calculate safe bycatch limits for this species in European waters.

A total of 9650 km was surveyed in July 2007, covering an area of 967 538 km^2 extending west from the limit of the shelf, to the boundary of the EEZ's (Exclusive Economic Zone) of the UK, Ireland, France and Spain. The area was divided into four blocks (see Table 5 and Figure 4), with each block surveyed by a different vessel following transects designed to obtain a representative sample (equal coverage probability) of the area. CODA used the same visual survey methodology as SCANS-II (i.e. the "trial configuration"), with two observer teams on each ship acting independently; for details see Laake and Borchers, 2004, Macleod *et al*., 2008 and SCANS-II, 2008. Passive acoustic detection systems already used during the SCANS-II survey were also deployed by each vessel with the aim of generating an abundance estimate for sperm whales and collecting acoustic data on delphinids. From the visual methods, CODA aimed to provide, for the first time, estimates of abundance for some species for which no prior data were available in offshore waters (i.e. bottlenose dolphins, sperm whales, beaked whales, etc.) and also to obtain unbiased abundance estimates for common dolphins and baleen whales for which only partial estimates of abundance were available prior to CODA (i.e. from the MICA, NASS and SIAR surveys-Goujon *et al*., 1993; Cañadas *et al*., 2004; Ó'Cadhla *et al*., 2004). Furthermore, the estimates produced by previous studies did not take into account some of the sources of bias identified in cetacean surveys, in particular, incomplete detection of animals on the track line and the responsive movement of animals in relation to the vessel.

Table 5. Block sizes, realized effort and planned effort by the 5 vessels during the CODA survey. The table also indicates the percentage of the planned effort which was achieved in each block. Surveys took place in July 2007.

Block	Ship	Surface area (km2)	Total effort (km) Beaufort<6	Planned effort (km)	% effort achieved
1	Mars Chaser	348 722	3409	3773	90.3
2	Rari and Germinal	336 407	2297	3299	69.6
3	Coornide de Saavedra	160 537	2180	2251	96.9
4	Investigador	121 872	1765	2065	85.5
Total		967 538	9651	11 388	84.8

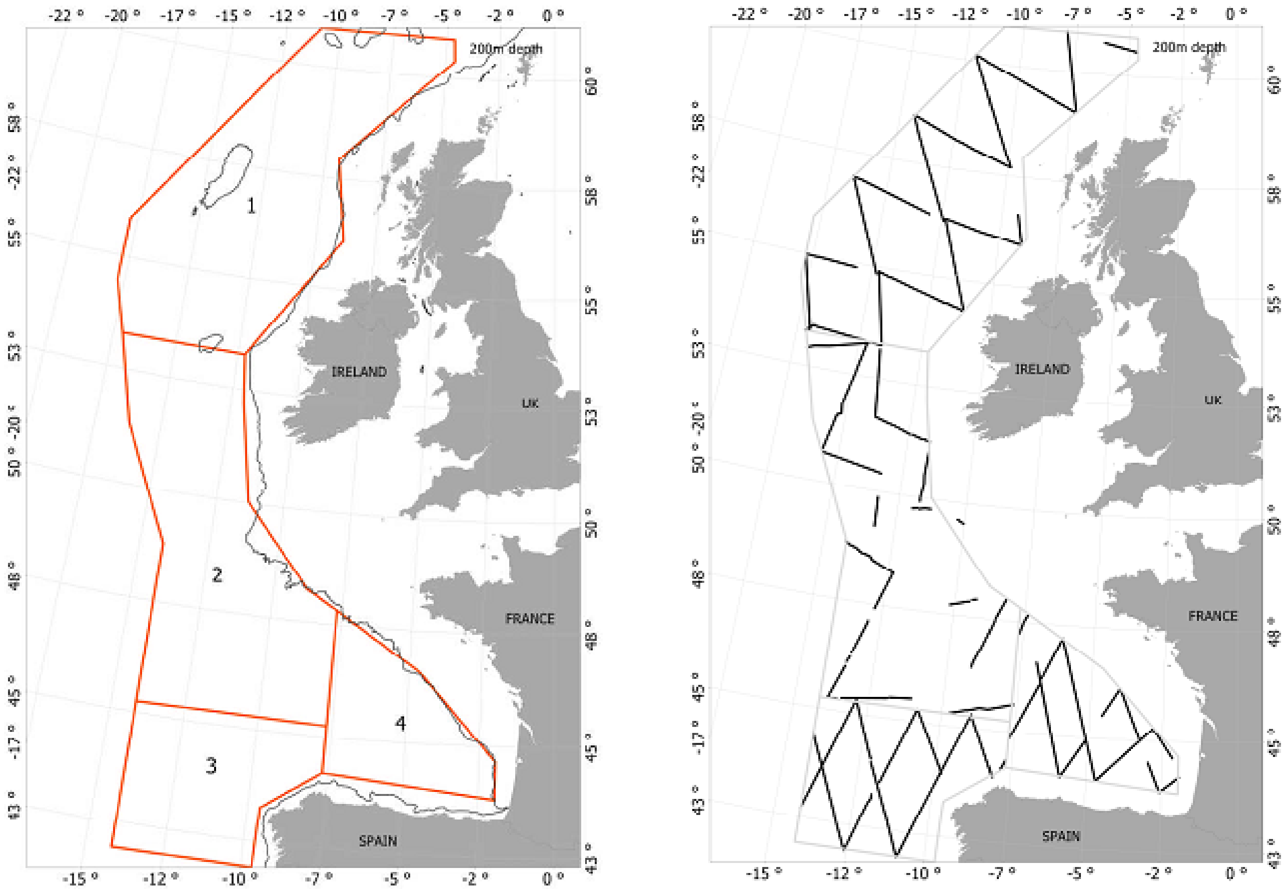

Figure 4. Survey region showing the blocks in which the area was divided and the realized effort achieved in good conditions (Beaufort sea state < 5) in each block (right figure). (Only data collected during Beaufort sea state 0–4 were used to estimate abundance).

7.1.1 Estimates of abundance

Sighting numbers varied greatly between species. The numbers of observations available to fit detection functions for the main species/categories are given in Table 6.

Small sample sizes restricted the design-based analysis to the conventional line transect method for minke whales, bottlenose dolphins and beaked whales; estimates are given in Table 7. Abundance could not be estimated for white-sided dolphins as only 14 sightings were made.

Design-based estimates of abundance for the remaining species/categories were made using mark-recapture distance sampling (MRDS) analysis (for details see Borchers *et al*., 1998, 2006; Macleod *et al*., 2008), which has been developed in an attempt to correct for biases as a consequence of reactive movement by animals in response to the survey ship. Table 8 lists the abundance estimates obtained for the different species, together with the values for density (animals/km^2) and coefficient of variations (CVs).

Model-based abundance estimates were calculated using Density Surface Modelling (DSM) techniques, with the aim of improving the precision of the abundance estimates and to obtain information on habitat use. Details of the methodology are given in Cañadas and Hammond, 2008. Results from the DSM for the main species are given in Table 9. In general, abundance estimates obtained by both methods (design-based and model-based) were very similar, though better precision was obtained using the model-based approach (smaller CVs) for almost all the species/groups, with the exception of the beaked whales and pilot whales for which slightly better precision was achieved with the design-based method.

Best estimates for each species are therefore those obtained by the model-based method for common and striped dolphins, fin, sei and sperm whales and the category "large whales", and those obtained by the design-based method for beaked and pilot whales (Table 10).

7.1.2 Mapping summer distributions and investigating habitat use

Density surface modelling also provided information on the spatial distribution of abundance and habitat use.

Common and striped dolphins displayed a similar distribution, with higher densities predicted to occur in the southern part of the surveyed area (Bay of Biscay), and associated with the shelf break. Highest densities of long-finned pilot whales were predicted to occur in the northwestern part of the surveyed area; associated with deep waters, seabed slopes with a southeast orientation and warmer temperatures. Two main areas of distribution were predicted for beaked whales in the surveyed area: the inner part of the Bay of Biscay in association with the deep underwater canyons; and in the northwestern part of the surveyed area, west of the Hebrides, Scotland. Sperm whale predicted density was highest in northwestern waters of the Iberian Peninsula, the inner part of the Bay of Biscay, and off the northwest coast of the Hebrides. Higher densities of fin whales were predicted in the southern part of the surveyed area, in areas of sea surface temperature ranging from 16–19˚C, and depths between 1000–3000 m.

7.1.3 Acoustic data

For passive acoustic detection of cetaceans, each vessel towed a hydrophone. These were the same hydrophones used during the SCANS II survey 2005, but had additional hydrophone elements and were extended with an extra 200 m of cable. To date, only data obtained on high frequency harbour porpoise clicks and broadband recordings of sperm whales have been analysed. CODA data from one of the vessels (Mars Chaser), which had been used to collect acoustic successfully during the SCANS II survey, were too noisy to analyse. The main difference between the CODA survey and previous studies was that all acoustic data were recorded then processed offline, rather than being processed in real time.

Only one harbour porpoise detection was made, which is not unsurprising because most of the CODA survey effort was conducted in deeper waters. Broad band (200 Hz to 90 kHz bandwidth) recordings were made for the detection of other odontocete species, and sperm whale abundance was estimated using broadly similar methods employed by previous acoustic studies (Leaper *et al.*, 2000; Lewis *et al.*, 2007).

In total, 247 sperm whales were detected. Although occurring mostly in groups of up to tens of animals, the majority of sperm whales could be individually tracked (and a perpendicular distance calculated). Sperm whale abundance for blocks 2, 3 and 4 (the French and Spanish sectors of the survey) were 2239 (95% CI: 1707–2936) animals which is higher than, but not statistically different from, the visual survey estimate of sperm whale abundance for all blocks.

The vocal behaviour of sperm whales (regular loud clicks, produced for a high percentage of the time) makes them relatively easy to survey acoustically and the assumption that all, or nearly all, animals close to the trackline are detected is probably safe. At present, it has not been possible to determine absolute abundance for any other species using line transect survey data, as a consequence of difficulties in identifying all calls to species. However, recent advances in call recognition (e.g. Gillespie and Caillat, 2008) suggest that relative measures of abundance will be possible for a wider range of species in the near future.

Table 6. Sample sizes available for fitting detection functions. Numbers of schools detected within the truncation distance of the transect line by observer 1 (primary), observer 2 (tracker) and both (i.e. duplicates) while on search effort. Data from sea states 0–4 were used in all cases. Note that for bottlenose dolphins there were only 30 sightings in total and 22 sightings for minke whales.

Species	Seen by	Number of sightings
Common dolphin, striped dolphin, common/striped	Tracker	173
	Primary	165
	Duplicate	73
Long-finned pilot whales	Tracker	59
	Primary	46
	Duplicate	19
All pilot whales	Tracker	62
	Primary	49
	Duplicate	21
Fin whales	Tracker	203
	Primary	187
	Duplicate	85
Large whales (fin whales, sei whales and fin/sei)	Tracker	223
	Primary	204
	Duplicate	92
Sperm whales	Tracker	47
	Primary	31
	Duplicate	17
Beaked whales	Tracker	26
	Primary	23
	Duplicate	7

Table 7. Results from the CODA survey, conventional line transect abundance estimates. Figures in parentheses are the coefficient of variation (CVs) while the numbers in square brackets correspond to the 95% confidence intervals. Updated from Macleod *et al.*, 2008.

Species	Block	Animal abundance	Animal density (animals/km2)
Bottlenose dolphin	1	5709 (0.35)	0.02 (0.35)
	2	11 536 (0.33)	0.03 (0.33)
	3	876 (0.82)	0.005 (0.82)
	4	1174 (0.45)	0.01 (0.45)
	Total	19 295 (0.25) [11 842–31 440]	0.020 (0.25)
Minke whales	1	5547 (1.03)	0.016 (1.03)
	2	1218 (1.04)	0.004 (1.04)
	3	0	0
	4	0	0
	Total	6765 (0.99) [1239–36 925]	0.007 (0.99)
Beaked whales	1	3512 (0.33)	0.01 (0.34)
	2	785 (0.43)	0.002 (0.43)
	3	597 (0.55)	0.004 (0.55)
	4	2097 (0.45)	0.017 (0.45)
	Total	6992 (0.25) [4287–11 403]	0.0072 (0.25)

Table 8. Results from the CODA survey, estimates of animal abundance and animal density (animals/km²) using the design-based (MRDS) approach. Figures in parentheses are the coefficient of variation (CVs) while the numbers in square brackets correspond to the 95% confidence intervals. Updated from Macleod et al., 2008. [Large baleen whale: includes fin, sei and any unidentified large baleen whale].

Species	Block	Animal abundance	Animal density (animals/km2)
Common dolphin	1	3546 (0.76)	0.01 (0.76)
	2	53 638 (0.54)	0.16 (0.54)
	3	12 378 (1.23)	0.08 (1.23)
	4	48 701 (0.51)	0.40 (0.51)
	Total	118 264 (0.38) [56 915–246 740]	0.12 (0.38)
Striped dolphin	1	519 (1.05)	0.0015 (1.05)
	2	33 254 (1.57)	0.10 (1.57)
	3	7546 (0.62)	0.05 (0.62)
	4	20 045 (0.56)	0.16 (0.56)
	Total	61 364 (0.93) [12 323–305 568]	0.06 (0.93)
Common, striped + common/striped	1	4065 (0.67)	0.012 (0.67)
	2	115 398 (0.80)	0.343 (0.80)
	3	24 551 (0.66)	0.153 (0.67)
	4	80 152 (0.37)	0.658 (0.37)
	Total	224 166 (0.48) [90 979–552 331]	0.232 (0.48)
Fin whales	1	248 (0.45)	0.001 (0.45)
	2	3668 (0.34)	0.011 (0.34)
	3	3113 (0.22)	0.019 (0.22)
	4	595 (0.72)	0.005 (0.72)
	Total	7625 (0.21) [5028–11 563]	0.008 (0.21)
Sei whales	1	0	0
	2	0	0
	3	366 (0.33)	0.002 (0.33)
	4	0	0
	Total	366 (0.33) [176–762]	0.0004 (0.33)
Large baleen whales	1	250 (0.44)	0.0007 (0.44)
	2	3853 (0.33)	0.011 (0.33)
	3	3 529 (0.22)	0.022 (0.22)
	4	605 (0.72)	0.005 (0.72)
	Total	8237 (0.20) [5475–12 390]	0.008 (0.20)
Unidentified large whale	1	352 (0.43)	0.001 (0.43)
	2	5997 (0.43)	0.018 (0.43)
	3	226 (0.32)	0.001 (0.32)
	4	26 (0.71)	0.0002 (0.71)

Species	Block	Animal abundance	Animal density (animals/km2)
	Total	6601 (0.40) [3003–14 512]	0.007 (0.40)
Large baleen whale + unidentified large whale	1	574 (0.27)	0.002 (0.27)
	2	9648 (0.37)	0.029 (0.37)
	3	3636 (0.19)	0.022 (0.19)
	4	693 (0.70)	0.006 (0.70)
	Total	14 550 (0.26) [8561–24 729]	0.015 (0.26)
Fin whale + unidentified large whale	1	574 (0.27)	0.002 (0.27)
	2	9493 (0.37)	0.028 (0.37)
	3	3207 (0.19)	0.020 (0.19)
	4	693 (0.70)	0.006 (0.70)
	Total	13 966 (0.27) [8088–24 119]	0.014 (0.27)
Long finned pilot whales	1	18 709 (0.37)	0.054 (0.37)
	2	5566 (0.75)	0.017 (0.75)
	3	194 (0.88)	0.001 (0.88)
	4	632 (1.10)	0.005 (1.10)
	Total	25 101 (0.33) [13 251–47 550]	0.026 (0.33)
All pilot whales	1	22 034 (0.37)	0.063 (0.37)
	2	4148 (0.55)	0.012 (0.55)
	3	238 (0.91)	0.001 (0.91)
	4	358 (0.91)	0.003 (0.91)
	Total	26 778 (0.34) [13 835–51 831]	0.028 (0.34)
Sperm whales	1	363 (0.46)	0.001 (0.46)
	2	759 (0.52)	0.002 (0.52)
	3	560 (0.55)	0.003 (0.55)
	4	409 (0.55)	0.003 (0.55)
	Total	2091 (0.34) [1077–4057]	0.002 (0.34)

Table 9. Results from the CODA survey, estimates of animal abundance and animal density (animals/km²) using the model-based (DSM) approach. Figures in parentheses are the coefficient of variation (CVs) while the numbers in square brackets correspond to the 95% confidence intervals. [Large baleen whale density data cannot be included at this stage].

Species	Block	Animal abundance	Animal density (animals/km2)
Common dolphin	1	4216 (0.57)	0.012 (0.57)
	2	52 749 (0.39)	0.157 (0.39)
	3	21 071 (0.51)	0.131 (0.51)
	4	38 673 (0.46)	0.317 (0.46)
	Total	116 709 (0.34) [61 397–221 849]	0.121 (0.34)
Striped dolphin	1	272 (0.80)	0.0008 (0.80)
	2	39 534 (0.62)	0.118 (0.62)
	3	10 501 (0.42)	0.065 (0.42)
	4	17 108 (0.44)	0.140 (0.44)
	Total	67 414 (0.38) [32 543–139 653]	0.070 (0.38)
Common, striped and common/striped	1	2317 (0.74)	0.007 (0.74)
	2	108 614 (0.35)	0.323 (0.35)
	3	26 010 (0.34)	0.162 (0.34)
	4	122 664 (0.49)	1.007 (0.49)
	Total	259 605 (0.37) [128 818–523 175]	0.268 (0.37)
Long finned pilot whales	1	18 255 (0.38)	0.0523 (0.38)
	2	6054 (0.43)	0.0180 (0.3)
	3	429 (0.69)	0.0027 (0.69)
	4	599 (0.46)	0.0049 (0.46)
	Total	25 338 (0.35) [19 212–49 725]	0.0262 (0.35)
Sperm whales	1	480 (0.33)	0.0014 (0.33)
	2	509 (0.38)	0.0015 (0.38)
	3	611 (0.37)	0.0038 (0.37)
	4	477 (0.33)	0.0039 (0.33)
	Total	2077 (0.20) [1404–3073]	0.0021 (0.20)
Beaked whales	1	3889 (0.44)	0.0112 (0.44)
	2	642 (0.39)	0.0019 (0.39)
	3	656 (0.34)	0.0041 (0.34)
	4	2156 (0.50)	0.0177 (0.50)
	Total	7343 (0.31) [4075–13 230]	0.0076 (0.31)
Fin whale	1	204	
	2	4854	
	3	3206	
	4	755	

Species	Block	Animal abundance	Animal density (animals/km2)
	Total	9019 (0.11) [7265–11 197]	
Large baleen whales	1	206	
	2	5171	
	3	3487	
	4	756	
	Total	9619 (0.11) [7760–11 924]	

Table 10. Design-based and model-based abundance estimates for the whole survey area. Best estimates (based on lower CV) are shown in bold.

Species	Design-based abundance estimate (CV)	Model-based abundance estimate (CV)
Common dolphin	118 264 (0.38)	116 709 (0.34)
Striped dolphin	61 364 (0.93)	67 414 (0.38)
Common and striped dolphin	224 166 (0.48)	259 605 (0.37)
Sperm whale	2091 (0.34)	2077 (0.20)
Fin whale	7641 (0.21)	9019 (0.11)
Large baleen whales	8237 (0.20)	9619 (0.11)
Long-finned pilot whale	25 101 (0.33)	25 338 (0.35)
Beaked whales	6992 (0.25)	7343 (0.31)

7.1.4 Statistical power to detect trends

Recent information on statistical power to detect trends in cetacean population abundance using large-scale surveys such as SCANS, SCANS-II and CODA is presented and discussed in ToR F.

7.2 SCANS II and CODA management framework

In the WG report from last year (WGMME 2008) we described the management framework developed as part of the SCANS-II project for harbour porpoises in the European Atlantic and North Sea. The framework used all the available information (on population abundance, estimates of bycatch, biology, etc.) to generate "safe" bycatch limits for harbour porpoises in the Northeast Atlantic and North Sea, which would allow specified conservation objectives to be achieved, e.g. as set by a number of International Agreements such as ASCOBANS (Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas) and the Habitats Directive.

Since last year's report, results have become available from further work carried out on harbour porpoises in the North Sea (SCANS-II 2008; Winship, 2009), and common dolphin in the Northeast Atlantic (CODA 2009). A brief summary of these results is presented in this section, and for a more detailed account on the methodology and data used see Annex 1.

SCANS-II 2008 and Winship, 2009 explored the performance of two candidate management procedures for calculating bycatch limits: the CLA (Catch Limit Algorithm) and PBR (Potential Biological Removal). The CLA procedure, developed for commercial whaling by the IWC, uses time-series of both population abundance estimates and bycatch data. The PBR procedure, employed by the USA Government, only uses a single estimate of population size. Both procedures explicitly incorporate uncertainty in the estimates of population size (see WGMME 2008). A series of simulations were performed to compare the behaviour of both procedures, to tune the procedures to specific conservation objectives, and to test the robustness of the procedures to a range of uncertainties regarding population dynamics and structure, the environment, observation and implementation. Three possible interpretations of the ASCOBANS conservation objective ((1) population to recover to and/or be maintained *at* 80% of carrying capacity; (2) *at or above* 80%; and (3) *at or above* 80% of carrying capacity i*n a worst case scenario*) were used to tune the management procedures, because no other specific conservation objectives are available for cetaceans in western European waters.

Preliminary annual bycatch limits for harbour porpoise in the North Sea are outlined in Table 11 (taken from SCANS-II 2008). These values ranged from 187–1685 depending on the procedure, tuning (conservation objectives) and management areas used (SCANS-II 2008; Winship, 2009). Bias in estimates of abundance and bycatch affected the performance of both management procedures. The less information that was available (i.e. fewer, less precise surveys), the lower the bycatch limits. Overall, bycatch limits would be more stable over time under the CLA procedure, which could make management actions to implement them easier. For harbour porpoise in the North Sea, there are estimates of historical bycatch and two estimates of abundance (11 years apart) so there is an advantage in using the CLA procedure. It should be noted though that the time-series of harbour porpoise historical bycatch data used in the CLA approach were very likely underestimates of the true historical bycatch, as a consequence of a lack of data.

WGMME 2008 recommended that of the two approaches (a PBR type procedure and a CLA type procedure) tested in SCANS II, the WGMME agrees with the advice from SCANS II and **recommends** that ICES consider the CLA approach for future evaluation of bycatch levels and advice on conservation objectives management actions.

Satisfactory performance of the first and second tunings depends on the availability of unbiased data on abundance and bycatch. The third tuning is a highly conservative approach to maintaining a population *at or above* 80% of carrying capacity *in a worst-case situation*, where time-series of estimates of abundance and bycatch might be considerably biased upwards and downwards, respectively. In light of the available data, the WG **recommends** the third tuning CLA approach for future evaluation of bycatch levels and advice on conservation objectives management actions.

Harbour porpoise population structure within the North Sea is further assessed in ToR b.

The CODA project further developed the management framework produced by SCANS-II, and applied it to calculate preliminary "safe" bycatch limits for common dolphins in European waters. A detailed account on the bycatch management for common dolphins is given in Annex 1. The SCANS-II and CODA abundance estimates were combined to obtain a single population estimate for the species (180 075, CV=0.272). Again, three different tunings (with the three possible interpretations of the ASCOBANS conservation objective: population to recover to and/or be maintained *at* 80% of carrying capacity; *at or above* 80% and *at or above* 80% of carrying capacity i*n a worst case scenario*) were developed for common dolphins inhabiting the management area (SCANS-II and CODA survey areas; see ToR b for further information on common dolphin population structure). Estimated bycatch limits are given in Table 12 (taken from CODA 2009).

As mentioned above, the only input to the PBR procedure is a single estimate of abundance, whereas the CLA procedure makes use of information on current and historical bycatch rates, and multiple estimates of abundance, if available, to give a more informed assessment of population status. Historical estimates of bycatch for common dolphins are available for some fisheries in the Northeast Atlantic (reviewed in WGMME 2008 and see also results of the NECESSITY project) and potentially there are also other available estimates of abundance prior to the SCANS-II/CODA surveys. For example, Cañadas *et al*., in press estimated 273 159

(CV=0.26) common dolphins in block W of the North Atlantic Sighting Survey (NASS) in 1995, although the NASS survey area was further offshore compared with SCANS-II and CODA (see WGMME, 2008 for map outlining survey areas). The availability of historical data on bycatch and abundance confers an advantage to using the CLA procedure. However, it should be noted that annual common dolphin estimates of bycatch are only minimum estimates, because only limited data are available for a few fisheries (WGMME, 2008). An additional feature of the CLA procedure is its internal protection mechanism, which enhances the recovery of depleted populations by setting bycatch to zero if the population is estimated to be, in the present case, <50% of carrying capacity. It was concluded that the features of the CLA procedure and the advantages that these confer are sufficient for it to be considered as the best bycatch management procedure for common dolphins in the Northeast Atlantic. The three tunings developed were considered suitable for achieving the conservation objective adopted from ASCOBANS, but as a consequence of the high uncertainty in some of the available data the WG **recommends** the use of the third tuning CLA approach. A re-evaluation of the approach would be undertaken in future when additional information, in particular bycatch, becomes available.

Table 11. Example bycatch limits for harbour porpoise in the North Sea using three versions (tunings) of the PBR and CLA management procedures. Tuning 1: population to recover to and/or be maintained at 80% of carrying capacity. Tuning 2: population to recover to and/or be maintained at or above 80% of carrying capacity. Tuning 3: population to recover to and/or be maintained at or above 80% of carrying capacity in a worst case scenario. [Reproduced from Winship, 2008].

AREA	PBR TUNING			CLA TUNING		
	1	2	3	1	2	3
North Sea	1685	1246	403	1449	840	211
Northern North Sea	698	516	166	1075	623	156
Southern North Sea	964	712	230	216	125	31

Table 12. Bycatch limits for common dolphin in the combined SCANS-II/CODA survey area calculated using three versions (tunings) of the PBR and CLA management procedures. Tuning 1: population to recover to and/or be maintained at 80% of carrying capacity. Tuning 2: population to recover to and/or be maintained at or above 80% of carrying capacity. Tuning 3: population to recover to and/or be maintained at or above 80% of carrying capacity in a worst case scenario. The PBR procedure used only the abundance estimate. Two sets of limits are given for the CLA procedure: one based solely on the abundance estimate and one based on the abundance estimate and the time-series of historical bycatch up to mid-2006. [Reproduced from CODA, 2009].

Historical bycatch data used	PBR tuning			CLA tuning		
	1	2	3	1	2	3
No	1524	1092	345	1909	1061	280
Yes	-	-	-	1547	860	227

7.2.1 Bycatch management

As stated in CODA project report, "the development of the bycatch management procedures under CODA and SCANS-II has great potential for conservation benefit. The procedures provide a means to calculate safe limits to bycatch that will allow conservation objectives to be met in the long term. They can thus form part of long-term strategies to manage bycatch. However, the benefits are not immediate because there are policy decisions to be made before a particular procedure can be implemented.

Before a management procedure can be implemented for a particular species in a particular region, the following steps need to be taken:

Agreement by policy-makers on the exact conservation/management objective(s);

Agreement by policy-makers to implement the procedure for one or more species in one or more regions;

Consideration by scientists of whether or not the available information for each species indicates that there is a need to conduct further simulation testing to examine uncertainties that may not have been fully explored;

In particular, if there is evidence of subpopulation structure, consideration by scientists of any further simulation testing required and/or identification of any subareas that may be considered to contain subpopulations;

In addition, if there is evidence of historical bycatch but no data, consideration by scientists of any further simulation testing required including the generation of appropriate dataseries based on the best available information;

Final determination by scientists, based on the results of Steps 3–5, of how to implement the procedure for each species/region;

Agreement by policy-makers to implement the procedure;

Generation by scientists of bycatch limits for a specified period (e.g. five years);

Establishment of a mechanism for feedback of information from bycatch monitoring programmes to inform the next implementation of the procedure when the period for which bycatch limits have been set expires.

Step 1 is clearly best made at the European level. Similarly, Step 2 should ideally be made collectively although most species do not occur in all parts of the European Atlantic. Steps 3–6 can be done by the team of scientists that have developed the procedure or by others under their supervision/instruction. The amount of work involved depends on the species. The work accomplished in the SCANS-II and CODA projects for the harbour porpoise and common dolphin means that for these species these steps could be completed fairly rapidly; other species will take longer. Step 7 is another that should be made at the European level; Step 8 can then be taken immediately. Step 9 is very important because removals from a population need to be incorporated when the procedure is re-implemented and this new information (or lack of it) may determine which tuning of the procedure is implemented in future".

7.3 Recommondations

We recommend:

- the continuity of surveys to estimate absolute abundance such as SCANS-II and CODA, at least with a frequency between 5–10 years. If possible both the shelf and offshore waters should be covered simultaneously;
- the continuation of the development of a click classification procedure that would allow the isolation of common dolphin vocalisations, to obtain distribution maps for the species with the acoustic data and to compare with those obtained from visual data;
- the improvement of the procedure for assessing the impact of bycatch on common dolphin populations by including further data on: historical estimates of abundance and the age structure of natural mortality;
- the improvement of the current estimates of incidental capture rates for common dolphins, especially as a consequence of a lack of adequate historical bycatch estimates;
- that ICES and DG MARE consider the CLA approach for future evaluation of bycatch levels and advice on conservation objectives management actions in both harbour porpoises and common dolphins.

We strongly recommend:

- the continuation, and establishment in some cases, of national observer bycatch programmes in order to obtain current estimates of incidental capture for all marine mammal species;
- that the bycatch management procedures developed under SCANS-II and CODA projects are taken into consideration by DG MARE when reviewing the EU Regulation 812/2004.

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7.5 Update on research undertaken by PINRO

The Polar Scientific Institute of Marine Fisheries and Oceanography (PINRO) conducts annual scientific studies on marine mammals. The main objectives are to determine distribution and abundance, investigate the behaviour and biology, and to evaluate the influence of marine mammals on fishery resources and the ecosystem as a whole. The data are collected by means of large- and small-scale aerial, ship and coastal surveys, and the survey area includes the Kara, White, Barents, Norwegian Seas and the North Atlantic Ocean.

7.5.1 Background

PINRO conducts long-term studies on marine mammals, with the first aerial survey on harp seal undertaken in the White Sea between 1927 and 1928. From 1959 until the mid-1970s, surveys were carried out every 3 to 4 years (with progressive technical improvements). Also during this period, while the Soviet Union continued whaling, scientific aircrafts were used for searching and estimating the abundance of large cetaceans. Between 1994 and 1997, a multispectral method of surveying, combining visual and infrared techniques, was developed. Since 1998, a specially built and equipped aircraft AN-26 "Arctica" has carried out aerial surveys; permitting long-distance flights without landing, thus allowing surveys of remote areas.

During 1950s and 1960s, the distribution and abundance of large cetaceans from the platforms of whaling vessels were conducted by PINRO staff, until whaling ceased. After which, investigations were limited to those assessing the abundance of white whales. In 2002, ship-based surveys recommended that marine mammal observers partook in various fishery and hydrological surveys conducted by the PINRO and foreign colleagues. The majority of sightings were opportunistic before summer of 2007, at which time PINRO staff participated (planning, collection of data and analysis of results) in the T-NASS survey, which used Russian, Norwegian and Icelandic vessels.

Coastal monitoring, by both land and boat, has been conducted annually since 2003. The main objectives are to assess the distribution, abundance, biology and prey of harbour, grey, ringed and bearded seals, harbour porpoises and minke whales.

7.5.2 Methodology of ship and aerial sighting surveys

Initially, data collection was sporadic, not systematic, as observers had other duties whilst on board. Observer effort increased from 2002 onwards, when PINRO staff participated in the Joint Russian-Norwegian Ecosystem Survey of the Barents Sea. Further, the sighting methodology was modified as a consequence of NAMMCO recommendations in 2007, in order to make data more comparable with those collected by European colleagues. As a result, when funding and opportunities permitted it, two marine mammal observers partook in sighting surveys. Observations were made from the bridge; each observer covered a 90° sector, from 0° to 90° on either side of the vessel. When only one observer was present, one sector (0° to 180°) was covered.

Table 13. The results of observations of marine mammals in the Barents Sea area in 2008.

Species	Period				Number of observed animals	%	Number of sightings	% sightings
	Winter	Spring-summer	Summer-autumn	Autumn				
Minke whale	-	3	153	-	156	4.31	150	25.77
Blue whale	-		3	-	3	0.08	3	0.52
Humpback whale	-	3	92	-	95	2.62	48	8.25
Fin whale	-	12	71	-	83	2.29	58	9.97
Northern bottlenose whale	-	-	-	6	6	0.17	2	0.34
Sperm whale	-	-	10	-	10	0.28	10	1.72
Killer whale	-	6	17	-	23	0.64	9	1.55
White whale	-	-	65	-	65	1.80	37	6.36
White-beaked dolphin	100	1164	1392	20	2676	73.92	150	25.77
Harbour porpoise	5	-	31	-	36	0.99	11	1.89
Walrus	-	-	3	-	3	0.08	2	0.34
Harp seal	-	-	181	-	181	5.00	19	3.26
Hooded seal	-	-	1	-	1	0.03	1	0.17
Ringed seal	-	-	1	-	1	0.03	1	0.17
Whale sp.	-	1	51	-	9	0.25	38	6.53
Dolphin sp.	-	3	167	-	170	4.70	16	2.75
Seal sp.	-	-	57	-	57	1.57	25	4.30
Polar bear	-	-	2	-	2	0.06	2	0.34
Total	105	1192	2297	26	3620	100	582	100.00

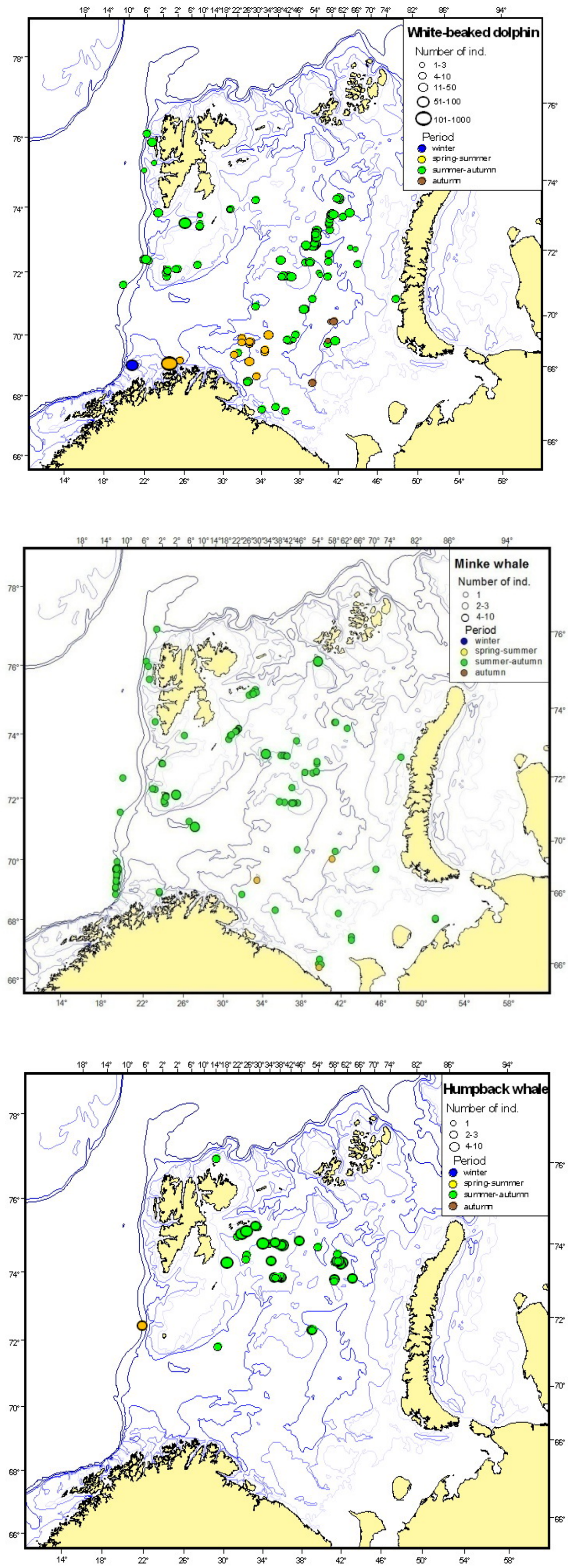

Figure 5. Distribution of (a) white-beaked dolphins, (b) minke whales and (c) humpback whales in the Barents Sea in 2008 using data from both ship and aerial surveys.

Parameters recorded were: species, or closest species group; bearing and distance to observation; minimum and maximum estimated group size when more than one animal was observed; sea-state; date and time; and apparent behaviour (e.g. feeding, resting, travelling in a set direction, etc.). Observations were only made while the vessel was travelling, during weather conditions of <4 on the Beaufort scale, and with little or no fog. Observations were made using the naked eye, although binoculars were also used to aid in observing marine mammals at long distances.

Airborne surveys were carried out by 2–4 observers simultaneously from each side of the aircraft through bubble windows. A standard coverage sector was 45°; mean survey altitude on transects was 200 m. An observer usually counted a sector of less than 90° perpendicular to the window. He/she also had an opportunity to observe the sectors in front and behind depending on visual conditions. This occasionally improved the accuracy of counting. Under normal operating conditions a swathe width of 200 m on each side of the aircraft was surveyed. In poor visibility, the transect width was reduced, in good visibility the transect width occasionally was increased.

7.5.3 Results of study distribution of cetaceans in 2008

In 2008, because of a number of other ongoing projects such as assessing anthropogenic impacts from oil and gas exploration, limited sightings data were obtained, apart from the Barents Sea. Highest densities of cetaceans were observed in the northern and northwestern sections of the Barents Sea. The distribution of different species (white-beaked dolphins, minke whales, humpback whales, see Table 13, Figure 5) were correlated with higher densities of fish (capelin, polar cod and others).

7.5.4 Future work

Annual aerial, ship and coastal surveys will be continued in future, with new areas of research being initiated. Historical data will be analysed, and currently a report is being prepared for NAMMCO on "harbour seal's ecology, population status and influence on stocks of salmon fish along the Murmansk Coast", and PINRO staff are co-authors on the forth coming Russian-Norwegian monograph "Ecosystem of the Barents Sea". Finally, further investigations into the dietary requirements of marine mammals, and their influence on industrial fish stocks and ecosystem as the whole in the White, Barents, Norwegian Sea and areas of the North Atlantic, will be undertaken. PINRO is open to future joint research collaborations, with international colleagues, and will be adapting its survey methodology, and other research areas such as dietary analysis, through bodies such as the ICES WGMME.

8 ToR e. Review available EU Habitats Directive FCS reports for marine mammals and suggest appropriate conservation assessment criteria

Review available EU Habitats Directive Favourable Conservation Status (FCS) reports for marine mammals submitted by Member States, including a summary of any issues identified and solutions utilized. Suggest any appropriate conservation assessment criteria that can be used within the ICES area and quantitative measures against which these assessments could realistically be measured.

8.1 Introduction

Article 17 of the Directive requires that, every six years, Member States draw up a report on the implementation of the measures taken under the Habitats Directive. These reports are assembled into a single comprehensive draft report by the European Commission then passed back to Member States for verification prior to eventual publication. A copy of the database, complied from the Member State reports was supplied to ICES in case it was useful in carrying out its advisory functions on marine mammals. ICES SGBYC (Study Group on Bycatch) was asked to examine the database from the perspective of bycatch, whilst WGMME examined it from the perspective of range and population. As part of this examination, WGMME also utilized the individual Member State reports and the collated European level assessments by biogeographical region available on the European Topic Centre on Biological Diversity (ETC/BD) website (http://biodiversity.eionet.europa.eu/article17). For the purposes of this analysis, only the Marine-Atlantic biogeographical region was considered.

8.2 Results

A summary of the database and ETC/BD European level FCS collated results by species for the Marine-Atlantic region is given in Table 14. Whilst reviewing these results, a number of issues were identified:

8.2.1 Baseline used for assessments

For many cetacean species, there was generally a heavy reliance by most Member States reporting in the Atlantic-marine region on the two SCANS survey results, which provide the most comprehensive large-scale assessment of summer distribution and abundance in the North Sea and adjacent areas. However, some Member States, and/or for some species, different baselines are/were used. For example, the baseline against which population assessments were made for harbour porpoises by Belgium, Germany, Denmark, France, UK, Ireland, Netherlands, and Sweden was the first SCANS survey in 1994. In contrast, Spain and Portugal, the waters of which were not covered by SCANS I, used more historical data from 1982 and 1950, respectively. A more extensive variation in the reference baseline was noted for the seal reports. Of the nine Member States reporting on common seals (*Phoca vitulina)*, eight different baselines were identified for assessing trends in the population assessments. The use of different baselines makes an accurate collated assessment of trends in population or range at the European scale impossible.

8.2.2 Assessment of range

Range and how it changes through time is a fundamental ecological characteristic of a species, but its measurement still remains a substantial challenge (Gaston and Fuller, 2009). There are two fundamentally different concepts that are used to measure range. The 'extent of occurrence' is the area which lies within the outer most geographic limits to the occurrence of a species whilst the 'area of occupancy' is that within those outer most limits over which it actually occurs. Although the guidance is unclear, FCS reporting on range seems to equate to the 'extent of occurrence' whilst reporting on habitat to 'area of occupancy'.

While understanding the range of marine mammal species might be helpful in assessing their conservation status and while range can be subjected to qualitative assessment, the data generally available do not allow a quantitative estimate of surface area. Although data on range does exist, it often does not translate well to the proforma required for FCS reporting. When reporting range, most Member States submitted distribution data, which was recognized by ETC/BD in many of the collated assessments.

When considering range as a parameter to assess conservation status, it should be noted that the presence of a species is far easier to detect than its absence and, as such, changes in range may take some time to become obvious. An expansion of range, with animals appearing where they were previously absent, is likely to be more noticeable than a retraction of range. For marine mammals, it should be noted that it is distribution data rather than range data that is most commonly available and it needs to be recognized that these are distinctly different parameters.

Because marine mammals are wide-ranging, with large spatio-temporal variations in their distribution, it is very difficult to detect trends in range, or to know if apparent changes are long-term changes in range or in distribution within their range. An example of this is the harbour porpoise in the North Sea. Between SCANS 1994 and SCANS II 2005, although no significant change could be detected in population abundance, there was a southerly shift in distribution of the species. Member States to the north of the region therefore reported a decline (e.g. Denmark) leading to an unfavourable assessment whilst those in the south reported an increase (e.g. Belgium and Germany) leading to a favourable assessment. Although it is recognized that there are a number of threats and pressures affecting this species, the conservation assessments by individual Member States could, in this instance, appear to have been influenced by normal animal behaviour and natural movement.

8.2.3 Assessment of habitat

Similarly to range, cetacean habitats (e.g. feeding and breeding areas) vary temporally and spatially and are influenced by natural and anthropogenic factors (e.g. Ingram *et al*., 2007; MacLeod *et al*., 2007; Weir *et al*., 2007). It is therefore often difficult to determine what features characterize cetacean habitats and, thus, to determine their extent. Cetacean distribution has often been linked to prominent topography such as seamounts and escarpments and also to sea surface temperature and local primary productivity (Mendes *et al*., 2002; Evans *et al*., 2003; Hastie *et al*., 2004; Marubini *et al*., in press). There are possible factors limiting the use of some areas, including changes in environmental variables, prey depletion, habitat exclusion by other species and anthropogenically driven habitat alteration (either temporally or permanently), but these are extremely difficult to quantify with current knowledge. 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 distribution 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 an 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.

8.2.4 Assessment of population

The assessment of population was equated with abundance by most Member States. As with the assessment of range, much of the data available on abundance did not translate well to the proforma for FCS reporting. For example, the report assumed that a minimum and maximum population estimate would be known. However, most Member States for many of the cetacean species on which they reported had only a single estimated value about which there were no confidence intervals to allow the calculation of minimum and maximum population abundance estimates. For example, of the seven Member States reporting on bottlenose dolphins (*Tursiops truncatus*), all provided a single estimated population size rather than minimum and maximum values. In contrast, for harbour porpoises (*Phocoena phocoena*), five Member States provided minimum and maximum population estimates whilst a further four had a single estimated population size with no minimum and maximum values. Minimum and maximum population estimates were estimated by most Member States for grey seals (*Halichoerus grypus*) whilst for harbour seals (*Phoca vitulina*) five provided minimum and maximum estimates and a further three a single population value.

Data on abundance collected using different methods at different times/seasons cannot easily or accurately be collated to provide a large-scale assessment. Using data that already exist at an appropriate biological scale would be more appropriate. For cetaceans, most Member States reported data from the SCANS survey sectors appropriate to their waters. This was then amalgamated by ETC/BD to provide the biogeographical regional assessment. It would have been much better to allow reporting at the appropriate biological scale where the data already exists in such a format, rather than requiring it to be divided up by Member States then ETC/BD re-collating it. By doing this the value of the European scale assessment was much reduced with, for example, confidence intervals on the abundance estimates being lost.

Additionally, there was little opportunity to report separately on the status of subdivisions or subpopulations (where these are known to exist) within a particular species. This is particularly pertinent for bottlenose dolphins where inshore and offshore subdivisions occur, but is also relevant to other species. For example, reported grey seal and common seal pup production at different colonies varied; declining in some, increasing in others or remaining reasonably stable. Because a single assessment was required for each species, the status of the larger subdivision/population/colony will outweigh the status of a much smaller one where they are different and may obscure issues of conservation concern.

8.2.5 Consistency in the European level assessment

Although the majority of the collated assessments have clear audit trails as to how the overall judgement was derived, for cetaceans, these often focused on range and/or distribution rather than abundance. This has lead to overall assessments for fin and minke whales, and white-sided, white beaked and striped dolphins being given as unknown or unfavourable (inadequate), despite the majority of the population being assigned a favourable status. In contrast, the seal assessments focused on abundance data and, thereby, provide a more accurate assessment of the species at the biogeographical regional scale.

For the harbour porpoise assessment in the Marine-Atlantic biogeographical region, a discrepancy was noted between the information in the database and that available on the ETC/BD website. In the database, this species was considered to be in a favourable condition. In contrast, on the ETC/BD website, the overall result is unfavourable (inadequate). The discrepancy appears to have arisen from a single stakeholder comment:

> *'While the automated assessment with over 75% FV results in "FV" at EU level, on expert assessment we would argue for a "U1": The species shows definitely a decline on the border of its eastern range (reflected in U1 and U2 in 5 Member States). As the population assessment should also include the assessment of changes in distribution/ densities in all parts of its natural range, method 2DG does not give an optimal result.'*

This comment leads to the overall assessment on the ETC/BD website being altered but not the database. The assessment on the website was justified using the unknown or unfavourable future prospects assessments of Belgium, France, the Netherlands, Portugal, Sweden and Denmark, which were given precedence over the favourable UK and Irish assessments.

WGMME would argue that harbour porpoises in the Marine-Atlantic region should be considered to be in a favourable condition. Whether assessed by area or abundance, the majority of the population has been assessed as favourable. Additionally, an overall assessment of unfavourable (inadequate) ignores the data from the two SCANS surveys indicating that no significant change could be detected in abundance over the last decade over the majority of the European continental shelf. This was noted in the individual Member State reports by Belgium, Denmark, UK and the Netherlands.

8.2.6 Consideration of rare, vagrant and occasional species

Three different approaches were adopted by various Member States in the reporting of rare, vagrant and occasional species. Some Member States did not complete reports at all, whilst Ireland, Portugal and the Netherlands completed reports for all species known to occasionally occur in their waters. These reports contained 'not applicable' responses to most of the reporting requirements. Because of this lack of data, the UK took a third approach and provided summary paragraphs for each of the occasional species rather than completing full reports. In their overall assessments, however, ETC/BD does not appear to have utilized these summary paragraphs and nor have they been included in the database or on the website.

Differences were also noted between the information in the database and that available via the ETC/BD website with respect to a number of rare, vagrant and occasional species. For example, the database contained information provided by Member States on the northern bottlenose whale (*Hyperoodon rostratus*) and the ringed seal (*Phoca hispida botanica*), harp seal (*Phoca groenlandica*), hooded seal (*Cystophora cristata*) and bearded seal (*Erignathus barbatus*), which were missing from the website.

8.2.7 Life history and health status parameters

Under the surveillance requirements of the Habitats Directive, monitoring should be able to detect a decline in population of 1% per annum over a fixed period, or that the population is more than 25% below the favourable reference population or, alternatively, if reproduction, mortality and age-structure strongly deviate from normal. It was noted that there is no specific opportunity to report on life-history parameters or health status, where such information is available, in the proforma required for FCS reporting.

8.3 Potential conservation assessment criteria, appropriate quantitative measures for the ICES area and recommendations for future FCS reporting

There are international legislative requirements and/or obligations to monitor distribution and abundance, including trends, health status and anthropogenic impacts, particularly bycatch (e.g. The Habitats Directive and obligations of contracting parties to CMS (particularly ASCOBANS) and OSPAR). WGMME felt that it would be more appropriate to focus on these requirements and, rather than to develop new conservation assessment criteria for the ICES area, propose quantitative measures for assessment that meet the various legislative requirements and/or obligations that already exist. As part of the consideration of monitoring requirements outlined in ToR f, consideration is given to these quantitative assessments, including the power to detect trends over time in abundance and life-history parameters.

The inconsistencies and issues noted above have lead WGMME to recommend that the database and/or the information available on the ETC/DB website cannot be used for a reliable analysis of the distribution and abundance of marine mammals in European waters. Should such an analysis be required, it seems likely that a first step should be to issue some consistent and explicit guidance on completion of these reports by Member States. It is also recommended that consideration should be given to:

- Development of a common designated baseline (e.g. SCANS I, II or CODA depending on the cetacean species and Member State in the Atlantic region) against which future trends in abundance and distribution can be assessed.
- The possibility to report on abundance and distribution (rather than range) of highly mobile species at a biologically appropriate scale where such data exist.
- A facility to report estimated population size as well as the minimum and maximum estimates where such data exist.
- To accommodate the above, an evaluation of the format of the reporting form is required and consideration needs to be given to the reporting requirements for rare, vagrant and occasional species.
- Assessments should be based on evidence (i.e. data) rather than judgement.

In a number of the European level assessments (e.g. common short beaked dolphin, Risso's dolphin, the northern bottlenose whale and Sowerby's beaked whale), ETC/BD state that '*Range, population and distribution data need to be collected in future, according to a common scheme, in order to allow acceptable comparisons amongst MS*.' To meet the requirements of the Habitats Directive, international collaborative monitoring of cetaceans has already been advocated by many Member States as a way of providing biologically meaningful data to allow accurate assessments, and is also suggested in this report (see ToR f).

It is proposed here that the international collaborative monitoring might be taken further and, that for future FCS assessments of highly mobile and wide ranging species, Member States should be able to report at an appropriate biological scale where such data exist. This would allow ETC/BD to produce accurate and biologically meaningful reports, relevant to the conservation of the species and would allow appropriate management measures to be instigated where necessary. The original report form and a suggested new form are outlined in Annex 2 and 3.

With respect to rare, vagrant and occasional species (which includes the above mentioned northern bottlenose whale and Sowerby's beaked whale), it is proposed that a new form is developed for each biogeographical region listing all marine mammal species known to occur in the region. Member States could then tick each rare, vagrant or occasional species known from their waters and provide additional comments where appropriate. An example of such a form is given in Annex 4 for the Marine-Atlantic region.

8.4 Recommendations

- WGMME **strongly recommends** that the European Commission (ETC/BD) reconsider the data requirements for FCS reporting with respect to highly mobile, wide ranging species and, most notably, consider allowing reporting at an appropriate biological scale where such data exist. This would allow ETC/BD to produce accurate and biologically meaningful assessments, relevant to the conservation of the species and would aid instigation of appropriate management measures where necessary.
- WGMME **strongly recommends** that the European Commission (ETC/BD) reconsider the reporting requirements for rare, vagrant and occasional species occurring in individual water of Member States.
- WGMME **recommends** that comprehensive, consistent and explicit guidance on the completion of FCS reports is issued by the European Commission if the data

from future assessments is to be used to provide a reliable analysis of the distribution and abundance of marine mammals in European waters.

- As part of the above guidance, WGMME **strongly recommends** that all future FCS assessments should be evidence based rather than allowing expert judgements of the various parameters used to assess conservation status. This would lead to biologically accurate assessments relevant to the conservation of the species.
- WGMME **recommends** that Member States develop international collaborative monitoring strategies for marine mammals in order to meet the surveillance requirements of the Habitats Directive.

8.5 References

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Table 14: ETC/BD collated summary of FCS assessments for marine mammals in the Atlantic-marine biogeographic region. (FV = favourable, U(I) = unfavourable (inadequate), U(2) = unfavourable (bad), XX = unknown and NA = not assessed).

Species	Range	Population	Habitat	Overall assessment	ETC/BD justification and WGMME comments
Balanidae					
Eubalaena glacialis	NA	NA	NA	NA	Ireland and Portugal reported as occasional. UK summary not acknowledged
Balaenopteridae					
Balaenoptera acutorostrata	FV	U(1)	FV	U(1)	As a result of Portugal's U(1) report, despite FV reports from UK and Ireland where majority of population resides. SCANS surveys found no evidence of a change in abundance over the last decade.
Balaenoptera borealis	XX	XX	XX	XX	Based on Irish and Portuguese reports. Netherlands reported as occasional. UK summary not acknowledged.
Balaenoptera musculus	XX	XX	XX	XX	Based on Irish and Portuguese reports. UK summary not acknowledged.
Balaenoptera physalus	XX	XX	FV	XX	Based on Spanish, French and Portuguese reports, despite FV assessments from UK and Ireland where majority of population resides
Megaptera novaeangliae	XX	XX	XX	XX	All countries reporting concluded XX conservation status
Physeteidae					
Kogia breviceps	XX	XX	FV	XX	Based on Portuguese report. Reported as occasional in Ireland and Netherlands. UK summary not acknowledged.
Physeter catodon	XX	XX	XX	XX	All countries reporting concluded XX conservation status
Ziphidae					
Hyperoodon ampullatus	XX	XX	XX	XX	Based on Irish report. Netherlands list as occasional. UK summary not acknowledged.
Hyperoodon rostratus	NA	NA	NA	NA	Netherlands reported as occasional
Mesoplodon bidens	XX	XX	XX	XX	Based on Irish report. Netherlands list as occasional. UK summary not acknowledged.
Mesoplodon densirostris	NA	NA	NA	NA	Reported as occasional by Portugal
Mesoplodon europaeus	NA	NA	NA	NA	Reported as occasional by Ireland and Portugal. UK summary not acknowledged.

Species	Range	Population	Habitat	Overall assessment	ETC/BD justification and WGMME comments
Mesoplodon mirus	NA	NA	NA	NA	Reported as occasional by Ireland, UK summary not acknowledged
Ziphius cavirostris	XX	XX	XX	XX	All countries reporting concluded XX conservation status
Monodontidae					
Monodon monocerus	NA	NA	NA	NA	Reported as occasional by Netherlands. UK summary not acknowledged.
Delphinidea					
Delphinapterus leucas	NA	NA	NA	NA	Ireland and Netherlands reported as occasional.
Delphinus delphis	FV	XX	FV	XX	Because of XX population and future prospects sub-conclusions from France, Ireland and UK
Globicephala melas	XX	XX	XX	XX	All countries reporting concluded XX conservation status
Grampus griseus	XX	XX	XX	XX	All countries reporting concluded XX conservation status
Lagenorhynchus acutus	FV	XX	FV	XX	Because of XX assessment from France and UK, despite FV assessment by Ireland which provided the only abundance estimate
Lagenorhynchus albirostris	FV	XX	XX	XX	Because of XX assessment from France, Ireland and Netherlands, despite FV assessment by UK. SCANS surveys found no evidence of a change in abundance over the last decade.
Orcinus orca	XX	XX	XX	XX	All countries reporting concluded XX conservation status
Pseudorca crassidens	NA	NA	NA	NA	Reported as occasional by Ireland, Netherlands and Portugal. UK summary not acknowledged.
Stenella coeruleoalba	XX	XX	XX	XX	XX from Spain, France and Irelands reports, despite Portugal FV assessment covering majority of population
Turisops truncates	FV	FV	FV	FV	FV status from Ireland and UK which cover majority of population
Phocoenidae					
Phocoena phocoena (Database)	FV	FV	FV	FV	FV due to IE and UK assessments which cover the majority of the population by range and abundance.

Species	Range	Population	Habitat	Overall assessment	ETC/BD justification and WGMME comments
Phocoena phocoena (ETC/BD website)	NA	U(1)	NA	U(1)	As a consequence of the unknown future prospects of BE, FR and NL and the unfavourable-inadequate future prospects of PT, SE and DK, despite the FV status in IE and UK covering approximately 68% of population. SCANS surveys found no evidence of a change in abundance over the last decade.
Phocidae					
Cystophora cristata	NA	NA	NA	NA	Netherlands and Portugal reported as occasional, UK summary not acknowledged.
Erignathus barbatus	NA	NA	NA	NA	Portugal reported as occasional, UK summary not acknowledged.
Halichoerus grypus	FV	FV	FV	FV	Because of the population status (trend and numbers) of the UK colonies, which represent 93% of the European Atlantic population.
Phoca groenlandica	NA	NA	NA	NA	Netherlands reported as occasional, UK summary not acknowledged.
Phoca hispida	NA	NA	NA	NA	Netherlands reported as occasional, UK summary not acknowledged.
Phoca hispida bottnica	NA	NA	NA	NA	Portugal reported as occasional.
Phoca vitulina	FV	U(1)	XX	U(1)	Because of the population status (trend and numbers) of the UK colonies, which represent 50% of the European Atlantic population.

9 ToR f. Develop a framework for surveillance and monitoring of marine mammals applicable to the ICES area that is realistically achievable by contracting parties

9.1 Introduction

Current monitoring of marine mammals in the ICES area has two main motivations: to meet the requirements of conservation legislation/management objectives (international, European, national, regional) and to underpin sustainable harvesting (whether or not hunting actually currently takes place). Within ICES, the legislative frameworks for the USA and Canada clearly differ from the European situation. In the present report we focus on monitoring and surveillance for conservation of marine mammals in Europe. Reflecting legal requirements for conservation monitoring of marine mammals in Europe, we focus mainly on monitoring of cetacean populations. Relevant information on seals appears under TORs a and c of the present report, and if requested, will be reviewed in more detail in 2010. The "strategy" to be developed should cover aspects such as coordination, standardization, quality control, training and archiving of data and samples, as well as the actual surveillance.

The request from ICES to develop a framework coincides with the availability of a draft UK Cetacean Surveillance Strategy, which provides a possible model for a surveillance strategy for conservation of cetaceans in Europe, and from which many of the points made here have been taken. Among other background documents available were the ASCOBANS Conservation Plan for Harbour Porpoises (*Phocoena phocoena*) in the North Sea (Document AC15/Doc.14 (WG)) and outcomes from the 2008 conference on "Strategies for monitoring marine mammal populations" held at the University of La Rochelle, France, in November 2008. Bycatch issues were recently addressed in the 2008 report of the ICES Study Group for Bycatch Of Protected Species (SGBYC). In the present report we review current and possible approaches to surveillance of cetaceans and pinnipeds in Europe. However, WGMME is not at present able to fully define a Europe-wide strategy and recommends that work on this continues in 2010.

JNCC 2008 note that "the European Commission considers that effective surveillance of species' conservation status under the Habitats Directive must be undertaken at regular time intervals, concern all species of cetacean and cover all areas where these species are present. The surveillance system must also ensure that information is available on the level and range of the cetacean population so that its conservation status can be properly assessed. The surveillance scheme also needs to be flexible enough to respond to new information and techniques, and surveillance data gathered needs to be quickly accessible". JNCC 2008 conclude that it will not be possible to meet the Habitats Directive requirements for surveillance in full, largely as a consequence of the low statistical power to detect trends arising even from intensive and expensive sampling. Noting that EC guidance allows Member States to deviate from Habitats Directive requirements, the UK strategy "is designed to meet the surveillance requirements to the best of our ability taking appropriateness and cost-effectiveness into account".

Marine mammals face a range of threats, many of anthropogenic origin, which, in no particular order, include: bycatch/entanglement (in active or discarded gear), resource competition, habitat degradation, chemical pollution (e.g. PCBs, heavy metals, oil spills, and plastics), climate change, noise disturbance (e.g. seismic surveys, active sonar, disturbance by boat traffic and offshore construction activities), ship strikes and hunting. Some of these threats are specifically addressed by legislation, while others, notably climate change and resource competition are less tractable.

Monitoring and surveillance requires some operational definition of the entity being surveyed, e.g. a population or stock, whether defined on the basis of genetic studies or pragmatic division of a species range into subunits. Marine mammals are highly mobile and, at least the species level and often at the population or stock level, these functional units cross national boundaries and/or extend into international waters, so that international coordination of monitoring is essential.

Any framework must additionally recognize the basic differences between survey methods for pinnipeds and cetaceans, as well as the differing requirements for surveying different species according to their abundance (common or rare), habitat (coastal or oceanic), dispersion (e.g. migrations, group structure) and behaviour (e.g. time at the surface).

In addition to looking at this ToR from the point of view of the Habitats Directive and the EC 812/2004 regulation, we are also looking at this from the point of view of international agreements (e.g. strandings monitoring under ASCOBANS) and the future implementation of the Marine Strategy Framework Directive (MSFD).

9.2 Legislative requirements

9.2.1 Legislation

Many different international conventions, commissions, and regulations deal directly or indirectly with marine mammals. Most of these concern the protection and conservation of marine mammals, while others deal with the prevention of incidental catches. Some of the requirements set out in international law remain very general, stating, for instance only, that certain marine mammals should be protected, while others entail concrete legal obligations. To meet such obligations, certain data need to be available, which inevitably entails monitoring requirements. In many cases the collection of such data are neglected, and the methods collecting them and the level of detail or accuracy in which they are collected differ throughout the range of the species concerned. This creates difficulties in the assessment of whether the obligations have been fulfilled or not.

Aside from international commitments, national legislation on the protection and conservation of certain marine mammals exists in countries bordering the North Atlantic. In many cases this legislation is more detailed than the obligations under international law. Not dealt with here is the regulation of harvesting marine mammals, as organized within the IWC, NAMMCO and individual countries. Sustainable harvest requires data on population status, and an appropriate system of monitoring, management and regulatory support.

Below, a brief overview is given of the most relevant international fora on the protection and conservation of marine mammals throughout the North Atlantic, followed by information needs that come with their implementation. Clearly, legislation evolves over time and, while international/European legislation is the driver for much national government conservation action, it should not be assumed to provide a definitive solution. Thus, the value of site-based conservation, in particular for many cetaceans, is questionable. Furthermore, monitoring and surveillance, and specific research initiatives, also have a "sentinel" function, to alert scientists and authorities to changing conditions and new threats.

Annex IV of the Habitats Directive of the European Community (EC) contains a list of marine mammals that have to be strictly protected. For a number of these (listed in Annex II), sites known as Special Areas of Conservation (SACs) need to be selected by Member States to contribute to conserving their habitats, which, for wide ranging marine species, need to be designated where 'there is a clearly identifiable area representing the physical and biological factors essential to their life and reproduction'. Additionally, under Article 12, a system to monitor incidental capture and killing of species listed in Annex IV needs to be put in place, and further research or conservation measures need to be put in place to ensure that capture and killing does not have a significant negative impact on the species concerned.

The most relevant European Community legislation concerning incidental catches of cetaceans is Regulation 812/2004, which contains measures on monitoring incidental catches of small cetaceans and the use of acoustic deterrents (pingers) on certain fishing nets. As a result of the annual reporting from Member States over the last three years, it has become apparent that the fisheries and/or gears which require monitoring under this legislation are not necessarily those with the most significant cetacean bycatches. As a result, this legislation is being reviewed in 2009.

The Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) provides certain marine mammals with a strict protection, while for others exploitation is allowed so long as their population numbers are not put in danger. For Member States of the EC the provisions of the Bern Convention are largely taken up in the Habitats Directive.

The Convention of Migratory Species (Bonn Convention, CMS) sets out general provisions for the protection and conservation of certain migratory marine mammals, and also operates as a framework for a range of more specific multilateral agreements dealing with seals or cetaceans. Regional agreements were concluded for the conservation of small cetaceans in the Baltic, North East Atlantic, Irish and North Seas (ASCOBANS), and on the conservation of seals in the Wadden Sea.

Annex V and Appendix 3 of the OSPAR Convention for the protection of the marine environment in the North-east Atlantic deal with the protection and conservation of the ecosystems and biological diversity of the maritime area. To guide the setting of priorities for the implementation of Annex V, OSPAR has compiled an initial list of species to be protected; this list contains a number of cetaceans. In a pilot project, Ecological Quality Objectives (EcoQO's) for the North Sea are set up, among others for bycatch of harbour porpoises and for common and grey seal population trends (see ToRs a and c; WGMME 2008).

In most countries bordering the North Atlantic, and especially those not bound by the provisions set out by the EC, a more detailed and dedicated national legislation concerning marine mammals is put in place than provided for in the international conventions and commitments. Examples are the national legislation set out in Norway, Iceland, the United States (Marine Mammal Protection Act) and Canada. The national legislation dealing with environmental impact assessment or with activities such as seismic surveys refers in many countries (a.o.) to marine mammals.

9.2.2 Data requirements

Certain data are needed to assess whether national or international commitments and obligations were met or not, or whether certain activities impact or will impact on marine mammals. Therefore provisions for collecting such data need to be established. While the fora mentioned above differ in the species they deal with, in their geographic scope and in their objectives, they entail minimal information needs. Without specifically referring to the specific fora, these minimal information needs can be summarized as follows:

- Spatial and temporal distribution and abundance data, and trends.
- Level of incidental mortality and harvest.
- Health status of marine mammals, for instance related to pollution.

In addition, to assess the biological significance of a number of human activities directly or indirectly impacting on marine mammals, and consequently to be able to assess, propose and establish mitigating measures, baseline information on certain activities and on their effects is necessary. For instance, basic data are necessary on:

- Fisheries activities, to be able to assess bycatch levels and competition for food;

- Seismic surveys and offshore construction (such as offshore wind farms), to assess disturbance, physical damage to marine mammals and habitat deterioration;
- Shipping, in order to assess disturbance and the impact of ship strikes on the population of certain cetaceans.

It is implicitly assumed above that species identification is clear and that populations have been defined. Where this is not the case, further research is needed. Furthermore, although usually not specifically highlighted as a requirement, interpretation of abundance and health data depends fundamentally on availability of life-history information (age, reproductive status, and derived information such as mortality rate, birth rate, age-at-maturity).

Specific examples of requirements

ASCOBANS states that annual bycatch levels for harbour porpoises should be reduced to below 1.7% of the best population abundance estimate, as it aims to restore/maintain populations at 80% of carrying capacity (ASCOBANS, 2000, 2006). This objective was included within the OSPAR North Sea pilot project on EcoQO's. Note, however, that WGMME 2008 recommended that the harbour porpoise EcoQO should be based on the Catch Limit Algorithm (CLA) approach and not the value of 1.7%. Also in this OSPAR pilot project, an objective for seal populations is set with no decline in population size or pup production of ≥10% as represented in a five-year running mean or point estimates (separated by up to five years).

Under the requirements of the Habitats Directive, a surveillance strategy needs to be put in place in order to determine the "conservation status" of each of the species for future reporting. Conservation status can be considered favourable if:

- population dynamics data indicate that the species is maintaining itself on a long-term basis as a viable component of its natural habitats;
- the natural range of the species is neither being reduced nor is likely to be reduced in the foreseeable future, and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

This surveillance is required to be able to detect a decline in range equivalent to loss of more than 1% per annum from the baseline assessment or more than 10% below the favourable reference range. For population changes the surveillance should be able to detect a 1% decline per annum, or that the population is more than 25% below favourable reference population, or alternatively if reproduction, mortality and age-structure strongly deviate from normal. Under the Habitats Directive, Member States are required to report every six years to the European Commission on their implementation of the Directive, and the effectiveness of the provisions, including an assessment of the conservation status of habitat types and species listed in the annexes (WGMME 2008).

Details of monitoring levels required under Council Regulation 812/2004 are given in Articles 4 and 5 and Annex III of that regulation. Regulation 812/2004 requires that sampling should be geared to achieve a bycatch estimate with a coefficient of variation (CV) of less than 0.3 (see SGBYC 2008).

The UK Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended) requires all geological surveys and the drilling of shallow boreholes related to oil and gas activities to proceed only after written consent has been obtained from the Secretary of State. As a condition of consent it is a requirement that the Joint Nature Conservation Committee (JNCC) guidelines for minimizing acoustic disturbance to marine mammals are followed. As part of compliance with these guidelines, cetacean sightings are recorded during seismic survey operations (http://www.jncc.gov.uk/page-1534#1785). Additional guidelines are being developed for minimizing acoustic disturbance to marine mammals during activities involving explosives and piling (http://www.jncc.gov.uk/pdf/consultation%20_epsannexb.pdf).

9.3 General issues in surveillance and monitoring of marine mammals

Several common themes emerge when reviewing legal requirements for reporting the conservation status of marine mammals in relation to our knowledge of the species being monitored. Among the most important are:

- marine mammals range across national boundaries;
- there is no "one size fits all" monitoring strategy that will deliver all the required information on all species in all areas;
- there is a trade-off between statistical power and cost, such that not all monitoring targets are realistically achievable.

9.3.1 Appropriate reference points and links to management action

Before conducting any surveillance/monitoring it is important to clearly define its objectives and the required outcomes. In some cases the scope of conservation legislation is not clearly defined and/or reference points are impractical to use. For example:

- In the UK, the Habitats Directive was initially interpreted as applying to territorial waters out to 12 nautical miles offshore but is now accepted to apply to marine waters out to 200 nautical miles of the territorial baselines of Member States and to seabed areas claimed under continental shelf extensions (JNCC 2008).
- The range of highly mobile marine species is difficult to define, costly to determine, requires a different surveillance regime to abundance estimation (focussing on areas where the species is rarest rather than where it is most abundant hard to define) and is ultimately uninformative (identification critical habitat, e.g. for feeding and reproduction, is arguably much more useful).
- Reporting at national level on the conservation status of wide-ranging highly mobile species can be uninformative and potentially misleading.
- It is unlikely to be possible to estimate absolute abundance of the rarer species, even with extensive surveys.

Any surveillance method adopted is implicitly or explicitly more suitable for some species than for others, e.g. oceanic species are poorly represented in strandings and visual surveys of coastal waters; detectability of cetaceans during visual surveys varies according to body size, surface time, dispersion and behaviour.

While the Habitats Directive specifies the need to maintain favourable conservation status for protected species, and defines criteria by which unfavourable status may be recognized, it is up to Member States how this is achieved. In the UK, evaluations of conservation status of cetaceans have so far indicated species to either have favourable or unknown status. In contrast, for seals, the harbour seal was reported as unfavourable (inadequate) as a consequence of large declines in some colonies. The reasons for this decline were unclear and, as a result, significant funding has been provided to identify the cause(s) and suggest, where possible, mechanisms through which the conservation status can be improved. Although it is recognized that some problems (e.g. epizootics) may be uncontrollable, ideally a surveillance strategy should be linked to contingency plans for management action.

The accurate definition of populations or stocks is essential to underpin effective conservation. It has to be known if a species forms different populations in its range or if it is only one (panmictic) population. Genetic studies can be complemented by studies on ecological tracers (e.g. stable isotopes, parasites), morphometrics and photo identification.

See ToR e for discussion of a range of issues related to the implementation of surveillance and reporting to meet requirements of the EU Habitats Directive.

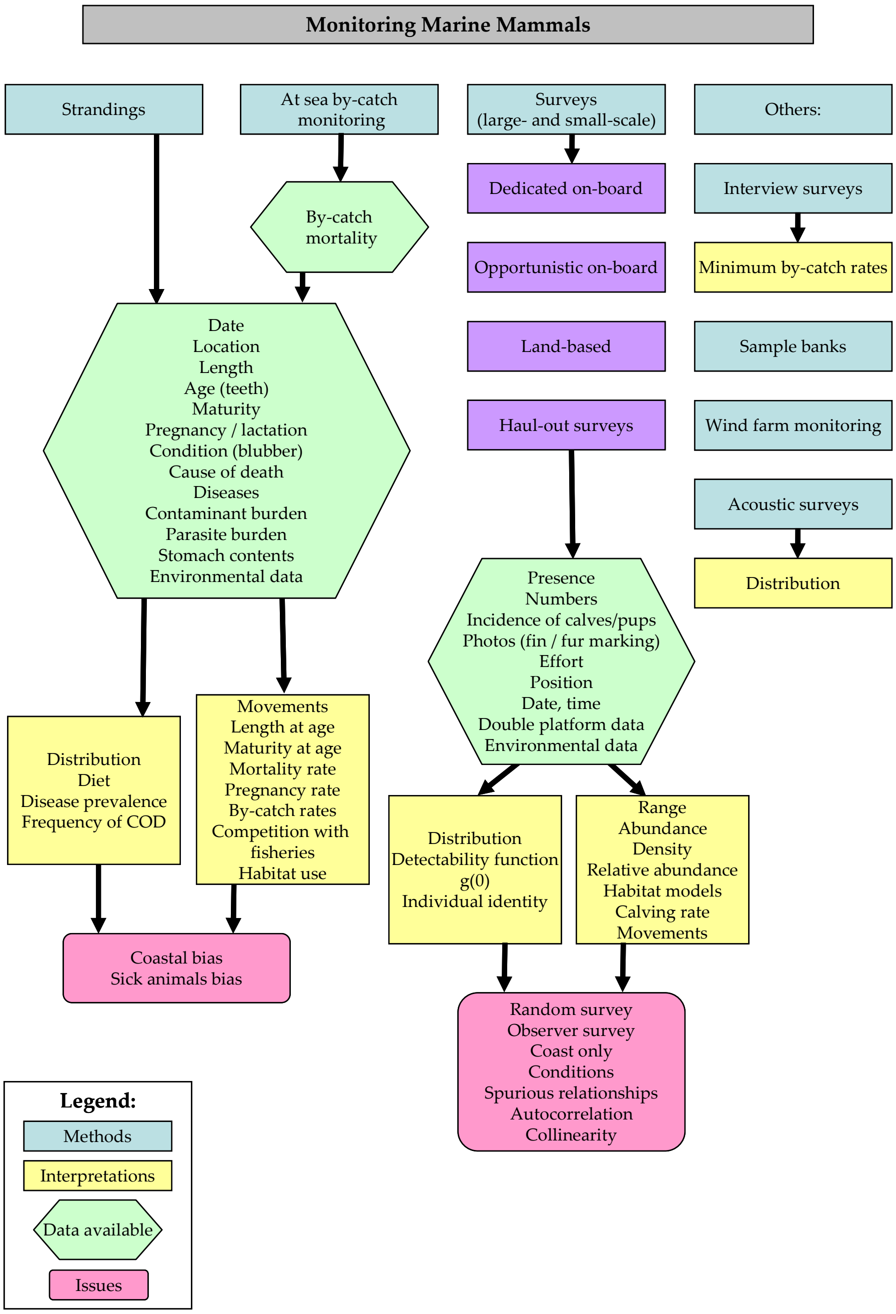

Figure 6. Schematic representation of the main type of surveillance/monitoring of cetaceans that are currently undertaken.

9.3.2 Statistical power to detect trends

The power to detect trends depends on good survey design (e.g. to minimize biases), sample size and the statistical distribution of the parameter being measured.

Even where estimates of abundance can be made, these are often bounded by relatively large confidence intervals, thus the power to detect trends through time can be low. Power can be increased by carrying out more surveys, but these are costly and there is a law of diminishing returns. With infrequent surveys, we may not be sure that a change has occurred until many years after it has occurred (JNCC 2008). Separate analyses have recently been carried out of the statistical power of large- and small-scale boat-based surveys, in both cases highlighting the point that only rather large changes in abundance would be detectable. While no combined simulations have been carried out, it is probable that a combination of 10-yearly large-scale surveys and local surveys with a higher (e.g. annual) frequency would significantly improve power to detect trends, although this is contingent on adoption of a standardized protocol for the local surveys.

Large-scale boat-based surveys: A recent power analysis by Winship and co-authors, unpublished data investigated the power of large-scale surveys (e.g. SCANS, SCANSII, CODA) to detect a 5% per annum (exponential) decline over ten years with annual monitoring and a one-tailed alpha significance level of 0.05 (also assuming that CV is constant and not related to abundance). Simulations are based on the assumption that such surveys are run every year. Results indicated a high power to detect trends only for harbour porpoise (based on SCANS II data) and bottlenose dolphins in offshore waters (based on CODA data; see Figure 7 below). With an effort of 10 000 km every year for ten annual surveys there is a power of 0.92 to detect a 5% decline of harbour porpoises per year (i.e. a 37% decline over 9 years) during that period. However, the power to detect a 37% decline between two abundance estimates (i.e. with the current periodicity of large-scale surveys) with the same CV is only 0.29.

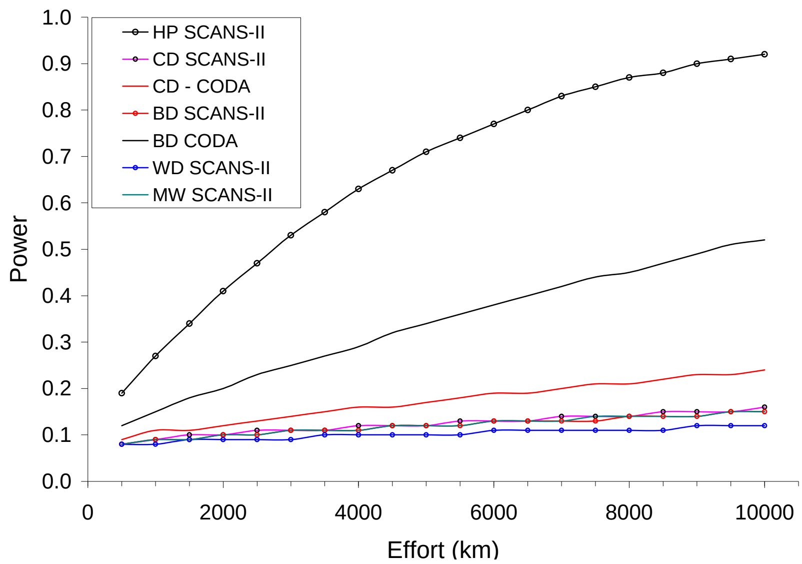

Figure 7. Power analysis simulation results, HP = harbour porpoise, CD = common dolphin, WD = white-beaked dolphin, BD = bottlenose dolphin, MW = minke whale.

Small-scale surveys: Thomas, 2008 examined the suitability of using data from small-scale surveys in UK waters for monitoring purposes, using a subset of data from the Irish Sea. He comments that, while it is premature to discuss the exact size of trends that may be detectable, because the metrics are not yet defined and variance components unknown, it is clear 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.

Bycatch: Regulation 812 requires that sampling should be designed to achieve a bycatch estimate with a coefficient of variation (CV) of less than 0.3. However, rare events, such as the bycatch of marine mammals, result in large CVs. The amount of observer coverage needed to achieve a CV of 0.3 for the bycatch estimates varies widely among different fisheries. Observer effort allocation varies between countries and fisheries, and is constrained by available funding.

The lower the bycatch rate, the larger the sample (observer coverage) required to achieve a CV of 0.3. CV can be estimated only if there is one or more observed bycatch events because otherwise it is undefined. Computing the CV of a mortality estimate is of course only possible where previous data allow one to establish the statistical distribution of bycatch events. In many cases there are no pre-existing data, and in some cases, annual variations in fishing effort causes difficulties in calculating required observer effort.

Given these considerations an alternative way to establish the level of monitoring could be to refer to a predetermined bycatch reference limit for each management unit. The bycatch reference level needs to be defined according to the biological characteristics of the populations and the management objectives (Northridge and Thomas, 2003). When these characteristics are not known, a precautionary reference limit can be set (1%, 1.7% or others) by analogy with other populations of small cetaceans. The level of effort coverage would be then fixed as to ensure that the incidental catches are below this reference limit. Wade, 1998 pointed out that for a fishery that has not previously been observed, it is more appropriate to ensure that sampling levels are sufficient to make the probability of observing zero takes (bycatches) very small when the true number of takes is high enough to be of concern.

Strandings: Strandings schemes involve essentially opportunistic sampling of dead animals to obtain health and life-history data and it is consequently difficult to avoid biased samples (e.g. overrepresentation of animals using coastal areas and in poor health). In terms of primary monitoring goals, sufficient necropsies should be carried out to be able to detect changes in importance of different cause of death categories. Thus the UK strandings monitoring programme is funded to do 100 necropsies per year. Power analysis has indicated that this is statistically powerful enough (80%) to detect changes in the incidence of major causes of death for common dolphins and harbour porpoises (Pinn, 2008).

Comparison of estimates of pregnancy and mortality rates in harbour porpoises, based on animals stranded in Scotland, suggests that pregnancy rates are substantially underestimated (Graham Pierce, unpublished data). Power analysis suggested that extremely large variations in the pregnancy rate of common dolphins in the Northeast Atlantic would have to occur, in order to detect a statistically significant increase or decrease in the pregnancy rate (Murphy, 2008). At a power of ≥80%, and an initial pregnancy rate of 25%, a sample size of >150 females would be required to detect an absolute decline of >13% in the pregnancy rate, whereas a sample size of >100 females would detect a decline >16%. A sample size of 50 females however, would only detect a decline of >20% (pregnancy rate at 0.05 or below) and at a lower power of 72%. In contrast, if an increase occurred in the pregnancy rate, a sample size of >150 females would be needed to detect a >16% increase in the pregnancy rate at a power of ≥80%. It should be noted that changes in pregnancy rate may become biologically significant before they can be detected statistically.

9.3.3 Life history data and other ancillary data

Abundance trends are underpinned by demography. To understand, model and predict population, measures or estimates of population parameters are needed, including age structure, mortality rate and birth rate. Modelling can both help maximize the information extracted from surveillance and evaluate the performance of surveillance in relation to objectives. While there are important issues of bias, data on age and maturity are normally derived from strandings/bycatch monitoring programmes. These data allow estimation of age structure, pregnancy and mortality rates, age-at-maturity and growth rate, and are essential to allow interpretation of health status data. Collection of environmental data (e.g. on currents, storms) and experimental/modelling studies of carcass transport can provide insights into likely biases in strandings data. Core funding for strandings programmes should (but usually does not) include provision for determination of age and maturity as well as for monitoring of health status.

The value of collection of environmental data during visual surveys is increasingly recognized, not only to allow survey effort to be standardized but to improve understanding of heterogeneity of distribution, facilitating habitat use modelling and improved abundance estimates. Some habitat modelling techniques do not need effort data but for most purposes, including evaluation of survey coverage, effort data are essential. The absence of effort information is a major limitation to the value of much opportunistic sightings data.

9.3.4 International coordination, standardization, training and resourcing, quality control

In most cases, the range of marine mammal populations does not correspond to national boundaries, and populations can extend across several countries (especially migratory species such as great whales). Therefore, cooperation between countries is necessary for good conservation management.

There is currently little Europe-wide coordination between small-scale surveys or between strandings networks. Although common protocols either exist or are under development (e.g. European Cetacean Society Guidelines, Joint Cetacean Protocol), there is wide variation in methodology. In addition, existing monitoring programmes use different methodology and standardization is a major priority to allow data to be compared between countries.

The lack of standardization and coordination arises for various reasons:

- Surveillance programmes have arisen to meet different objectives.
- Some monitoring programmes have been implemented by the voluntary sector (e.g. many strandings networks, SeaWatch Foundation) while others arose from regional or national government initiatives (e.g. UK stranding scheme).
- Many programmes have no long-term funding, having been implemented on an individual project basis.
- The levels of resourcing of monitoring and training of personnel vary widely.
- Institutional, educational, language and cultural barriers.

While agreement of common protocols is a priority for sightings and strandings monitoring, such protocols must take into account variation in resourcing levels and staff training, perhaps by specifying several levels of monitoring intensity. A particular feature of marine mammal monitoring is the prominent (and arguably essential) role of the voluntary sector in data collection. This requires some trade-off between making allowances for the diversity of persons involved and ensuring that data quality is adequate. Differences in the world views of professional ecologists and amateur environmentalists should not be ignored. Associated with standardization, a system for quality control and evaluation (monitoring of the monitoring) is essential.

9.3.5 Common databases, sample banks, access and archiving

Sightings databases include the Joint Cetacean Database, which contains more than 31 000 effort-related cetacean sightings, mainly from Sea Watch, European Seabirds at Sea and SCANS I. This database was the basis for the Atlas of Cetacean Distribution in Northwest European Waters (Reid *et al.*, 2003). In 2007, the ASCOBANS Advisory Committee Meeting proposed a new Joint Cetacean Protocol (JCP), involving a virtual, web-based database maintenance and providing a mechanism through which data collection standards could be harmonized.

The availability of data and tissue samples from marine mammal strandings is a key issue when attempting to compare data between areas and for long-term studies. Some stranding networks in the North Sea area keep sample collections and databases but very few marine mammal tissue banks exist in Europe and none of them is directly available in North Sea. There is geographical and temporal variation in causes of death, pollutant concentrations, feeding habits, and scientific expertise (some laboratories associated with a stranding network being specialized in one field of marine mammal science but not in others). A central tissue bank and associated database would facilitate rapid and efficient sharing of data and samples, as well as enhancing coordination and standardization of methodology. The database associated with the tissue bank should provide information on species, location and time of stranding, age, sex, maturity, lesions and cause of death. It should also provide information on scientific investigations being performed using available data and tissues to avoid overlap.

The proposed European tissue bank and database for marine mammals is under development by Royal Belgian Institute of Natural Sciences (MUMM department) and the University of Liege (Department of Pathology). It aims to provide high quality samples of marine mammals (small and large cetaceans and pinnipeds) from across Europe for research purposes on a non-profit basis, through scientific collaborations based on bilateral agreements. The tissue bank, accessible via a web portal, should facilitate the exchange of samples and support studies on temporal and geographical patterns and trends. Scientists and contributors could order tissues selected by species, area and time of collection, age, sex, tissues, lesions, and conservation procedure. Marine mammals would be necropsied and tissues collected, fixed and stored, following protocols to be standardized within Europe.

RBINS-MUMM and ULDP have, since 1990, assembled a tissue bank with more than 15 000 samples from marine mammals stranded in Belgium, France, Ireland and the Netherlands. Discussions with groups from between Belgium, France, Germany, Ireland, the Netherlands and the UK are ongoing. Samples are kept frozen or fixed for use in studies on pathology, parasitology, toxicology, life history, genetics, microbiology, etc. A web portal linked with a related database will facilitate the exchange of samples, including samples stored at other sites. Potential users of the tissue bank(s) and associated database will be required to agree to its terms and conditions of use. The system will be hosted at MUMM and linked with the existing stranding database (http://www.mumm.ac.be/EN/ Management/Nature/strandings.php).

Two other national marine mammal tissue banks accessible through a web portal have been developed to date. One, within the ICES area, was developed by the National Oceanic and Atmospheric Administration, NOAA, of the US Department of Commerce (https://mmhsrp.nmfs.noaa.gov/tissbk/). The other was created the University of Padua and the Italian Central Institute for Applied Marine Research (ICRAM), Italy (http://www.mammiferimarini.sperivet.unipd.it/eng/index.php).

Issues remain to be resolved concerning sample ownership, prioritization of use of the samples, and authorship. A Steering Committee with representatives of participating countries can be set up to decide on how to share the material. A delay of two years has been proposed, between the moment the samples are incorporated into the tissue bank and the moment they are available for use. This period will allow the partner who provided the samples to perform his/her own scientific investigations on the material. Other points of concern are the possible extra work (encoding data) and the extra cost (organization of workshop for standardization of necropsy and sampling procedure, for encoding tissues in the tissue bank). Concerning the first point, standardization of database with automatic procedures for data export can be proposed. For the latter, national and international funding will be sought with the support of international organization (ASCOBANS, ACCOBAM, IWC, etc). Last, but not least, is the issue of access to the web portal with different levels of protection, limited access being provided through a password-protected log-in system. Identified investigators will have access to the entire dataset while other users will be restricted to the page for the selection of tissues. This initiative will be of interest to both the participating countries and international organizations such as ICES, ASCOBANS and IWC.

9.4 Overview of different types of monitoring

JNCC 2008 describes a surveillance strategy for cetaceans in UK waters, including specific objectives for each component of the programme and its likely costs. This covers:

- Monitoring of strandings-the current programme is well-established but the budget covers a limited number of necropsies and do not include costs of collecting supporting data such as age and maturity.
- Bycatch monitoring.
- Large-scale boat-based surveys on a decadal cycle. Because SCANS II and CODA included both visual and acoustic monitoring it is assumed that both are included.
- Annual monitoring at a local scale, including use of dedicated surveys and platforms of opportunity, overseen by a Steering Group.
- The Joint Cetacean Protocol-a web-based common database for sightings surveys, with the remit to cover the whole Northeast Atlantic, again overseen by a Steering Group. Equivalent initiatives for bycatch monitoring and strandings are not currently part of the strategy although it should be noted that bycatch monitoring is coordinated through ICES, SGBYC and the UK will make strandings data available to an international database (as is required by Contracting Parties to ASCOBANS).

In the sections below we review the main monitoring and surveillance approaches used for marine mammals, particularly cetaceans.

9.4.1 Bycatch monitoring

The primary statutory requirement (following Regulation 812/2004) is to estimate bycatch rates for cetaceans by particular fleets, notably those deploying gillnets, pelagic trawls, high opening trawls and driftnets in vessels equal to or larger than 15 m overall length. Also Member States should collect scientific data on incidental catches of cetaceans for vessels less than 15 m, where possible. Estimates should have a coefficient of variation not exceeding 0.30. Note that bycatch information is also required under OSPAR, so information beyond what is requested in 812/2004 is also necessary.

Monitoring the bycatch of marine mammals in EU demersal trawl fishery should be assessed based on observer data collected under the DCR regulations (SGBYC 2008). SGBYC 2008 also recommended that, as an absolute minimum measure, the reporting of bycatch should also become mandatory in all fisheries and areas where comprehensive monitoring programmes were not in place.

Recreational fishery is not included under Regulation 812/2004. In some part of the North Sea, such as the southern area, recreational fisheries with small fishing boats are suspected to be responsible for significant captures of seals and small cetaceans. Systematic necropsy of stranded marine mammals would help to identify such mortalities.

A monitoring programme could include the following components:

- Design and implementation, initially as pilot schemes, of independent at-sea observer schemes to monitor marine mammal bycatch on board vessels operating in specified fisheries. This included vessels under 15 m in length.
- Collection of scientific data on incidental catches of marine mammals, prioritizing fisheries where no previous studies have examined the bycatch rate. The pilot monitoring programmes should be implemented for at least two consecutive years.
- The pilot monitoring schemes should provide estimates of bycatch of cetaceans per unit effort, broken down by species and aim to determine the variability of bycatch, which will provide the basis for the design of subsequent sampling strategies.
- Pilot study of Electronic Monitoring (EM) system for fisheries control on smaller vessels.
- Interviews in ports for small-scale fisheries (see section on interview sampling) and of non-professional fishers for recreational fishery.
- Monitoring of evidence of bycatch among stranded marine mammals and evaluation of temporal and geographical patterns.
- Monitoring of age, sex and maturity status of bycaught individuals, using data obtained directly from fisheries and also stranding programmes, in order to assess the direct consequences of the specific fishery on the marine mammal population.

Provision of accurate estimates of bycatches and associated confidence limits for protected species and quantifying the impact of introducing mitigation technologies requires a high level of on-board observer coverage, typically at a level of 25–30% of total fishing effort (Northridge and Thomas, 2003). Current levels of coverage are frequently at much lower levels than this. The amount of fishing effort to be observed under pilot schemes is specified in the Regulation, which states a minimum of 5% of effort needs to be monitored and where fleet size is small, at least three vessels should be sampled. For pelagic trawls (single and pair), from 1 December to 31 March in ICES Subareas VI, VII and VIII, sampling should be at a rate of 10% of effort.

Regulation 812/2004 also seeks assessment and monitoring of the impact of pingers on bycatch but few Member States have been able to carry out such monitoring. This is mainly as a consequence of the high cost of maintaining observer programmes. In some cases, data from anecdotal sources have been used to supplement the quantitative data gathered from observer programmes. The lack of systematic monitoring prevents the true extent of bycatch and potential impacts of mitigation from being fully understood. Scientific monitoring is essential to identify unexpected negative effects of mitigation devices (SGBYC 2008).

Data collected during bycatch monitoring will normally include:

- Identification of the type(s) of fishery concerned (areas, period, target species), including small vessels and recreational fishery.
- Descriptors of the fishing operations and fishing effort (gear characteristics, location and timing of beginning and end of effective fishing operation).
- The number of incidentally caught marine mammals and information on the species, size, or weight and sex, samples of skin and teeth, and records of animals lost during hauling the gear or released alive.
- Additional information such as the use of acoustic deterrent devices during fishing operations, cetacean sightings (including behaviour in relation to the fishing operation), environmental conditions.

9.4.2 Health status and stranding monitoring

Health status monitoring is part of the standard monitoring carried out in the UK to meet its obligations under the Habitats Directive, although the Directive does not specify the means by which this information should be obtained. Monitoring of strandings is however obligatory under ASCOBANS. Strandings can indicate where bycatch might be an issue although a dedicated bycatch monitoring scheme is the only way to get a good handle on fisheries' bycatch.

Adequate monitoring of marine mammal strandings, including necropsies, requires good organization and significant investments of money and time, normally through coordinated networks. The work required to determine health status of stranded animals is multidisciplinary, requiring biological, life history, pathological and toxicological investigation. Monitoring work can provide data and samples to support research into various aspects of cetacean biology and ecology. Databases (for all information collected) and sample banks should be maintained. Basic functions of a stranding network should include:

1) A mechanism for notification of strandings (e.g. through the coastguard, police, local authorities and public awareness);

Rapid and effective response, including making of any pertinent decision (animal rescue and transportation, euthanasia, necropsy);

Collection and maintenance of all data and samples required for monitoring and in support of associated research programmes;

Provision of scientific advice to decision-makers.

Such networks exist for most but not all European countries bordering the North Sea (see Annex 5) However, strandings monitoring programmes are not standardized in Europe, some reporting only strandings without post-mortem investigations, other performing complete a necropsy and tissue collection for tissue banking. In some countries, only cetaceans are considered, or there is no national coordination or funding of the networks, and/or funding is short-term and project-based. While voluntary groups/NGOs monitor strandings along many coastlines (e.g. in Spain, Ireland, UK), some Member States have made no attempt to address their obligation to monitor strandings. [Note: "obligations" have a different legal status to "requirements"].

In addition to information on health status, a range of other data and samples can be obtained from stranded animals, not all of which are necessary to meet monitoring requirements but all of which can help improve understanding of the biology and ecology of the species, and put health status data in its proper context.

- Location and date of stranding.
- Species, numbers and sexes, of animals involved.
- Length, weight and other morphometric characters such as blubber thickness (an indicator of condition).
- Age (from teeth), maturity and reproductive status (from examination scars in ovaries, examination of milk glands, presence of a foetus). Such life-history data can be used to estimate population age structure, mortality and pregnancy rates, age-at-maturity and growth rates, among other parameters. Age data in particular are essential to interpret individual health and population status.
- Cause of death, including diagnosis of bycatch.
- Stomach contents analysis, to provide information on diet and insights into the potential of competition with fisheries.

- Samples of skin, blubber, liver, kidney, etc, for use in genetic studies, estimation of contaminant burdens (POPs, toxic elements), fatty acid and stable isotope analysis, among others.

9.4.3 Visual surveys

Abundance estimates are needed to monitor the status of a species and to detect trends in its population numbers. For the European marine mammal species, robust abundance estimates are required to detect changes in conservation status and to assess the impact of potential threats on the populations such as incidental capture in fishing gear (bycatch), seismic and other sonar activities, pollution, etc.

Large-scale visual surveys

Absolute abundance estimates for marine mammals require dedicated surveys on a scale large enough to cover a significant part of the distribution of the species. Large scale surveys have involved the use of vessels and aircraft to assure maximum coverage of the area under study. Large-scale surveys are costly and require international coordination.

Dedicated large-scale surveys probably represent the most efficient way to collect standardized data for wide-ranging species. By deploying large boats (or planes) they can extend into deep-water areas inaccessible to small boats (although conversely, they may be unable to cover shallow coastal waters). Large boats can also carry two observer platforms, permitting estimation of the proportion of animals on the track line that are missed, and hence deriving absolute abundance. Absolute abundance can only be calculated if sufficient data are collected (i.e. a large enough number of animals are seen), which generally requires considerable survey effort even for the commoner species.

Line transect sampling allows the density of a species to be estimated along a series of transects, and to extrapolate this density to the entire survey area (Evans and Hammond, 2004). Estimates of abundance are often bounded by relatively large confidence intervals, thus the power to detect trends through time can be low. Power can be increased by carrying out more surveys, but there is a trade-off between increase in power and associated costs. This high cost has resulted in adoption of a 10-year cycle with only one month surveyed.

A disadvantage of ship surveys is that many cetaceans move in response to the survey platform (Palka and Hammond, 2001). Aircraft platforms are usually limited to areas relatively near land. If it is necessary to conduct surveys far from the coastline, aircraft with a large range can be used. For instance, the scientific aircraft AN-26 "Arctica" is able to cover more than 1500 nautical miles without landing (see ToR d). Aerial surveys have the advantage of covering large areas in a short time but the disadvantage that animals are only in view briefly and therefore may be missed or misidentified. However, aircraft can be equipped with special photo, video and infrared instrumentation to permit collection of more reliable data.

Local-scale visual surveys

Information on marine mammal populations (relative abundance, distribution, habitat use, and trends, etc.) can also be obtained by local-scale visual surveys that cover the presence, distribution and abundance of a particular species or of all species in a small geographical area. They can be conducted from fixed stations (e.g. coastal land-based observation points) or from aerial or boat based platforms. Fixed station visual surveys can be carried out along a migrating corridor or in areas of permanent habitat use. Generally they are cheaper than ship or aircraft based surveys, and consequently are often undertaken at much greater frequencies. However, they can only cover a very limited area and be affected by unknown factors influencing cetacean presence in the observation area. Aerial platforms, such as aircrafts and helicopters, can be widely applied in local-scale marine mammal surveys by using different models of tracks. Boat-based platforms can be used to investigate high density or exactly bounded areas (protected, impacted, polluted, etc.) and also allow the application of line transect sampling.

Local-scale surveys have been used to identify coastal areas important for particular species and variations in numbers both seasonally and over the longer term. They are also useful to measure the relative abundance, to make inferences about whether a population or the number of animals in an area is going up or down and to assess the occupancy of a predefined area. Occupancy is a relatively simple measure that represents the proportion of locations surveyed where a species is recorded. These locations are usually defined as grid cells of a size relative to the survey being conducted. Occupancy has the advantage of being quick and easy to calculate and can provide a picture of fine-scale changes in distribution and an index of abundance changes. A positive relationship between local abundance and occupancy is one of the most widely reported patterns in population and community ecology (Freckleton *et al*., 2006; Gaston *et al*., 2006).

Platforms of opportunity

Another source of data are the use of opportunistic platforms such as fishery surveys, ferries, etc., that provide a potentially valuable and cost-effective resource for monitoring purposes. Because marine mammal monitoring is not the main objective in these cases, survey coverage of the population/area of interest may be unrepresentative. Joining together all the information available from these platforms of opportunity and the international coordination of this work would allow better use of the information.

9.4.4 Monitoring of additional pressures and impacts

Monitoring of the potential impacts of certain pressures such as disturbance can be a requirement for noise producing activities, such as the construction of an offshore windfarm. In addition, there are several drivers for the prevention of disturbance to marine mammals. ASCOBANS requires Parties to work towards the prevention of disturbance, especially of an acoustic nature. The (US) National Research Council´s Committee on Potential Impacts of Ambient Noise in the Ocean on Marine Mammals recommended that a long-term ocean noise monitoring programme over a broad range of frequencies should be established, monitoring noise in geographically diverse areas with emphasis on marine mammal habitats (National Research Council 2003). Ocean noise can be monitored with buoys equipped with hydrophones and other sensors recording sounds from whales, fish, ships and other sources. In a European context, the recent Marine Strategy Framework Directive will possibly drive the development of an indicator of the noise pressure in the marine environment.

Underwater noise can have direct effects on individual marine mammals, but also indirect effects through an impact on their prey and habitat. Data on underwater noise and its effects on marine mammals are in most cases very incomplete and are often contradictory. In general, a difference is made in chronic and acute effects, the former comprising displacement from preferred areas and disruption of behaviour patterns and the latter injury or death of marine organisms caused by short but intense noise sources. A long exposure to less intense sound sources can have sublethal effects, including chronic hearing loss and effects related to stress.

There are several sources of human-generated underwater noise such as noise generated by ship traffic, dredging and construction, oil drilling and production, geophysical surveys, sonar and ocean research (seismology, acoustic propagation, acoustic tomography and thermometry). As the intensity of shipping has increased during the last decades, an impact on marine mammals is likely, although it is very difficult to qualify and quantify such an impact.

More acute effects can occur because of noise with high energy levels. High noise levels are caused by different human activities: seismic surveys, offshore wind farm construction works, the use of military sonar, and the use of explosives. Concerns have been expressed over the lack of investigation into the potential effects on cetaceans of prevalent noise sources such as those from sonar, depth finders and fishery acoustics gear (Nowacek *et al*., 2007).

Throughout the North Sea the construction of thousands of offshore windmills is being planned. Although some preventive or mitigating measures are being envisaged, eliminating effects on marine mammals will be impossible. Especially during pile driving activities, very high noise levels can occur (Nedwell and Howell, 2004; Parvin and Nedwell, 2006a; b; Thomson *et al*., 2006), which can disturb porpoises up to tens of kilometres from its source. It is also possible that effects will occur during the operational phases of wind farms, but such effects remain largely to be investigated (Dolman *et al*., 2007).

In many countries monitoring programmes for assessing the impact of the construction and operation of offshore wind farms are being set up, often as a prerequisite for construction and operation permits. Next to monitoring the effects on the distribution and abundance of marine mammals in and around the wind park site using for instance ship-based or aerial surveys, or static acoustic methods, also the physical parameter 'noise' needs to be monitored. In many cases this is the only variable that will be measurable, given that observing effects in the field, and especially possible sublethal effects, is challenging. The assessment of the impact needs to take account of the results of studies describing hearing thresholds of different marine mammal species and effects of noise levels as measured on animals in captivity. However, exposure-effect experiments with marine mammals are challenging.

9.4.5 Additional and complementary approaches

Acoustic monitoring of cetaceans

Visual surveys (land-based, ship-based, aerial), all depend on daylight, weather conditions, and appearance of animals at the surface. Acoustic surveys avoid these issues and are of particular value for:

- species which spend long periods underwater and echo-locate almost continuously while at depth, such as sperm whale;
- species that are difficult to detect during boat/land-based surveys, such as harbour porpoises;
- studies on habitat use of coastal species such as bottlenose dolphins.

Acoustic ship surveys can detect trends in relative abundance and complement ship-based visual surveys, giving two independent and complementary datasets from the same area. Fixed hydrophone units can collect data over long periods and thus provide useful data on seasonality of presence, as well as movements, of odontocete cetaceans, although issues remain in distinguishing certain species. There is also the potential of absolute density estimation from these static units for a variety of species.

Issues that need to be considered include:

- Mysticete and odontocete sounds are very different, so equipment is needed depending of the species targeted, although recent equipment (C-PODs) are able to distinguish several different groups of species.
- Directionality and range of detection must be taken into account.
- It must be possible to identify background noise (e.g. ship sonar, etc).

- For estimating density from fixed hydrophone units, the detection probability, animal localization, cue rate and proportion of false positive detections need further investigation.

Satellite telemetry and tracking

Satellite telemetry is a good method to investigate movements (including any seasonal migration) and, with a large enough sample, has the potential for identifying important habitats or areas. However, to make inferences about large populations ranging over a wide area, many animals need to be tagged, especially in species with high individual variation in behaviour (Teilmann *et al.*, 2004; 2008). For some areas and species this would be a significant logistical and costly challenge whilst for other species there are tag attachment issues.

Photo-ID

Photo-identification of individual animals can be used to estimate abundance (based on 'mark-recapture' methods) and to obtain data on home ranges, movements and social organization. It depends on individuals having recognizable markings or fin shapes, the ability to obtain suitable photographs and to take into account the fact that marks can change over the time. Photo-identification is possible for many species, particularly those with a wide range of markings, including bottlenose dolphins (dorsal fins), humpback whales (flukes) and seals (pelage).

Carcass recovery schemes

Getting fishers to report bycatch and/or bring carcasses back to shore can be very difficult, especially in countries where legislation prohibits the landing of marine mammals. Other reasons that constrain carcass recovery include the feeling of fishers that bringing the dead animals back to shore is 'extra work' or socially unacceptable or there is simply lack of deck or hold space. Therefore, most incidental captures are thrown back into the sea. In Spain, for instance, López *et al*., 2003 requested that cetaceans bycaught by Galician fishers were recovered and brought back to shore, but only 17 carcasses were recovered between 1998 and 1999 and this has not improved in recent years. In Portugal, fishers reported bycaught cetaceans until 1981 when national legislation was passed that made killing cetaceans illegal and fishers became too afraid to report their incidental bycatches (Sequeria and Ferreira, 1994).

For the southern North Sea, the prevalence of bycatch would be largely underestimated if based only on the number of porpoises reported by fishers (Jauniaux *et al*., 2002). Aside from net marks and cuts made by fishers (flipper amputation, sharp trans-abdominal or trans-thoracic opening), there are few specific signs of capture and evidence should be interpreted with caution. In addition, even the net marks or cuts are not always present. Such considerations reinforce the necessity to perform complete necropsy and sampling based on standard methodology. Otherwise, the rate of accidental capture will be underestimated from stranded marine mammals.

Interview surveys

The use of questionnaires in ecology has increased over the last decade. In studies concerning human impacts on wild species, questionnaires often provide the best means of obtaining quantitative data from a large number of sites. Interviews with fishers can deliver valuable information about accidental bycatch of marine mammals in terms of species affected, numbers, susceptible fishing techniques, etc. They can also help to identify fishers who are likely cooperate with observers, and vessels which may have greater problems with interactions for subsequent on-board observations and carcass recovery schemes. Face-to-face interviews generally result in higher response rates than telephone and postal surveys; they are however more costly and time consuming. Questionnaires should be piloted prior to their use, the question and answer format should be kept as simple as possible and the sample size should be sufficient for the statistical analysis. The accuracy of data should be assessed by ground-truthing where relevant (White *et al*., 2005).

Monitoring habitat quality

Habitat quality is difficult to measure. Information which could contribute to understanding habitat quality includes models of habitat use or niche characteristics, coupled with information on the type of use of each type of habitat (e.g. feeding, calving) from which preferred or critical parameter values could be identified and essential habitat defined (e.g. preferred temperature and depth ranges). Obvious sources of disturbance (e.g. boat traffic, offshore construction) can be identified and also areas of substantial habitat degradation (e.g. high pollution levels, oil spills, severe overfishing). The recent Marine Strategy Framework Directive asks for the establishment of a comprehensive set of environmental targets and associated indicators for Member States waters so as to guide progress towards achieving good environmental status in the marine environment.

9.5 Recommendations

- As a prerequisite to achieving a coherent strategy for surveillance and monitoring of marine mammals applicable to European waters, there is a need to clarify and where necessary update, reference points used to identify favourable conservation status of cetaceans in European waters, bearing in mind the limitations to statistical power of monitoring.
- Attention must be given to international coordination and standardization of protocols for stranding networks, and development of an international database/sample bank. Where currently lacking, national funding for such networks is recommended, while being sensitive to the important contribution of the voluntary sector to this activity.
- While it seems clear that monitoring of abundance, bycatch and health status may reasonably form the core of surveillance for cetaceans, the importance of other types of information (e.g. life-history data) and monitoring of specific threats (e.g. offshore construction) should also be recognized when designing a surveillance strategy.
- Monitoring programme design should take account of new findings on the stock structure (e.g. ToR b and the identification of an isolated Iberian stock for harbour porpoise).
- Further work is needed to define the scope and detailed content of a strategy for surveillance and monitoring of marine mammals applicable to the ICES area, taking into account the different legislative frameworks operating in the northwest and Northeast Atlantic, conservation requirements for pinnipeds and, where appropriate, surveillance needs to support sustainable harvest.

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10 ToR g. Update on development of database for seals, and report on the status of any intersessional work

10.1 Requirement

To collate information from seal population monitoring programmes across the ICES area and to populate a database so details for different areas can be more easily compared.

10.2 Area of relevance

The area of relevance is the North-east Atlantic and the North Sea, where the European species of the harbour (common) seal, *Phoca vitulina vitulina*, and the Atlantic grey seal, *Halichoerus grypus*, are found. Countries participating include: Norway, Sweden, Denmark, Germany, the Netherlands, Belgium, France, UK, and Ireland. In future, the area covered may extend to include the Faroe Islands, the Baltic Sea in conjunction with the HELCOM Expert Group on Seals (i.e. to include the Baltic countries: Sweden, Finland, Russia, Estonia, Latvia, Lithuania and Poland and Russia), the Barents Sea (Russia) and the Northwest Atlantic (Iceland, Greenland, Canada and the USA).

To date, Denmark, Germany, the Netherlands, Belgium and the UK have provided data. Norway, Sweden, Belgium, France and Ireland have agreed in principle to provide data. Data from these counties will be incorporated when permission is granted; it is to be hoped before the next meeting of the WGMME in 2010.

10.3 Issues

Most importantly, the relevance and longevity of this seal database is entirely dependent on the frequency and extent to which it is populated with information from different countries. Most organizations that monitor seal populations are very understandably protective of their data, as it takes a lot of time, expense and effort to collect and collate. It is imperative that the database remains secure and that its contents are not accessible by other parties without the consent and knowledge of the contributors.

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

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

10.4 Database structure

To date, the current seal population database format is a simple MS Excel workbook. The database will be retained and updated by the ICES database manager. There will be separate worksheets for the following:

- Harbour seal metadata;

- Harbour seal moult surveys;
- Harbour seal pup surveys;
- Harbour seal breeding surveys;
- Grey seal metadata;
- Grey seal pups surveys;
- Grey seal moult surveys;

10.4.1 Harbour seal metadata

Virtually identical with grey seal metadata. The country, contact individual(s), e-mail address(es), Institute(s) and address(es), parameter(s) surveyed, year(s) of survey, frequency of survey, details of the methods used, the area covered, comments. More detailed explanation of methods used during surveys including any limitations imposed to account for environmental factors e.g. numbers of hours from the time of low tide when surveys can be carried out; any other methods to minimize the effect of environmental variables. Window of opportunity over which surveys are carried out; for both breeding season and moult.

10.4.2 Harbour seal moult surveys

This contains the results of surveys carried out during the harbour seal annual moult.

10.4.3 Harbour seal breeding surveys-pups

As above, but reporting numbers of pups counted during surveys. Includes information on whether the data represent pup counts, or whether the counts are converted into an estimate of pup production.

10.4.4 Harbour seal breeding surveys-adults

Numbers of adults counted on surveys carried out during the breeding season. In some areas (Wadden Sea, UK Moray Firth) breeding season surveys are carried out annually.

10.4.5 Grey seal metadata

This worksheet contains information on:

The country, contact individual(s), e-mail address(es), Institute(s) and address(es), parameter(s) surveyed, year(s) of survey, frequency of survey, details of the methods used, the area covered, comments, indication whether pup production estimates are converted to total population size.

10.4.6 Grey seal pup production estimates

This worksheet contains the results of the grey seal pup production monitoring programmes. The data are organized by country, location within the country, ICES area, OSPAR area, whether an OSPAR EcoQO area. Data for each area is arranged by year of survey.

10.4.7 Grey seal moult surveys

Some countries also monitor grey seal numbers during their moult between December and April e.g. Wadden Sea Trilateral group (regular surveys) and the Republic of Ireland (one survey).

11 Future work and recommendations

11.1 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 9 of this document.

11.2 Recommendation I

Power analysis should be used to assess the effectiveness of the existing survey schemes, relative to the specific EcoQO.

11.3 Recommendation II

Moult counts instead of pup counts for grey seals in the Wadden Sea; though the importance to continue efforts in obtaining pup count data was noted, in order to compare with available data from the UK.

11.4 Recommendation III

Provision of feedback by OSPAR to ICES, in an appropriate time frame, when EcoQOs are triggered. In addition, the WG would appreciate OSPAR and ICES to encourage and support the responsible entity (e.g. *governments)* to take appropriate action. The WG would be prepared to assist in making specific recommendations (e.g. research to be carried out, management measures to be taken).

11.5 Recommendation IV

The use of four management units within southern Scandinavia waters in the North Sea area: (1) Skagerrak, (2) Kattegat, (3) central Limfjord and (4) the Wadden Sea therefore splitting the current EcoQO sub-unit "Kattegat, Skaggerak and Oslofjord".

11.6 Recommendation V

Use the current OSPAR EcoQO grey seal subunit boundaries, as outlined in the 2007 OSPAR handbook.

11.7 Recommendation VI

A Northeast Atlantic wide genetic study of grey seal population structure should be initiated.

11.8 Recommendation VII

Genetic studies of harbour seals should be carried out in areas where such information is lacking, in particular for populations where hunting is conducted.

11.9 Recommendation VIII

Regular surveys are required to determine trends for all harbour and grey seal management subunits, and recommends either their establishment, or continuation.

11.10 Recommendation IX

Removals of harbour and grey seals, catch and bycatch, should be recorded for all OSPAR EcoQO subunits.

11.11 Recommendation X

Iberian harbour porpoise population and the NE Atlantic harbour porpoise population (continuous system-France to Norway) are managed separately.

11.12 Recommendation XI

The Iberian harbour porpoise population should be given a high priority for conservation, because of its presumed small population size, low genetic diversity and likely susceptibility to habitat degradation.

11.13 Recommendation XII

Immediate action by the Spanish and Portuguese governments in monitoring and conserving the Iberian harbour porpoise population.

11.14 Recommendation XIII

A large-scale Northeast Atlantic harbour porpoise study which combines both genetic and ecological tracers should be undertaken

11.15 Recommendation XIV

Due to a lack of sampling of offshore common dolphins for genetic analysis, the WGMME recommends that the management unit/area for the *D. delphis* population in the NE Atlantic be confined to the continental shelf and slope waters, and the oceanic waters of the Bay of Biscay.

11.16 Recommendation XV

All *D. delphis* and data available (genetic and ecological) in the ICES area are analysed together, in order to get the most comprehensive picture of population structure.

11.17 Recommendation XVI

Continuity of surveys to estimate absolute abundance such as SCANS-II and CODA, at least with a frequency between 5–10 years. If possible both the shelf and offshore waters should be covered simultaneously.

11.18 Recommendation XVII

DG MARE consider the CLA approach (the third tuning approach where appropriate) for future evaluation of bycatch levels and advice on conservation objectives management actions in both harbour porpoises and common dolphins.

11.19 Recommendation XVIII

The continuation, and establishment in some cases, of national observer bycatch programmes in order to obtain current estimates of incidental capture for all marine mammal species.

11.20 Recommendation XIX

By-catch management procedures developed under SCANS-II and CODA projects are taken into consideration by DG MARE when reviewing the EU Regulation 812/2004.

11.21 Recommendation XX

The EC (ETC/BD) reconsider the data requirements for FCS reporting with respect to highly mobile, wide ranging species and, most notably, consider permitting reporting at an appropriate biological scale where such data exist. This would allow ETC/BD to produce accurate and biologically meaningful assessments, relevant to the conservation of the species and would aid instigation of appropriate management measures where necessary.

11.22 Recommendation XXI

The EC (ETC/BD) reconsider the reporting requirements for rare, vagrant and occasional species occurring in individual water of Member States.

11.23 Recommendation XXII

Comprehensive, consistent and explicit guidance on the completion of FCS reports is issued by the European Commission if the data from future assessments is to be used to provide a reliable analysis of the distribution and abundance of marine mammals in European waters.

11.24 Recommendation XXIII

As part of the above guidance, all future FCS assessments should be evidence based rather than allowing expert judgements of the various parameters used to assess conservation status. This would lead to biologically accurate assessments relevant to the conservation of the species.

11.25 Recommendation XXIV

Member States develop international collaborative monitoring strategies for marine mammals in order to meet the surveillance requirements of the Habitats Directive.

11.26 Recommendation XXV

A prerequisite to achieving a coherent strategy for surveillance and monitoring of marine mammals applicable to European waters, there is a need to clarify and where necessary update, reference points used to identify favourable conservation status of cetaceans in European waters, bearing in mind the limitations to statistical power of monitoring.

11.27 Recommendation XXVI

Attention must be given to international coordination and standardization of protocols for stranding networks, and development of an international database/sample bank. Where currently lacking, national funding for such networks is recommended, while being sensitive to the important contribution of the voluntary sector to this activity.

11.28 Recommendation XXVII

While it seems clear that monitoring of abundance, bycatch and health status may reasonably form the core of surveillance for cetaceans, the WG noted the importance of other types of information (e.g. life-history data) and the monitoring of specific threats (e.g. offshore construction), and recommended their inclusion when designing a surveillance strategy.

11.29 Recommendation XXVIII

Monitoring programme design should take account of new findings on the stock structure (e.g. ToR b and the identification of an isolated Iberian stock for harbour porpoise).

11.30 Recommendation XXIX

Further work is needed to define the scope and detailed content of a strategy for surveillance and monitoring of marine mammals applicable to the ICES area, taking into account the different legislative frameworks operating in the northwest and Northeast Atlantic, conservation requirements for pinnipeds and, where appropriate, surveillance needs to support sustainable harvest.

Annex 1. Management procedure developed under the CODA project

Bycatch assessment and safe limits

As part of the EU SCANS-II project, bycatch assessment methods and management procedures were developed for harbour porpoise in the European Atlantic and North Sea (SCANS-II, 2008; Winship 2009). As part of the CODA project, these methods and procedures were developed further and applied to common dolphins in the Northeast Atlantic.

Assessment of the impact of bycatch on common dolphin

An understanding of the state and dynamics of a population is a prerequisite for assessing the impact of bycatch on its conservation status. Four quantities of particular interest are: 1) the bycatch removed from the population, 2) the size of the population, 3) the rate at which the population can grow in the absence of bycatch, and 4) the population size that could be achieved in the absence of bycatch. While knowledge of these quantities is essential to conservation and management, estimates of these quantities are often lacking or highly uncertain, as is the case for common dolphins in the Northeast Atlantic.

An integrated population dynamics model was developed for assessing the state and dynamics of a small cetacean population subject to bycatch. The population model is an age-structured model of the female component of a small cetacean population. The model can be fitted to a range of data on the population (e.g. abundance), life history (e.g. pregnancy rate, sexual maturity-at-age, age structure of natural mortality) and bycatch (e.g. age structure of bycatch mortality). The numbers of bycaught animals can be treated as known input to the model or bycatch can be estimated by fitting the model to data on bycatch rate per unit fishing effort with total fishing effort as input. The model is flexible and allows for a range of scenarios with respect to population dynamics (e.g. density-independent or density-dependent dynamics) and population structure (e.g. multiple subpopulations with dispersal among them). The model is fitted in a Bayesian statistical framework using a Markov chain Monte Carlo method.

The integrated population dynamics model was fitted to several datasets on common dolphins in the Northeast Atlantic. The SCANS-II and CODA surveys provided absolute abundance estimates for common dolphins in Northeast Atlantic shelf waters in July 2005 and offshore waters in July 2007, respectively. Life history data were available for stranded and bycaught females from the UK and Ireland including sexual maturity status of known-aged animals, pregnancy status of mature animals, and age-at-death of animals dying as a result of natural causes and bycatch. Estimates of previous bycatch of common dolphins in several fisheries in the Northeast Atlantic were available from the literature.

The assessment was conducted for the period 1990–2007. The population was treated as a single, panmictic population inhabiting the Northeast Atlantic. The SCANS-II and CODA abundance estimates were combined into a single abundance estimate for this population, 180 075 (CV=0.272), and was assigned to the year between the two surveys, July 2006. Four model scenarios were considered which differed with respect to whether population dynamics were density-dependent or density independent, whether or not the population was assumed to be at carrying capacity at the beginning of the study period, parameterization of age-specific natural survival rates.

The main result of the assessment was that the combination of data and model used did not provide useful information about the main population parameters of interest. The posterior probability distributions for maximum birth rate, carrying capacity and initial population size were wide and uninformative. The model fitted the single estimate of abundance reasonably well, but there were large uncertainties in estimated population size during the study period. As a result of these uninformative posterior distributions the posterior distributions for population growth rate and maximum population growth rate were also uninformative. The model fitted the data on pregnancy rate and age at sexual maturity reasonably well but the estimation of natural survival rates was problematic; it was difficult to obtain convergent estimates for some of the survival parameters with either method.

Determining safe bycatch limits for common dolphin

Bycatch management procedures

Management procedures were developed for calculating bycatch limits for small cetacean populations. We considered two existing management procedures, the Potential Biological Removal procedure of the US Government (PBR, Wade, 1998) and the Catch Limit Algorithm procedure of the International Whaling Commission (IWC; CLA, Cooke, 1999), as candidates for this purpose. Both procedures take information about a small cetacean population as input and output a bycatch limit. The PBR procedure takes a single, current estimate of population size as input. The CLA procedure takes time-series of estimates of population size and estimates of previous bycatch as input. Both procedures explicitly incorporate uncertainty in the estimates of population size. Thus, the procedures also require estimates of the precision of the estimates of population size as input. Under the PBR procedure, the calculation of the bycatch limit uses a single, relatively simple equation. Under the CLA procedure, the calculation of the bycatch limit is slightly more demanding computationally, involving statistically fitting a simple population model to the input dataseries then calculating the bycatch limit as a function of several quantities estimated through the model fitting. An important element of both procedures is the ability to update the bycatch limit as new data on the population become available. The procedures are applied at the spatial resolution of defined management areas. A given procedure is applied separately to each management area resulting in a separate bycatch limit for each area.

Conservation objectives and tuning the management procedures

A key element of both management procedures is the ability to 'tune' the procedure, i.e. adjust the bycatch limits, to achieve specific conservation objectives, which must be established in quantitative terms. Only then can safe bycatch limits be calculated. For the purposes of this project, we used the interim conservation objective agreed by ASCOBANS: to allow populations to recover to and/or maintain 80% of carrying capacity in the long term. Carrying capacity is defined as the population size that would theoretically be reached by a population in the absence of bycatch. This objective is partially quantitative but two factors are not fully defined. First, "long term" is not specified. We used a period of 200 years for the development of the management framework. Second, "recovering to and/or maintain 80% of carrying capacity" can be interpreted in different ways.

We developed three versions of the management procedures, achieved by different tunings of the parameters, to reflect this. The first was that this is an expected target that should be reached <u>on average</u>. Our first tuning, therefore, ensured that the procedures reached or exceeded 80% carrying capacity 50% of the time. This is the way the IWC's CLA was tuned. The second interpretation is that the population should recover to and/or be maintained <u>at or above</u> 80% of carrying capacity. To capture this, our second tuning ensured that 80% carrying capacity was achieved 95% of the time. This is a stricter target and produces a more conservative procedure. The third, an extreme alternative, extended the second tuning to meet the conservation objective in the face of a <u>"worst case" scenario</u>. This is a much more conservative approach and, by definition, has lower plausibility than the other two.

The management procedures developed are generic but the specific results are entirely dependent on the conservation objective adopted. If it is determined that alternative and/or additional conservation/management objectives are appropriate, the management procedures can easily be tuned to the new objective(s).

Operating model

We developed a computer-based simulation model, or operating model, for tuning the bycatch management procedures so that one would expect to meet specific conservation objectives in practice and for testing and comparing the performance of the two procedures. The operating model simulates a small cetacean population over time while periodically simulating surveys of the size of this population. Bycatch is removed from this population annually according to bycatch limits set by the management procedures. Critically, the management procedures do not have knowledge of the true size of the population; they only have the simulated survey data and bycatch limits as input. This is the key aspect of the simulation model that mimics how the management procedures would operate in reality and thus how one would expect populations to fare under the management procedures in practice. The model of the cetacean population incorporates age structure, density-dependence (in birth rate), multiple subpopulations (with dispersal among them), and environmental variation (represented by systematic changes in carrying capacity, periodic catastrophic mortality events, and random fluctuations in birth rate). Survey estimates are generated with random error and potentially directional bias. Similarly, bycatch is modelled as a random (and potentially biased) realization of the set bycatch limit. The operating model allows for multiple management areas that do not necessarily correspond to the spatial ranges of subpopulations. Thus, the model allows for flexible spatial scenarios regarding management and subpopulation structure (e.g. seasonal mixing).

Tuning the management procedures

The operating model was used to tune the management procedures so that one would expect to achieve the conservation objective in practice. All three tunings were based on a single subpopulation inhabiting a single management area. The operating model was used to simulate this subpopulation subject to bycatch as limited by the management procedures for a period of 200 years. Population status at the end of the 200-year simulation period was examined to determine whether or not the conservation objective was achieved. If the objective was not achieved then the values of the tuning parameters of the management procedures were adjusted and the simulation was run again. This process was iterated until the conservation objective was achieved.

The first version was developed in a manner similar to the tuning of the CLA by the IWC. All parameters of the operating model were set at their baseline values. Initial population status (population size as a proportion of carrying capacity) was set to 0.99. We chose 4% per year as a conservative maximum population growth rate for common dolphins and a conservative maximum net productivity level of 50% of carrying capacity. The management procedures were then tuned under this scenario so that the median population status after 200 years was 80%. This tuning is therefore appropriate to a conservation objective of maintaining the population at 80% of carrying capacity in the long term.

The second version tuning was developed in exactly the same way except that the management procedures were tuned so that there was a 95% probability that population status was ≥80% after 200 years. This is appropriate to a conservation objective of maintaining the population at or above 80% of carrying capacity in the long term.

The third "worst-case" version used population parameter values identical with the first two versions and all parameters of the operating model were set at their baseline values except two. A 50% overestimate in absolute estimates of population size and a 50% underestimate in estimates of future bycatch were chosen as worst-case scenarios. Initial population statuses ranging from 0.05–1.00 were considered for this tuning. The management procedures were then tuned so that there was a 95% probability that population status was ≥0.80 after 200 years. This tuning is therefore appropriate to a conservation objective of maintaining the population at or above 80% of carrying capacity in the long term under a worst-case scenario.

The difference in the three versions (tunings) of the PBR and CLA management procedures are illustrated in Figure 8. In the first version, PBR1 and CLA1, the population is maintained at 80% of carrying capacity, as defined by the conservation objective. In the second version, PBR2 and CLA2, the population is maintained at a higher percentage of carrying capacity (85-90%) because of the requirement to achieve the conservation objective 95% of the time. In the third version, PBR3 and CLA3, the population is maintained at an even higher percentage of carrying capacity (~95%) because of the additional requirement to achieve the conservation objective under a "worst-case" scenario.

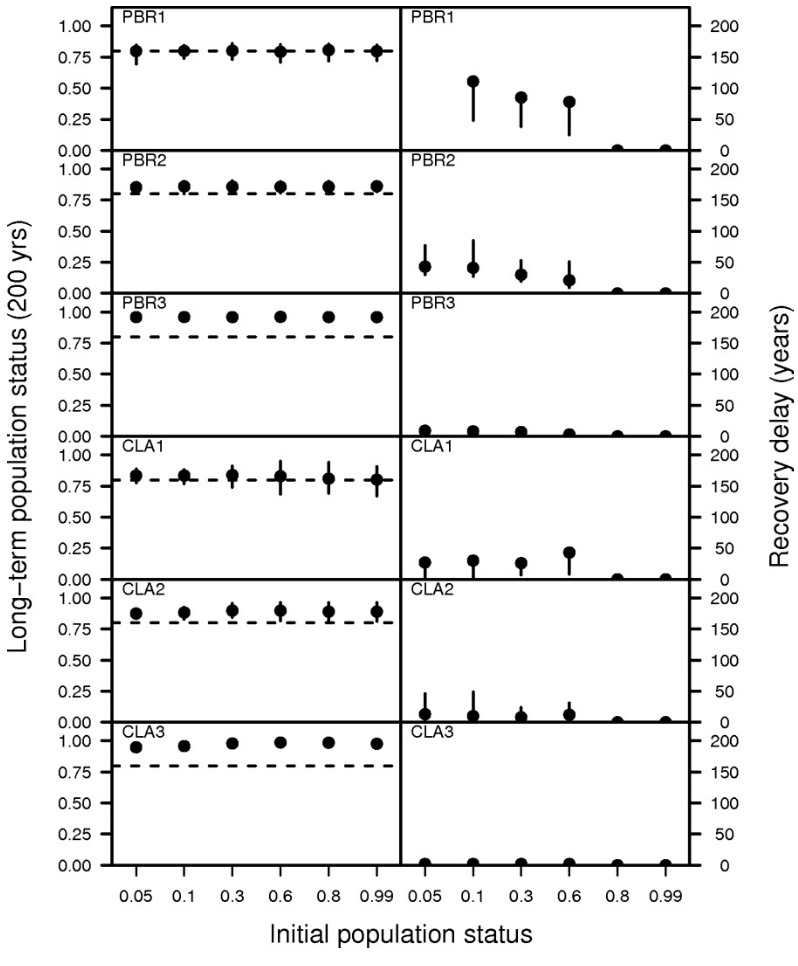

Figure 8. Performance of three tunings of the PBR and CLA management procedures under the baseline scenario with respect to achieving the conservation objective (long-term population status) and recovery delay. Points represent median results from 100 simulations and error bars represent the 90% interval of simulation outcomes. Population status is defined as population size as a proportion of carrying capacity. The horizontal dashed lines indicate the conservation objective: population status = 80%. Recovery delay is defined as the delay in recovery of a population to 80% of carrying capacity relative to a scenario without bycatch.

The delay in recovery of depleted populations to 80% of carrying capacity under the CLA procedure tended to be shorter than under the PBR procedure for a given tuning and initial population status. This was because of the faster short-term recovery of highly depleted populations under the CLA procedure because of its internal protection mechanism.

PBR or CLA management procedure?

The tuned PBR and CLA management procedures developed here are similar but there are some key differences. The only input to the PBR procedure is a single estimate of abundance, whereas the CLA procedure makes use of information on bycatch and on multiple estimates of abundance, if available, to give a more informed assessment of population status. As documented, there are estimates of previous common dolphin bycatch available for several fisheries the Northeast Atlantic and there are estimates of historical abundance of common dolphins in the Northeast Atlantic that could be used. The availability of historical data on bycatch and abundance confers an advantage to using the CLA procedure.

Another feature of the CLA procedure is its internal protection mechanism, which enhances the recovery of depleted populations by setting bycatch to zero if the population is estimated to be, in our version, <50% of carrying capacity. The PBR procedure cannot implement such an internal protection mechanism because it relies on a single estimate of population size and cannot, therefore, estimate the level of the population relative to carrying capacity. An advantage of the PBR procedure is its simplicity but this simplicity does not give any advantage in the context of its use within the management framework presented here.

We conclude that the features of the CLA procedure and the advantages that these confer are sufficient for it to be considered as the best management procedure for common dolphins in the Northeast Atlantic.

Which version (tuning) of management procedure?

The three tunings developed allow for three interpretations of the conservation objective adopted from ASCOBANS (to allow populations to recover to and/or maintain 80% of carrying capacity in the long term). The first tuning of the management procedures is a robust mechanism for setting limits to bycatch to achieve the conservation objective of allowing a population to recover to and be maintained *at* 80% of carrying capacity. The second tuning achieves the conservation objective of maintaining a population *at or above* 80% of carrying capacity. Satisfactory performance of the first and second tunings depends on the availability of dataseries of historical and current estimates of abundance and bycatch that are essentially unbiased. The third tuning is a highly conservative approach to maintaining a population *at or above* 80% of carrying capacity *in a worst case situation* where time-series of estimates of abundance and bycatch are considerably biased upwards and downwards, respectively.

If input data are judged to be of sufficient accuracy then either the first or the second tuning is appropriate. If consistent bias of the magnitude tested in either abundance or bycatch were considered plausible, then the third tuning would be more appropriate. We recommend that for application/implementation for any species in a particular region, the judgement of which tuning to use be based on an assessment of the available information. This may include conducting more simulation testing in cases where it is not clear whether or not a procedure is robust to plausible uncertainties. If the third tuning were adopted because of such uncertainty, more information on, in particular, bycatch would allow a re-evaluation in future.

Calculating safe bycatch limits for common dolphin

The operating model was used to calculate bycatch limits for common dolphins in the Northeast Atlantic.

Based on the available information about common dolphin population structure in the Northeast Atlantic (Murphy *et al*., 2008), the combined CODA and SCANS-II survey area was used as an appropriate management area. Bycatch limits for common dolphins were calculated for this area using the tuned PBR and CLA management procedures and the combined SCANS-II/CODA abundance estimate, 180,075 (CV=0.272), assigned to July 2006 assuming no knowledge of previous bycatch. The CLA management procedure can also use estimates of previous bycatch, so a second set of bycatch limits was calculated using the tuned CLA procedure, the abundance estimate and a time-series of bycatch estimates.

The bycatch limits generated from the operating model and management procedures are given in Table 1. These bycatch limits are entirely dependent on the stated conservation objective, on the tunings used to achieve it under different interpretations, and on the data that were used to initiate the procedure. These bycatch limits are therefore indicative and cannot immediately be used for management purposes. Before that can happen a series of steps must be taken (see next section), initiated by agreeing conservation objective(s) at the policy level.

Table 1. Bycatch limits for common dolphin in the combined SCANS-II/CODA survey area calculated using three versions (tunings) of the PBR and CLA management procedures. Tuning 1: population to recover to and/or be maintained at 80% of carrying capacity. Tuning 2: population to recover to and/or be maintained at or above 80% of carrying capacity. Tuning 3: population to recover to and/or be maintained at or above 80% of carrying capacity in a worst case scenario. The PBR procedure used only the abundance estimate. Two sets of limits are given for the CLA procedure: one based solely on the abundance estimate and one based on the abundance estimate and the time-series of historical bycatch up to mid-2006.

	PBR tuning			CLA tuning		
Historical bycatch data used	1	2	3	1	2	3
No	1524	1092	345	1909	1061	280
Yes	-	-	-	1547	860	227

Bycatch management

The development of the bycatch management procedures under this project and previously under project SCANS-II has great potential for conservation benefit. The procedures provide a means to calculate safe limits to bycatch that will allow conservation objectives to be met in the long term. They can thus form part of long-term strategies to manage bycatch. However, the benefits are not immediate because there are policy decisions to be made before a particular procedure can be implemented.

Before a management procedure can be implemented for a particular species in a particular region, the following steps need to be taken:

1) Agreement by policy-makers on the exact conservation/management objective(s);

Agreement by policy-makers to implement the procedure for one or more species in one or more regions;

Consideration by scientists of whether or not the available information for each species indicates that there is a need to conduct further simulation testing to examine uncertainties that may not have been fully explored;

In particular, if there is evidence of subpopulation structure, consideration by scientists of any further simulation testing required and/or identification of any subareas that may be considered to contain subpopulations;

In addition, if there is evidence of historical bycatch but no data, consideration by scientists of any further simulation testing required including the generation of appropriate dataseries based on the best available information;

Final determination by scientists, based on the results of Steps 3–5, of how to implement the procedure for each species/region;

Agreement by policy-makers to implement the procedure;

Generation by scientists of bycatch limits for a specified period (e.g. 5 years);

Establishment of a mechanism for feedback of information from bycatch monitoring programmes to inform the next implementation of the procedure when the period for which bycatch limits have been set expires.

Step 1 is clearly best made at the European level. Similarly, Step 2 should ideally be made collectively although most species do not occur in all parts of the European Atlantic. Steps 3–6 can be done by the team of scientists that have developed the procedure or by others under their supervision/instruction. The amount of work involved depends on the species. The work accomplished in the SCANS-II and CODA projects for the harbour porpoise and common dolphin means that for these species these steps could be completed fairly rapidly; other species will take longer. Step 7 is another that should be made at the European level; Step 8 can then be taken immediately. Step 9 is very important because removals from a population need to be incorporated when the procedure is re-implemented and this new information (or lack of it) may determine which tuning of the procedure is implemented in future.

Annex 2. Original FCS reporting form

The 2008 Reporting form (with notes)

National level

(WGMME note: this section contains national level maps. In the versions available on the ETC/BD website there are no coastlines included making interpretation extremely difficult).

Distribution map	
Range map	

Biogeographical or marine level

(WGMME note: despite the title of this section, the information is reported at the national level and not for the biogeographical region).

2.1 Biogeographical region or marine region: Atlantic ocean		
2.2 Published sources and/or websites		
2.3 Range of species in the biogeographic region or marine region		
2.3.1 Surface range of the species in km^2		
2.3.2 Date of range determination		
2.3.3 Quality of data concerning range		
2.3.4 Range trend		
2.3.5 Range trend magnitude (km^2)-optional		
2.3.6 Range trend period		
2.3.7 Reasons for reported trend		
Other (specify)		
2.4 Population of the species in the biogeographic region or marine region		
2.4.1 Population size estimation		
Minimum population	Maximum population	Population units
2.4.2 Date of population estimation		
2.4.3 Method used for population estimation		
2.4.4 Quality of population data		
2.4.5 Population trend		
2.4.6 Population trend magnitude		
2.4.7 Population trend period		
2.4.8 Reasons for reported trend		
Other (specify)		
2.4.9 Justification of % thresholds for trends (optional)		
2.4.10 Main pressures		
2.4.11 Threats		
2.5 Habitat for the species in the biogeographic region or marine region		
2.5.1 Habitats for the species		
2.5.2 Area estimation (km^2)		

2.5.3 Date of estimation		
2.5.4 Quality of the data		
2.5.5 Trend of the habitat		
2.5.6 Trend period		
2.5.7 Reasons for reported trend		
Other (specify)		
2.6 Future prospects for the species		
2.7 Complementary information		
2.7.1 Favourable reference range (km²)		
2.7.2 Favourable reference population		
2.7.3 Suitable habitat for the species (km²)		
2.7.4 Other relevant information		
Conclusion	**Biogeographical or marine level**	**Conclusions within Natura 2000 sites (optional)**
(2.3) Range		
(2.4) Population		
(2.5) Habitat for the species		
(2.6) Future prospects		
Overall assessment		

Annex 3. Suggested new FCS reporting form

Maps for biogeographical region

(WGMME note: this section should contain maps of known distribution and/or range within the biogeographical region including coastlines).

Distribution map	

Data for biogeographical region

(WGMME note: where available data should be reported at an appropriate biological scale, e.g. the European continental shelf for harbour porpoises).

Regional Level		
2.1 Biogeographical region or marine region: Atlantic ocean		
2.2 Published sources and/or websites		
2.3 Range of species in the biogeographic region or marine region		
2.3.1 Date of distribution determination		
2.3.2 Quality of distribution data		
2.3.3 Distribution baseline reference		
2.3.4 Distribution trend		
2.3.5 Distribution trend period		
2.3.6 Reasons for reported trend		
Other (specify)		
2.4 Population of the species in the biogeographic region or marine region		
2.4.1 Population size estimation		
Estimated abundance:	Coefficient of variation:	
Minimum abundance:	Maximum abundance:	
2.4.2 Date of abundance estimation		
2.4.3 Method used for abundance estimation		
2.4.4 Quality of abundance data		
2.4.5 Reference baseline for abundance trend		
2.4.6 Abundance trend		
2.4.7 Abundance trend period		
2.4.8 Reasons for reported trend		
2.4.9 Main conservation pressures and threats		
2.5 Future prospects for the species		
2.6 Complementary information		
2.6.1 Favourable reference distribution (map)		
2.6.2 Favourable reference abundance		
2.6.3 Data of reference data		
2.6.4 Other relevant information		
Conclusion	**Biogeographical or marine level**	**Conclusions within Natura 2000 sites (optional)**
(2.3) Distribution		
(2.4) Abundance		

(2.5) Future prospects	
Overall assessment	

Annex 4. Suggested form for rare, vagrant and occasional species within the Marine-Atlantic biogeographical region

Species	Presence recorded	Comments
	Balanidae	
Eubalaena glacialis		
	Balaenopteridae	
Balaenoptera acutorostrata		
Balaenoptera borealis		
Balaenoptera musculus		
Balaenoptera physalus		
Megaptera novaeangliae		
	Physeteidae	
Kogia breviceps		
Physeter catodon		
	Ziphidae	
Hyperoodon ampullatus		
Mesoplodon bidens		
Mesoplodon densirostris		
Mesoplodon europaeus		
Mesoplodon mirus		
Ziphius cavirostris		
	Monodontidae	
Monodon monocerus		
	Delphinidea	
Delphinapterus leucas		
Delphinus delphis		
Globicephala melas		
Grampus griseus		
Lagenorhynchus acutus		
Lagenorhynchus albirostris		
Orcinus orca		
Pseudorca crassidens		
Stenella coeruleoalba		
Turisops truncatus		
	Phocoenidae	
Phocoena phocoena		
	Phocidae	
Halichoerus grypus		
Phoca vitulina		
Phoca hispida		
Phoca groenlandica		
Erignathus barbatus		
Cystophora cristata		

Annex 5. Inventory of current strandings monitoring networks

Country	Stranding network name	Stranding network affiliation	Coordinators/contact person	Contact e-mail	Marine Mammals	Website	Remarks
Belgium	MARIN Marine Animals Research and Intervention Network	MUMM, Royal Belgian Institute of Natural Sciences	J. Haelter	j.haelter@mumm.ac.be	All	http://www.mumm.ac.be/EN/Management/Nature/search_strandings.php	Stranding and sighting monitoring
Belgium	MARIN Marine Animals Research and Intervention Network	Department of veterinary pathology, University of Liege		t.jauniaux@ulg.ac.be	All		Necropsy and samples collection
the Netherlands		Nationaal Natuurhistorisch Museum Naturalis, Darwinweg 2, 2333 CR Leiden	grouw@naturalis.nnm.nl	grouw@naturalis.nnm.nl	Cetaceans	http://www.walvisstrandingen.nl/get?alias=ws	Collaboration between IMARES, NIOZ, MARIN (see Belgium) and Veterinary college of the Utrecht University for selected small cetaceans necropsy and samples collection
UK: Wales, Northern Ireland, Scotland, England	UK Cetacean Strandings Investigation Programme	The Wellcome Building, Institute of Zoology, Zoological Society of London, Regent's Park, London NW1 4RY	P. Jepson	Paul.Jepson@ioz.ac.uk	All	www.ukstrandings.org	Necropsy and samples collection
UK: Wales, Northen Ireland, Scotland, England	UK Cetacean Strandings Investigation Programme	The Wellcome Building, Institute of Zoology, Zoological Society of London, Regent's Park, London NW1 4RY	R. Deaville	Rob.Deaville@ioz.ac.uk	All	www.ukstrandings.org	Necropsy and samples collection
Denmark		Maritime Museum Copenhagen		rs@fimus.dk			
Denmark		Zoological Museum, Copenhagen		hjbaagoe@snm.ku.dk			

Country	Stranding network name	Stranding network affiliation	Coordinators/contact person	Contact e-mail	Marine Mammals	Website	Remarks
Germany: Schleswig-Holstein	S-H Stranding Network	RTC Center Westcoast of the CA- University of Kiel, Hafentoern 1, 25761 Buesum, Germany	U. Siebert	ursula.siebert@ftz-west.uni-kiel.de	All	http://www.uni-kiel.de/ftzwest/ag7/forschung_mm-e.shtml	Necropsy and samples collection; Age determination
Germany: Meck-Pomm	M-P Stranding Network	Deutsches Meeresmuseum, Katharinenberg 14-20, 18439 Stralsund, Germany	H. Benke	harald.benke@meeresmuseum.de	All	http://www.meeresmuseum.de/wissenschaft/index.htm	Necropsy and samples collection
Germany: Lower Saxony		LAVES Cuxhaven, Schleusenstr. 1, 27472 Cuxhaven	S. Ramdohr	Sven.Ramdohr@laves.niedersachsen.de	All	http://www.laves.niedersachsen.de	Necropsy and samples collection
Poland		Hel Marine Station, 84-150 Hel, ul.Morska 2, Poland	Joanna Skeris-Gruchal	ocejs@univ.gda.pl	All	www.hel.univ.gda.pl	Necropsy and samples collection
Norway		Tromso					
Norway		Institute of Marine Research PO Box 1870 Nordnes 5817 Bergen					
Portugal: Madeira	Madeira Whale Museum					http://www.cetaceos-madeira.com/	Monitoring, rescue, post-mortem and sampling
Portugal: Azores	Azores Stranding Network						Monitoring, rescue, post-mortem and sampling
Portugal: mainland		Institute for Nature Conservation					Monitoring, rescue, post-mortem and sampling
Portugal: mainland		Portuguese Wildlife Society Figueira da Foz	M Ferreira				Necropsies and Rehab
Ireland	Irish Whale and Dolphin Group		Mick O'Connell	mickoconnell3@eircom.net	Cetaceans	http://www.iwdg.ie/	Record cetacean species, length, sex and occasionally take skin for genetic samples

Country	Stranding network name	Stranding network affiliation	Coordinators/contact person	Contact e-mail	Marine Mammals	Website	Remarks
France		CRMM, La Rochelle University	V. Ridoux	vincent.ridoux@univ-lr.fr	All		Monitoring, rescue, post-mortem and sampling
Islande		Marine Research Institute	G.A. Víkingsson	gisli@hafro.is		www.hafro.is	
Italy					Cetaceans		
Slovenia	MORIGENOS, Marine Mammals Research and Conservation Society	Jarska cesta 36/a SI-1000 Ljubljana,	T. Genov	tilen.genov@gmail.com	Cetaceans	http://www.morigenos.org/index.php?lang=2	Monitoring, rescue, post-mortem and sampling
Malta	Nature Trust Malta				Cetaceans	http://www.naturetrustmalta.org/page.asp?p=1400&l=1	Monitoring, rescue, post-mortem and sampling
Greece	Pelagos Cetacean Research Institute		A. Frantzis	afrantzis@otenet.gr	All	http://www.pelagosinstitute.gr/en/homepage/index.html	Monitoring, rescue
Greece	Veterinary Faculty, University of Thessalonik		A. Komnenou	natakomn@vet.auth.gr	All		Postmortem and sampling
Israel	IMMRAC – Israeli Marine Mammals Research and Assistance Center	IMMRAC, POBox 1066, Michmoret 40297	D. Kerem	dankerem@research.haifa.ac.il	Cetaceans	http://immrac.haifa.ac.il/english/introduction.html	Monitoring, rescue, post-mortem and sampling
Croatia					Cetaceans	http://www.blue-world.org/	Monitoring
Israel	IMMRAC – Israeli Marine Mammals Research and Assistance Center	IMMRAC, POBox 1066, Michmoret 40297	O. Goffman	goffman@research.haifa.ac.il	Cetaceans	http://immrac.haifa.ac.il/english/introduction.html	Monitoring, rescue, post-mortem and sampling
Spain	AMBAR		P. Cermeño	pcermeno@yahoo.com			
Spain	Museo Marítimo del Cantábrico	Regional Administration	G. García-Castrillo	ggc@mmc.e.telefonica.net			

Country	Stranding network name	Stranding network affiliation	Coordinators/contact person	Contact e-mail	Marine Mammals	Website	Remarks
Spain	CEPESMA	Regional Administration	L. Laria	cepesma@cetáceos.com			
Spain	CEMMA	Regional Administration	A. López	cemma@arrakis.es			
Spain	Canarias conservación	Regional Administration	M. Carrillo	canariasconservacion@gmail.com			
Spain	S.E.C.A.C.	Regional Administration	V. Martín	ziphius@teide.net			
Spain	C.R.E.M.A., Aula del Mar.	Regional Administration	J.L. Mons	Jose Luis Mons:crema@auladelmar.info			
Spain	PROMAR	Regional Administration	F. Toledano	promar.almeria@nodo50			
Spain	GRAMPUS	Regional Administration	Sonia Alis	grampus@terra.es			
Spain	Cavanilles Institute, University of Valencia.	Regional Administration	J.A. Raga	toni.raga@uv.es			
Spain	C.R.A.M.	Regional Administration	M. Gazo	manel@cram.es			
Spain	ANSE	Regional Administration	P. García				
Spain	Cavanilles Institute, University of Valencia.	Regional Administration	J.A. Raga	toni.raga@uv.es			

Annex 6. List of participants

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Annex 7. Agenda

WGMME 2009 programme

Vigo, Spain 2–6 February 2009

Monday, 2nd February 2009

08:30 departing from Hotel Bahia

09:00 start of meeting **plenary session**: opening of meeting, setting up of Internet connection, adoption of agenda

11:00 coffee break

11:30 forming of subgroups and leads, setting up of work plan

13.30 lunch break

15:00 work in subgroups

16.30 coffee break

17.00 **plenary session** update from ToR c

20:30 dinner (optional) place to be announced

Tuesday, 3rd February 2009

08:30 departing from Hotel Bahia

09:00 **plenary session** update from leads of ToRs

11:00 coffee break

11:30 work in subgroups

13.30 lunch break

15:00 **plenary session** review print outs of available first drafts

ToR d Begoña

ToR f Graham

16.30 coffee break

16.45 work in subgroups

19.00 end of session

20:30 dinner (optional) place to be announced

Wednesday, 4th February 2009

08:30 departing from Hotel Bahia

09:00 **plenary session** update from leads of ToRs

ToR b Presentation by Michael

ToR e Eunice

11:00 coffee break

11:30 work in subgroups

13.30 lunch break

15:00 work in subgroups

16.30 coffee break

16.45 work in subgroups

18:30 bus to Baiona

21:00 dinner in Baiona

Thursday, 5th February 2009

08:30 departing from Hotel Bahia

09:00 Seal subgroup discussion, Callan, Gordon, Kjell, Ilka, Sophie

ToR c Kjell

discussion on ToR g lead by Callan

discussion on ToR a lead by Gordon

11:00 coffee break

11:30 **plenary session**

ToR b Begoña

ToR e Eunice

ToR b Theirry and Michael

ToR f Graham

13.30 lunch break

15:00 **plenary session**

ToR c Kjell

ToR a Gordon

ToR g Callan

16:00 **plenary session**

adoption of final drafts

16.30 coffee break

Review of recommendations

Review of ToRs 2010

Discussion of meeting venue 2010

20:30 dinner (optional) place to be announced

Friday, 6th February 2009

09.00 finish any outstanding work

Annex 8. WGMME Terms of Reference for 2010

The **Working Group on Marine Mammal Ecology** [WGMME] (Chair: Sinéad Murphy, UK) will meet in Horta, The Azores, from xx February to xx February 2010 to:

a) Review the effects of wind farm construction and operation on marine mammals and provide advice on monitoring and mitigation schemes;

b) Review the current contaminant loads reported in marine mammals in the ICES area, the cause–effect relationships between contaminants and health status, and the population-level effects of environmental impacts;

c) Further development of the framework for surveillance and monitoring of marine mammals applicable to the ICES area;

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

e) Provide information on abundance, distribution, population structure and incidental capture of marine mammals off the Azores;

f) Review of the scope, objectives and technical issues of the initiative for a European Marine Mammal Tissue Bank;

g) Update on development of the ICES seal database, status of intersessional work.

WGMME will report to the attention of the Advisory Committee (ACOM) by xx March 2010.

Supporting Information

PRIORITY:	
Scientific justification and relation to action plan:	
Resource requirements:	No specific requirements beyond the needs of members to prepare for, and participate in, the meeting.
Participants:	The Group is normally attended by some 20–25 members and guests.
Secretariat facilities:	None.
Financial:	No financial implications.
Linkages to advisory committees:	WGMME reports to ACOM
Linkages to other committees or groups:	
Linkages to other organizations:	

Annex 9. Recommendations

Recommendation	For follow up by:
Power analysis should be used to assess the effectiveness of the existing survey schemes, relative to the specific EcoQO	OSPAR
Moult counts instead of pup counts for grey seals in the Wadden Sea; though the importance to continue efforts in obtaining pup count data was noted, in order to compare with available data from the UK	OSPAR
Provision of feedback by OSPAR to ICES, in an appropriate time frame, when EcoQOs are triggered. In addition, the WG would appreciate OSPAR and ICES to encourage and support the responsible entity (e.g. governments) to take appropriate action. The WG would be prepared to assist in making specific recommendations (e.g. research to be carried out, management measures to be taken)	OSPAR
The use of four management units within southern Scandinavia waters in the North Sea area: (1) Skagerrak, (2) Kattegat, (3) central Limfjord and (4) the Wadden Sea, therefore splitting the current EcoQO sub-unit "Kattegat, Skaggerak and Oslofjord"	OSPAR
Use the current OSPAR EcoQO grey seal subunit boundaries, as outlined in the 2007 OSPAR handbook	OSPAR
A Northeast Atlantic wide genetic study of grey seal population structure should be initiated	EC, ICES, OSPAR
Genetic studies of harbour seals should be carried out in areas where such information is lacking, in particular for populations were hunting is conducted	EC, ICES, OSPAR
Regular surveys are required to determine trends for all harbour and grey seal management subunits, and recommends either their establishment, or continuation	EC, ICES, OSPAR
Removals of harbour and grey seals, catch and bycatch, should be recorded for all OSPAR EcoQO subunits	EC, ICES, OSPAR
Iberian harbour porpoise population and the NE Atlantic harbour porpoise population (continuous system-France to Norway) are managed separately	EC, ICES
The Iberian harbour porpoise population should be given a high priority for conservation, because of its presumed small population size, low genetic diversity and likely susceptibility to habitat degradation	EC, ICES
Immediate action by the Spanish and Portuguese governments in monitoring and conserving the Iberian harbour porpoise population	Spainish and portuguese government
A large-scale Northeast Atlantic harbour porpoise study which combines both genetic and ecological tracers should be undertaken	EC, ICES

Due to a lack of sampling of offshore common dolphins for genetic analysis, the management unit/area for the *D. delphis* population in the NE Atlantic be confined to the continental shelf and slope waters, and the oceanic waters of the Bay of Biscay	EC, ICES
All *D. delphis* samples and data available (genetic and ecological) in the ICES area are analysed together, in order to get the most comprehensive picture of the population structure	EC, ICES
Continuity of surveys to estimate absolute abundance such as SCANS-II and CODA, at least with a frequency between 5–10 years. If possible both the shelf and offshore waters should be covered simultaneously	EC, ICES, OSPAR
DG MARE consider the CLA approach (the third tuning approach where appropriate) for future evaluation of bycatch levels and advice on conservation objectives management actions in both harbour porpoises and common dolphins	EC, ICES, OSPAR
The continuation, and establishment in some cases, of national observer bycatch programmes in order to obtain current estimates of incidental capture for all marine mammal species	EC DG MARE
By-catch management procedures developed under SCANS-II and CODA projects are taken into consideration by DG MARE when reviewing the EU Regulation 812/2004	EC DG MARE
The EC (ETC/BD) reconsider the data requirements for FCS reporting with respect to highly mobile, wide ranging species and, most notably, consider permitting reporting at an appropriate biological scale where such data exist. This would allow ETC/BD to produce accurate and biologically meaningful assessments, relevant to the conservation of the species and would aid instigation of appropriate management measures where necessary	EC
The EC (ETC/BD) reconsider the reporting requirements for rare, vagrant and occasional species occurring in individual water of Member States	EC
Comprehensive, consistent and explicit guidance on the completion of FCS reports is issued by the European Commission if the data from future assessments is to be used to provide a reliable analysis of the distribution and abundance of marine mammals in European waters	EC
As part of the above guidance, all future FCS assessments should be evidence based rather than allowing expert judgements of the various parameters used to assess conservation status. This would lead to biologically accurate assessments relevant to the conservation of the species	EC
Member States develop international collaborative monitoring strategies for marine mammals in order to meet the surveillance requirements of the Habitats Directive	EC

A prerequisite to achieving a coherent strategy for surveillance and monitoring of marine mammals applicable to European waters, there is a need to clarify and where necessary update, reference points used to identify favourable conservation status of cetaceans in European waters, bearing in mind the limitations to statistical power of monitoring	ICES, EC
Attention must be given to international coordination and standardization of protocols for stranding networks, and development of an international database/sample bank. Where currently lacking, national funding for such networks is recommended, while being sensitive to the important contribution of the voluntary sector to this activity	ICES, EC
While it seems clear that monitoring of abundance, bycatch and health status may reasonably form the core of surveillance for cetaceans, the WG noted the importance of other types of information (e.g. life-history data) and the monitoring of specific threats (e.g. offshore construction), and recommended their inclusion when designing a surveillance strategy	ICES, EC
Monitoring programme design should take account of new findings on the stock structure (e.g. ToR b and the identification of an isolated Iberian stock for harbour porpoise)	ICES, EC
Further work is needed to define the scope and detailed content of a strategy for surveillance and monitoring of marine mammals applicable to the ICES area, taking into account the different legislative frameworks operating in the northwest and Northeast Atlantic, conservation requirements for pinnipeds and, where appropriate, surveillance needs to support sustainable harvest	ICES, EC

Annex 10. Technical Minutes from the Marine Mammal Review Group

- RGMAM
- By correspondence; deadline 6 May 2009
- Participants: Henrik Skov (Chair), Olle Karlsson, Droplaug Olafsdottir
- Working Group: WGMME
- Audience to write for: These comments are to be provided to the Advice Drafting Group on Marine Mammals (ADGMAM) for consideration at its meeting on May 14–15 2009.

ToR A. Review of Quality Assurance Arrangements for Select EcoQOs

OSPAR 5 asked ICES to review the quality assurance arrangements for the following EcoQOs and make suggestions for their further development and/or improvement on:

i) harbour seal population trends; and

ii) grey seal pup production

General

The ToR reviews available information in order to propose biologically appropriate management units for seals in the North Sea. Geographical subunits for EcoQOs for seals are currently based on survey effort, comparability of data, geographical separation and reliability of interpreting observed trends.

For harbour seal WGMME recommends additional boundaries in southern Scandinavia waters based on genetic difference. Furthermore, slight alterations to the UK subareas are suggested in accordance with the areas that are monitored most frequently.

For grey seal WGMME recommendations for changes to EcoQO subunits are minor. Changes in the UK EcoQO subunits names are proposed in order to include two recently established colonies from Norfolk. The German subunit are renamed “German Wadden Sea” and finally, removal of the “French North Sea and Channel coast” subunit was proposed as the area was considered geographically outside the boundaries of the North Sea.

Comments

These recommendations seem reasonable. Information on ecological markers may be suggested for future consideration and evaluation of the subunits boundaries.

WGMME recommends that power analysis should be used to assess the effectiveness of the existing survey schemes, relative to the specific EcoQO.

Comments

This should be advised especially when taking into account the relatively small size of subunits for coastal seal EcoQOs, and if variances in the seal counts become large the EcoQOs may not be triggered when it should as a consequence of low power to detect changes.

WGMME recommends that the EcoQO for grey seal be changed for the Wadden Sea. As a consequence of specific circumstances pup counts in the area give insufficient information on the grey seal status in the area and the WG recommends using moult counts instead.

Comments

The ideal approach is to survey pup counts but for reasons listed in the report it is not likely to reveal trends in seal numbers in the Wadden Sea. Moult counts may therefore be suggested as an alternative. It is however not clear how continued efforts in obtaining pup counts in the area will be useful for comparison with available data from the UK as is also recommended by the WG.

WGMME recommends feedback from OSPAR, in an appropriate time frame, when EcoQOs are triggered.

Comments

An important remark is that if the EcoQOs are not met, then the alert calls for research rather than immediate management actions. The EcoQOs alerts are likely to be delayed because of long intervals (often 5 years) between monitoring surveys for many units or subunits of coastal seal populations. Results from research may not give immediate results so the time frame for advice given, planning and implementing the relevant research programmes should be kept as short as possible. Therefore it is important to have a set schedule for the procedure of scientific advice to follow in case an EcoQO is triggered. A predefined action plan should therefore be included in the quality control (QC) for the EcoQOs specifying how to react when the quality objectives are not met. A feedback or request directed to ICES is an appropriate procedure and should be recommended.

Specific comments on Section 4 (ToR A)

Section 4.2 Quality Assurance

It is stated that seal monitoring should confirm to established methodologies. For harbour seal, surveys should be undertaken at key times in the annual cycle. It is, however, unclear when the key times occur, is it or is it not during moult or breeding? For grey seals, it is stated that breeding season surveys should be undertaken to inform on number of pups born, which is the most cost-effective way for monitoring this species. This might be true for land breeding grey seals, however pup surveys of ice breeding grey seals are not cost-effective. And ice breeding is predominant in the Baltic population.

ToR B. Review of population structure of *D. delphis*

General

Defining population structure for wide ranging marine mammals is a difficult task. Defining population structure either on an ecological or an evolutionary scale needs access to a large number of samples, often from a large area. Samples that for most species are not available in the numbers that are needed for a thorough investigation. That means that management decisions often are based on very limited data. Even for harbour porpoise that has been studied quite intensively in this area the population structure for some parts of its range is still under debate. For common dolphins the number of analysed individuals is small and at the same time knowledge of distribution is scarce. Therefore management decisions needs to incorporate the uncertainty of the data.

The basis for only one *D. delphis* population exists in the Northeast Atlantic ranging from waters off Scotland to Portugal

Some genetic difference has been observed between northern (i.e. Scottish) and southern (i.e. Portugal and eastern central Atlantic) areas (Natoli *et al.*, 2006, Amaral *et al.*, 2007). Further studies have given indications that the observed difference may be as a consequence of marginal position of the dolphins in the distributional range that may have led to smaller exchange rates of migrants to neighbouring aggregations (Mirimin *et al.*, 2007). Other studies in the NE-Atlantic have not revealed genetic difference within the area from Scotland to Portugal.

Comments

WGMME concludes that the lack of clear genetic evidence of population structure in the NE Atlantic is an argument for a single population existing in the area; suggesting one management area. The absence of clear evidence of genetic structure in the NE Atlantic is however no proof of a single population structure in the region. Seasonal movements and segregation by sex and age classes may have affected the results of the genetic studies conducted so far but these factors have not been included in the genetic analyses. The conclusion is therefore that genetic data has not demonstrated any population structure in the area. The reason may be a single population situation, but can also be as a consequence of lack of data, or too short time frame to generate genetic difference between isolated populations.

The basis for separate populations have been reported in the Northwest Atlantic and the Mediterranean Sea; based on genetic data

Weak genetic differentiation has been observed between NW and NE Atlantic. One study was based on small sample size (n=13) (Natoli *et al.*, 2006) and other has only revealed low genetic differentiation (Mirimin *et al.*, 2009).

WGMME concludes (in the first remark) that "…separate populations have been reported in the Northwest Atlantic…"

Comments

The fact that the samples in these studies are exclusively from the continental shelves and slope regions on each side of the N Atlantic, make it impossible to conclude whether the two study areas represent two separate populations, or whether they belong to a continuous system within a single population. The conclusion is that the current knowledge of genetic structure cannot be used to define clear population boundaries and management areas across the N Atlantic. Comparison with samples from the off shore areas in the mid Atlantic is necessary to conclude on potential separated population in the NE and NW Atlantic based on genetic data.

Further comments on Section 5.6 "Population structure in common dolphins"

WGMME remarks that genetically divergent lineage within the genus *Delphinus* has been identified in the NE Atlantic raising questions regarding to the taxonomic status of common dolphins in this region.

It is difficult to make a comment on this remark because the Murphy *et al.*, in press Report is not made available to the reviewers. So the conclusion here must be to agree with the WGMME and recommend further analysis.

WGMME highly recommends that all the samples and data available (genetic and ecological) in the ICES area are analysed together, in order to get the most comprehensive picture of the population structure. Meta-analyses on all samples available from different areas should indeed be recommended in order to detect for genetic and ecological differentiation on a small and large geographical scale within the N Atlantic Ocean. In addition to these recommendation, seasonal and gender comparisons should be suggested noting that the seasonal migrations and sex/age segregations in the population (s) are not known.

Specific comments

Legend Figure 3b: black dots indicate common dolphin sightings not area covered.

Section 5.5. third paragraph, reports on lack of observer effort, beyond the mid Atlantic ridge. The TNASS 2007 survey may somewhat add information on common dolphin sightings for the NW Atlantic.

Section 5.6.1. first paragraph, "In any case, such a low level genetic differentiation between both sides of the North Atlantic Ocean suggest common dolphins in these two regions are highly connected , i.e. with a level of high level of gene flow" and again in first line in Section 5.6.3 "…though high levels of gene flow exits between both regions". This is not necessarily the case. The reason for lack of genetic difference could be because of relatively recent postglacial expansion of distribution and that not enough time has elapsed in order to generate significant genetic difference.

ToR C. Review the geographical subunits for EcoQOs for ICES areas for harbour and grey seals based on most appropriate data and make recommendations

General

The Working Group has considered genetic studies made on harbour seals and grey seals in relation to the subunits for ECOQOs. For most areas the subunits for the EcoQOs are smaller than the management units defined from the genetic studies. However few studies have focused on defining substructuring of seals in the ICES area. However Allen *et al*., 1995 found genetic differentiation between grey seals from Isle of May and North Rona in Scotland and Graves *et al*., 2009 found genetic differentiation between grey seals in the Baltic Sea.

How much knowledge regarding population structure that is needed is dependent of the management objectives. For the populations of both grey and harbour seals that are hunted, it is important to have a fine level of stock delineation. Therefore we agree with the recommendations made by the WG. More information regarding population structure both within grey and harbour seals are needed to for a proper management.

References

Graves, J.A., Heylar, A., Biuw, M., Jüssi, M., Jüssi, I. and Karlsson, O. 2009. Microsatellite and mtDNA analysis of the population structure of grey seals (*Halichoerus grypus*) from three breeding areas in theBaltic Sea. Conserv. Genet 10:59–68.

ToR D. Review any further information/analyses from SCANS II/CODA and make recommendations

Two of the listed objectives of CODA were:

1) To map summer distribution of the main cetacean species found in offshore waters in the Northeast Atlantic (common and striped dolphins, bottlenosed dolphins, fin, sei and minke whales), and deep-diving whale species such as sperm, beaked and pilot whales.

2) To generate unbiased abundance estimates for these species.

A summary of effort, sightings and acoustic data collected during CODA is listed in the Report and the WG recommends the continuity of surveys such as SCANS-II and CODA at least with a frequency between 5–10 years. If possible both shelf and offshore waters should be covered simultaneously. The WG does, however, not acknowledge that cetacean surveys have been conducted in ICES areas in the Northern North Atlantic adjacent to the SCANS-II and CODA areas every 5–6 years since 1987 (NASS, NILS). Simultaneous to CODA in 2007 an expanded NASS area was surveyed including areas west of Greenland and northeast coast of Canada (TNASS), while the waters to the southwest was 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 simultaneous surveys in 2007 In the N Atlantic give unique opportunity to nearly complete coverage of the offshore northern North Atlantic.