Agenda Item 4.2: **ASCOBANS Recovery Plan for Harbour Porpoises in the North Sea (NSRP)**

ASCOBANS Recovery Plan for Harbour Porpoises (*Phocoena phocoena*) in the North Sea *and* Background Document

Submitted by: **Secretariat**

NOTE:
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ASCOBANS Recovery Plan for Harbour Porpoises (*Phocoena phocoena* L.) in the North Sea

4th draft (Do not cite without permission of ASCOBANS!)

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1. Introduction

Harbour porpoises (*Phocoena phocoena*, Linnaeus 1758) are widely distributed in shelf waters of the temperate North Atlantic and North Pacific Oceans and in some semi-enclosed seas (such as the Black and Baltic Seas). The North Sea is a most important habitat for the harbour porpoises in the North East Atlantic and possibly globally. Harbour porpoises are exposed to a number of anthropogenic pressures and are listed in several international conservation instruments.

The 5th International Conference on the Protection of the North Sea (Bergen, Norway, 20 – 21 March 2002) called for a recovery plan for harbour porpoises in the North Sea to be developed and adopted (Paragraph 30, Bergen Declaration). In the Bergen Declaration and ASCOBANS (ASCOBANS 1992), the North Sea is clearly delineated (Figure 1).

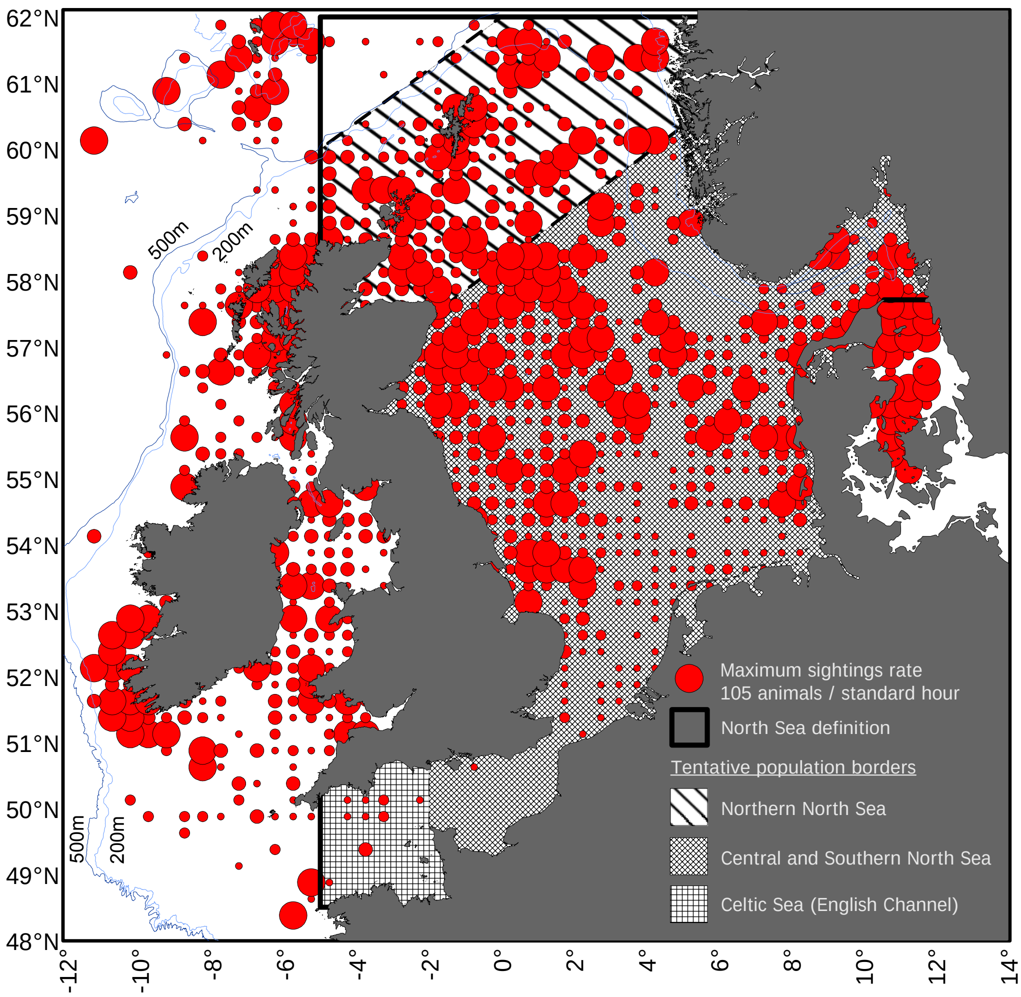

Figure 1: MAP of the North Sea as defined at the 5th International Conference on the Protection of the North Sea in Bergen, Norway, 20 – 21 March 2002, showing the tentative harbour porpoise population borders and the distribution of harbour porpoises in the North Sea and adjacent waters. Data have been pooled from 1979 to 1997, all seasons are combined (Reid *et al.*, 2003).

Germany volunteered in 2003 to draft a recovery plan within the framework of ASCOBANS and in association with non-Party Norway. This Plan aims to restore North Sea harbour porpoises to a favourable conservation status. In defining “favourable conservation status” the plan takes account of those goals and/or definitions previously agreed under the EU Habitats Directive and ASCOBANS.

This document reviews the current state of knowledge about North Sea harbour porpoises and recommends a series of actions for ensuring that harbour porpoises attain a favourable conservation status and that the population attains at least 80 % of its potential population size.

2. Population structure, abundance and distribution

Harbour porpoises occur throughout the North Sea and adjacent waters and are highly mobile. Various lines of evidence indicate that sub-populations exist within the North Sea. However, there are no clearly defined boundaries between these sub-populations. IWC/ASCOBANS (2000) divided the harbour porpoises occurring in the North Sea for practical management purposes into a Northern North Sea stock, a Central and southern North Sea stock and an additional one occurring in the western Channel (figure 1, table 1). There are open borders to the north, north west, Kattegat and south west shelf seas. The implications of these open borders are that additional management actions may be needed outside the boundaries of the North Sea as defined in this document in order to achieve objectives within the North Sea.

Table 1: Abundance and densities of harbour porpoises in the North Sea and adjacent waters during SCANS I as estimated by Hammond *et al. 1995* and SCANS II. Figures in round brackets are coefficients of variation; figures in square brackets are 95% confidence intervals.

Greater Region	**Animal Abundance** [number of animals]	
	SCANS I	**SCANS II**
Northern North Sea	98,564 [66,679 – 145,697]	
Central & southern North Sea	169,888 [124,121 – 232,530]	
English Channel (mostly)	0	
Celtic Shelf	36,280 (0.57)	

Within areas inhabited by stocks, distribution is not uniform. For instance, in records from 1979 – 1997, the sighting rates in the south eastern North Sea, the southern Bight and the northern English Channel were substantially lower than in areas further north (figure 1). Indeed, reports of changes in distribution and relative abundance of porpoises in certain areas based on time series analysis of stranding records and incidental sightings provided some evidence that harbour porpoise might have declined in some areas, such as the southern North Sea and the English Channel since the 1950s or even before then (Verwey 1975, Duguy 1977, Smeenk 1987, Camphuysen & Leopold 1993, Camphuysen 1994, Collet 1995, Reijnders et al. 1996). More recent surveys have found higher sighting (Scheidat *et al*. 2003, Brasseur *et al*. 2004, Scheidat *et al*. 2004) and stranding rates (Haelters *et al.* 2002, Jauniaux *et al.* 2002, Kiszka *et al*. 2004, Camphuysen 2004) in the south eastern North Sea and southern Bight than previously.

3. Risks

There is sufficient knowledge on the incidental mortality of harbour porpoises due to entanglement in fishing gear, and it is likely that this, possibly coupled with effects on habitat caused by other human uses may be compromising favourable conservation status. The extent to which each use contributes to this is not known. The following section briefly describes major risks to harbour porpoises in the North Sea for each stock (for a more detailed account of risks to harbour porpoises in the North Sea also see under 3. in the Background Document to the ASCOBANS Recovery Plan for Harbour Porpoises in the North Sea).

3.1. Direct removal of harbour porpoises

There is no deliberate taking of harbour porpoises in the North Sea. However, almost all fishing gear and in particular gill and tangle nets bear the risk of incidental entanglement of harbour porpoises (Table 2; (Clausen & Andersen 1988, Kinze 1994, Tregenza et al. 1997, Northridge & Hammond 1999, Vinther 1999). In order to understand the scale of these risks, it is necessary to establish independent scientific observer schemes. Many, but not all, fisheries in the North Sea have been observed for bycatch. The lack of comprehensive observer schemes in the North Sea, partly addressed by the implementation of Council Regulation (EC) No 812/2004, has prevented the full quantification of bycatch. The first results of observation made under EC 812/2004 have to be submitted to the European Commission by June 2006.

Table 2: Summary of bycatch information and data. Figures in square brackets are 95% confidence intervals.

Greater Region	ICES area	Country	Main gear type	Target species	Size of fisheries	Estimation method	Year	Total reported bycatch	Estimated annual bycatch	Seasonal peaks	Source
Kat./IDW/German Baltic	IIIa	Sweden	bottom trawls			fishermen interviews	2001	-	80	-	(ASCOBANS 2004)a
			pelagic trawls	herring				1	11		Lunneryd *et a*l., 2004
			trammel nets	lumpfish				1	8		
			gillnets	sole, cod, crab				6	70		
Skagerrak	IIIa	Sweden	gillnets, trammel nets, pelagic trawls	cod		fishermen interviews	2001	-	20	-	ASCOBANS, 2004a
			bottom trawls					2	25	-	Lunneryd *et a*l., 2004
Northern North Sea	IV	UK	set nets	cod, skate, turbot, sole, monkfish, dogfish			1995 - 2002	-	439 [371 – 640]	-	ASCOBANS, 2004a
Central & Southern North Sea	IV	Denmark	wreck nets, gillnets	cod, hake, turbot, plaice, sole	very large	observer program	1987 - 2002	-	5,817/5,591*	-	Vinther & Larsen, 2002
	IV b	Germany	gillnets	cod, turbot, sole, other demersal fish	small	observer program	2002 - 2003	-	25-30	-	Flores & Kock, 2003
	IVc	Belgium	gillnets			strandings	2004	7	-	-	ASCOBANS, 2004a; Haelters & Kerckhof, 2004; 2005
			unknown					3-10	-	-	
	IVc	Netherlands	gillnets	unknown	unknown	strandings	2003 & 2004	-	100	-	Reijnders, 2005; García Hartman, *et al.*, 2004
Celtic Shelf (incl. Channel)	VII e	UK	gillnets	hake	medium	Observer program	August 1992 – March 1994	28	740 [383 – 1097]	March - May	Tregenza *et al.*, 1997
			tangle nets					1			
			wreck nets					0			
	VII g, h, j, k	Ireland	gillnets, wreck and tangle nets	hake and other white fish				14	1497 [566 – 2428]		

* Extrapolated from bycatch rates determined from observers 1987 – 2001. First estimate is based on fleet effort, second is based on landings as used by Vinther (1999). Bycatch is probably overestimated due to use of pingers in cod wreck fishery not being accounted for.

3.1.1. Northern North Sea

Observation of bycatch has been conducted in UK North Sea set-net fisheries for cod, sole, skate and turbot and bycatch rates were low. Studies on bycatch are under way in Norwegian waters, but results are not yet available.

3.1.2. Central and southern North Sea

Bottom-set gillnets are used extensively in the central and southern North Sea. A variety of national observer schemes have shown substantial bycatch of harbour porpoises in this area. The general reduction of fishing effort in this area in the most recent years has likely led to reduced overall bycatch compared with past levels (Vinther & Larsen 2002).

(ASCOBANS 2000) defined a total anthropogenic removal above 1.7% of the estimated harbour porpoise abundance as unacceptable. The total known bycatch in this area has exceeded this level. This led to the adoption by the EU of a Regulation laying down measures concerning incidental catches (EC 812/2004) to alleviate the problem (see 4.1. in the Background Document to the ASCOBANS Recovery Plan for Harbour Porpoises in the North Sea).

3.1.3. Western Channel

Observer schemes have documented substantial bycatch in the UK and Irish hake gillnet fishery in the Celtic Sea and western Channel. No observations on bycatch rates have yet been conducted on the substantial French or Spanish fleets working in this area. The scale of the bycatch in this area appears to also exceed the 1.7% criterion. EC Regulation 812/2004 also makes provisions to address bycatch in this area (see 4.1. in the Background Document to the ASCOBANS Recovery Plan for Harbour Porpoises in the North Sea).

3.2. Effects on harbour porpoise habitat

Other human uses, such as discharge of contaminants, shipping and hydrocarbon exploration and production, and on a more localized scale, e.g. sewage discharge, constructions (including wind farms), aquaculture, mineral extraction (sand and gravel), recreational activities, competition for prey by fisheries and military use may all indirectly affect harbour porpoise health through changes in the quality of their habitat. It is very difficult to assess any one of these in quantitative terms and to what extent they have an impact on the conservation status of harbour porpoises. This is due largely to the lack of knowledge on cause-effect relationships for individual factors, but it is also likely that the effects of these activities (and bycatch) may act in cumulative and synergistic ways.

The distribution of these uses over the North Sea suggests that effects on habitat will be greatest in coastal and shallow water areas used by harbour porpoises. In addition to these locally-acting effects, global changes in climate and ocean circulation may also affect harbour porpoises.

An approximate distribution and scale of human uses of the North Sea in relation to sub-populations of harbour porpoises is summarized in table 3.

Table 3: Showing the approximate distribution and scale of human uses in the North Sea in relation to the harbour porpoise sub-populations, +++ = major use, ++ = medium use, + = minor use.

	Northern North Sea	**Central & southern North Sea**	**Western English Channel**
Fishing	+++	+++	+++
Contaminant discharge	+	++	+
Shipping	+	+++	+++
Hydrocarbon exploration	+++	+++	
Sewage discharge	+	+++	+
Construction	+	+++	
Aquaculture	++	+	
Mineral extraction		++	
Recreation	+	+++	++
Military	+	+	+

4. Possible measures to improve the conservation status of harbour porpoises

4.1. Reduction of bycatch

The most effective measure to protect harbour porpoises that is known at this point would be to cease gill and tangle netting. This however is economically and socially undesirable. However, some targeted closure on a temporal and/or spatial scale and/or reduction of fishing effort may be feasible. In addition, gear types or their use may be modified so that they catch less porpoises. Currently, the most effective modification known is the attachment of acoustic deterrents (permanent pingers) to gillnets. However, in some fisheries, acoustic deterrents may be impractical and uncertainties remain about the longer-term efficacy of these devices and potential negative effects on harbour porpoise habitat. The technology of pingers and other gear modifications is currently being examined and developed in order to improve practicality and reduce these negative effects (see also under 4.1. in the Background Document to the ASCOBANS Recovery Plan for Harbour Porpoises in the North Sea).

4.2. Reduction of effects of fishing on habitat

Fishing may affect harbour porpoise habitat through removal of prey and effects on substrates. Most fish stocks in the North Sea are below the level of Maximum Sustainable

Yield (MSY). Increasing their population and stock sizes might have a positive effect on both fisheries and prey of harbour porpoises.

4.3. Reduction of contaminants

Many international instruments and regulations (e.g. OSPAR, Water Framework Directive, MARPOL) aim to reduce or eliminate the discharge of contaminants (see also under 4.2. in the Background Document to the ASCOBANS Recovery Plan for Harbour Porpoises in the North Sea).

4.4. Shipping

The predominant effect of shipping on harbour porpoises is the noise that emanates from the ship's propellers, machinery, the hull's passage through the water and sonar (depth sounders and fish finders). Noise may impede communication between harbour porpoises and cause behavioural and distributional changes. Noise mitigation measures, such as the design of more silent equipment or optimising vessel speed have the potential to reduce any negative effects on harbour porpoises (and other marine biota that use sound). Through changes of locations of shipping routes, important habitat for harbour porpoises might be avoided (see also under 4.3.1. in the Background Document to the ASCOBANS Recovery Plan for Harbour Porpoises in the North Sea).

4.5. Hydrocarbon exploration

Noise is generated during all phases of hydrocarbon exploration. Seismic surveys (exploration), pile driving, pipe laying (installation), drilling and platform operations (production) as well as decommissioning are all activities generating loud noise and potentially pose a risk to harbour porpoises. The difficulty of proving the detrimental effects of acoustic disturbance on harbour porpoises necessitates a precautionary approach in dealing with this issue. ASCOBANS has adopted two resolutions on disturbance (Resolution No.4, 2000) and on the effects of noise and of vessels (Resolution No. 5, 2003) recommending the introduction of guidelines on measures and procedures for seismic surveys. These guidelines provide the opportunity to alter the timing of surveys or to minimise their duration; reduce noise levels as far as possible; avoid starting surveys when cetaceans are known to be in the immediate vicinity. Further measures could be introduced in areas of particular importance to cetaceans (see also under 4.3.2. in the Background Document to the ASCOBANS Recovery Plan for Harbour Porpoises in the North Sea).

4.6. Sewage and debris discharge

Many international instruments and regulations aim at reducing or eliminating the discharge of sewage from ships and from land based sources (e.g. MARPOL, Water Framework Directive, Montreal Guidelines for the Protection of the Marine Environment against Pollution from Land-based Sources).

The best solution to these problems is the prevention and control of pollution at the source, and in some cases further large-scale infrastructural improvements may be required.

4.7. Construction

Construction activities are among the noisiest sound sources in the North Sea. Construction has been shown to displace harbour porpoises at least temporarily from areas of sea, so a precautionary approach should be adopted. The two ASCOBANS resolutions mentioned under 4.5. may be applied to activities dealing with the construction of features in the North Sea: the timing of activities could be carefully selected in order to minimise their duration and potential effect on harbour porpoises. Noise levels may be able to be reduced by the use of sleeving, cushioning or bubble curtains. Activities should not be started when cetaceans are known to be in the immediate vicinity. Construction of new port and marina developments could be timed to avoid crucial times for harbour porpoises (e.g. March – May) (see also under 4.3.2. in the Background Document to the ASCOBANS Recovery Plan for Harbour Porpoises in the North Sea).

4.8. Aquaculture

Aquaculture may affect harbour porpoise habitat through introducing waste (including medicines), and through the presence of installations in potential harbour porpoise habitat. In addition, acoustic devices to deter seals (AHDs) from the area of fish farms also affect harbour porpoises. In recent years, environmental measures have been introduced in some areas to reduce the environmental effect of the industry (e.g. The Aquaculture Act, Norway). These measures include requirements for the technical standard of floating fish farming installations, environmental monitoring and internal control.

4.9. Mineral extraction

Mineral extraction might be restricted to relatively small areas in the North Sea. However, it removes the top layer of the seabed and may affect habitat for prey species (e.g. sandeels) of the harbour porpoise. The most effective measure to protect harbour porpoises would be to cease mineral extraction. Generally, this is not economically desirable or feasible. The use of full environmental impact assessment for this industry might reduce potential effects (see also under 4.3.2. in the Background Document to the ASCOBANS Recovery Plan for Harbour Porpoises in the North Sea).

4.10. Recreation

The most effective measure is to prohibit or limit access to important harbour porpoise habitat, but at present only a few such areas are known and it is likely that the location of "important areas" will vary temporally. A more appropriate approach might therefore be the adoption of generic guidelines that would reduce potential effects in all areas. Guidelines describing how to behave in the presence of harbour porpoises exist on national levels.

4.11. Military

The most effective measure is to cease all military activities in the North Sea which is not realisable. Military high frequency sonar used in shallow waters like the North Sea is not as harmful as mid- or low frequency sonar, but disturbance to harbour porpoises can be minimised by monitoring systems that will enable adaptive management of activities should harbour porpoises be in the vicinity.

5. Recommendations

5.1 Bycatch

ASCOBANS acknowledges that the adoption of Council Regulation (EC) No 812/2004 has been an important first step towards the reduction of bycatch and now is awaiting reports on its implementation. Possible gaps in the area and timing of measures should be identified, assessed and addressed (see also under 5.1., A.1 – A.5 in the Background Document to the ASCOBANS Recovery Plan for Harbour Porpoises in the North Sea).

5.1.1. Observation schemes

Regular evaluation of the impact of all fisheries particularly gillnet fisheries need to be carried out to better determine if and to what extent certain types of fisheries pose a risk to harbour porpoises. The most recent assessment has been carried out by ICES (2001) and Kaschner, (2003). In cases where there is insufficient information to assess the impact of a fishery, appropriate observer schemes need to be established as a matter of urgency.

In the northern and central North Sea, three independent programs for monitoring bycatches of marine mammals are currently under testing for Norwegian coastal and offshore fisheries including gill-net fisheries. These observation and reporting programmes are currently generating data, and the first estimates of marine mammal bycatches are anticipated to be completed by December 2006.

In the central and southern North Sea, no data are presently available for French set net fisheries in the eastern part of the Channel and set net fisheries in Dutch waters. For set net fisheries in Belgium there are limited data available. Continued monitoring is required of the UK, Danish, Swedish and German set net fisheries to check the effectiveness of mitigation measures when they are introduced. Further monitoring is needed in those fisheries not affected by Council Regulation (EC) 812/2004 (boats under 15m, boats using <220 mm nets or longer than 400m nets)

In the western Channel and on the Celtic Shelf, monitoring is required in French and Spanish set net fisheries both to assess bycatch levels and the effectiveness of mitigation measures when they are introduced. Continued monitoring is required for the UK and Irish set net fisheries to check the effectiveness of mitigation measures when they are introduced.

It is recommended that observation schemes be established for recreational gillnet fisheries and for gillnet fisheries using vessels less than 15 m in length.

5.1.2. Bycatch reduction

Any new gear should have an Environmental Impact Assessment (EIA) and/or Strategic Environmental Assessment (SEA)[1] concerning its effect on species, habitat and the ecosystem. New gear should be tested in full-scale fishery operations before they are considered for introduction in commercial fisheries.

ASCOBANS awaits the Member States' annual reports on the implementation of (EC) 812/2004 due to be submitted to the Commission by 1 June and other project reports (e.g. NECESSITY, IMPACT); this information is essential to recommend further steps. However, early indications are that not all the provisions of (EC) 812/2004, particularly the pinger requirements, are being implemented by all affected Member States and that, therefore, better implementation and enforcement of this legislation or alternative measures need to be introduced as a matter of urgency.

Article 12.4 of the Habitats Directive requires Member States to take research or conservation measures as required to ensure that incidental capture and killing does not have a significant negative impact on the species concerned. Therefore, if a significant bycatch problem is identified appropriate measures to reduce bycatch should be taken immediately (including

[1] All EIA and SEA should include evaluation of the importance of the area for harbour porpoises, including seasonal usage, direct effects on harbour porpoises and indirect effects from noise emitted from the proposed development and what effect this will have on the porpoises and their habitat, as well as consideration of alternative development options and mitigation.

time and area closures or modification of the fisheries concerned if effective measures are available).

The development of alternative methods to reduce harbour porpoise bycatch, such as interactive pingers and other gear modifications should be encouraged and their efficacy, applicability in the fisheries concerned and potential impacts should be fully assessed before deployment can be recommended.

The effects of commercial depths sounders and fish finders should be studied.

5.2. Fishing impacts on harbour porpoise habitats

The general management of fish stocks needs to be improved. Increasing abundance of fish will reduce the effort required to land the quota and might improve prey availability for harbour porpoises. Despite claims that the European Union is moving towards an ecosystem approach to fisheries management there is little evidence that the needs of harbour porpoises (and other marine wildlife) are being taken into account when advice is being given and decisions on harvesting are being made. The impact of fishing on the seabed and potential effects on prey of harbour porpoises needs further elucidation. Regulations to reduce and eliminate loss and deliberate discarding of fishing gear are required. Studies on the impact of fish finding sonar on harbour porpoises are required.

5.3. Contaminant discharge and emissions

A better implementation of all current regulations in force is necessary as well as surveillance if the regulations are appropriate for their purpose. Studies linking cause and effects of contaminants on harbour porpoises need to be carried out (e.g. Pollution 2000+ as described in Reijnders *et al*., 1999). This includes continuation of current stranding and necropsy schemes (e.g. Jepson *et al*., 2000; Siebert *et al*., 2001; Jauniaux *et al*., 2002; García Hartmann *et al*., 2004).

5.4. Shipping

Quieter ships and quieter operation of vessels needs to be encouraged. An EIA should be required on any new shipping lane and ferry route proposal. This includes the use of ‘fast’ ships on existing routes. Modelling and assessment of the effect of shipping lanes on harbour porpoises and their habitat should be carried out (see also under 5.1., C.1 in the Background Document to the ASCOBANS Recovery Plan for Harbour Porpoises in the North Sea).

5.5. Hydrocarbon exploration

EIAs and SEAs on hydrocarbon exploration and production need to be introduced in all North Sea waters and should include issues such as noise and its effects on harbour porpoises. Noise should be reduced where possible (see also under 5.1., C.2 in the Background Document to the ASCOBANS Recovery Plan for Harbour Porpoises in the North Sea).

5.6. Sewage and debris discharge
A better implementation of all current regulations in force is necessary as well as surveillance if the regulations are appropriate for their purpose. In view of the negative impacts of anthropogenic nutrient inputs over extended parts of the North Sea coastal zones, implementation of the OSPAR Strategy to Combat Eutrophication should be pursued vigorously. Efforts should be focused on emissions, discharges and losses from agricultural and urban sources, in particular through enforced application and compliance with the EC Directives 91/676/EEC and 91/271/EEC concerning nitrate and urban wastewaters.

5.7. Construction
EIAs on new developments should include issues concerning harbour porpoises, especially noise associated with construction work. Noise should be reduced where possible by taking appropriate measures including the examples listed under 4.7. Further research on cumulative effects of construction in the North Sea (such as multiple wind farms) and the practicability and effectiveness of noise reducing equipment is required (see also under 5.1., C.2 in the Background Document to the ASCOBANS Recovery Plan for Harbour Porpoises in the North Sea).

5.8. Aquaculture
Impact assessments as well as SEAs focussing on effects of aquaculture on harbour porpoises and their habitat are required. In particular, measures should be introduced to regulate and reduce the noise emissions associated with use of acoustic harassment devices (AHDs) where these may be detrimental to harbour porpoises.

5.9. Mineral extraction
EIAs and SEAs should have particular emphasis on the effect of harbour porpoise habitat destruction and noise. Important harbour porpoise habitat should be avoided if possible (see also under 5.1., C.3 in the Background Document to the ASCOBANS Recovery Plan for Harbour Porpoises in the North Sea).

5.10. Recreation
Public awareness needs to be raised (see also under 5.1., C.6 in the Background Document to the ASCOBANS Recovery Plan for Harbour Porpoises in the North Sea). The establishment and promotion of guidelines for activities that affect harbour porpoises should be prioritised.

Management of recreational fisheries needs to be improved (see also under 5.2.). EIAs for port and marina developments should include issues concerned with harbour porpoises (see also under 5.7.). Deliberate and reckless disturbance need to be banned.

5.11. Military

As far as military activities are concerned, the armed forces are expected to act in accordance with articles 236 and 237 paragraph 2 of the Convention on the Law of the Sea of 1982 to undertake any reasonable efforts to avoid any disturbance to harbour porpoises (and other wildlife). ASCOBANS encourages military forces to adhere to this by real-time monitoring (including acoustics) during military operations and in military ranges.

5.12. Scientific studies

Trends in distribution and abundance as well as seasonal variations and habitat requirement are important issues in monitoring. There appears to be a particular need for studies on possible stocks and their separation. Investigation of movements of porpoises within the Celtic Sea, English Channel and southern North Sea are required.

In order to evaluate the direct and indirect impacts of fishing on harbour porpoises and how bycatch can be reduced, efforts should be made to determine their foraging habits in relation to various types of fishing gear and the species of fish harbour porpoises feed on.

Harbour porpoise hearing and communication need further examination in order to assess the impact of noise and the possible masking in communication.

Appropriate indicators of "health status" need to be developed in order to be able to declare a stock as healthy or not. There is an urgent need for the development of pathological indicators for acoustic trauma and the inclusion of pathological examinations for acoustic trauma into health monitoring schemes to get estimates of the pathological order of magnitude of the "noise problem".

Collaboration to monitor harbour porpoise populations should be undertaken on an intermediate international scale (e.g. trilateral collaboration in the Wadden Sea). Further work should continue to determine if any marine areas contain any physical and/or biological factors that are essential to harbour porpoises.

6. Implementation

Many of the above recommendations reflect regulations and obligations already in place. To facilitate the implementation of these, ASCOBANS will assemble a support pack for those undertaking environmental assessment.

While measures to control and reduce pressures and impacts on the marine environment do exist, they have been developed in a sector by sector approach resulting in a patchwork of policies, legislation, programmes and actions plans at national, regional, EU and international level. It is necessary to encourage North Sea Member States to harmonise their national efforts (e.g. SEAs) to ensure that the Recovery Plan is implemented.

In implementing the above recommendations, particular emphasis should be given to influences apparent to harbour porpoises in the southern North Sea and the English Channel.

Implementation of the plan requires the participation of both governmental and non-governmental organizations. This collective effort must be coordinated and monitored to ensure that the objectives set for the North Sea Harbour Porpoise Recovery Plan are pursued. It is recommended that ASCOBANS sets up a steering group similar to the Jastarnia group to that effect.

The steering group members should be selected from among industries, environmental groups and governmental organizations. They would be asked to solicit commitments from the various organizations identified as competent entities for implementing the recovery plan schedule.

Duties of the committee would be:

- to promote and coordinate the implementation of the plan;
- to gather information on its implementation, the results obtained, the objectives reached, and the difficulties encountered;
- to communicate this information to the general public through regular reporting in an appreciable format;
- to appoint a group of experts to evaluate the effectiveness of the plan every three years and to update it. The conclusions of this group should be made public.

In the following implementation schedule, the recommendations are classified as actions, monitoring, activities or research activities. The organizations/institutes that should be involved in the implementation of the recommendations are identified; dates for completion of the tasks are suggested, and, when possible, the cost is estimated.

	Activities			Legislative entity	Implementing institutions	Time frame	Cost	Comments
	Action	Monitoring	Research					
Observer schemes	Regular evaluation of all fisheries, particularly gillnet fisheries, including those subject to mitigation measures	Observer schemes for recreational gillnet fisheries and for gillnet fisheries using boats <15 m in length	Collect scientific data on incidental catches of harbour porpoises for vessels with overall length < 15 m	EC, North Sea Range States		On-going		Particular need for data from Norway in the Northern North Sea and Central North Sea, data from UK, French, Belgian and Dutch set net fisheries in the southern North Sea and eastern part of the Channel, data from French and Spanish set net fisheries in the western Channel and on the Celtic Shelf and from non North Sea states which operate in the North Sea
Bycatch reduction	Implement existing regulations and where ineffective, introduce alternative measures; Test new gear in full-scale fisheries operations before first use	Ongoing monitoring of efficacy of mitigation measures	Carry out EIA and/or SEA on any new gear; Encourage development of interactive pingers and other gear modifications	EC, North Sea Range States				
Fishing impacts	Improve the general managing of fish stocks		Determine impact of fishing on the seabed and of fish finding sonars on harbour porpoises					
Contaminant discharge & emissions	Implementation of all currant regulations	Surveillance if implemented regulations are appropriate	Further studies on effects of contaminants linking cause & effect Continuation of stranding and necropsy schemes					

Shipping	Quieter ships and operation of vessels		EIA on any new shipping lane and ferry route proposal Modelling & assessment of effect of shipping lanes	IMO, EC, North Sea Range States		
Hydrocarbon exploration	Reduce noise where possible		EIAs on new developments			
Sewage and debris discharge	Implementation of all currant regulations	Surveillance if implemented regulations are appropriate				
Construction	Reduce noise where possible		EIAs on new developments Further research on cumulative effects of construction work and the practicability and effectiveness of noise reducing equipment			
Aquaculture	Introduce regulation of noise emissions from AHDs		Impact assessment and SEAs			
Mineral extraction	Avoid important harbour porpoise habitat		EIAs and SEAs with particular emphasis on the effect of habitat destruction and noise			
Recreation	Raise public awareness		Establish guidelines etc. (see p. 11)			
Military	Act in accordance with articles 236 and 237 paragraph 2 of the Convention on the Law of the Sea of 1982					Avoid disturbance through real-time monitoring during military operations

Scientific studies	Trends in distribution and abundance; Studies on possible sub-populations and their separation; Complete information on diet of harbour porpoises; Study the possible effects of noise on harbour porpoises and the hearing and communication of harbour porpoises; Define appropriate indicators of “health status”; develop pathological indicators for acoustic trauma; determine if any marine areas contain any physical and/or biological factors essential to harbour porpoises

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Background document to the ASCOBANS Recovery Plan for Harbour Porpoises (*Phocoena phocoena* L.) in the North Sea

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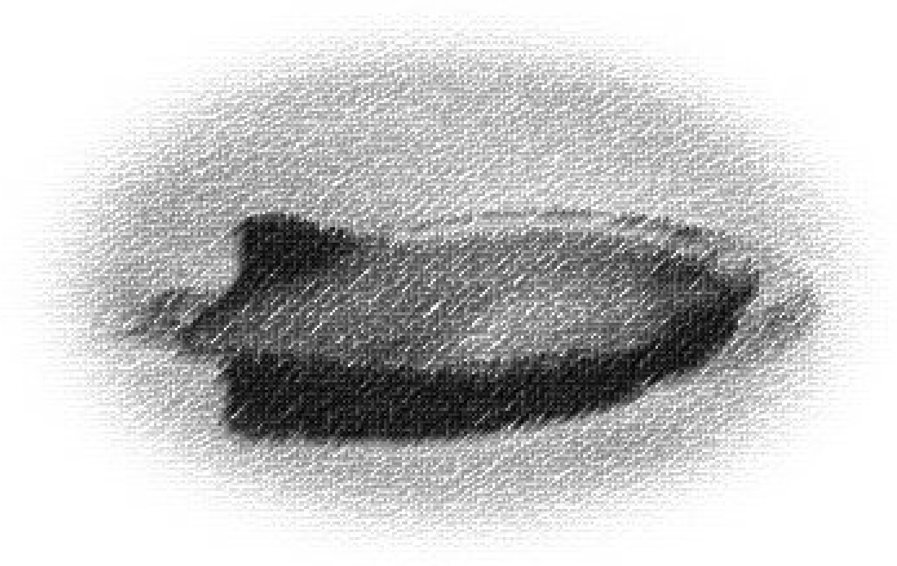

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Contents

Executive Summary

Harbour porpoises (*Phocoena phocoena*), with approximately 270,000 animals in the North Sea and notably the most abundant species of cetacean, are classified as being in need of strict protection under the EC Habitats and Species Directive 1992 (Habitats Directive) and the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention).

Through genetic analyses, the use of tooth ultra-structure and distribution data including satellite-tagging, three potential stocks of harbour porpoises have been identified in the North Sea. These are the northern North Sea population, the central and southern North Sea population possibly extending into the English Channel and the Celtic Sea population which may extend into the English Channel as well.

In spite of relatively high stock estimates in some areas (e.g. northern North Sea and central North Sea), there have been notable declines in others (e.g. southern North Sea and English Channel) and concerns have been raised about adverse effects that incidental takes in various fisheries, pollution, elevated underwater noise and other environmental changes may have on habitat quality and on abundance of the North Sea harbour porpoise populations.

The 5th International Conference on the Protection of the North Sea (Bergen, Norway, 20 – 21 March 2002) called for a recovery plan for harbour porpoises in the North Sea to be developed. ASCOBANS (Agreement on the Conservation of Small Cetaceans in the Baltic and North Seas) took the role, led by Germany, to draft such a Plan. This document identifies known and potential factors posing a risk or threat to the North Sea harbour porpoise populations and recommends actions to reduce them.

Recovery of the North Sea harbour porpoise will be achieved when population numbers and conditions reach a state where natural events and human activities will not threaten the survival of the different stocks and the historical distribution range is occupied.

Almost all countries bordering the North Sea and adjacent waters have reported bycatch of harbour porpoises in fisheries. Highest mortalities of harbour porpoises in fishing nets have been observed in association with bottom-set nets deployed for demersal species such as cod, turbot, lumpfish, plaice, sole and ray species. Gear deployed in these fisheries include trammel nets, tangle nets and gillnets set at different heights and using different mesh sizes. Not all fisheries that may pose this threat have yet been monitored for bycatch. However, bycatch levels recorded to date exceed sustainable levels in most areas of the North Sea.

Examination of carcasses suggests that contamination may pose another threat. High levels of PCBs and DDT have been associated with a notable decline of harbour porpoise numbers in Dutch waters during the 1950s, although this is difficult to determine, given the simultaneous effects of prey depletion and bycatch in the area.

The combined and potentially synergistic effects of disease, stress induced by disturbance, and contaminant exposure are likely to be having detrimental effects on the North Sea harbour porpoise populations. Even if the respective impacts of contamination and disturbance have not decisively been established, preventive action can be justified. Waiting for full scientific evidence to be available before proceeding can only hinder the recovery of the harbour porpoise.

Other risks have not been investigated adequately yet, but disturbance by commercial and recreational traffic, dredging and some forms of coastal development (e.g. wind parks) could emerge as significant negative factors.

This document details the multitude of factors that impact on harbour porpoises in the North Sea. However, it is widely recognised that bycatch is the single most significant threat and needs to be addressed with highest priority.

The Recovery Plan discusses efforts already in place to protect the harbour porpoise, it identifies a series of recommended further actions and proposes their order of priority. Organizations that should participate in implementing the recommendations are identified. The following aims and actions are recommended:

A. Achieve in the North Sea, particularly for the stocks in the central and southern North Sea and the Channel an overall reduction in incidental entanglement in fishing gear to below levels that are having or may have, either singly or in combination, negative impacts on the conservation status of the population;
B. Achieve an overall reduction in toxic contaminant to below levels that are having or may have, either singly or in combination, negative impacts on the conservation status of the population;
C. Reduce disturbance caused by human activities in areas currently or historically frequented by harbour porpoise to below levels that are having or may have, either singly or in combination, negative impacts on the conservation status of the population;
D. Monitor the state of the sub-populations;
E. Investigate other potential obstacles to harbour porpoise recovery.

Given that numbers of bycaught harbour porpoises in the North Sea exceeds the definition of "unacceptable interactions" of a total anthropogenic removal above 1.7% of the best available estimate of abundance as agreed by ASCOBANS, a number of actions are directed at reducing incidental mortality in fishing gear. More specifically, it is recommended that all North Sea states should establish a comprehensive observation program to monitor the incidental capture and killing of harbour porpoises as required under Council Directive 92/43/EEC. The provisions of Regulation (EC) No 812/2004 must be implemented and enforced fully or, if its provisions are considered to be unfeasible or ineffective, alternative mitigation measures should be introduced immediately to reduce porpoise bycatch in the affected fisheries. To achieve adequate protection of vulnerable inshore populations and prevent redeployment of gillnet and tangle net effort to vessels less than 12 m long, it is recommended that an assessment of all static net effort in the North Sea should be undertaken. This will help to identify areas where gillnet use should be restricted or halted and areas where mandatory pinger deployment or other fishery modifications should be introduced.

The plan also recommends actions for reducing disturbance and establishing a coexistence of harbour porpoises and humans. For example, measures to limit the noise and speed of boats or the numbers of boats in a given area could be examined as well as the introduction of a voluntary code of conduct for boaters in areas where there are known to be high numbers of harbour porpoises.

A number of research activities have been integrated into the plan to help guide action. Research projects are also directed at identifying other possible obstacles to recovery. Hearing and communication of the harbour porpoise, their diet, and the effects of ship noise, including navigational sonar, on harbour porpoises and on their prey species are among the aspects of harbour porpoise biology and ecology that should be investigated.
Further research into harbour porpoise behaviour around fishing nets and the reasons for their entanglement, as well as ways to enhance either the attentiveness of the porpoise or the acoustic visibility of nets without affecting catch rates is recommended.

Finally, monitoring is essential to document the effectiveness of the plan by indicating any improvement or deterioration of the situation. This should include conducting comprehensive aerial population surveys every three to five years and continuing the national stranding programs.

The various organizations involved in the implementation of the Recovery Plan are identified in an implementation schedule. Each action is assigned a priority order, and cost estimates as well as dates for completion of the recommendations are suggested. A strategy for monitoring the plan is also proposed.

Abbreviations

ACME = Advisory Committee on the Marine Environment
ASCOBANS = Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas
ADCP = Acoustic Doppler Current Profiler
ATOC = Acoustic Thermometry of Ocean Climate
BAT = best available technique
BEP = best environmental practice
Ca = cadmium
CFP = Common Fisheries Policy
CITES = Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMS = Convention on Migratory Species of Wild Animals
CO_2 = Carbon dioxide
Cr = chromium
Cu = copper
dB = decibel
DDT = dichlorodiphenyl trichloroethane
DMV = Dolphin morbillivirus
DNA = deoxyribonucleic acid
EC = European Community
EEZ = exclusive economic zone
EIA = environmental impact assessment
ESAS = European Seabirds at Sea database
EU = European Union
(k)Hz = (kilo)Herz
HELCOM = Helsinki Commission
HESS = High Energy Seismic Survey
Hg = mercury
ICES = International Council for the Exploration of the Sea
IWC = International Whaling Commission
km = kilometre
m = metre
MMPA = Marine Mammal Protection Act
MPA = Marine protected area
MW = mega watts
NASS = North Atlantic Sightings Surveys
NGO = Non-governmental organisation
Pa = Pascal
PAHs = polycyclic aromatic hydrocarbons
Pb = lead
PBDEs = polybrominated diphenylethers (brominated flame retardant)
PCBs = polychlorinated biphenyls
PFCs = perfluorochemicals
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
PMV = Porpoise morbillivirus
PODs = Porpoise Click Detectors
POPs = persistent organic pollutants
pSCI = proposed site of community interest

PTS = permanent threshold shift
SAC = Special area of conservation
SCANS = Small Cetaceans Abundance in the North Sea (survey)
Se = selenium
SGFEN = Subgroup on Fishery and the Environment
SMRU = Sea Mammal Research Unit
SWF = Sea Watch Foundation
TBT = Tributyltin
TTS = temporary threshold shift
UME = Unusual mortality event
UV = Ultra violet
Zn = zinc

Directives and Regulations mentioned in this document

Directive 76/769/EEC	on the approximation of the laws, regulations and administrative provisions of the Member States relating to restrictions on the marketing and use of certain dangerous substances and preparations
Directive 79/409/EEC	on the conservation of wild birds (birds directive)
Directive 85/337/EEC	on environmental impact assessment
Directive 91/271/EEC	on urban waste water treatment
Directive 91/676/EEC	on nitrates from agricultural sources
Directive 92/43/EEC	on the conservation of natural habitats and of wild fauna and flora (Habitats Directive)
Directive 93/67/EEC	on risk assessment of new notified substances
Directive 96/59/EC	on the disposal of polychlorinated biphenyls and polychlorinated terphenyls (PCB/PCT)
Directive 97/11/EEC	on environmental impact assessment (amends 85/337/EEC)
Regulation EC 1488/94	lays down the principles for the assessment of risks to man and the environment of existing substances
Regulation EC 850/98	for the conservation of fishery resources through technical measures for the protection of juveniles of marine organisms
Regulation EC 2371/2002	on the conservation and sustainable exploitation of fisheries resources under the Common Fisheries Policy
Regulation EC 812/2004	laying down measures concerning the incidental catches of cetaceans in fisheries and amending Regulation (EC) No 88/98

1. Introduction

Harbour porpoises (*Phocoena phocoena*, Linnaeus 1758) are widely distributed in shelf waters of the temperate North Atlantic and North Pacific Oceans and in some semi-enclosed seas (e.g. Black and Baltic Seas). The small phocoenid is notably the most abundant species of cetacean in the North Sea (Hammond *et al*., 1995, 2002). In spite of relatively high population estimates in the region overall, there have been documented declines in the distribution and apparent abundance of the species in certain areas during the latter half of the twentieth century. This has raised concerns about adverse effects that incidental takes in various fisheries, elevated underwater noise due to seismic activity, shipping, aggregate extraction, construction of wind farms, pollutants, prey depletion etc. may be having on harbour porpoises in the North Atlantic and on the populations of the North Sea and adjacent waters in particular.

Harbour porpoises are listed in

- the EC Habitats and Species Directive 1992 (92/43/EEC), Annex II (Animal and plant species of community interest whose conservation requires the designation of special areas of conservation) and Annex IV (Animal and plant species of community interest in need of strict protection),
- the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Appendix II (species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled),
- the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention), Appendix II (Strictly protected fauna species), in
- the Convention on Migratory Species (Bonn Convention), Appendix 2, and
- is listed in the IUCN Red List of Threatened Species as *vulnerable* throughout their range and protected through various regional and national acts.

Harbour porpoise furthermore are covered by the Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS), a regional agreement under the Bonn Convention.

Several political decisions which were made in response to the increased awareness of the need for conservation of biodiversity and the sustainability of any use of natural resources directly concern small cetaceans, such as the harbour porpoise.

The 5th International Conference on the Protection of the North Sea (Bergen, Norway, 20 – 21 March 2002) called for a recovery plan for harbour porpoises in the North Sea to be developed and adopted (Paragraph 30, Bergen Declaration). In the Bergen Declaration and ASCOBANS (ASCOBANS, 1992), the North Sea is defined as the body of water:

a) southwards of latitude 62°N, and eastwards of longitude 5°W at the north west side;
b) northwards of latitude 57° 44.8'N from the northern most point of Denmark to the coast of Sweden; and
c) eastwards of longitude 5°W and northwards of latitude 48°30'N, at the south side (Figure 1).

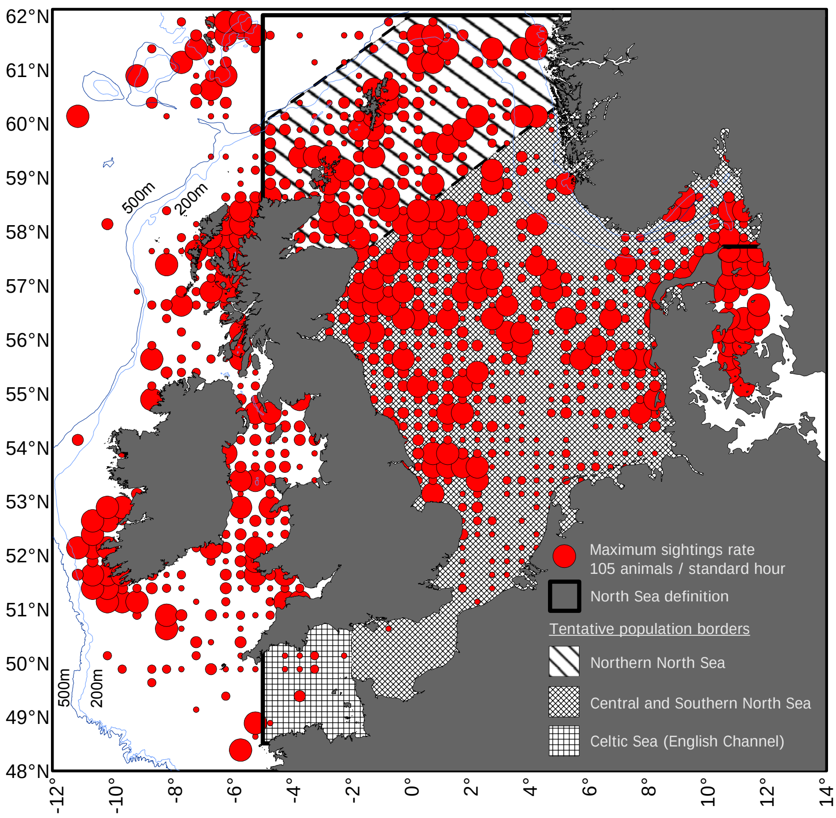


Figure 1: MAP of the North Sea as defined at the 5th International Conference on the Protection of the North Sea in Bergen, Norway, 20 – 21 March 2002, showing the tentative harbour porpoise population borders and the distribution of harbour porpoises in the North Sea and adjacent waters. Data have been pooled from 1979 to 1997, all seasons are combined (Reid *et al.*, 2003).

The declaration of the Joint Ministerial Meeting of the Helsinki and OSPAR Commissions (Bremen, Germany, 25 – 26 June 2003) adopted the common statement "Towards an Ecosystem Approach to the Management of Human Activities" (Paragraph 13) which highlights the need to develop and promote the implementation of a Recovery Plan for harbour porpoises in the North Sea. ASCOBANS took a leading role in drafting a Recovery Plan for Harbour Porpoises in the North Sea, because they have gained considerable experience with the development of the recovery plan for harbour porpoises in the Baltic ("Jastarnia Plan").

ASCOBANS was established under the UN Convention on Migratory Species (CMS or Bonn Convention). The aim of ASCOBANS is “to restore and/or maintain biological or management stocks of small cetaceans at a level they would reach when there is the lowest possible anthropogenic influence” (ASCOBANS, 1997a). The short-term goal of ASCOBANS is to restore stocks/populations to, or maintain them at, 80% or more of their carrying capacity (ASCOBANS, 1997a). The figure is based on the fact that the maximum net productivity level of toothed whales and seals is estimated to range between 50 – 85 %, and are likely somewhere between 0.58 – 73 % as found for fur seals, for the carrying capacity of the habitat they occupy (Taylor & DeMaster, 1993). Because seals and odontocetes differed less than 1 % in the modelling, it is assumed that the latter range holds also true for small cetaceans. Since ASCOBANS is an organization which does not strive to maximum net productivity as a resource management body would, but to a more natural regulation, the value of 80 % or more is chosen (Rijnders, 1997).

In 2000, ASCOBANS defined a total anthropogenic removal above 1.7% of the estimated harbour porpoise abundance as unacceptable and adopted the intermediate precautionary objective to reduce bycatch to less than 1% of the best available population estimate (ASCOBANS, 2000a). The figure of 1%, chosen as a reasonable and precautionary level beyond which one should be concerned about the sustainability of anthropogenic removals, is based on the assumption that the maximum net production of a harbour porpoise population could be lower than 4% per year (Woodley & Read, 1991; Palka, 1996), and that bycatch and abundance estimates are associated with uncertainties (IWC, 1996). In view of these concerns, this Recovery Plan was developed to remove risks and limiting factors and allow the stocks to be maintained at current levels, or in case of depleted stocks to grow.

This document reviews the current state of knowledge about North Sea harbour porpoises, recommends a series of actions for ensuring their survival and proposes an implementation plan. The goal of the Recovery Plan is to bring population numbers and conditions to a state where natural events and human activities will not threaten the survival of the North Sea harbour porpoise populations.

2. Population structure, abundance and distribution

The following definitions will be used: the term "population" will be applied only to reproductively isolated large scale groups of harbour porpoises, while both the terms "sub-population" and "stock" will be used to describe genetically or morphologically distinguishable but not completely isolated sub-units of a population in reproductive terms.

Confined to the northern hemisphere, with a more or less circumpolar distribution in temperate regions (Gaskin, 1984), harbour porpoises generally inhabit coastal areas, and are typically found at depths of less than 200 metres (Carwardine, 2000); although they have been recorded in deeper waters (Reid *et al*., 2003).

2.1. Population structure

Since the understanding of population structure is vital in evaluating the effects of threats to harbour porpoise – and indeed for the formulation of sound management procedures – the IWC-ASCOBANS *Working Group on Harbour Porpoise* attempted to define the boundaries of assumed sub-populations in the North Sea in order to be able to model the impact of bycatch on individual stocks (IWC, 2000). This determination of sub-populations was primarily carried out using existing mitochondrial DNA studies. They yielded great differences among putative populations. These were subsequently ascribed to potential female philopatry and the comparatively lower dispersal rates of females. Repopulation of depleted areas by females from other stocks is expected to be slow and the movements of the more transient males might not be able to compensate for this. The risk of local depletion would increase if females were more resident than males. The "lowest common denominator" should therefore be local and genetically distinguishable sub-populations of females. Based on these findings, three sub-populations or stocks were identified – their boundaries largely following the borders of ICES areas (IWC, 2000) (Figure 1):

(i) Northern North Sea,
(ii) Central and southern North Sea (including the eastern part of the English Channel)
(iii) Celtic Shelf (with the western part of the English Channel) .

2.1.1. Northern North Sea

Harbour porpoises are distributed across the North Sea with some areas of concentration along the Danish and North-German coasts and only a few regions of low density which may distinguish stock boundaries (Donovan & Bjørge, 1995) (also see under 3). Walton (1997) analysed the population structure of harbour porpoises in British and adjacent waters using mitochondrial DNA and found significant differences between harbour porpoises from the northern North Sea (Northern Scotland) and the southern North Sea (Eastern England). He used south-east Scotland where no animals were found as the provisional border line. Tolley *et al*. (1999), using 66 porpoises sampled from the British northern North Sea that were analysed by Walton (1997), found no significant difference between females from southern Norway (south of 65°) and northern Scotland. Both, the study by Walton (1997) and the tagging work done by Teilmann (Teilmann, unpubl. data), suggest that there is a boundary somewhere in the middle of the North Sea. However, not all genetic studies have clear results and no tagging has been done in the central and southern North Sea, so the boundary and whether there is a clear year-round boundary, is still uncertain.

The border to the population in the north-west was based on the lack of sightings in the deep channel between the Faeroes and Shetland (Reid *et al*., 2003).

2.1.2. Central and southern North Sea

Walton (1997) found evidence for genetic differences between animals in the southern North Sea and the northern North Sea. Whereas Walton found no differences between animals from the Dutch coast and animals from the English coast, analyses of 12 microsatellite loci by Andersen *et al*. (2001) indicated that the Dutch sample consisted of a mixture of British and Danish North Sea harbour porpoises. They did not find evidence which suggested a separate Channel population. The sample size was probably too small (n = 327) to demonstrate a difference. Lockyer (1999) using teeth ultra-structure analysis suggested that porpoises in the North Sea are divided into a northern and a southern North Sea sub-population.

The boundary in the Channel was made based on the lack of sightings noted by Reid *et al*. (2003) in the middle of the Channel. There are sightings in the western part that gradually decrease towards the east. The same picture can be seen in the eastern part of the Channel suggesting movements of porpoises from the Celtic Sea and southern North Sea into the Channel but with no or little overlap in the middle. Indeed, porpoise have increasingly been observed in the first quarter of the year in the southern North Sea and the eastern part of the Channel.

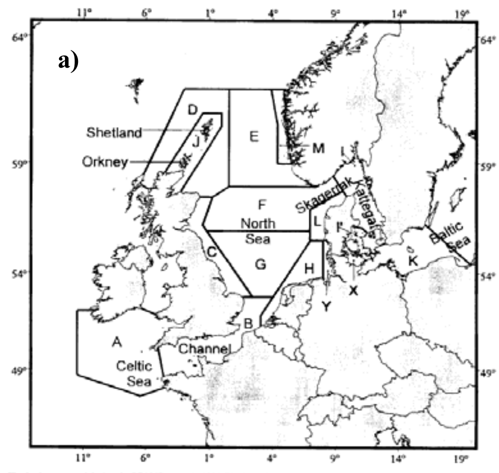
2.1.3. Celtic Shelf

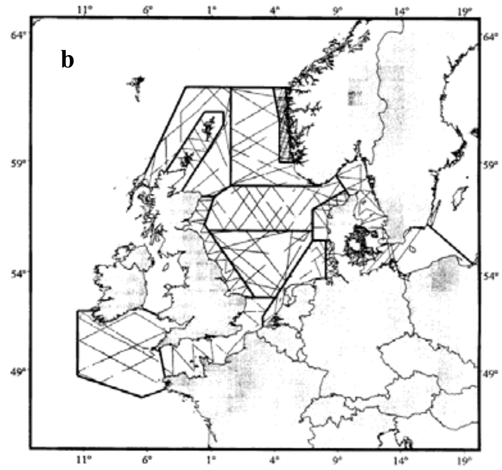
The IWC-ASCOBANS *Working Group on Harbour Porpoise* (IWC, 2000) agreed that the Celtic Shelf sub-populations extent into the Irish Sea and along the west coast of Ireland. Therefore, although the North Sea is clearly defined for the Recovery plan, the Celtic Shelf area is included, since what happens to the sub-population there will affect the animals in the North Sea.

2.2. Abundance and distribution

Abundance estimates for cetaceans can be obtained using a number of techniques. Ship-based and/or aerial sighting surveys as well as bycatch and stranding records form the basis of current abundance estimates in the North Sea.
The systematic approach to dedicated sightings surveys using different observer platforms reduces biases and uncertainties, but these cannot be eliminated.

Several surveys have been conducted in the north-east Atlantic to estimate the size of harbour porpoise populations. In 1987 and 1989, the North Atlantic Sightings Surveys (NASS) estimated minke whale abundance. They also provided an estimate of harbour porpoise abundance in the Norwegian waters of the North Sea west of 7 °E and south of 66 °N down to 56 °N (Bjørge & Øien, 1995). Harbour porpoises were also found to be relatively abundant further west around Northern Scotland and the Shetland Islands (Northridge *et al*., 1995).
Surveys of the central and southern North Sea suggested high densities of harbour porpoise throughout the northern part of this region with maximum concentrations occurring off the islands of Sylt and Amrum in the German Wadden Sea (e.g. Heide-Jørgensen *et al*., 1993; Benke & Siebert, 1994, Scheidat *et al*., 2004). Recently, high numbers have been observed in the Dutch part of the North Sea (Brasseur *et al.,* 2004; Reijnders *et al*., 2005; Camphuysen, 2004). These equal the densities found in the Schleswig-Holstein part of the North Sea (Scheidat *et al*., 2004). Very low numbers are believed to exist in the Eastern English Channel, though porpoises increase in numbers further West in the Channel (Camphuysen, 1994; Hammond *et al*., 1995; Northridge *et al*., 1995) and on the Celtic Shelf (Leopold *et al*., 1992).
The most wide-ranging survey conducted has been the SCANS survey of summer 1994 (Hammond *et al*., 1995) which produced the most reliable estimates of harbour porpoise abundance in the North Sea and adjacent waters to date. The survey covered almost the combined total area of surveys listed above (Figure 2). The survey produced an estimated North Sea population of approximately 270,000 animals (169,888 in the central and southern North Sea, 98,564 in the northern North Sea) with a further 36,000 in the Skagerrak and Belt Seas and another 36,000 (CV = 0.57) over the Celtic Shelf between Ireland and Brittany (Table 1).





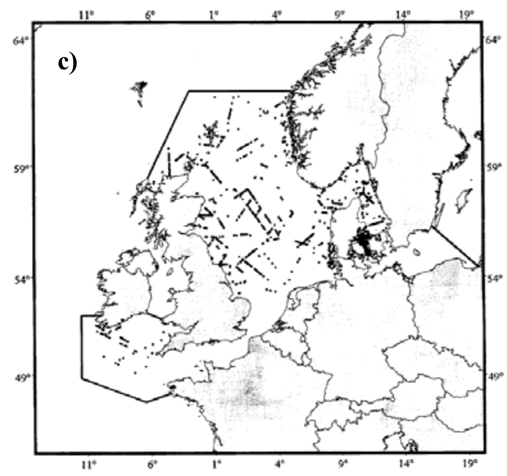


Figure 2. Maps of the SCANS survey area of summer 1994 showing a) blocks A – I surveyed by ship, blocks I´(a subset of block I), J – M, X and Y surveyed by aircraft; b) cruise tracks of all survey ships and aircraft; c) sightings of *Phocoena phocoena* made on effort during shipboard and aerial surveys (Hammond *et al.*, 2002).

No porpoises were seen in the English Channel or the southern North Sea during this survey.

In summer 2005, the SCANS II survey was carried out. In addition to the area surveyed during SCANS, this new project also covered continental shelf waters to the west of Britain, Ireland, France, Spain and Portugal and additional areas in the Baltic Sea. Data will not be available until May 2006 (Kelly MacLeod, pers. comm.).

Bjørge & Øien (1995) published abundance estimates of 82,000 animals (CV = 0.24; g(0) = 1) in the northern North Sea and southern Norwegian waters. Surveys in summer 2002 and 2003 estimated 35,000 – 39,000 porpoises (CV = 0.10) to be present in the German part of the North Sea (Scheidat *et al.*, 2004).

Table 1: Abundance and densities of harbour porpoises in the North Sea and adjacent waters by SCANS block as estimated by Hammond *et al*., 1995. Subtotals and totals do not include block I' which was a subset of block I. Figures in round brackets are coefficients of variation; figures in square brackets are 95% confidence intervals.

Greater Region	**SCANS block**	**Animal Abundance** [number of animals]	**Animal density** [number of animals/km^2]
Central & Southern North Sea	C	16,939 (0.18)	0.387
	F	92,340 (0.25)	0.776
	G	38,616 (0.34)	0.340
	H	4,211 (0.29)	0.095
	L	11,870 (0.47)	0.635
	Y	5,912 (0.27)	0.812
Subtotal (C & S North Sea)		**169,888 [124,121 – 232,530]**	
Northern North Sea (partially)	E	31,419 (0.49)	0.288
Northern North Sea (mostly)	D	37,144 (0.25)	0.363
Northern North Sea	J	24,335 (0.34)	0.784
Northern North Sea (partially)	M	5,666 (0.27)	0.449
Subtotal (Northern North Sea)		**98,564 [66,679 – 145,697]**	
English Channel (mostly)	B	0	0.000
Celtic Shelf	A	36,280 (0.57)	0.180

2.2.1. Seasonal peaks in distribution and movements between stocks

The distribution of harbour porpoises varies considerably between different seasons and areas. Even a survey as extensive as SCANS can only represent a temporally and spatially limited snapshot of population size for July or the summer season at most.

A number of studies have provided information on seasonal changes in harbour porpoise abundance. They may be indicative of small-scale and meso-scale annual movements/migrations (Northridge *et al*., 1995, Scheidat *et al*., 2004, Teilmann, unpublished data). Northridge *et al*. (1995) noted that harbour porpoises in the North Sea appeared to aggregate into two major groupings during early spring (January to March): one in the deeper waters of the north-western North Sea, and one off the west coast of Jutland and Schleswig-Holstein. Particularly two shallow banks, the Amrum Bank in German waters and Horn's Reef in Danish waters, appear to be important harbour porpoise habitat in the eastern part of the North Sea (Skov *et al*., 1994). During this time, harbour porpoises have also been found to be most common in Dutch coastal waters, indicating a potential third aggregation (Camphuysen & Leopold, 1993; Brasseur *et al*., 2004; Camphuysen, 2004; Figure 3).

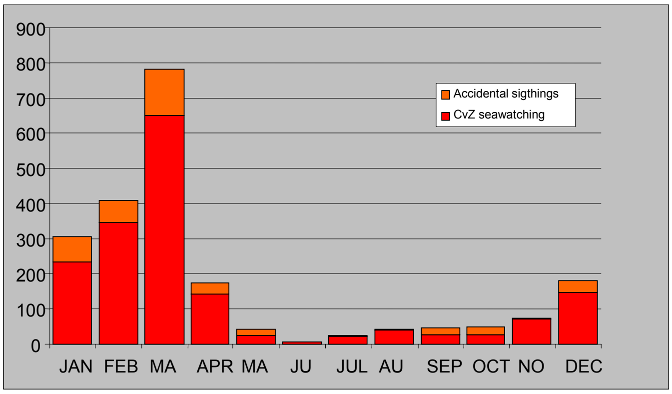


Figure 3: Seasonal pattern of harbour porpoises reported from Dutch coastal sites since 1970 (Marine Mammal Database, updated 03.01.2004, source: http://home.planet.nl/~camphuys/Bruinvis.html)

During the second quarter of the year, coinciding with the calving season in early summer, the North Sea harbour porpoises are primarily found in the northern part of the German North Sea, close to the Danish border (Scheidat *et al*., 2004).

During the third quarter of the year, the summer months covered during the SCANS survey, porpoises were distributed throughout the North Sea. However, highest densities occurred along both the West and the East coast of the Schleswig-Holstein – Jutland peninsula (SCANS block Y, L, I; Figure 2) as well as in the region around the Shetland Islands (J). Bjørge & Øien (1995) observed relatively dense aggregations of porpoises in the Northern North Sea, north of 56°N, especially in July. In the southern most part of the North Sea and the eastern part of the English Channel, porpoises were either absent or very rare during these months (Hammond *et al*., 1995, Reid *et al*., 2003).

The animals apparently re-aggregate into the three potential groupings in the north-western North Sea, the waters off Denmark and the Dutch coast during the last quarter of the year.

2.2.2. Population decline and comeback?

Nothing is known about the development of harbour porpoise sub-populations over time. Reports of changes in distribution and relative abundance of porpoises in certain areas based on time series analysis of stranding records and incidental sightings provided some evidence that harbour porpoise occurrence have changed in some areas, such as the southern North Sea and the English Channel (Van Deinse, 1952 cited in Champhuysen & Leopold, 1993; Verwey, 1975; Duguy, 1977; Smeenk, 1987; Champhuysen, 1994; Collet, 1995; Reijnders *et al*., 1996). Verwey made regular observations of harbour porpoise in the Marsdiep, the inlet of the Dutch Wadden Sea between the mainland and the island of Texel, during the period 1931 – 1973. In 1951, Verwey wrote to Van Deinse that in his opinion the numbers of harbour porpoise in the Marsdiep and western Wadden Sea had declined during or just after World War II (Smeenk, 1987). The analysis of strandings data revealed a general decline in numbers since the 1960s or even before (Figure 4).

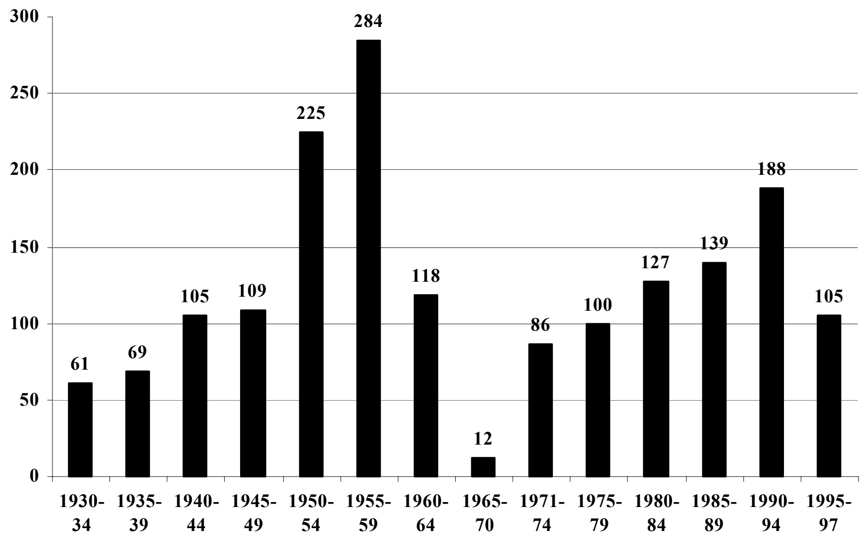


Figure 4: Strandings of harbour porpoise *Phocoena phocoena* on the Dutch coast during 1930-1997 (sources: Smeenk, 1986; 1989; 1992; 1995; 2003)

Other observers in The Netherlands, Germany and Denmark expressed similar assumptions, though no quantitative data were available (Verwey, 1975). Evans (1980) presented some preliminary evidence of a decline in the southern North Sea and English Channel, and has since then verified this by analyses of longer-term data from these regions (Evans *et al*., 1986; Evans 1987). According to Duguy (1977), the harbour porpoise was once common along the French coast, but numbers observed on an ad hoc basis declined.

The causes for changes are not immediately clear. The avoidance of Dutch coastal waters might have been food related, since the late 1950s/early 1960s saw a strong decline in the stocks of several fish species which porpoises are known to feed on, especially herring. According to Reijnders (1992), the major causes for decrease were changes in prey availability and bycatch. Prey limitation, caused initially by overfishing, followed by a shift in spawning and feeding areas towards the North, caused porpoises to move away from the coastal areas. Reproduction and health might have been negatively affected by pollutants, too. Smeenk (1987) attributed the initial cause of the decline of harbour porpoise in Dutch waters to pollution of the southern North

Sea, particularly its coastal areas, with organochlorines such as DDT (Dichlorodiphenyl trichloroethane) and its derivates, and especially PCBs (Polychlorinated biphenyls). Porpoise numbers off the Dutch coast dropped sharply in the early sixties which is the period when the disastrous effects of these compounds became evident, in terrestrial as well as in marine ecosystems. Concentrations of pollutants on the Dutch side of the North Sea could have accounted for the fact that the decrease in porpoise numbers near the Dutch coast was noticed some years earlier than off England (Smeenk, 1987). Finally, bycatch of harbour porpoise might have aggravated the decline of a population already under pressure (Addink & Smeenk, 1999).

The latest compilation of data demonstrates that there has been an increase in sightings of harbour porpoises off the Dutch coast that started in the mid 1990s (Figure 5). Similarly, strandings along the Dutch, Belgian and French coast have increased indicating a possible come-back of the harbour porpoise in these waters (Camphuysen, 1994; Haelters *et al*., 2002, Jauniaux, *et al*., 2002; Brasseur *et al*., 2004; Kiszka *et al*., 2004, Camphuysen, 2004; Reijnders, 2005). This increase might be the result of a distribution shift rather than a recent rise in the local sub-population, because the ratio of juveniles to adults was not modified (Jauniaux *et al*., 2002). As reported by Reijnders (1992) and Addink & Smeenk (1999), changes in the abundance of odontocetes in certain regions may be related to the abundance of prey. The porpoise may have come back to Dutch waters because of altered food conditions, either because more food became available, or because food resources elsewhere had deteriorated (Camphuysen & Leopold, 1993).

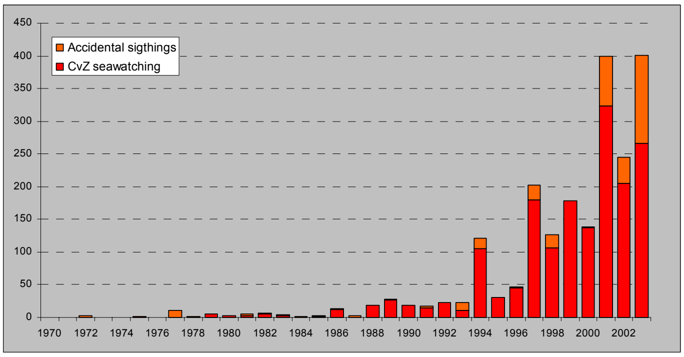


Figure 5: Number of harbour porpoises reported from Dutch coastal sites since 1970 (Marine Mammal Database, updated 03.01.2004, source: http://home.planet.nl/~camphuys/Bruinvis.html).

3. Risks for the harbour porpoise

This section reviews the current status of knowledge on three types of risks to harbour porpoise in the North Sea: incidental entanglement in fishing gear (bycatch), environmental changes, pollutants (organochlorines, hydrocarbons, perfluorooctane, trace metals), noise, disease, effects of fishing and climate change.

The greatest widespread risks for harbour porpoises in the North Sea are considered to be bycatch in fisheries, pollution and shipping noise. Depletion of prey fish and other anthropogenic disturbances are additional impact factors, but for which the evidence is less conclusive.

3.1. Incidental entanglement in fishing gear

Early records of incidental takes of harbour porpoise in the North Sea date back to the 19th century (Lockyer & Kinze, 2003). More recently, almost all countries bordering the North Sea and adjacent waters have reported bycatch in their fisheries (e.g. Donovan & Bjørge, 1995; Tregenza *et al*., 1997; ASCOBANS, 1997b, 2004a). Bycatch levels differ in different fisheries, but total mortalities are considered to be unacceptably high in a number of cases (Kraus *et al*., 1995; Tregenza *et al*., 1997; Northridge & Hammond, 1999; Vinther, 1999). Even the lower levels of bycatch occurring in other fisheries, need to be considered in the context of total mortalities caused by all fisheries operating in the area, as well as other anthropogenic factors impacting on the affected population.

Highest mortalities of harbour porpoise in fishing nets have been observed in association with bottom-set nets developed for demersal species such as cod, turbot, lumpfish, plaice, sole and ray species (Table 2) (e.g. Clausen & Andersen, 1988; Kinze, 1994; Tregenza *et al*., 1997; Northridge & Hammond, 1999; Vinther, 1999). This is probably due to harbour porpoise feeding behaviour on or near the seabed (Ross & Isaac, 2004). Gear deployed in these fisheries include trammel nets, tangle nets and gillnets set at different heights and using different mesh sizes. Bycatch rates vary depending on gear type and deployment mode (Perrin *et al*., 1994; ASCOBANS 1997). Gear other than set nets appear to be less harmful for harbour porpoise. However, few other fisheries have been monitored (IWC, 1996). Bycatch of porpoises in trawl fisheries has been recorded, but in small numbers (Clausen & Andersen, 1988; Northridge & Lankester, 1990; Kinze, 1994, Flores & Kock, 2003; Skóra & Kuklik, 2003; Lynneryd *et al*.,

Table 2: Summary of bycatch information and data. Figures in square brackets are 95% confidence intervals.

Greater Region	ICES area	Country	Main gear type	Target species	Size of fisheries	Estimation method	Year	Total reported bycatch	Estimated annual bycatch	Seasonal peaks	Source
Kat./IDW/German Baltic	IIIa	Sweden	bottom trawls			fishermen interviews	2001	-	80	-	ASCOBANS 2004a
			pelagic trawls	herring				1	11		Lunneryd *et al*., 2004
			trammel nets	lumpfish				1	8		
			gillnets	sole, cod, crab				6	70		
Skagerrak	IIIa	Sweden	gillnets, trammel nets, pelagic trawls	cod		fishermen interviews	2001	-	20	-	ASCOBANS, 2004a
			bottom trawls					2	25	-	Lunneryd *et al*., 2004
Northern North Sea	IV	UK	set nets	cod, skate, turbot, sole, monkfish, dogfish			1995 - 2002	-	439 [371 – 640]	-	ASCOBANS, 2004a
Central & Southern North Sea	IV	Denmark	wreck nets, gillnets	cod, hake, turbot, plaice, sole	very large	observer program	1987 - 2002	-	5,817/5,591*	-	Vinther & Larsen, 2002
	IV b	Germany	gillnets	cod, turbot, sole, other demersal fish	small	observer program	2002 - 2003	-	25-30	-	Flores & Kock, 2003
	IVc	Belgium	gillnets			strandings	2004	7	-	-	ASCOBANS, 2004a; Haelters & Kerckhof, 2004; 2005
			unknown					3-10	-	-	
	IVc	Netherlands	gillnets	unknown	unknown	strandings	2003 & 2004	-	100	-	Reijnders, 2005; García Hartman *et al*., 2004
Celtic Shelf (incl. Channel)	VII e	UK	gillnets	hake	medium	Observer program	August 1992 – March 1994	28	740 [383 – 1097]	March - May	Tregenza *et al*., 1997
			tangle nets					1			
			wreck nets					0			
	VII g, h, j, k	Ireland	gillnets, wreck and tangle nets	hake and other white fish				14	1497 [566 – 2428]		

* Extrapolated from bycatch rates determined from observers 1987 – 2001. First estimate is based on fleet effort, second is based on landings as used by Vinther (1999). Bycatch is probably overestimated due to use of pingers in cod wreck fishery not being accounted for.

2004). The few studies conducted in trawl fisheries in Danish waters suggest that the catch in trawls may represent 2 – 19% of the total bycatch (Clausen & Kinze, 1993, as cited in Lowry & Teilmann, 1994). In order to understand the scale of these risks, it is necessary to establish independent scientific observer schemes. Many, but not all, fisheries in the North Sea have been observed for bycatch. The lack of comprehensive observer schemes in the North Sea, partly addressed by the implementation of Council Regulation (EC) No 812/2004, has prevented the full quantification of bycatch. The first results of observation made under EC 812/2004 have to be submitted to the European Commission by June 2006.

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3.1.1. Northern North Sea

United Kingdom

Observation of bycatch has been conducted in UK North Sea set-net fisheries for cod, sole, skate and turbot producing estimated catches for the period 1995-1999 (CEC 2002). On the basis of these findings and changes in fishing effort, further updated figures have been produced. The estimated total catch in set nets in 2002 was 439 porpoises (ASCOBANS, 2004 a).

Norway

Studies on the amount of bycatch are under way in Norway. Results, however are not yet available.

3.1.2. Central and southern North Sea

Bottom-set gillnets are used extensively in the central and southern North Sea. A variety of national observer schemes have shown substantial bycatch of harbour porpoises in this area. The total known bycatch in this area has exceeded the level of unacceptable total anthropogenic removal of 1.7 % defined by ASCOBANS (2000). This has led to the adoption by the EU of a Regulation laying down measures concerning incidental catches (EC 812/2004) to alleviate the problem.

Denmark

Updated estimates of the bycatch of porpoise in the Danish North Sea bottom-set gillnet fisheries for turbot, cod, hake and plaice were provided by Vinther & Larsen (2002). The new estimate uses an extrapolation method where changes in fleet effort or landings respectively have been taken into account. The first method estimated a mean annual bycatch of 5,817 porpoises, the second method one of 5,591 porpoises These estimates, however, do not take account of the mandatory use of pingers in the cod wreck net fishery during the third quarter of the year since 2000 and are therefore likely to be overestimates (It was estimated that the third quarter cod wreck net fishery would have been responsible for 570 porpoise entanglements in 2000 and 405 in 2001).

Netherlands

ICES (2002) noted that some information on harbour porpoise bycatch in Dutch coastal waters exists from stranding schemes rather than observer schemes. During 1997 and 1998, amongst the 50 dead porpoises annually recovered on average through a stranding network, around 50% were diagnosed as being bycaught. In 2003 and 2004, of the annually recovered porpoises at least 100 were diagnosed as bycatch victims (Reijnders, 2005).

Belgium

In 2004, 7 harbour porpoises were incidentally killed in gillnets and 3 – 10 in unknown gear (information from the 2004 Belgian report to ASCOBANS; Haelters & Kerckhof, 2004; 2005). This information arises predominantly from stranding schemes rather than observer schemes.

Germany

An observer program on board German gillnet vessels fishing for cod, turbot, sole and other demersal fish in 2002 – 2003 yielded an estimated harbour porpoise bycatch of 25 – 30 animals annually (Flores & Kock, 2003).

Sweden

A telephone inquiry was carried out in 2002 concerning by-catches of seals, harbour porpoises and birds in the Swedish fishing industry. The sample corresponded to 16.6% of all Swedish fishing vessels in service during 2001 and yielded 10 bycaught harbour porpoises in the Kattegat and Skagerrak. This gave an extrapolation of 114 bycaught specimens (84 - 148, 95 % c.f.). Bycatches were reported in both trawl and gillnets (Lunneryd *et al*., 2004).

An alternative to observer programs or direct interview studies with fishermen is a detailed logbook system. In 1997 such a system was launched by the Swedish Fisheries Board. Fishermen were contracted to keep a detailed daily log of fish catches, seal disturbance (damage to gear, to fish and catch losses) and by-caught seals, harbour porpoises and birds. In total, nearly 38,000 fishing records have been collected to date from a participating group of over 100 fishermen. The fishermen are compensated for their trouble with a small payment. To ensure that the information is properly recorded, all fishermen are contacted personally on a regular basis, and their entries are checked during site visits and by statistical means. In 2004 no harbour porpoises were reported by-caught. The fishing effort represented by the participants in the logbook scheme is approximately 5 % of the total fishing effort in the Swedish coastal fisheries. (Lunneryd *et al*., 2005).

3.1.3. Celtic Shelf

Tregenza *et al*. (1997) estimated an annual bycatch of 740 harbour porpoises in the UK hake gillnet fishery and of 1500 harbour porpoises in the Irish hake fishery in the Celtic Sea giving a combined annual total catch of over 2200 porpoises in the two fleets. It should be noted that French and Spanish fleets also operate bottom-set net fisheries in this area that have not been subject to observer monitoring.

3.1.4. Fisheries of most concern

In autumn 2001, ICES responded to a request from the European Commission to provide advice on other marine organisms than those targeted by commercial fisheries. The EC requested advice on possible remedial action related to (1) fisheries with a significant impact on cetaceans, (2) other mortality sources for cetaceans, and (3) the risks created by fisheries on identified populations (ICES, 2001). ICES identified the fisheries using the following four criteria:

1. Bycatch rates possibly exceed rates considered to be sustainable for the species or population,
2. Populations are severely depressed relative to historic size and bycatch mortality may be a deterrent to recovery,
3. Populations are intrinsically small, and even low numbers of kills represent an important source of mortality to the populations,
4. Experience drawn from similar fisheries and species in other areas should be the basis of management action until fishery-specific data are sufficient to support management actions.

The fisheries identified by ICES to be of most concern for harbour porpoise bycatch are listed in table 3. No other fishery was felt likely to be a great threat on its own.

Table 3: Fisheries in the North Sea that are most concerning for harbour porpoise bycatch levels. Adapted to the cases of harbour porpoise from ICES (2001). See text for the description of concern criteria.

Gear type	Location	Country and fishery	Concern criteria
Gillnets (incl. tangle nets)	Central/Southern North Sea, including coastal waters	Denmark, cod, hake and flatfish	1
		UK, cod and flatfish	1
	Channel and Southern Bight of North Sea	UK, France, Belgium, Netherlands, Denmark	2, 4
	Kattegat, Skagerrak, [1]	Denmark, cod and flatfish	2,4
		Sweden, cod, flatfish and herring	1

[1] Relevant for this recovery plan is the Skagerrak.

3.2. Environmental changes

3.2.1. Pollutants

3.2.1.1. Persistent organic contaminants

Pollutants in the marine environment are various. One report estimated 2,400 lipophilic and persistent organic pollutants (POPs) in global waters, with 390 of them known toxins with potential for bioaccumulation (O'Shea *et al*., 1998). These pollutants include organochlorines such as DDT (dichlorodiphenyl trichloroethane) and PCBs (polychlorinated biphenyls) and other groups of compounds, for example oil and oil-derived polyaromatic hydrocarbons (PAHs), perfluorochemicals (PFCs), flame retardants such as polybrominated diphenylethers (PBDEs) and anti-fouling agents such as tributyltin (TBT) (Table 4). Harbour porpoises, being top predators and having a low metabolic capacity for degradation, accumulate high concentrations of lipophilic and persistent organic compounds through their diet (Law *et al*., 1998). They have a limited capacity to metabolise PCBs compared to terrestrial mammals and seals (Tanabe *et al*., 1988).

Levels of contaminants in body tissues depend largely upon the nutritional status, sex, age and geographic location of the harbour porpoise in question (Reijnders, 1996; Reijnders *et al*., 1999; Siebert *et al*., 1999; Bennet *et al*., 2001, Das *et al*., 2003; 2004). Females transfer a large part of their contaminant load to the newborn via gestation and lactation (Clausen & Andersen, 1988; O'Shea, 1999; Grillo *et al*., 2001 and references therein). This places a particularly large burden on new born calves.

A clear cause and effect relationship between residue levels of organic contaminants and the observed effects has been demonstrated in a few studies only (e.g. Reijnders, 1986). The supposed effects of high PCBs and other contaminant loads (e.g. TBT) include immuno-suppression, a higher susceptibility to infectious diseases and physiological changes that lower

Table 4: Examples of anthropogenic marine pollutants and their properties discussed in this section.

Pollutant	Abbreviation	Usage/Occurrence	Properties	Threat
Dichlorodiphenyl trichloroethane	DDT	Formerly used as a pesticide	Very persistent in the environment, bioaccumulates	Neurotoxin, influences the hormonal balance
Polychlorinated biphenyls	PCBs	Formerly used in coolants & lubricants in transformers, capacitors, & other electrical equipment	Highly lipophilic, bioaccumulate	immuno-suppression, a higher susceptibility to infectious diseases, physiological changes that lower the reproductive potential through hormone imbalance
Polyaromatic hydrocarbons	PAHs	formed during the incomplete burning of coal, oil, gas, garbage or other organic substances like tobacco or charbroiled meat	Lipophilic, readily bioaccumulate	carcinogen
Perfluoro-chemicals	PFCs	Repel oil and water; resist heat and chemicals	Highly lipophilic, environmentally stable, readily bioaccumulate	Damage the immune system
Polybrominated diphenylethers	PBDEs	Flame retardants; added to textiles and others	Highly lipophilic, environmentally stable, readily bioaccumulate	What little is known about their toxicology resembles that of PCBs
Tributyltin	TBT	Antifouling paint	bioaccumulates	Adversely affects endocrine & immune systems, neurotoxin

the reproductive potential of marine mammals through hormone imbalance (Hughes, 1998, O'Shea, 1999, Irwin, 2005). Jepson *et al*. (1999, 2005) found a significant relationship between elevated blubber PCB concentrations and mortality due to infectious disease in harbour porpoises. This suggests a possible relationship between chronic PCB exposure and mortality due to infectious diseases.

Gubbay and Earll (2000) reviewed the effects of oil spills on cetaceans and highlighted the fact that there are limited scientific data and considerable uncertainty surrounding this subject. Ingestion of oil may occur when cetaceans are in direct contact with a spill. In mammals generally, ingestion of oil can cause a number of effects including irritation of the gastrointestinal tract (Zieserl, 1979) and liver damage. High doses can adversely effect the nervous system (Caldwell & Caldwell, 1982 as cited in Hughes, 1998). Ingestion through their prey is also possible, since hydrocarbons persist in the food chain, particularly in species lacking the appropriate detoxification mechanisms.

Oil may also limit prey resources as exposures to PAHs are known to affect egg production of fish. PAHs have the potential to affect the numerous organisms at early life stages that reside in the surface micro layer of the oceans, where PAHs can become concentrated (WWF, 1997). The lipophilic nature of PAHs enables them to cross biological membranes and accumulate in organisms, causing considerable damage (Marsili *et al*., 2001).

Studies on the effects of PFCs on marine mammals are nonexistent, though PFCs have been detected in various animals, including cetaceans from the Mediterranean and Baltic (Kannan, *et al*., 2002). Laboratory studies with perfluorooctanoic acid (PFOA) involving rats showed low birth weight, small pituitary gland, altered maternal care behaviour, high pup mortality, and significant changes in the brain, liver, spleen, thymus, adrenal gland, kidney, prostate, testes and epididymides (Thayer *et al*., 2003). All studies to date indicate that perfluorinated compounds damage the immune system.

3.2.1.2. Heavy metals

Heavy metals are usually divided into essential (e.g. zinc, copper, chromium, selenium, nickel, aluminium) and non-essential metals (e.g. mercury, cadmium, lead), the latter being potentially toxic even at low concentrations. Heavy metals reach the North Sea via both airborne and waterborne inputs. Inputs are also generated by some sea-based activities, such as exploitation of offshore resources and dumping of dredged materials (OSPAR, 2000a). Typical atmospheric deposition levels at around 500 km from the coasts are an order of magnitude lower than deposition into coastal waters close to industrialised areas. Once in the system, the metals concentrate in protein rich tissues such as liver and muscle (Grillo *et al*. 2001).

Very few studies have tried to link metal concentrations measured in free ranging marine mammals and health status (Hÿvarinen & Sipilä, 1984; Siebert *et al*., 1999; Bennet *et al*., 2001). High heavy metal burdens in cetaceans have been associated with a variety of adverse responses including lymphocytic infiltration, lesions and fatty degeneration and decreasing nutritional state and lung pathology (Grillo *et al*., 2001, Siebert *et al*., 1999; Bennet *et al*., 2001; Das *et al*., 2004, Sabin *et al*., 2004).

Specifically in harbour porpoises, Siebert *et al*. (1999) examined the possible relationship between mercury (Hg) tissue concentrations and disease in harbour porpoises from the German waters of the North and Baltic Seas. A higher mercury content has been measured in organs of harbour porpoises from the North Sea than in those of the Baltic Sea, indicating that mercury is a more important threat for animals of the North Sea than for animals from the Baltic Sea. High Hg concentrations were associated with prevalence of parasitic infection and pneumonia. Bennet *et al*. (2001) have also used this indirect approach to investigate the prediction that increased exposure to toxic metals results in lowered resistance to infectious disease in harbour porpoises from the coasts of England and Wales. Mean liver concentrations of Hg, selenium (Se), Hg:Se ratio, and zinc (Zn) were significantly higher in porpoises that died of infectious diseases (parasitic, bacterial, fungal and viral pathogens such as pneumonia), compared to porpoises that died from physical trauma (most frequently entrapment in fishing gear). Liver concentrations of lead (Pb), cadmium (Cd), copper (Cu), and chromium (Cr) did not differ between the two groups. Similarly, high Zn and Hg concentrations were also observed in some porpoises collected along the southern North Sea coast compared to individuals bycaught in Iceland, Norway or the Baltic Sea (Das *et al*., 2004). Increasing Zn levels were observed with degrading body condition (emaciation and bronchopneumonia), while Hg increase was not significant. These increasing concentrations were not related to a shrinking of liver mass, remaining unchanged during the emaciation (Das *et al*., 2004).

3.2.2. Noise

Ambient noise is generally unwanted environmental background noise which clutters and masks other sounds (Knudsen *et al*., 1948; Richardson *et al*., 1995). The main causes of noise in the marine environment are (a) shipping and other man-made (anthropogenic) noise, (b) sea state noise (water motion), (c) seismic noise (from volcanic and tectonic activity), (d) marine life and (e) thermal noise (Knudsen *et al*., 1948; Richardson *et al*., 1995)

All different noises have characteristic signatures including frequencies and different ranges of sound pressure levels. Low frequency sound propagates better over long range, but requires a higher received level to be detected against the higher noise level compared to high-frequency sound (Au *et al*., 2000).

Odontocete cetaceans (including harbour porpoise) detect, localize and characterize underwater objects through the use of echolocation sounds (Au, 1993; Verboom & Kastelein, 1995). The underwater hearing of harbour porpoise has not been extensively studied. Available studies so far concluded that harbour porpoise have hearing capabilities from 0.25 to 180 kHz (9.5 octaves, Kastelein *et al*., 2002). Maximum sensitivity (about 33 dB re 1 µPa) apparently occurs between 100 and 140 kHz and most sensitive hearing (defined as 10 dB within maximum sensitivity) between 16 and 140 kHz (3.1 octaves), with a slightly reduced sensitivity around 64 kHz (Figure 6).

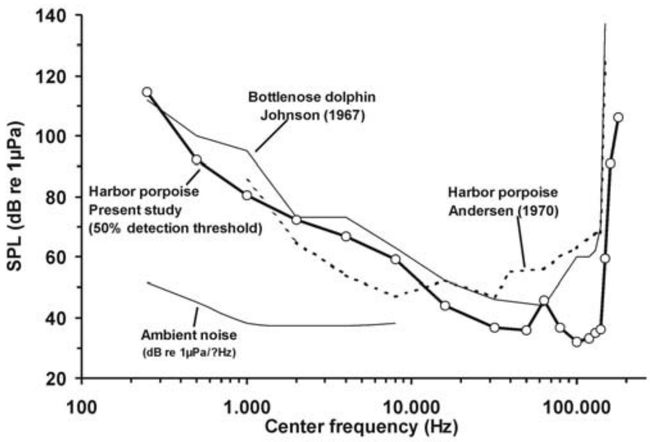

Figure 6: The mean 50% detection threshold of a harbour porpoise in dB re 1 µPa for narrow-band FM signals. Also shown is the audiogram determined by Andersen (1970) for one harbour porpoise (sample size per frequency threshold unknown, and definition of the threshold unknown), and the audiogram of an Atlantic bottlenose dolphin (Johnson, 1976). The spectral level of the ambient noise in the pool is shown up to 8 kHz (note that this is a different unit than the one along the y-axis) (from Kastelein *et al*., 2002).

When assessing the potential effects of man-made noise on marine mammals, it is important to estimate the radius within which acoustic effects are expected. Richardson *et al.* (1995) distinguish four criteria for defining the radius or zone of influence depending on the distance to the sound source (Figure 7):

- The *zone of audibility*: the animal might hear the sound, but there is no reaction
- The *zone of responsiveness*: the animal reacts behaviourally or physiologically. Behavioural reactions might be: increased alertness, panic, disruption of certain behaviours such as hunting, resting, migrating, social interactions, avoidance reactions, and possibly short- or long term displacement from an area.
- The *zone of masking*: the noise is strong enough to interfere with detection of other sounds, such as communication or echolocation calls, prey sounds, or other natural environmental sounds. This zone is highly variable in size.
- The *zone of hearing loss, discomfort, or injury*: the received sound level near the noise source is high enough to cause discomfort or tissue damage to auditory or other systems. It is distinguished between temporary threshold shift (TTS) and permanent threshold shift (PTS). Generally it is assumed that repeated or continuous TTS leads to PTS (Richardson *et al.*, 1995).

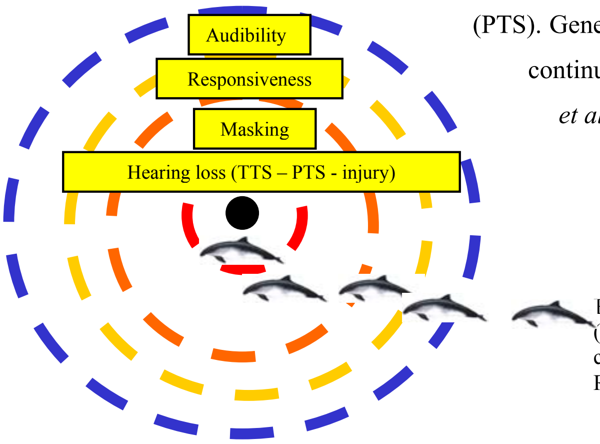

Figure 7: Zones of noise influence (Frank Thomsen, personal communication, adapted from Richardson *et al.*, 1995).

The North Sea is relatively shallow, so the dispersion of sound can roughly be described by cylindrical spreading equations, and sound energy will decrease linearly with distance from the source. Most problems are likely to relate to masking effects which interfere with the harbour porpoise's ability to respond to naturally generated sound, rather than actual hearing loss which will only occur within a few hundred metres of a particularly loud sound source.

3.2.2.1. Shipping

The North Sea contains some of the busiest shipping routes in the world. Daily, more than 400 ships pass through and 600 ships cross (including 200 ferries) the Strait of Dover (OSPAR, 2000a). Approximately half the shipping activity in the Greater North Sea consists of ferries and roll-on/roll-off vessels on fixed routes (OSPAR, 2000a).

Noise from ships dominates marine waters and emanates from the ships' propellers, machinery, the hull's passage through the water and the increasing use of sonar and depth sounders (Perry, 1998). In general, older and larger vessels produce more noise than newer or smaller ones (Gordon & Moscrop, 1996). Most shipping noise occurs in the low frequency range (< 1 kHz), but small leisure crafts generate sound from 1 kHz up to 50 kHz (Evans, 1996).

Polacheck & Thorpe (1990) found that harbour porpoise exhibited an avoidance reaction to survey vessels. Evans *et al*. (1992) observed that harbour porpoise in South East Shetland avoided vessels of all sizes, sometimes even moving out of the area completely. They were more likely to avoid infrequent vessels than routine vessels such as regular ferry services. Scheidat & Palka (1996) also gathered results that indicated a change in behaviour and swimming directions in some animals in response to a survey vessel. Herr *et al.* (2005) revealed a negative correlation between harbour porpoise densities and shipping densities in the German Bight, hinting on porpoises avoiding areas with dense sea traffic.

By contrast, harbour porpoises have been seen to approach catamarans, sailing boats and surfers and to accompany them for a while (Prochnow & Kock, 2000 and references therein). Disturbance from such silent activities thus appears to be unlikely.

In recreational areas where there are concentrations of power boats and jet skis, the increased noise level as well as the speed of these vessels might pose a risk and a considerable source of disturbance to the porpoise. Observations during the Surf World Cup off the Island of Sylt in 1995, when jet skis were frequently in use, revealed that these craft had the effect of scaring the harbour porpoise away. They completely disappeared from the area during the competition, but returned again once the event had finished (Prochnow & Kock, 2000).

The use of high-speed ferries appears to be a growing industry which has potential to impact upon harbour porpoise (ASCOBANS, 2004b), but research on this topic is still lacking.

3.2.2.2. Oil and gas explorations

The major oil developments have taken place especially in the northern parts of the North Sea in the exclusive economic zones (EEZ) of the United Kingdom and Norway. Gas deposits are exploited mainly in the shallower southern regions in the EEZs of the United Kingdom, The Netherlands, and Denmark as well as in Norwegian waters. There are also several gas and oil production platforms in the Wadden Sea (OSPAR, 2000a).

Noise is generated during all phases of oil and gas exploration. Noise sources may be continuous or impulsive and can be described as being transient or permanent (Table 5). Seismic surveys (exploration), pile driving, pipe laying (installation), drilling and platform operations (production) as well as explosive wellhead decommissioning are all activities generating loud noise and potentially posing a risk on harbour porpoise.

Seismic surveys in the marine environment often operate over extensive areas for long periods of time searching for oil and gas reserves beneath the seabed. Air guns, cylinders of compressed air, produce an acoustic signal by rapidly releasing a volume of compressed air into the water column, forming a rapidly expanding and contracting bubble. Sound energy radiating outward from the gun array propagates predominantly downward through the seabed up to 4 km into the earth's crust and reflects from discontinuities in the underlying rock strata indicating the presence of oil or gas sources (Goold & Fish, 1998; Parsons *et al*., 2003).

Table 5: Summary of noise sources and activities associated with oil and gas exploration and production (adopted from Parsons *et al*., 2003; C = continuous, d = days, I = impulsive, m = months, P = permanent, T = transient, w = weeks, y = years).

	Activity	Source	Source type	Duration
Exploration	Seismic surveys	Air guns & Seismic vessels	I	T (w, m)
	Exploratory drilling	Machinery noise	C	T (w)
	Transport (equipment & personnel)	Helicopters & Support vessels	C	T (d, w)
Installation	Pile driving	Pile driver & Support vessel	I	T (w, m)
	Pipe-laying	Pipe laying vessel & support	C	T (w)
	Trenching	Trenching vessel & support	C	T (w)
	Transport (equipment & personnel)	Helicopters & ships	C	T (w)
Production	Drilling	Machinery noise	C	P (y)
	Power generation	Gas turbines	C	P (y)
	Pumping	Gnereators	C	P (y)
	Transport (equipment & personnel)	Pumps, separators	C	
		Helicopters & support vessels	C	T (d, w)
Decommissioning	Destruction of pipes	Explosives	I	T (d, w)
	Transport (equipment & personnel)	Machinery noise	C	T (d, w)
		Helicopters & support vessels	C	T (d, w)

The output of air gun arrays is usually designed to produce a concentration of low-frequency energy, but the impulsive nature of the bubble collapse inevitably results in a broadband sound characteristic. In general, source levels at the low-frequency end of the spectrum are high, between 220 – 255 dB re 1 μPa @ 1 m (Richardson *et al*., 1995; Parsons *et al*., 2003). Although the direction of greatest sound intensity is downwards, a considerable amount of energy is radiated in directions away from the beam axis (McCauley, 1994 as cited in Parsons *et al*., 2003, Goold & Fish, 1998). This refers especially to higher frequencies.

The extent to which seismic disturbance affects small cetaceans is not known for certain, since only a limited amount of research has been done. Most published research relates to the effects on large whales, and the high-frequency energy in the seismic pulse spectrum (>1 kHz) has generally been ignored in the literature (Goold & Fish, 1998).

Seismic airguns produce predominantly low frequency sounds, but it has been shown that high frequency noise is also produced. Goold & Fish (1998) found significant levels of energy across the recorded bandwidth up to 22 kHz. This high frequency sound, incidental to seismic operations, will overlap with the frequencies used by toothed whales, and could potentially cause disturbance to harbour porpoise. Observations made by Goold (1996) suggest an avoidance reaction of dolphins to air gun emissions. At 500 – 800 Hz, Richardson *et al.* (1995) expected components of the seismic sounds from a ship to exceed both the typical ambient noise levels and the absolute auditory threshold of harbour porpoises as far as 100 km away.

Harbour porpoise could also be affected indirectly as a result of the effects of seismic surveys on prey species. Loud noise over extended periods could cause temporary dispersion of aggregations of fish (e.g. Engås *et al*., 1996; McCauley *et al*., 2000; Engås & Løkkeborg, 2001) Engås *et al*. (1996) and Hassel *et al*. (2003, 2004) observed that seismic shooting could severely affect fish distribution, local abundance, and catch rates. Trawl catches of cod and haddock and longline catches of haddock declined on average by about 50% (by mass) after shooting started. In this context it might be important that herring, an important component of harbour porpoise diet in the North Sea, is known to have special auditory capabilities (e.g. Enger *et al*., 1993, Culik *et al*., 2001). Loud noise over extended periods could cause temporary dispersion of aggregations of fish, resulting in a loss to the harbour porpoise, and/or higher energy demands associated with foraging activities.

Offshore oil and gas production is usually carried out from bottom-standing metal platforms, from man-made islands/caissons or from drill ships/semi-submersibles. Their design and construction, and local oceanographic conditions will affect both the path of the sound in the water column and how much sound is transmitted. The larger the surface area in contact with the water, the more noise an object transmits. During construction, noise is more efficiently coupled to the water through steel or concrete hulls or caissons than it is through gravel or sand islands. The temperature, salinity and pressure will affect how efficiently sound is transmitted (Parsons *et al*., 2003).

Between 1990 – 92 and 1996 – 98, the number of platforms increased from 300 to 475, and oil production almost doubled (Table 6).

Only relatively few studies on the underwater noise around drilling platforms have been undertaken. In all studies low frequency noise (< 200 Hz) was transmitted most efficiently, while broadband noise sources decreased more rapidly to ambient levels than tonal noise sources (Richardson *et al*., 1995).

Table 6: Gas and oil production by countries bordering the North Sea in 1996 – 1998 (OSPAR, 2000a).

Country [1]	**Number of platforms in production**	**Gas production (10^9 m^3/y)**	**Oil production (10^6 t/y)**
Denmark (1996)	36	6	10
Germany (1996)	2	0.3	0.5
Netherlands (1996)	107	27.4	1.8
Norway (1998)	80	42	145
United Kingdom (1997)	250	92	128
TOTAL	475	167.7	285.3

[1] Belgium, France and Sweden do not have gas or oil production.

There are few data on the reaction of marine mammals to drilling noise and no clear evidence of avoidance by small odontocetes to drilling noise. No studies on harbour porpoises around oil platforms have been carried out, since they are very difficult to study from oil rigs, but bottlenose dolphins, Risso's dolphins and common dolphins were seen close to oil platforms in the North West Atlantic, and sightings rates were similar in areas with and without rigs (Sørensen *et al*, 1984).

Current UK regulations call for the complete removal of offshore oil and gas industry structures once production has finished, to leave a clear, unimpeded seabed (Nedwell *et al*., 2001). For this reason, when wellheads are decommissioned, the upper part of the wellhead is explosively cut and recovered to the surface.

The use of underwater explosives prompts concerns about the possible effects that detonations could have on the marine environment and on marine mammals. Clearly it would be preferable not to detonate explosives during periods when marine mammals are within ranges at which they might be injured by such explosions (either through the noise or the shock wave produced by the explosion), but data are still lacking.

3.2.2.3. Sand and gravel extraction

The marine aggregate extraction industry is well established and growing in a number of countries, providing up to 15% of some nation's demands for sand and gravel (ICES, 1992). By far the highest demand for marine sand and gravel in all OSPAR regions exists in the North Sea, where production increased from 34 million m^3 in 1989 to 40 million m^3 in 1996 (OSPAR, 2000a). Most commercially workable deposits of sand and gravel occur in the shallower regions of the southern North Sea. The majority of sand extraction in the North Sea occurs in The Netherlands (Table 7).

Information on potential effects of sand and gravel extraction on marine mammals are almost nonexistent. According to a study associated with locating a dredged material disposal site in Cape Cod Bay evidence available on suspended sediments indicated that elevated levels of suspended sediments would have no effect on whales (Battelle, 1987). This conclusion was based on the speculation that whales often live in turbid environments; and certain species are known to feed on organisms in or on the sediment.

Table 7: Quantities of sand and gravel (m^3) taken from marine sources in 1996 and average for 1992 – 1997. (from ICES, 1997; OSPAR, 1998 as shown in OSPAR, 2000a).

Country	1996	Average per year (1992 - 1997)
Belgium	1 444 629	1 833 333
Denmark	3 700 000	5 083 333
France *	590 000	2 200 000
Germany	1 100 000	
Netherlands	23 200 000	17 366 666
Norway **	86 111	118 333
Sweden #	0	5 917
United Kingdom **	9 500 000	13 600 000
TOTAL	39 620 740	

* Data from France. ** m^3 estimated from tonnes.
# Since 1992 no sand and gravel extraction occurs in the Swedish part of the Kattegat and Skagerrak area due to environmental reasons.

Secondary effects may be significantly more important than direct impacts. The dredgers emit broad-band noise of approximately 180 db (re 1 μPa @ 1m) with highest source levels between 20 and 1000 Hz (Richardson *et al*., 1995). Above 30 Hz, source levels are comparable to those of a large tanker (Richardson *et al*., 1995). While a tanker leaves an area quite quickly, the dredgers used for sand and gravel mining are more or less stationary. There are no data on the effects of noise emitted from dredgers on harbour porpoise.

In light of these findings from other cetaceans (e.g. Richardson *et al*., 1985; Bryant *et al*., 1984 cited in Richardson *et al*., 1995), it would be useful to assess the impact of dredging on harbour porpoise.

Impacts on main prey species of harbour porpoise may also be important. Primary effects of dredging will be e.g. on sand eels, as well as on their habitats. Sand eels can comprise up to 40% of the diet of harbour porpoise in the German Bight (Benke *et al*., 1998). Both zooplankton and phytoplankton can be affected by exposure to elevated suspended sediment. This may cause secondary effects on fish and their marine mammal predators. If fish actively avoid dredging plumes, harbour porpoise in the area may have to exert more effort in feeding or other

behavioural changes. The available information presently is inadequate to allow any conclusions to be drawn about this issue, beyond suggesting that a potential for adverse impacts exists.
Dredging also is believed to have a negative impact on the environment as the contaminants adsorbed on the particulate matter are discharged into the open water when the sediments are stirred up and carried on an underwater site for disposal (see also chapter 4.2.1.)

3.2.2.4. Wind parks

In order to fulfil the Kyoto Protocol of 1997 many countries have made commitments to expand their current renewable energy sectors. Wind farms offer many benefits over traditional energy sources and are expected to contribute more and more to a reduction in climate change in forthcoming years (Dolman *et al*., 2003). It is expected that within 10 years, wind parks with a capacity of thousands of megawatts will be installed in European waters.
The potentially adverse impacts of marine wind farms on marine wildlife have only recently been recognized. The environmental impact of marine wind farms can be separated into long or short-term influences: Construction and decommissioning phases have many short-term associated impacts, while the operational phase is likely to be a major source of long-term impacts (Dolman *et al*., 2003, Tougaard *et al*., 2003).

During the construction phase of the wind farm, increased ship traffic and turbidity due to construction and cable laying in the area is likely to have an effect on harbour porpoise to some degree. The most disturbing activity will be the ramming of monopiles into the seabed. This procedure might generate high intensity sounds of more than 250 dB re 1 µPa at a range of 1 m (Maxon, 2000), potentially able to cause permanent hearing damage to marine mammals and likely to affect animals over larger distances (Culik *et al*., 2001; Koschinski *et al.*, 2003, Dolman *et al*., 2003, Tougaard *et al*., 2003). The noise during pile driving has the potential to cause auditory damage. Temporary threshold shift (TTS) in harbour porpoise might potentially be generated within 0.5 km of the sound source (Thomsen, pers. comm.). During construction at different neighbouring or even widely spaced sites, an additive effect can be assumed (Koschinski *et al*., 2003). The temporary habitat loss can affect biological fitness of harbour porpoises if the remaining low-noise habitat is sub-optimal in terms of maintaining the population (Koschinski *et al*., 2003). Nedwell *et al.* (2004) calculated a range of 7,400 m for significant avoidance reactions of harbour porpoises from pile driving for windmill installations at North Hoyle/UK.

During the operational phase of the wind farm, the continual operational noise and vibrations from the wind turbines have potential to cause long term effects (Dolman *et al*., 2003). Operational farms produce broadband low frequency noise (< 1 kHz) above ambient noise levels but their noise is not higher than the ambient noise in the frequency range above approximately 1 kHz (Degn, 2002). Hoffmann *et al*. (2000) suggested that harbour porpoise will be displaced more permanently from a smaller area during the operational phase. Unless this area is considered to be a critical habitat, the overall effect is assumed to be insignificant. Henriksen *et al*. (2001), however, assumed that harbour porpoise can only hear the turbines in a small part of the wind farm area (up to a distance of 50 m from the wind farm, assuming cylindrical spreading) and will therefore not be affected by the noise. Sightings and acoustic records of harbour porpoise entering the marine wind farm area at Horns Reef, Denmark, illustrate that porpoise do enter this area, despite the presence of the marine wind farm (Teilmann *et al*., 2002). However, this does not demonstrate if and to what extent porpoises are being affected by the farm nor does it allow any assessment as to how significant any such impact might be. A porpoise might still enter an area that is important to it or cross an area to get to an important one if it has to do so, despite negative consequences and exposure to certain sound levels for a prolonged period that might adversely affect the porpoise. Information on noise emissions from 5 MW turbines and possible negative reactions of harbour porpoises are still lacking, because machines of this size do not yet exist. Furthermore, cumulative effects from several large wind farms in one region, above that adding to other detrimental anthropogenic impacts are completely unknown.

Even though offshore wind-farming is a young business, the possibility arises that turbines may have to be removed from a park or a whole wind park is to be decommissioned. So far, there are no data available on the effects of such an undertaking on cetaceans, but if conclusions from the decommissioning of oil platforms can be drawn, the use of underwater explosives appears to be most likely and prompts concerns about the possible effects such detonations might have on the marine environment and on the well-being of marine mammals.

3.2.2.5. Sonar from military operations and research/survey activities

There is a growing body of evidence pointing to military activities as a major source of underwater noise. In several studies concerns were expressed about the potential impacts of military activities upon cetaceans.

Active sonar is the use of acoustic energy for locating and surveying (ICES, 2005). Sonar can use all sound frequencies and can be conveniently categorised into low (< 1 kHz), mid (1 to 10 kHz) and high frequency (>10 kHz). Military sonars use all frequencies, while civilian sonar uses some mid but mostly high frequencies (ICES, 2005). Most boats and ships have simple depth-finding sonar (fathometers). Other available sonar is used to find fish, to measure currents, to survey fish and plankton, to analyse sediment layers (e.g. parametric echo-sounders), and to map the ocean floor such as side-scan and multibeam sonar (Richardson *et al*., 1995). Military vessels routinely use active sonar on exercises and during routine activities. Many military sonar is designed to search for, locate, and classify submarines, while others detect obstacles such as the seafloor, ice overhead and objects ahead. Sonar is attached to mines and torpedoes to find targets and can be fixed to the ocean floor, suspended or towed from vessels or helicopters or built into sonobuoys dropped and controlled from aircraft (Richardson *et al*., 1995).

Sonar systems used for scientific purposes usually emit short pulses of sound and are designed to focus as much energy as possible in narrow ranges of direction (Parsons *et al*., 2003). Low- and mid-frequency anti-submarine warfare sonar generally has a horizontal directionality covering up to 360°, and signals of much longer duration. Sonar frequencies range from a few hundred hertz for long-range search sonar to several hundred kilohertz for sonar used in mine-hunting, accurate mapping and profiling, and plankton surveys (Table 8).

Table 8: The acoustic properties of some active sonar systems (adapted from Richardson *et al*., 1995; Gill & Evans, 2002; Parsons *et al*., 2003; Zimmer, 2003; Evans & Miller, 2003).

Sonar type	**Frequency range (kHz)**	**Source levels (dB re 1 µPa/1m)**
Environmental Sonar		
Echo sounders	12-200	180-245
Bottom profilers	0.4-30	200-230
ADCP[a]	0.075-1.2	216
ATOC[b]	0.06-0.09	195
Short-range Imaging Sonar		
Side-scan	50-500	220-230
Multi-beam	15.5	237
Navigation (transponders)	7-60	180-200
Long-range detection sonar		
a) Tactical (Military) Search & surveillance	2-57	230+
Mine & obstacle avoidance	25-500	220+
Weapon-mounted	15-200	200+
b) LFAS	0.05-0.5	200+
Examples of long-range detection sonar:		
SURTASS LFA	0.1-0.5	240 (18*215)
SLC TVDS LF[c]	0.45-0.65, 0.7	214-228
SLC TVDS MF[c]	2.8-3.2, 3.3	223-226
AN/SQS-53C[d]	2.6, 3.3	223
AN/SQS-56[d]	6.9, 7.5, 8.2	245

[a] ADCP = Acoustic Doppler Current Profiler
[b] ATOC = Acoustic Thermometry of Ocean Climate
[c] Linked to mass stranding, Greece
[d] Linked to mass strandings in Bahamas & Canaries

The effects of sonar testing on cetaceans have best been observed in deep diving cetaceans such as sperm whales and beaked whales. Watkins *et al*. (1985 as cited in Perry 1998) noted that sperm whales reacted to military sonar at distances of 20 km or more from the source. Sonar at frequencies of 6 – 28 kHz caused cessation of calling and sometimes avoidance. Strandings of beaked whales in Greece in 1996, in the Bahamas in 2000, and on the coast of Fuerteventura and Lanzarote in the Canary Islands in 2002 (Anonymous, 2002, Jepson *et al*. 2003, Fernandez *et al*. 2004) were linked to mid-frequency sonar testings. Necropsies indicated ear and brain trauma. The whales suffered haemorrhaging in the inner ears and cranial air spaces consistent with impulsive trauma by intense, loud sound that did not come from a nearby explosion (Parsons *et al*., 2003 and references therein).

Whether or not harbour porpoises are affected by sonar is still unknown. The only incidence recorded were 14 stranded harbour porpoises during the period of May to June 2003 in Washington State, an abnormally high number when compared to the average stranding rate of 6 per year recorded over the past decade (Norman *et al*., 2004). The strandings coincided with use of mid-range sonar in Haro Strait between Vancouver Island (Canada) and San Juan Island (USA) in May 2003 and observations by researchers and the public who reported altered behaviour of marine mammals in the area. Eleven porpoises were collected for necropsy. The examinations did not reveal definitive signs of acoustic trauma in any of the porpoises examined. The possibility of acoustic trauma as a contributory factor in the mortality of any of the porpoises could not be ruled out, though, as lesions consistent with acoustic trauma can be difficult to interpret or obscured, especially in animals in advanced state of decomposition (Norman *et al*., 2004). Parsons *et al*. (2000) observed fewer harbour porpoises near exercise areas during military training exercises. This decrease in sightings was very defined when visualized in graphs and proved to be statistically significant in some cases.

3.2.3. Sewage discharge

Sewage effluent entering coastal waters can contain a variety of harmful substances including viral, bacterial and protozoan pathogens (Grillo *et al*., 2001). In many coastal countries, urban and industrial sewage and wastewaters are discharged into coastal waters, the contents of these wastewaters pose a potential threat to marine species inhabiting these waters and their associated ecosystems. Domestic sewage discharged into coastal waters contains a mix of both harmless and infectious micro-organisms (Rees, 1993).

There is limited information on the effects of sewage-borne pathogens on the marine ecosystem and the species therein, including the harbour porpoise. However, porpoises, being mammals, are

vulnerable to a number of diseases, parasites and pathogens which can be transmitted either via human or agricultural sewage waste or may occur naturally in the marine environment (Grillo *et al.*, 2001).
High levels of organochlorine contaminants or mercury in harbour porpoise populations may reduce their immune resistance and contribute to the severity of infections (Aguilar & Borrell, 1995, Ross *et al*., 1996, Jepson et al., 1999; Siebert et al., 1999; Van Bressem *et al*., 2001; Jauniaux *et al*., 2002). Van Bressem *et al*. (2001) presented data that suggest that the populations of harbour porpoises from the NE Atlantic and North Sea are losing their immunity to the dolphin morbillivirus (DMV, family Paramyxoviridae) and may soon be at risk from new virus introductions. The re-introduction of cetacean morbillivirus into these populations could cause epidemics which would further deplete their numbers. Van Bressem *et al*. (1999) suggested that the synergistic interactions between mortalities in fisheries and morbillivirus epizootics could significantly reduce the number of individuals of some populations and increase their risk of extinction.

3.2.3.1. Eutrophication and algal blooms

The increase of discharges from domestic, industrial and agriculture activities, the growth of industrial sectors such as basic chemistry and food processing industries, the application of increasing amounts of fertilizers on agricultural soils, the intensification of cattle farming and the use of polyphosphates in detergents have all contributed to increases in nutrient loads in coastal waters. The introduction of large quantities of nutrients can lead to increases in primary production and algal biomass. Degradation of this biomass requires large quantities of oxygen. This can be a major problem in areas with restricted water exchange capacity or stratified bodies of water. In these cases major algal blooms have led to serious damage to aquaculture through oxygen depletion and toxin formation.

Harbour porpoises may be affected through consumption of fish contaminated by toxic algal blooms. Though no evidence for this has been found in the North Sea to date, analyses conducted on dolphins stranded along the Florida panhandle in spring of 2004 suggested that brevetoxins could be harmful for marine mammals. Brevetoxins, naturally occurring neurotoxins produced by the alga *Karenia brevis*, were found at high levels in the stomach contents of all dolphins examined, and at variable levels in the tissues of these animals (NOAA, 2004). The concentrations of brevetoxins observed in the analysed sub-sample of the stomach contents were greater than or equal to those observed in previous marine mammal mortality events associated with Florida red tides in the Gulf of Mexico. Fish (planktivorous, herbivorous, and omnivorous fish species) collected from St. Joseph Bay tested positive for brevetoxins in stomach contents and in muscle, liver, and gill tissues. The presence of toxic fish and water suggested that there was an undetected bloom somewhere either in the bay itself or in waters in which the fish or dolphins were feeding. A similar unusual mortality event (UME) involving dolphins had occurred in 1999-2000 in the same area of Florida and was correlated with a *Karenia brevis* bloom.

Karenia brevis is an example of a toxic alga along the south-eastern Atlantic coast, mainly in the Gulf of Mexico, but harmful algal blooms have occurred on several occasions in the North Sea also. One of the best examples has been the *Chrysochromulina polylepis* bloom in the Skagerrak and the Kattegat in 1988 which caused extensive mortality of benthic and pelagic organisms in addition to farmed fish, due to the toxins produced by the *Chrysochromulina* algae (e.g. Gjøsæter *et al*., 2000). Noxious blooms of *Phaeocystis* and *Coscinodiscus* recurred on the south-eastern and eastern coasts of the North Sea (OSPAR, 2000a).

3.2.4. Effects of fisheries on the food resources or harbour porpoises

The North Sea is one of the most intensively fished areas of the world, but the complex nature of the marine environment means that intensive fishing activities do not always have predictable consequences (Northridge & Lankester, 1990). The effects of fisheries on prey resources or harbour porpoises may be direct or indirect, depending on whether the target species of the fishery is a prey item of the harbour porpoise, of the harbour porpoise's prey, or another competitor (Hammond *et al*., 1995). The greatest effect will occur when a fishery and the harbour porpoise compete for the same target species. Changes in the distribution and abundance of prey species of the harbour porpoise may cause physical effects on individuals and changes in distribution and abundance in harbour porpoise populations. Harbour porpoises live on patchy food resources and are generally considered opportunistic feeders. The term "opportunistic" might not be applicable however, because it means that a predator feeds on the most abundant prey available, and it is not known if this is indeed the case for harbour porpoises. Forcing the harbour porpoise to switch prey may imply forcing it into a sub-optimal niche or habitat which may have long-term adverse effects on survivorship and productivity (IWC, 1996). It has been suggested that due to its small body size, its energetically demanding reproductive schedule and its relatively cold water habitat that the harbour porpoise can never survive without food for more than a few days (Yashui & Gaskin, 1987).

Evans (1995) noted a marked decline in harbour porpoise numbers around the Shetland Islands during the 1980s, whilst major changes occurred in local fisheries. Reijnders (1992) associated the decline in numbers of harbour porpoises seen in coastal waters of the southern North Sea with the massive decline in herring numbers during the 1980s. The fact that herring numbers are recovering and that there has been an increase in sightings of harbour porpoises on the Belgian and Dutch coast (Reijnders, 1992; Camphuysen, 1994) may support this argument.

The bottom trawl fishery has an indirect effect on harbour porpoises. It removes benthic organisms and alters habitats (Bergman & Hup, 1992). These habitats are often nurseries for fish that when older are prey for harbour porpoises.

Knowledge on quantitative relationships between feeding ecology and critical levels of prey availability where animals need to choose between switching prey or leaving the area, is still lacking. In order to evaluate the direct and indirect impacts of fisheries on populations of harbour porpoises, efforts should be made to find out more about their foraging habits in relation to various types of fishing gear and the species of fish caught.

3.2.5. Recreation

Another issue of growing concern is the rapidly growing marine tourism industry. There have been concerns over the impact of tourism on cetaceans (e.g. Beach & Weinrich, 1989; Constantine, 2004). Different studies of the reactions of various mammals to human disturbance showed a significant reduction in resting behaviour (dolphins: Lusseau, 2003; Constantine *et al*., 2004; harp seals: Kovacs & Innes, 1990; Henry & Hammill, 2001; howler monkey: Grossberg *et al*., 2003; caribou: Duchesne *et al*., 2000; Amur tigers: Kerley *et al*., 2002). Resting is a fundamentally important behavioural state to the health of many species of animals (Constantine *et al*., 2004). The synchronization of behaviours such as resting and foraging are thought to be important for group cohesion, and that groups benefit through optimising care of offspring, anti-predator defence and increasing efficiency in exploiting food resources (Clark & Mangel, 1986). Chronic disturbance to populations of animals can cause behavioural changes, or even a population decline, that may persist several years after the disturbance has ceased. In some cases human disturbance may cause animals to abandon or not use ideal habitat thereby potentially increasing the risk of mortality to their offspring. Harbour porpoise, being very shy animals, are not (yet) exposed to tourism, but the fact that this industry is growing for other cetacean species (e.g. bottlenose dolphins) makes it necessary to assess short-term behavioural responses to boats and interpret the long-term consequences of these.

3.2.6. Effects of global warming and climate change

Climate change, resulting from increased concentrations of greenhouse gases in the atmosphere, is the most serious global problem. Global warming is expected to increase ocean temperatures by 1.4 °C to 5.8 °C by 2100, and to increase the flow of freshwater into the ocean through precipitation, run-off, and melting of glaciers. This warming, along with the associated changes in precipitation and sea-level rise will have important consequences for the environment (Pew Center on Global Climate Change, 2005).

As a result of increasing levels of carbon dioxide (CO_2) in the atmosphere, the acidity of seawater is decreasing: the pH has dropped from 8.2 to 8.1 over the past 200 years. Models forecast that it will drop to 7.8 by 2100, and may drop as low as 7.5 if the current level of input of carbon dioxide by man into the atmosphere is continued. Marine species that rely upon building up calcium-based structures will be adversely affected. This might have serious consequences on marine food webs in general (OSPAR, 2006).

Climate change will directly and indirectly affect harbour porpoise. The rise in temperature will affect their habitat, as the distribution and abundance of prey species in the oceans will change. Harbour porpoises live in a broad geographical range from warm temperate seas to the sub-arctic and might be not immediately vulnerable to slow changes in the ocean climate of the North Sea. However, as top predators, harbour porpoises are very vulnerable to changes in the lower trophic levels of marine productivity (Scheidat & Siebert, 2003). Should their prey be unable to adapt to such changes, harbour porpoise reproductive success and hence their abundance and population structure will be in jeopardy.

Another negative effect is the depletion of the ozone layer which protects the earth from ultraviolet (UV) radiation. Experiments have shown that UV-B radiation inhibits the photosynthesis of phytoplankton (e.g. Wangberg *et al*., 1999) and that krill dies within a week when exposed to very high doses of UV radiation (Newman *et al*., 1999). Effects on the lower trophic levels will most certainly have an effect on the higher levels. For cetaceans there may also be direct effects on their health in the form of skin cancer and eye problems (de Boer & Simmonds, 2003).

4. Towards a better protection of harbour porpoises

The following chapters recognize and discuss the efforts by ASCOBANS and other national and international bodies and fora already under consideration or in place to protect harbour porpoises. It is not the function of this Recovery Plan to duplicate the work of other international or national bodies, but to elaborate what efforts or data are still lacking and to help ASCOBANS to co-ordinate the efforts between North Sea states.

4.1. Reduction of harbour porpoise bycatch

There is a large number of international and regional treaties, conventions and agreements aiming to protect the marine environment in general, many of them covering fisheries or the exploitation of living resources, several making specific commitments or resolutions on the matter of incidental capture of cetaceans. The International Whaling Commission (IWC) recommended as early as 1975 that member nations begin to record the bycatch of small cetaceans in fisheries. The United Nations Convention on the Law of the Sea (UNCLOS) of 1982 requires contracting parties to make sure that species associated with or dependent on harvested species are not depleted to levels at which they would become seriously threatened. The Rio Earth Summit (1992), the UN Food and Agriculture Organisation Code of Conduct for Responsible Fishing (1994) and the Rome Consensus on World Fisheries (1995) all address the problem of indiscriminate fishing methods. The Convention on Migratory Species of Wild Animals (CMS) passed Resolution 6.2 in 1999 which recognises bycatch as one of the major causes of mortality of migratory species in the marine environment and requires Parties to the Convention to minimise as far as possible the incidental mortality of migratory species (CMS, 1999). In 2002, this resolution was reaffirmed when the CMS Parties emphasised that bycatch remains one of the major causes of mortality from human activities in the marine environment and recommended a rapid implementation of CMS Resolution 6.2 (CMS, 2002). In 2005, CMS passed resolution 8.14 recognizing that despite the progress made so far by Parties, bycatch remains a key factor that is threatening many species listed on Append I and Appendix II (includes the harbour porpoise) of the Convention, and that additional efforts are required to ensure that bycatch is reduced or controlled to levels which are not threatening the conservation status of these species.

The Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention[1]) of 1992 highlights the need for more research and information on the effects of fishing on non-target species such as marine mammals amongst other impacts, and for improvement in the monitoring and reporting of bycatch and discards (OSPAR, 2000b). In its implementation of the ecosystem approach 'ecological quality objectives' (EcoQOs) are being developed for the North Sea as a test case; one of these EcoQO's deals with harbour porpoise bycatch.

Article 2 of the Council Directive 92/43/EEC on the Conservation of Natural Habitats and Wild Fauna and Flora (Habitats Directive) of 1992 places a duty on Member States to ensure that any measures taken under the Directive are designed to "maintain or restore, at a favourable conservation status, natural habitats and species of wild fauna […] of community interest" (which include all cetaceans). Furthermore, article 12.4 requires Member States to establish a system to monitor the incidental capture and killing of Annex IV species, which includes (amongst others) the harbour porpoise. In light of the information gathered, Member States are required to take further research or conservation measures as required to ensure that incidental capture and killing does not have a significant negative impact on the species concerned.

ASCOBANS passed three resolutions on incidental take of small cetaceans in 1997 (Annex K), 2000 (Resolution No. 3) and 2003 (Resolution No. 6). Through the 2000 resolution, the Meeting of Parties defined unacceptable interactions as being, in the short term, a total anthropogenic removal above 1.7% of the best available estimate of abundance. It called on competent authorities to take precautionary measures to ensure that the total anthropogenic removal in the ASCOBANS area and adjacent waters was reduced as soon as possible to below this level. It also identified the intermediate precautionary objective to reduce bycatches to less than 1% of the best available population estimate. In the 2003 resolution,, the Meeting of the Parties regretted that the recommendations set out [at the Third MoP] to reduce bycatch to below 'unacceptable interaction' levels had probably not been fulfilled, and requested that Parties and Range States develop and implement national plans of action or similar measures to reduce the bycatch of small cetaceans.

Comment [W3]: I know this is mentioned in the Introduction – but I think it should be included in full here.

[1] The OSPAR Convention was opened for signature on 22 September 1992 and came into force on 25 March 1998. It replaced the former Oslo and Paris Conventions, but decisions, recommendations and all other agreements adopted under those conventions continue to apply, unless and until they are terminated by new measures adopted under the 1992 OSPAR Convention.

European Council Regulation No 812/2004 of April 2004 lays down measures concerning incidental catches of cetaceans in fisheries. The Regulation contains two main provisions with respect to the North Sea:

a) the use of acoustic deterrent devices (pingers) in gillnet and tangle net fisheries, and
b) onboard observer monitoring of bycatch.

These provisions only apply to certain fisheries and areas within EU waters as listed in the Annexes of the Regulation. Additionally, the Regulation makes provisions for reporting, assessing and reviewing its implementation (more detailed information on the Regulation is provided in the following chapters).

4.1.1. Pingers

Acoustic deterrents, or pingers, have been demonstrated to reduce harbour porpoise bycatch in gillnet fisheries. Currently two types of pingers exist:

- Permanently/continuously active pingers, and
- interactive pingers which only emit signals when triggered by a porpoise click (they are as yet only in the experimental phase and not commercially available).

Read (2000) has extensively reviewed the use of permanently/continuously active pingers in US fisheries and reported that bycatch rates for certain fisheries were reduced significantly (10-fold for harbour porpoise). Work carried out by the UK's Sea Mammal Research Unit (SMRU) on the set net fishery in the Celtic Sea, yielded a 92% reduction in bycatch of harbour porpoise in pingered nets compared to unpingered nets (SMRU, 2001).

Since August 2000, the use of pingers has been mandatory in the Danish cod wreck fishery between August and October. Here, the effect of pinger use is reported to be close to 100% reduction in bycatch (Larsen *et al*., 2002; Vinther & Larsen, 2002).

Despite the obvious effectiveness in reducing bycatch in set net fisheries, there are a number of operational drawbacks and concerns about the use of pingers. Operational drawbacks are

- pingers are expensive,
- they need a high level of maintenance,
- some types of pingers are prone to failure, and
- they may interfere with the setting and hauling of nets (reviewed by Read, 2000; Ross & Isaac, 2004).

Other shortcomings are:

- pingers may reduce the level of bycatch significantly but do not ensure zero bycatch,

- the effective monitoring and enforcement of pinger use may prove to be very difficult,
- porpoises might habituate to pingers – rendering the technology ineffective over time,
- the continuous and widespread use of pingers might displace harbour porpoise from some areas which are important foraging grounds for them (CEC, 2002a), and
- pingers emitting sound permanently would contribute to noise pollution in the ocean.

Several of these concerns have been addressed in recent studies:
Experimental studies in Canada have demonstrated that after a period of weeks of exposure to pingers, the animals began to surface closer to the acoustic devices (Cox *et al*., 2001). This did not mean that the pingers were necessarily ignored, but simply that the porpoises reacted less severely to their presence (Cox *et al*., 2001) thereby reducing the potential area of habitat loss. Lockyer *et al*. (2001) demonstrated on captive porpoises that once the source of sound emission was removed, the animals rapidly returned to the area from where they had been displaced.
More recent research has been directed towards interactive pingers, a deterrent device that only emits sound when triggered by the sonar clicks of an oncoming porpoise (Amundin *et al.*, 2002, Poulsen, 2004). This approach addresses the concerns of noise pollution and habituation with pingers transmitting sounds only when needed, thereby reducing potential habituation and habitat exclusion. Conversely, the device offers no protection to animals that are not echo-locating, indeed it could conceivably encourage porpoises to be silent, thereby increasing the risk of fatal net interactions. First trials with free-ranging harbour porpoise were promising (Poulsen, 2004). If this technology proves effective, then further potential disadvantages may be reduced.

Council Regulation EC 812/2004 lays down in Articles 2 and 3 that specified bottom-set gillnet and entangling net fisheries are required to use pingers during specified periods or all year in the areas indicated in Annex I. In the North Sea area, these are ICES areas IV (North Sea), III a (Skagerrak), VII e (Western English Channel) and VII d (Eastern English Channel). The starting date of this requirement was June 2005 for areas IV and III a, January 2006 for VII e and is January 2007 for VII d (see Annex I). The Regulation also details the technical specifications of the pingers to be used (see Annex II).
Member States may authorise the temporary use of acoustic deterrent devices which do not fulfil the technical specifications or conditions of use defined in annex II of the Regulation, provided that their effect on the reduction or incidental catches of cetaceans has been sufficiently documented. Such authorisations shall not be valid for more than two years.

4.1.2. Gear modifications

There are a number of modifications to fishing gear and deployment practices that have been tested with the view to reducing bycatch. Existing modifications range from changes in mesh size, twine diameter and deployment depth, to attempts to enhance the acoustic visibility of nets either through the use of nets with hollow cores or acoustic reflectors (Goodson *et al*. 1994, Silber *et al*., 1994; Koschinski & Culik, 1997), or nets impregnated with a metal compound such as iron oxide or barium sulphate, so called high-density nets (Larsen *et al*., 2002; Mooney *et al*., 2003; Trippel *et al*., 2003). Acoustic enhancement has a number of advantages relative to pingers of which the most important are:

- no habituation of porpoises
- no noise pollution, and
- no need for an energy source.

The reduction of bycatch through the better detectability of nets rests upon the unproven assumption that odontocetes become entangled because they fail to detect nets, or if they detect them, that they do not perceive them as hazardous. Larsen *et al*. (2002) presented several possible reasons for an animal to fail to detect nets:

- animals do not use their sonar to scan for obstacles sufficiently often (or fail to pay attention to them, even though echolocating)
- animals orient themselves in such a way that the net is out of the sound beam
- echoes from the nets are masked by echoes from swimming or entangled prey in and around the net, or
- the net itself is not detectable by the odontocetes at a sufficiently large distance to avoid entanglement.

Enhancing the detectability of nets could reduce bycatch in the latter two scenarios, while it alone will not have an effect on the level of bycatch in the former two cases. Studies of detection distances for porpoise and delphinids suggest that they are capable of detecting gillnets, although the detection distance can be quite short depending on ambient noise levels, angle of incidence, the net itself and attached materials such as floats or lead lines (Au, 1994; Kastelein *et al*., 2000). This suggests that harbour porpoises become entangled because they do not perceive nets as a hazard at a great enough distance. Kastelein *et al*. (2000) calculated that an increase in target strength of 10 dB is needed to increase net detection distance from 4 m to 7 m for porpoises. Only substantial changes in either material properties such as density and compressibility or dimensions of twine can cause such a large increase in target strength and will likely affect catch of target species and/or ease of handling for the fishermen.

Experiments with high-density nets have produced ambiguous results so far: bycatch rates were lower (e.g. Read, 2000; Mooney *et al*., 2003; Trippel *et al*., 2003), but the nets were also associated with unacceptably reductions in catch of the target species (Larsen *et al.*, 2002). Read (2000) reported, that in experiments in the Bay of Fundy bycatch was reduced significantly in nets impregnated with barium sulphate, while no significant difference was recorded in the take of the target fish species. Cox & Read (2004) concluded from observations on free-ranging harbour porpoise around chemically enhanced (with barium sulphate) gillnets in the Bay of Fundy that porpoises do not respond to the acoustic reflectivity of the modified nets. They rather attributed the effectiveness of these nets to some other mechanical property, such as increased stiffness as a result of the metal filler.

Other strategies for increasing detectability of nets involve adding a limited number of reflectors of a reasonable size to the net or a larger number of smaller reflectors, such as glass or metal beads in all or some of the knots of the net (Larsen *et al*., 2002). Another possibility to increase the animal's attention to the net is to attach a float line equipped with a sound generating unit producing 2.5 kHz tones that have been found to provoke the echolocation activity of harbour porpoise (Culik & Koschinski, 2004).

4.1.3. Monitoring

Article 12.4 of the Council Directive 92/43/EEC on the Conservation of Natural Habitats and Wild Fauna and Flora (Habitats Directive) of 1992 requires Member States to establish a system to monitor the incidental capture and killing of Annex IV species, which includes (amongst others) the harbour porpoise. EU Council Regulation EC 812/2004 (Articles 4 and 5) requires Member States to establish observer schemes to monitor the incidental capture of cetaceans in the fisheries and at levels specified in Annex III. However, the fisheries that are subject to pinger requirements under Articles 2 and 3 (which cover most of the North Sea area) are not included in Annex III, but should be subject to scientific studies or pilot projects to monitor and assess the effects of pinger use over time. Fishing vessels with an overall length of less than 15 m are exempt from the observer requirement, but for the fisheries listed in Annex III, these vessels should be monitored by appropriate scientific studies or pilot projects. Critically, the regulation includes no requirement to monitor cetacean bycatch by small vessels (<15 m) in the fisheries and areas subject to the pinger requirements (Annex I). This means that many vessels,

Comment [W4]: Annex II should surely be included in the annexes too?

particularly in inshore fisheries in areas where porpoise bycatch has already been identified as a significant problem are not required to be monitored.

4.2. Reduction in toxic contaminants believed to be having an impact on harbour porpoise

The OSPAR Convention is the basis for national legislation regulating

- the discharge from land-based sources,
- the elimination of pollution from dumping or incineration,
- the prevention and elimination of pollution from offshore sources, and
- the assessment of the quality of the marine environment in the waters of the OSPAR signatory states[2].

The OSPAR Hazardous Substances Strategy sets the objective of preventing pollution of the maritime area by continuously reducing discharges, emissions and losses of hazardous substances into the environment, with the ultimate aim of achieving concentrations in the marine environment close to background values known for naturally occurring substances and close to zero for man-made synthetic substances.

As its timeframe, the Hazardous Substances Strategy further declares that the Commission will implement this Strategy progressively by making every endeavour to move towards the target of the cessation of discharges, emissions and losses of hazardous substances by the year 2020.

The Commission cooperates with the EU in accelerating progress in improving tools for assessing risks of potential hazardous substances in the marine environment, drawing upon the relevant elements in the existing EU Technical Guidance in Support of Directive 93/67/EEC on Risk Assessment for New Notified Substances and Regulation EC 1488/94 on Risk Assessment for Existing Substances, and future expansions of that guidance.

Although the use of PCBs has been banned since the late 1970s, some measures still need to be implemented. It was agreed at the Third North Sea Conference (1990) and in PARCOM Decision 92/3, that by 1995 or by the end of 1999 at the latest, measures should be taken to phase out and to destroy all identifiable PCBs and hazardous PCB substitutes in an environmentally safe manner. Similar measures are provided for in Council Directive 96/59/EC.

A mechanism for a general ban on the use of organotin compounds in anti-fouling paints has been agreed within the International Maritime Organisation. The target is to prohibit their application from 2003 and to require the removal of tributyltin (TBT) from ship's hulls by the year 2008. Within the EC, controls on other TBT applications have been increased with the

[2] OSPAR signatory states are Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, the Netherlands, Norway, Portugal, Spain, Sweden and the United Kingdom.

revision of Directive 76/769/EEC. To address the harmful effects of anti-fouling systems used on ships, the Marine Environmental Protection Committee plans to develop a global legally-binding instrument (OSPAR, 2000a).

The Water Framework Directive (2000/60EC) of 2000 is the most substantial piece of EC water legislation to date. It sets a framework for comprehensive management of water resources in the European Community, within a common approach and with common objectives, principles and basic measures. It addresses inland surface waters, estuarine and coastal waters and groundwater[3]. The fundamental objective of the Water Framework Directive aims at maintaining “high status” of waters where it exists, preventing any deterioration in the existing status of waters and achieving at least “good status” in relation to all waters by 2015.

The European Commission is developing the Marine Strategy Directive (which is consistent with the Water Framework Directive) to protect more effectively seas in the European Union. The Marine Strategy Directive aims to achieve good environmental status of the EU's marine waters by 2021 and to protect the resource base upon which marine-related economic and social activities depend. The Marine Strategy will constitute the environmental pillar of the future maritime policy the European Commission is working on, designed to achieve the full economic potential of oceans and seas in harmony with the marine environment.

The European Commission has proposed a new European Union regulatory framework for chemicals called REACH (Registration, Evaluation, and Authorization of Chemicals), which creates incentives for companies to produce safer chemicals (Irwin, 2005).

4.3. Reduction of disturbance caused by human activities in areas frequented by harbour porpoise

4.3.1. Reduction of noise from boat traffic

Noise produced by vessels incidental to their operation has, under certain conditions, been interpreted as causing incidental harassment of marine mammals. There is general acceptance within the scientific, regulatory, and environmental communities that commercial shipping is one of the most significant anthropogenic sources of underwater noise (Southall, 2005), but there are currently no explicit guidelines or regulations in place any nation governing noise produced as a by-product of commercial vessel operation vis-à-vis marine mammals. While there may be general consensus that vessel noise is fairly widespread, there is much less agreement regarding

[3] According to the Water Framework Directive, “surface waters”, relevant for the assessment of the chemical quality of water, is limited to territorial waters of Member States, and “coastal waters” are limited to waters up to 1 nautical mile from the base line from which territorial waters extend.

how this may be affecting marine mammal populations and the extent to which currently available data support the development of effective regulations.

Basic noise mitigation techniques are (Richardson & Würsig, 1995):

- design equipment to be as silent as possible. Examples are: propeller shrouding used to silence military vessels, acoustic uncoupling of generators from hulls, engine trains from drive shafts and propellers, and other engineering techniques.
- Changes of locations of shipping routes (if possible in the North Sea) to avoid areas of high harbour porpoise concentrations if they are persistent.

Other operational changes include restricting vessel speed to 10 – 12 knots in areas of high harbour porpoise concentration. There are a number of ways in which disturbance from cetacean-watching boat trips can be reduced. These include:

- Education of operators and tourists about appropriate behaviour to adopt in the presence of cetaceans. A voluntary Code of Conduct (see Annex III for an example) could be distributed to operators in leaflet form, as well as being displayed on notice-boards on piers and harbours.
- This Code of Conduct could also be linked to a system of quality control, administered by a body such as Scottish Natural Heritage in the UK for example. Under this system, some form of seal of approval would be awarded to operators of whale watching boats only after their methods of working (e.g. efforts to minimise disturbance) had been carefully examined, modified if necessary and then approved. Tourists could then be encouraged only to use approved operators..
- Prohibiting or limiting access to vulnerable areas.

4.3.2. Reduction of disturbance from exploration and installation

Environmental Impact Assessment (EIA)

Licenses for the extraction of sand and gravel are required in most European countries. The EU EIA Directive 85/337/EEC amended by 97/11/EC regulates amongst others the extraction of minerals by marine or fluvial dredging. Member states have to decide on a case by case basis, and/or by reference to thresholds or criteria whether a project should be subject to assessment or not.

Since 1993, ICES' Advisory Committee on the Marine Environment (ACME) has published a number of guidelines and recommendations for EIA of marine aggregate dredging and on monitoring the environmental effects of extraction. The ICES Code of Practice for the

Commercial Extraction of Marine Sediments provides step-by-step advice on how marine dredging should be conducted in order to minimise conflicts with other users of the sea and to optimise the use of marine resources. Similarly, HELCOM adopted a recommendation (19/1) in 1998. This recommendation includes a list of guidelines on sediment extractions, including advice on EIA, extraction practices, sensitive and no-take areas, environmental monitoring and progress reporting.

ASCOBANS has adopted two resolutions on disturbance (Resolution No.4, 2000) and on the effects of noise and of vessels (Resolution No. 5, 2003) to introduce guidelines on measures and procedures for seismic surveys. These guidelines provide the opportunity to alter the timing of surveys or to minimise their duration; reduce noise levels as far as possible; avoid starting surveys when cetaceans are known to be in the immediate vicinity. Further measures could be introduced in areas of particular importance to cetaceans

Real-time monitoring

Knowing whether or not a harbour porpoise is present in an area may be important, for instant in areas of seismic surveys (see: JNCC, 2004 Guidelines for minimising acoustic disturbance to marine mammals from seismic surveys) or marine construction and extraction sites. Harbour porpoises are difficult to see and detectability varies with procedure, surfacing rate, distance from the observer, weather, and light conditions. Visual monitoring may be enhanced through thermal or night vision equipment (e.g. image intensifying telescopes). Acoustic methods can be used in most seasons and times of the day and generally detect porpoise at greater ranges than visual methods. PODs (Porpoise Click Detectors, a type of bioacoustic data logger) proved to be very effective in detecting the presence of harbour porpoise in the vicinity of a marine wind farm construction site (Teilmann *et al*., 2002; Henriksen *et al*., 2003; Tougaard *et al*., 2003).

Air bubble curtains

The use of air bubbles to attenuate pressure waves from drilling and ramming makes use of both the density difference between air and water and the resonance characteristics of bubbles to extract energy from the outward propagating pulses. This technique has not been widely investigated, but first experiments in Hong Kong (Würsig *et al*. 2000) and Canada (Vagle, 2003) demonstrated the potential of a bubble curtain to shroud percussive sounds produced during pile driving. In Hong Kong, bubbles created by running air into a perforated hose surrounding the pile driver reduced broadband noise generated by the pile driver by approximately 3 – 5 dB at distances of 250 and 1000 m, greatest reduction occurring at frequencies between 400 – 600 Hz (Würsig *et al*. 2000). In Canada, a noise reduction of approximately 20 dB was measured 30 m outside the bubble curtain (Vagle, 2003). The study also indicated that by making the bubbles smaller, the sound attenuation characteristics of any particular screen would be greatly enhanced. However, a problem with bubble screens observed is that the bubbles are not evenly spread around the circle, resulting in "holes" where the sound can escape. This could be overcome by the use of several concentric curtains which would also help to reduce the spreading sound even further. A second problem is that in the presence of currents the bubble screens loose their attenuating characteristics. Bubble curtains reinforced by tissue-fabric walls have further improved sound attenuation (minus 10 – 25 dB source level), effectively attenuating frequencies above 800 Hz, as well as reduced bubble spreading (CdoT, 2001).

4.4. Marine Protected Areas (MPAs) and Special Areas of Conservation (SACs)

Surveys from the SCANS project (1994) and local censuses demonstrated that the area west of the islands of Sylt and Amrum has high densities of harbour porpoise, with a high proportion of calves (Heide-Jørgensen *et al.,* 1993; Hammond *et al.*, 1995, 2002; Sonntag *et al.,* 1999). The animals are present all year round although with differences in time and space (Koch *et al.,* 1993, as cited in Prochnow & Kock, 2000). Recent aerial surveys in the German Exclusive Economic Zone (EEZ) in the North Sea indicate high densities of harbour porpoises further offshore close to the Danish border (Scheidat *et al*., 2003, Scheidat *et al*., 2004). In October 1999, the parliament of the Federal State of Schleswig-Holstein, Germany, decided to create a small cetacean sanctuary within the existing National Park "Wadden Sea of Schleswig-Holstein" to protect harbour porpoises. This park is part of the Trilateral Wadden Sea Cooperation – an international reserve administered jointly by Germany, The Netherlands and Denmark. Since 1999, the area of 124,000 ha inside the 12 nm zone to the west of the islands of Sylt and Amrum has been nominated as a SAC for harbour porpoises. Within the sanctuary, it is not allowed to set nets higher than 1.30 m and a mesh size > 150 mm (amended Coastal Fisheries Regulation of Schleswig-Holstein, Küstenfischereiverordnung 2005). This excludes the gillnet fishery for turbot, as the minimum mesh size for this fishery has been determined to be 220 mm (EC Regulation 850/98). However, turbot fishing has not been conducted in the area in recent years.

The Habitats Directive (92/43/EEC) together with the Birds Directive (79/409/EEC) is designed to provide a network of marine- and land-based protected areas in the European Community, a coherent network "NATURA 2000". Under the Habitats Directive, a number of SACs have been proposed as candidate areas to protect bottlenose dolphin and harbour porpoise habitat in several of the member countries.

Under the OSPAR Convention, the parties are obliged to identify marine species, habitats and ecosystems that need to be protected, conserved or restored. In 2003, the OSPAR Commission adopted Recommendation 2003/3 on the establishment of a network of well-managed MPAs to be put in place by 2010 to ensure the sustainable use, protection, and conservation of marine biological diversity and ecosystems. The initial list of threatened and declining species and habitats, aimed to set priorities for the conservation process, includes the harbour porpoise.

In 2004, Germany nominated three areas in the German EEZ in the North Sea named "Sylter Außenriff", "Doggerbank" and "Borkum-Riffgrund" (with 7630 km^2 in total, thus aiming to protect 27% of the entire German EEZ in the North Sea) as candidate sites (pSCI, proposed Sites of Community Interest) for the NATURA 2000 network under the Habitats Directive, protecting harbour porpoise among other species. The harbour porpoise provided the rationale for the selection of these sites: Sylter Außenriff, for example, harbours the largest known concentration of harbour porpoise in German waters. The two other sites have been selected for additional nature conservation targets, i.e. sandbanks and reefs. However, the Habitats Directive protects all species listed in Annex II in all protected areas as well as *per se*.

The UK proposed part of the inner Moray Firth in NE Scotland and Cardigan Bay in West Wales as SACs to protect the resident bottlenose dolphin populations there. Harbour porpoise are known to reside in both areas as well.

4.5. Monitoring the state of the stocks

Information on abundance is essential to assess the impact of bycatch and other anthropogenic threats to cetacean populations.

The SCANS-II survey, conducted in July 2005, was designed to extrapolate the absolute abundance of small cetacean populations, particularly of harbour porpoise, bottlenose dolphin and common dolphin inhabiting shelf waters of the Atlantic margin, the North Sea and adjacent waters. In addition to the area surveyed during SCANS, this new project also covered continental shelf waters to the west of Britain, Ireland, France, Spain and Portugal and additional areas in the Baltic Sea.

To estimate absolute abundance, a combination of shipboard and aerial surveys was carried out. Both visual and acoustic survey methods were used to detect cetaceans on the shipboard surveys The visual data collection and analytical methods developed for SCANS formed the basis for this project to maintain consistency and comparability but methods were revised to incorporate recent developments for shipboard and aerial surveys.

A second objective of SCANS-II was to develop and test methods to monitor cetacean populations.

The third objective was the development of a framework for management of bycatch.

4.5.1. Monitoring of health condition of the stocks

Strandings networks

Programs exist in most North Sea range states for recovering dead harbour porpoises washed ashore. These programs provide an alternative way to indirectly evaluate the potential impact of fishery on harbour porpoise populations by assessing the number of bycaught animals which drift ashore. During the period 1990 – 2000, for example García Hartmann *et al*. (2004) diagnosed at least 58.4% of the stranded porpoises recovered from Dutch beaches as bycatch. In Germany, 46% of stranded porpoises were identified as bycatches during 1991 – 1996 (Siebert *et al*., 2001). Minimum proportions estimated in other European countries have been lower: 34% in England and Wales during 1990 – 1996 (Jepson *et al*., 2000) and 10 – 20% during 1990 – 2000 on the coast of Belgium and northern France (Jauniaux *et al*., 2002).

Most health monitoring of stranding networks only cover the registration of obvious (blunt) trauma and net marks besides analyses of infections, other diseases, and contamination with environmental toxins. However, one major drawback is that no analyses for acoustic trauma are conducted within most health monitoring schemes. Thus, besides all difficulties associated with this issue, there is no indication about the pathological order of magnitude of the “noise problem”.

5. Recommended conservation actions

The major risks and limiting factors identified in the preceding sections served as the basis to outline actions recommended to improve the status of harbour porpoise stocks which may serve as background information for a Recovery Plan. The goal of all conservation actions should be to bring harbour porpoise population numbers and conditions to a state at which natural events and human activities will not threaten the survival of harbour porpoise sub-populations in the North Sea, in other words these should be management measures which will achieve and maintain a favourable conservation status of harbour porpoises in the North Sea.
Conservation status can be taken as “favourable” when

- population dynamics data suggest that harbour porpoises are maintaining themselves at a level enabling their long-term survival as a viable component of the marine ecosystem;
- the range of the harbour porpoise is neither reduced, nor is it likely to be reduced in the foreseeable future;
- habitat of favourable quality is and will be available to maintain harbour porpoises on a long term basis; and
- the distribution and abundance of harbour porpoises in the agreement area are returned to historic coverage and levels.

If any of the four conditions are not met, the conservation status of harbour porpoises is taken as “unfavourable”.

To achieve a favourable status, the following aims and activities are proposed:

F. Achieve in the North Sea, particularly for the stocks in the central and southern North Sea and the Channel an overall reduction in incidental entanglement in fishing gear to below levels that are having or may have, either singly or in combination, negative impacts on the conservation status of the population;
G. Achieve an overall reduction in toxic contaminant to below levels that are having or may have, either singly or in combination, negative impacts on the conservation status of the population;
H. Reduce disturbance caused by human activities in areas currently or historically frequented by harbour porpoise to below levels that are having or may have, either singly or in combination, negative impacts on the conservation status of the population;

I. Monitor the state of the sub-populations;

J. Investigate other potential obstacles to harbour porpoise recovery.

In order to monitor the success of the measurements suggested, monitoring and research activities need to be integrated into the plan. Monitoring is required to signal any improvement or deterioration of the situation, thus documenting the effectiveness of the plan. Research is needed to understand the ecological requirements of the harbour porpoise, to answer questions about the various obstacles to recovery, to evaluate the most suitable actions and to modify them accordingly, to develop more efficient monitoring methods, and to better assess development projects in terms of their effects on harbour porpoises.

5.1. Step-down outline and narrative

A. Achieve in the North Sea an overall reduction in incidental entanglement in fishing gear to below levels that are having or may have, either singly or in combination, negative impacts on the conservation status of the population

Bycatch is the most immediate threat to harbour porpoises in the North Sea as in other parts of the ASCOBANS area. Thus **bycatch reduction must have the highest priority** for a recovery plan for North Sea harbour porpoises. There is no universal solution to reducing bycatch, since the suitability and efficiency of mitigation measures depend on specific circumstances associated with a given fishery. Strategies should preferably have multiple mitigation approaches as a way of dealing with the uncertainty of outcome associated with any individual measure (Read, 2000). The same bycatch reduction measures might not be appropriate on the same time schedule for the whole of the North Sea – as harbour porpoises and fishing effort are not homogenously distributed over the area. **It is important that fishermen and their representatives are closely involved in the implementation process** (ASCOBANS, 2002). They need to be included in any discussions and decision-making that may have implications for their livelihoods.

A.1 Reduction of fishing effort in certain fisheries

There appears to be a direct relationship between fishing effort and the total number of animals caught in a specific type of fishery. **Reduction in fishing effort in these fisheries should lead to a proportional reduction of bycatch** (Read, 2000; CEC, 2002a). However, there should not be a shift from one gear to another gear which may have more negative effects on the environment (except on marine mammals). The reduction in fishing effort in the Danish gillnet fisheries in the North Sea in the most recent years has led to a reduction of the level of bycatch

(Vinther & Larsen 2002). Therefore, it is recommended that measures should be taken by the North Sea Range States to reduce the fishing effort of bottom-set gillnet fisheries in the North Sea, prioritising those fisheries with highest levels of bycatch or that would have the greatest impact on the recovery of depleted porpoise populations.

Comment [W5]: It will be very easy for States to claim they are doing/have done this already – due to effort reductions for stock management – However, it doesn't mean they have reduced effort in the most important fisheries – or that effort has not been redeployed.

Reduction in fishing effort may include

- a reduction in soak time (amount of time the nets are in the water)
- a reduction of net lengths,
- time and area fishery closures, and
- limitations of days at sea.

Certain fisheries, such as the gill net fishery on turbot, may no longer be viable if soak time and net length are reduced significantly. Reduced catch quotas or reduced fleet sizes will not necessarily reduce bycatch: reductions in catch quotas and/or fishing capacity may not necessarily lead to a reduction in fishing effort. Temporal closures of particular areas only appear reasonable when particular hotspots of harbour porpoise bycatch are identified (ICES, 2001).

For particular hotspots to be identified, it is necessary to **establish a comprehensive long-term bycatch observation program**. Monitoring of incidental capture of cetaceans is required under Council Directive 92/43/EEC (the Habitats Directive), and observer monitoring of some North Sea fisheries is required under EC Regulation 812/2004, although there are notable gaps in these latter requirements (see A5 below). However, the requirements of the Habitats Directive have been widely ignored by many Member States, it is yet to be seen how extensively the monitoring requirements of the bycatch regulation have been complied with, and Norway is not a Member of the EU and is therefore not covered by these obligations. The inadequacy of observation data to date means that for many areas it is generally not yet possible to define with certainty the boundaries of useful times or areas for closure, except on the basis of precaution.

Comment [W6]: As it stood this was not really true eg for some well defined inshore fisheries

A.2 Mandatory use of pingers

The starting date for **implementation of the pinger provision (EC 812/2004) was June 2005** in ICES sub-area IV and division III a for large mesh (> 220mm) gill and tangle nets, and August 2005 for wreck nets (≤ 400 m). Pingers were required on any bottom-set gillnet or entangling net in ICES divisions VII e, f, g, h, j from January 2006 and will be required in VII d from January 2007. Despite this phased introduction it is clear that these pinger requirements are not being met.

Boats less than 12 m long are exempt from these provisions, which in many areas comprise the majority of the fleet and of netting effort, including in areas of known harbour porpoise bycatch. Furthermore, the fisheries for which pingers are mandatory (Annex 1) are not included amongst those that have to be monitored by on-board observers (Annex III). Although there is a requirement for scientific studies or pilot projects to monitor and assess the effects of pinger use over time in the fisheries and areas concerned, it provides no specification for the detail, timeframe or extent of these studies, leaving the adequacy of this provision open to question.

It should be noted, however, that each EU member state has the power under the Common Fisheries Policy (CFP) to **apply additional fisheries management measures to its own vessels in its own waters** as long as they are compatible with the objectives of the CFP and are no less stringent than existing Community legislation (Article 10, Council Regulation EC 2371/2002). It is also notable that Norway is not an EU Member State and is therefore not subject to the requirements of EC 812/2004.

A.3 Gear modifications

There remains a need to **develop alternative approaches that combine substantial fishing effort reductions with the introduction of alternative fishing gear**.

A.4 Change of fishing methods away from gear known to be associated with high porpoise bycatch (i.e. bottom-set nets) and towards alternative gear that is less harmful

A changeover to fishing gear and fishing methods less harmful to harbour porpoises is another means to reduce bycatch while maintaining a fishery. **The investigation of potential benefits of gear switches from bottom-set gillnets to fish traps, fish pots and longlines must begin immediately, particularly in areas where porpoise are known or expected to occur frequently**.

The **development and introduction of replacement gear in the bottom-set gillnet fishery for cod and flatfish** should be undertaken as a high priority. Once cost-effectiveness has been demonstrated, development work should be coordinated among the range states and implementation should begin immediately. When defining cost-effectiveness, it is important to consider that catch levels may be less, but quality (and thus unit value) may be higher.

A.5 Monitoring schemes

As fisheries specified in Annex I of Regulation EC 812/2004 (subject to pinger use) are not included in Annex III (subject to observer schemes), vessels under 12 m are not required to use pingers or to assess bycatch levels through observer schemes. This leaves those fisheries where there is known to be a bycatch problem, such as the western English Channel, unmonitored and the harbour porpoise population there unprotected.

Conclusions for A.1 – A.5

It is recommended that **all North Sea range states, but most importantly those identified in table 3, should establish a comprehensive observation program run from year to year to be able to identify harbour porpoise bycatch hot spots as required under Council Directive 92/43/EEC**.

It is recommended to **extend observer schemes to include boats ≤ 15 m in length where possible and for those fisheries subject to pinger requirements** (Annex I). Observers should be used where physically possible and alternative monitoring methods, e.g. remote monitoring methods, should be explored for those vessels where onboard observation is not possible.

The **redirection of gillnet and tangle net effort to vessels less than 12 m long should be prevented** to protect in particular harbour porpoises moving inshore.

Further trials with interactive pingers are urgently required **to introduce interactive pingers as soon as possible and replace permanent pingers**.

Implementation of pingers should be short-term and therefore should be reconsidered within 3 years, with the expectation that pinger use will be replaced by longer-term mitigation measures at that time. The **rapid development of medium- and long-term approaches to mitigation** (e.g. reduced fishing effort in high-risk areas, conversion to fishing gear and practices that are much less likely to result in porpoise bycatch) **is crucial and should not be compromised**. This work should be initiated immediately and in parallel with the identification of high-risk areas and targeted pinger implementation efforts.

Further research into harbour porpoise behaviour around fishing nets and the reasons for their entanglement, as well as **possibilities to enhance either the attentiveness of the porpoise or the acoustic visibility of nets without affecting catch rates are recommended**.

A changeover from gillnets to less high-risk gear would almost certainly benefit porpoises. It is therefore recommended that **serious consideration should be given to replacing gillnets in areas where porpoise bycatch is known or likely to occur**.

Any replacement or changeover to potentially less harmful gear needs to be considered in view of potential impacts to harbour porpoise, the target fish species, and other biota such as seabirds.

B. Achieve an overall reduction in toxic contaminants believed to be having an impact on harbour porpoises

A greatly improved understanding is needed of the linkages between specific chemical exposures (type and amount) and endpoints of concern (e.g. impaired health, immunosuppression, reproductive disorders). No single approach is likely to be adequate for resolving the critical uncertainties that arise in relation to contaminants and marine mammals. Thus, there is a **need for multidisciplinary studies that integrate physiological, behavioural, reproductive, clinical, pathological, and toxicological data, with the ultimate goal of linking immune status, health, reproduction, and survival of individuals to trends observed or predicted at the population and ecosystem level** (e.g. IWC-report Pollution 2000+, Reijnders *et al*., 1999).

In view of the negative impacts of anthropogenic nutrient inputs over extended parts of the North Sea coastal zones, **implementation of the OSPAR Strategy to Combat Eutrophication should be pursued vigorously**. Efforts should be focused on emissions, discharges and losses from agricultural and urban sources, in particular through enforced application and compliance with the EC Directives 91/676/EEC and 91/271/EEC concerning nitrate and urban wastewaters.

C. Reduce disturbance caused by human activities in areas frequented by harbour porpoise

C.1 Minimize disturbance from boat traffic

The North Sea is crossed by some of the busiest shipping routes in the world. In 1996, about 270,000 ships entered the main 50 ports in the North Sea and Channel area (OSPAR, 2000a). Container transfer in the main ports increased by 120% in the ten years prior to the publication of OSPAR (2000a). A further increase of vessel traffic in the North Sea in the coming years is likely. Therefore, **finding mitigation measures to reduce vessel noise should be made a priority**.

Regulation of fast ferries, boats and jet skies should seek to prevent, or at least minimise, the potential for disturbance. **In the absence of any firm evidence for disturbance, the precautionary approach should be adopted.**

C.2. Minimize disturbance from exploration and construction in the sea

There is a lack of information on the potential impact of noise from oil and gas explorations and from marine wind farms on harbour porpoises. **Studies are urgently needed to assess the impact and critical values of emitted noise with respect to exploration, construction,**

production and decommissioning of oil and gas platforms and of wind farms as well as the practicality of possible mitigation measures, such as:

- conducting Environmental Impact Assessment (EIA)
- real-time monitoring,
- creating safety zones,
- scheduling activities to minimise impact, e.g. avoid work during calving and reproductive seasons in critical areas,
- following a ramp-up procedure (Richardson & Würsig, 1995; Tougaard *et al*., 2003),
- reducing sound emissions via technical measures such as bubble curtains (Würsig *et al*., 2000) or a coating of the ramming device (UFOPLAN-FKZ 204 53 102), or
- using alternative equipment such as a marine vibrator to survey the seabed (Deffenbaugh, 2001 as cited in Dolman, 2003).

C.2.1. Conducting EIAs

The amended EC Directive on environmental impact assessment, EIA, (97/11/EEC) demands consideration of the main alternatives studied and the reasons for the final choice – for example, to avoid a protected area. The developer is required to provide certain specified information to the case to enable a decision to be made by the authorities. The information supplied should consider significant direct and indirect effects on flora, fauna and landscape and the interrelationship of these with other aspects. Details of measures to reduce significant adverse effects should be included within the assessment. Cumulative effects must be assessed as well.

Cumulative effects can result in significant changes in the landscape and to biological diversity.

Therefore, in the case of oil and gas exploration and of wind farm construction, before conducting any work in sensitive areas (as defined in the Habitats Directive), **an Environmental Impact Assessment (EIA) according to the Habitats Directive article 6 is recommended to investigate and predict the impacts of noise and to elaborate a set of alternatives and mitigation measures on the basis of the impact assessment**. In the end, the **best available technique (BAT) and the best environmental practice (BEP) should be applied**.

C.2.2. Real-time monitoring

To increase the detection rates and therefore assist in minimizing disturbance to harbour porpoise, **a combination of visual and acoustic methods of detection is recommended**.

Upon detection of cetaceans in the vicinity of a survey, a construction or decommissioning site, a **shut down of the system or a halt of the work respectively is recommended**. Avoidance of critical habitats (long range) and critical times (e.g. April to August) is also recommended. Such monitoring is widely practiced now with respect to seismic activities (e.g. JNCC, 2004).

C.2.3. Safety zone

The safety zone for activities that emit intense underwater noise is currently based on the approximate distance for visual detection of cetaceans, because work methods that utilize distance criteria are easy to implement and to monitor. All guidelines and/or regulations should realize though that observers cannot see a reasonable percentage of animals within a radius of more than a few hundred metres.

In the past an isopleth safety zone of 180 dB has been proposed (e.g. by the High Energy Seismic Survey Team, HESS [cited in Moscrop & Swift, 1999] or by the US-Navy for the use of the SURTASS-LFAS - Low Frequency Active Sonar- [US-DoN, 2001]) for the use of sonar. However, no commonly accepted critical values/thresholds for received sound pressure levels exist yet. To develop “safety thresholds”, an “equal energy immission criterion” must be considered over a given time instead of a simple sound pressure level due to the complexity of underwater sound and its potential effects on marine mammals. No single sound pressure level (in dB) is appropriate as a general safety threshold (e.g. MMC, 2004). **Such an “equal energy immission threshold” needs to be species specific and therefore specified for harbour porpoises**.

C.2.4. Ramp-up procedure

Marine mammals nearby will move away before noise reaches adverse levels if the sound source is increased gradually (ramped-up). This would allow any nearby harbour porpoises to move away before the received power becomes high enough to cause adverse effects. It should be noted however, that ramping up a high energy sound source could be harmful (Pierson *et al*., 1998 as cited in Dolman, 2003). Animals might be attracted to the source by initially weak sounds and thus exposed to potentially harmful levels as sound intensity increases.

Studies of effectiveness/efficiency of ramp-up procedures are recommended.

C.2.5. Noise reducing methods related to construction works

Air bubble curtains have so far yielded promising results in reducing or baffling unnecessary high frequency noise or other acoustic energy sources during construction and operation of oil platforms. **Further trials with tissue reinforced bubble curtains and other methods/techniques to enhance attenuation of sound close to the source are recommended.**

C.2.6. Alternative methods

Another method for a seabed survey is the marine vibrator. It has a lower peak amplitude, slower rise time and needs significantly less energy above 100 Hz (Deffenbaugh, 2001 as cited in Dolman, 2003). Marine vibrators may be an alternative to airgun arrays currently in worldwide use for seismic activities. **Further research into the practicability of marine vibrators and other alternative methods to survey the seabed are recommended.**

C.3 Minimize disturbance from sand and gravel extraction

The behaviour or reactions of harbour porpoise in the vicinity of dredging vessels and effects of sand and gravel extraction on prey species, such as sand eels, is poorly understood.

Before permission for extraction is provided, **an EIA should be required**, as for example it is the case in the UK. If concerns are expressed about potential effects on harbour porpoises and if these concerns are sufficiently severe, extraction should not be permitted to go ahead.

It is recommended that during dredging activities, especially in areas where harbour porpoises are likely to occur, trained observers are aboard the dredge vessel or an ancillary vessel to observe the presence of any harbour porpoise or other cetacean in the vicinity of dredging activities and to document their behaviour in response to the dredging activities. Also, as suggested by Nairn *et al*. (2004), observers should be in communication with federal, state and local agencies responsible for documenting marine wildlife strandings concurrent with the dredging operations and for a certain period after completion of the operations (depending on time, duration and severity of the previous operation). **Research on habitat alteration with all side effects is needed**. **Recommendations for an EIA as mentioned above are applicable here.**

C.4 Minimize disturbance from sonar/military operations

As far as military activities are concerned, the armed forces are expected to act in accordance with articles 236 and 237 paragraph 2 of the Convention on the Law of the Sea of 1982 to undergo any reasonable efforts to avoid any disturbance to harbour porpoise.

The potential of military activities (e.g. use of sonar) to encroach cetacean habitats has to be considered, since military activities are undertaken in all oceans of the world, including the North Sea. As public information on the exact nature and extent of military activities are highly restricted for security reasons, the total impact of the military's ensonification on the North Sea is difficult to quantify.

The effect of mid-frequency sonar on harbour porpoise needs to be studied.

C.5 Establishment of Protected Areas

While the area of Sylter Außenriff proposed to the EU as candidate sites for the Natura 2000 network appears to be large enough to protect harbour porpoise to some extent, the two other areas appear to be too small to provide protection to harbour porpoises in German waters, but could be **reasonably enlarged by added MPAs, forming a network of MPAs under EU legislation in Denmark, The Netherlands and the United Kingdom, if they meet the criteria for site selection in those countries. MPAs can only be effective for the protection of harbour porpoises when management measures therein ensure a reduction of risks or threats to harbour porpoises**.

C.6 Raising public awareness

There is an increasing database of information about small cetacean conservation. However, such information is rendered useless if the overall message of the research and results on conservation needs, etc. are not communicated to policy makers and the public.

Public awareness must be an essential and integral part of any recovery plan. Unless people are aware that porpoises form an integral part of their local waters and need to be preserved because their existence is threatened, the public is unlikely to support any recovery effort. Other elements of the recovery plan depend largely on the decision-making processes of national or supranational governmental agencies and international regulatory bodies. Public awareness, however, is an area in which ASCOBANS has an independent role to play. **Parties to ASCOBANS have ongoing responsibilities and commitments to disseminate reliable information about North Sea harbour porpoises to the public and to actively promote their protection and recovery**.

Fishermen are among those people likely to interact directly and most frequently with harbour porpoise. They must be viewed as a prime audience. At the same time, it is important to reach members of the general public. They are consumers of fishery products on the one hand and the ultimate arbiters of public policy (via the democratic process) on the other. It is vital that public awareness efforts be objective, attendant to and respectful towards cultural and linguistic differences, and candid about scientific uncertainty. In fact, one of the greatest challenges to the implementation of this Recovery Plan is the uncertainty surrounding the porpoise population’s status and the nature and level of risks and threats to its existence.

In promoting public awareness, **ASCOBANS should avoid duplication of effort and cooperate with other institutions and programmes pursuing similar aims**. Moreover, ASCOBANS should strive to be part of important programs, such as the European Marine Strategy.

Recommendations:

- While acknowledging the proven value of national programmes in raising public awareness, **ASCOBANS should develop and promote a regional approach to North Sea harbour porpoise conservation**. This should aim to improve general awareness of the presence of harbour porpoise in the North Sea and understanding of the risks and threats they face with a view to enlisting the support of both the general public and stakeholders for the objectives of the plan, using models such as the programme "Look out for harbour porpoises" initiated by GSM (Society for the Conservation of Marine Mammals) for the Baltic Sea.

- **Efforts should be made to enlist the help of the general public in obtaining reports of porpoise observations throughout the North Sea**. This can be expected to improve understanding of porpoise distribution, relative abundance, and bycatch, while at the same time enhancing public support for recovery efforts.

- **The ASCOBANS Secretariat should continue to establish direct communication links with fishermen and other stakeholders at the international level** and seek their assistance in determining how to reach fishing communities and other target groups more effectively, e.g. via newsletters, tabloids, displays at fishing exhibitions etc.

- **The North Sea Range States should establish national focal points, with responsibility for coordinating public awareness efforts**. These focal points would be responsible for establishing and maintaining working relationships with fishing communities and other stakeholders at the national level and supporting the ASCOBANS Secretariat in its efforts to establish links with those groups.

D. Monitor the state of the populations

Monitoring the populations is essential to ensuring that any improvement or deterioration of their status is detected. It entails conducting population surveys and studying stranded carcasses. **Population size and structure need to be monitored** to discern trends, understand the mortality patterns and identify potential recruitment problems. There appears to be a **particular need for population details and investigation of movements of porpoises within the Celtic Sea, English Channel and Southern North Sea**.

D.1 Quantify bycatch, maintain and improve the national strandings networks

Bycatch needs to be quantified yearly by all member states. This could be done by sufficient onboard observer schemes where possible. **Forensic investigations of stranded animals should be continued** to determine cause of death by gear type (where possible). Greater efforts, such as distributing posters in coastal villages and towns, should be undertaken to make sure that stranded animals do not go unreported.

Necropsies should be continued to determine age at death and causes of death, and **to monitor the presence of pathogens, the physiological condition of the animals, and the reproductive**

state of females. **Contaminant levels should also continue to be monitored** to better understand the impact of contaminants on health and reproduction and to follow changes in chemical burden over time.

D.2 Monitor the health status of the populations

Appropriate indicators of "health status" need to be defined to be able to declare a population as healthy or not. Blood, blubber and skin samples are platforms to characterize physiological condition, genetic profile and chemical burden. The blood and blubber samples collected from preferably live animals could be used to assess immune functions and biochemical markers to determine the impact of contaminants on various physiological and reproductive parameters. **Samples collected should be analysed for the presence of antibodies to viruses** known to have caused epizootics elsewhere. **There is an urgent need for the development of pathological indicators for acoustic trauma and for inclusion of pathological examinations for acoustic trauma into health monitoring schemes** to get estimates of the pathological order of magnitude of the "noise problem".

D.3 Assessing the effectiveness of mitigation measures

An assessment of the effectiveness of mitigation measures should be conducted annually. **Further research into alternative mitigation measures** (e.g. gear modifications, effort reduction, alternative fishing methods) is recommended.

However, gaps in knowledge should not inhibit the implementation of already existing measures that can reduce or minimise risks for harbour porpoise, and that might contribute to a favourable conservation status of harbour porpoise in the North Sea.

E. Investigate other potential obstacles to harbour porpoise recovery

Many aspects of harbour porpoise conservation still remain uncertain. They require further attention. However, they should not serve as an excuse to further delaying implementation of a recovery plan and the implementation of as many suggestions made in the Plan in order to substantially reduce incidental mortality due to fisheries. As the Northeast Atlantic population and especially the southern North Sea population live in one of the most polluted and heavily fished marine environments of the world (Aguilar & Borrell, 1995) with heavy ship traffic, there are also other potential obstacles to recovery apart from bycatch. These additional factors also have to be taken into consideration with respect to a Recovery Plan for harbour porpoises.

E.1 Complete information on harbour porpoise hearing and communication

Harbour porpoise hearing and communication need further examination. It is important to examine to what degree they use or perceive lower frequencies. The impact of noise on behaviour at the population level is another important question to be answered. Research is needed on the possible effects of ship noise (including navigational sonar) on harbour porpoises and on the impacts of noise on prey species of the harbour porpoise.

E.2 Complete information on the diet of harbour porpoises

Knowledge on quantitative relationships between feeding ecology and critical levels of prey availability where animals need to choose between switching prey or leaving the area, is still lacking. In order to evaluate the direct and indirect impacts of fisheries on populations of harbour porpoise, **efforts should be made to find out more about their foraging habits in relation to various types of fishing gear and the species of fish they catch**.

5.2. Implementation Schedule

In this implementation schedule, the recommendations are classified as actions, monitoring, activities or research activities. The organizations/institutes that should be involved in the implementation of the recommendations are identified; dates for completion of the tasks are suggested, using 2005 as the starting year; and, when possible, the cost is estimated.

Given that all the activities will not begin at the same time, the target date should be read as the estimated number of years needed to finish the work proposed.

A priority (P) is assigned to the recommendations. The activities proposed aim at reducing threats and limiting factors, or increasing knowledge of the populations. The contribution of each activity to the recovery of the harbour porpoise is defined as follows:

1 – Critical activity
2 – Necessary activity
3 – Important activity
4 – Complementary activity

The plan is intended to be revised and updated every five years until the populations start showing signs of recovery. The first review should occur three years after the first implementation of pingers. It is also suggested that **North Sea range states (ASCOBANS members and non-members alike) be asked to supply ASCOBANS with updated information on an annual basis concerning progress in implementation**.

The letter beside each task refers to one of the following five aims and activities:

A. Achieve in the North Sea, particularly for the stocks in the central and southern North Sea and the Channel, an overall reduction in incidental entanglement in fishing gear to below levels that are having or may have, either singly or in combination, negative impacts on the conservation status of the population;
B. Achieve an overall reduction in toxic contaminant to below levels that are having or may have, either singly or in combination, negative impacts on the conservation status of the population;
C. Reduce disturbance caused by human activities in areas currently or historically frequented by harbour porpoise to below levels that are having or may have, either singly or in combination, negative impacts on the conservation status of the population;
D. Monitor the state of the sub-populations;
E. Investigate other potential obstacles to harbour porpoise recovery.

No	Activities: Action	Activities: Monitoring	Activities: Research	Legislative entities	Implementing entities	P	Time frame	Cost	Comments
A.1		Establish a program to monitor bycatch in **all** North Sea range states	Identify harbour porpoise bycatch hot spots	EC, North Sea Range States		1	On-going		Particular need for details within the Celtic Sea, English Channel and southern North Sea
A.2	Introduce mandatory pinger deployment					1	Start a.s.a.p., re-evaluate in 2008	Up to 6,000 € per boat	
			Assessment of static net effort to identify areas where gillnet use should be restricted or halted and mandatory pinger use should be introduced			1	2006		
			Develop a strategy for getting fishermen to support bycatch mitigation measures			1	2006		
		Monitor pinger deploying vessels for correct and effective use as well as for impacts of pingers				1	On-going		Use independent observers or remote monitoring methods
			Further trials with interactive pingers			2	On-going		
A.3			Investigate harbour porpoise behaviour around fishing nets and the reason for their entanglement			2	On-going		
			Investigate possibilities to enhance harbour porpoise attentiveness or acoustic visibility of nets			2	On-going		

No	Activities			Legislative entities	Implementing entities	P	Time frame	Cost	Comments
	Action	Monitoring	Research						
A.4			Initiate a review of all experiments to date with alternative gear and fishing practices that might be used to replace the current use of bottom-set gillnets in the North Sea			2	On-going		Objective of this review will be to identify promising gear for further development and testing
A.5		Monitor **all** gillnetting boats (including boats of ≤ 15 m in length)				1	On-going		Use independent observers or remote monitoring methods
B			Initiate mm ultidisciplinary studies that integrate physiological, behavioural, reproductive, clinical, pathological, and toxicological data, with the ultimate goal of linking immune status, health, reproduction, and survival of individuals to trends observed or predicted at the population and ecosystem level			2	On-going		

No	Activities: Action	Activities: Monitoring	Activities: Research	Legislative entities	Implementing entities	P	Time frame	Cost	Comments
B	Implement measures provided in OSPAR Hazardous Substances Strategy, PARCOM Decision 92/3, Council Directive 96/59/EC. OSPAR Strategy to Combat Eutrophication and EC Directives 91/676/EEC and 91/271/EEC					1	By 2020		
C.1			Develop equipment to be as silent as possible			2	On-going		
	Changes of location of boat lanes			IMO, EC, North Sea Range States		3	On-going		
	Keeping vessel speed down					2	On-going		
	Establish a voluntary code of conduct for eco-tourism					4	2006		Example of a code of conduct for minimising disturbance to marine mammals from the Wildlife Trusts Cornwall in Annex III
	Prohibit or limit access to vulnerable areas					3	On-going		
C.2	Conduct EIA before conducting any work and calculate a safety zone					2	On-going		
		Conduct real-time monitoring and stop work if porpoise are in the area				1	On-going		Use independent observers

No	Activities: Action	Activities: Monitoring	Activities: Research	Legislative entities	Implementing entities	P	Time frame	Cost	Comments
C.2			Study the effectiveness of ramp-up procedures			1	2007		
			Develop methods to enhance the attenuation of sound			1	On-going		
			Research the practicability of alternative methods to survey the seabed			1	On-going		
C.3	Conduct EIA before conducting any work and calculate a safety zone					2	On-going		
		Conduct real-time monitoring and stop work if porpoise are in the area				1	On-going		Use independent observers
	Reduce dredging in the North Sea					3	On-going		
C.4			Study the effect of mid-range sonar on harbour porpoise hearing			3	On-going		
C.5	Establish a network of protected areas					1	On-going		Identify habitat important for feeding or breeding for harbour porpoise
C.6			Develop and promote a regional approach to North Sea harbour porpoise conservation			3	On-going		Enlist the help of the general public in obtaining reports of porpoise observations
	Establish communication links with fishermen and other stake holders on an international level					3	On-going		

No	Activities: Action	Activities: Monitoring	Activities: Research	Legislative entities	Implementing entities	P	Time frame	Cost	Comments
C.6	Establish national focal points to establish and maintain working relationships with fishing communities and other stakeholders at the national level					3	On-going		
D.1		Maintain and improve strandings networks				1	On-going		
			Continue to perform necropsies to determine age at death and causes of death			1			
	monitor the presence of pathogens, the physiological condition of the animals, and the reproductive state of females					1			
	Monitor contaminant levels					1			
D.2			Define appropriate indicators of “health status”			1			
			Collect blood, blubber and skin samples			1			
			Collected samples should be analysed for the presence of antibodies to viruses			1			
		Monitor new toxins				1			

No	Activities: Action	Activities: Monitoring	Activities: Research	Legislative entities	Implementing entities	P	Time frame	Cost	Comments
D.3			Assess the effectiveness of mitigation measures			1	annually		
E.1			Study the hearing and communication of harbour porpoise further.			2			Do they use or perceive lower frequencies? What is the impact of noise on behaviour on the population level?
			Research the possible effects of navigational sonar from ships on harbour porpoise			2			
			Study the possible effects of noise on prey species of the harbour porpoise			3			
E.2			Complete information on diet of harbour porpoises			1	2007		

5.3. Implementation and monitoring of the recovery plan

Implementation of the plan requires the participation of both governmental and non-governmental organizations. This collective effort must be coordinated and monitored to ensure that the objectives set for the North Sea Harbour Porpoise Recovery Plan are pursued. It is recommended that ASCOBANS sets up a steering group similar to the Jastarnia group to that effect.

The steering group members should be selected from among industries, environmental groups and governmental organizations. They would be asked to solicit commitments from the various organizations identified as responsible entities for implementing the recovery plan schedule.

Duties of the committee would be:

- to promote and coordinate the implementation of the plan;
- to gather information on its implementation, the results obtained, the objectives reached, and the difficulties encountered;
- to communicate this information to the public through an annual report;
- to appoint a group of experts to evaluate the effectiveness of the plan every three years and to update it. The conclusions of this group should be made public.

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Annex I

Fisheries in which the use of acoustic deterrent devices is mandatory (from EC 812/2004, annex I)

Area	Gear	Period	Starting date
A. Baltic Sea area delimited by a line running from the Swedish coast at the point at longitude 13° E, thence due south to latitude 55° N, thence due east to longitude 14° E, thence due north to the coast of Sweden; and, Area delimited by a line running from the eastern coast of Sweden at the point at latitude 55°30' N, thence due east to longitude 15° E, thence due north to latitude 56° N, thence due east to longitude 16° E thence due north to the coast of Sweden	(a) Any bottom-set gillnet or entangling net	All year	1 June 2005
	(b) Any drift-net	All year	1 June 2005
B. ICES sub-area IV and division III a	(a) Any bottom-set gillnet or entangling net, or combination of these nets, the total length of which does not exceed 400 metres	(a) 1 August - 31 October	1 August 2005
	(b) Any bottom-set gillnet or entangling net with mesh sizes > 220 mm	(b) All year	1 June 2005
C. ICES divisions VII e, f, g, h, and j	(a) Any bottom-set gillnet or entangling net	(a) All year	1 January 2006
D. ICES division VII d	Any bottom-set gillnet or entangling net	All year	1 January 2007
E. Baltic Sea subdivision 24 (except for the area covered under A)	(a) Any bottom-set gillnet or entangling net	(a) All year	1 January 2007
	(b) Any drift-net	(b) All year	1 January 2007

Annex II

Technical specifications and conditions of use of acoustic deterrent devices (pingers) (from EC 812/2004, annex II).

Any acoustic deterrent devices used in application of Council Regulation EC 812/2004, article 2(1) shall meet one of the following sets of signal and implementation characteristics:

	Set 1	Set 2
	Signal characteristics	
Signal synthesis	Digital	Analogue
Tonal/wide band	Wide band/tonal	Tonal
Source levels (max - min) re 1 mPa@1m	145 dB	130 -150 dB
Fundamental frequency	(a) 20 - 160 KHz wide band sweeps (b) 10 kHz tonal	10 kHz
High-frequency harmonics	Yes	Yes
Pulse duration (nominal)	300 ms	300 ms
Interpulse interval	(a) 4 - 30 seconds randomised; (b) 4 seconds	4 seconds
	Implementation characteristics	
Maximum spacing between two acoustic deterrent devices along nets	200 m, with one acoustic device fixed at each end of the net (or combination of nets attached together)	100 m, with one acoustic device fixed at each end of the net (or combination of nets attached together)

Annex III

Example of a code of conduct for minimising disturbance to dolphins, basking sharks and other marine animals (from The Wildlife Trusts Cornwall, http://www.cornwallwildlifetrust.org.uk/nature/marine/harassment.htm)

Dolphins, porpoises, whales, basking sharks and turtles are some of the animals that share these waters with you. They are sensitive to disturbance so please show understanding when in their vicinity.
Certain vessels can disturb their daily activities, scaring them away and even causing injury. If you see anyone harassing or recklessly disturbing them, please report it to the police.

It is an offence to intentionally kill or injure cetaceans (dolphins, porpoises and whales). It is also an offence to disturb cetaceans and basking sharks. To do so intentionally or recklessly[4] may result in a prison sentence.

By following this code of conduct, and any local guidance that is in place, you will not commit an offence and will minimise stress to marine animals when you encounter them at sea.

1. On sighting cetaceans and other marine animals, fast vessels should gradually slow down to a slow speed (less than 6 knots). Wait until well clear of animals before gradually resuming original speed.
2. On encountering marine animals continue on your intended route. This will present predictable movements. Avoid erratic movements such as circling around the animals or sudden changes in speed.
3. Let the animals approach you. If they do choose to approach the vessel or bow-ride, maintain a steady speed without changing course.

[4] Recklessness is a legal term. A person who is heedless of the consequences of his actions or of danger will be reckless.

4. Allow groups of animals to remain together. Avoid deliberately driving through, or between, groups of animals. Proceeding slowly on a steady course will enable them to remove themselves from the path of a vessel as a group.
5. Leave cetaceans or sharks with young alone and avoid coming between a mother and her calf.
6. Always allow animals an escape route. Be aware of your surroundings. If there is more than one vessel in the vicinity avoid boxing animals in.
7. Do not swim with, touch or feed the animals, for your safety and theirs.
8. Do not throw rubbish or food near or around marine animals.
9. Minimise possible sources of noise disturbance and take care to avoid collision with animals when using sailing boats or boats with low engine noise as the animals are less likely to hear the vessel until it is close.
10. There should be no more than 1 vessel in close proximity to marine animals (less than 100m), and no more than 3 vessels in the vicinity (100m-1km) at any one time. Refrain from calling other vessels to the animals.
11. Presence in the watching area should be limited if there are other vessels in the vicinity interested in watching the marine life (15 minutes). The Wildlife and Countryside Act makes provision for licences to be issued to allow certain activities such as research and survey to take place.
12. Move away slowly if you notice signs of disturbance, such as erratic changes in speed and direction, or lengthy periods underwater.