THE HARBOUR PORPOISE in the southern North Sea

Abundance, threats and research- & management proposals

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Jan Haelters[1] & Kees (C.J.) Camphuysen[2]

[1] Royal Belgian Institute of Natural Sciences (RBINS), department Management Unit of the North Sea Mathematical Models (MUMM)
[2] Royal Netherlands Institute for Sea Research (NIOZ)

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Summary

The harbour porpoise *(Phocoena phocoena)* is the most numerous cetacean species in the North Sea. For reasons not well understood, it gradually disappeared from the southern North Sea during the 1950s, to make a spectacular return towards the end of the 20th century. The analysis of Belgian and Dutch sighting data, together with the results of research on the hundreds of animals washed ashore, yielded information on ecological aspects of the population, trends and threats.

The recent increase in numbers in the southern North Sea is probably food related, and is believed to be due to an influx of porpoises from more northern waters. Strandings data seem to indicate that the influx consists for the main part of juveniles, with significantly more males than females. However, stranded pregnant females and numerous neonates indicate that some reproduction takes place in the southern North Sea. Currently, a clear seasonal pattern is apparent in the presence of porpoises. A peak in numbers in coastal waters of the southern North Sea is reached between February and April. In late spring a northward migration towards more offshore waters is observed, and by summer the number of porpoises in coastal waters has become low. In the Dutch Delta Area (Zeeland) a small resident population seems to have been established. Observations during 2007 and 2008 have indicated that the seasonal pattern might not be stable.

Together with the return of the porpoise to the southern North Sea, a bycatch problem became apparent. Up to half of the stranded porpoises had been killed incidentally in fishing gear, a rate that justifies concerns. The main fishing gears responsible for the porpoise bycatch are gill- and tangle nets, considered otherwise as selective and relatively environmentally friendly.

Next to a lack of data on the ecology of the porpoise, data are lacking on the true level of bycatch, and on the extent, and spatial and temporal distribution of relevant fishing methods. To obtain such data, research initiatives should be coordinated and standardised internationally. Basic research funds should be structural and be provided for a long time span.

Currently protection initiatives are dispersed in many international nature conservation fora. Perhaps the best forum for the coordination of scientific research efforts in relation to porpoises in the North Sea would be ASCOBANS. For further developing measures, the most appropriate framework would be the European Community, given its competence in, and responsibilities for both fisheries and environmental matters. Also measures to prevent bycatch in recreational fisheries should be coordinated internationally. One of the most promising bycatch prevention measures is the use of pingers (acoustic alarms). However, many problems with their use remain, and currently they are not mandatory for most gill and tangle net fisheries in the southern North Sea.

While currently only few Belgian and Dutch fishermen use gill- and tangle nets, this is gradually changing, due to environmental concerns of beamtrawling and especially the soaring gasoline prices (up to the end of 2008). Therefore it is likely that without effective protective measures, the porpoise bycatch in certain areas in the North Sea will increase. It is clear that disentangling the problems the harbour porpoise is facing, is a challenging task, given the combination of environmental, social, economical, political, legal and technical factors involved.

Samenvatting

De bruinvis *(Phocoena phocoena)* is veruit de talrijkste walvisachtige in het Noordzeegebied. Om niet volledig begrepen redenen is de soort uit de zuidelijke Noordzee verdwenen aan het einde van de jaren vijftig van de 20e eeuw. Aan het einde van de 20e eeuw was er echter sprake van een spectaculaire terugkeer van de bruinvis in de Nederlandse en Belgische kustwateren. Een analyse van Belgische en Nederlandse waarnemingsgegevens, gekoppeld aan de resultaten van onderzoek van vele honderden gestrande bruinvissen, heeft belangrijke nieuwe inzichten opgeleverd in de ecologische achtergronden van de populatieontwikkelingen en bedreigingen van deze zeezoogdiersoort.

De recente toename van de bruinvis in de zuidelijke Noordzee is het gevolg van een verschuiving van een deel van de populatie vanuit de noordelijke Noordzee naar het zuiden, en is vermoedelijk voedsel-gerelateerd. Strandinggegevens laten uitschijnen dat vooral juveniele dieren migreren tot Belgische en Nederlandse kustwateren, en significant meer mannetjes dan wijfjes. De regelmatige strandingen van zwangere, adulte wijfjes en de talrijke pasgeboren bruinvissen die langs de kust aanspoelen laten echter zien dat in de zuidelijke Noordzee ook gereproduceerd wordt. Er werd de laatste jaren een duidelijk seizoenpatroon gevonden in de aanwezigheid van bruinvissen. Van februari tot en met april worden langs de kust de grootste aantallen waargenomen. Daarna volgt een migratie van de kust weg, en tegen de zomer zijn de aantallen bruinvissen in kustwateren zeer laag. Waarnemingen in 2007 en 2008 lijken echter uit te wijzen dat dit seizoenpatroon niet stabiel is. In het Nederlandse Deltagebied (Zeeland) lijkt een kleine populatie jaarrond te verblijven.

Tegelijk met de terugkeer van de bruinvis naar de zuidelijke Noordzee werd het probleem van bijvangsten actueel. Tot ongeveer de helft van alle gevonden bruinvissen bleek door incidentele vangst om het leven gekomen te zijn: een percentage dat bezorgdheid over de effecten op populatieniveau rechtvaardigt. Kieuw- en warnetten, in andere opzichten een selectief en relatief milieuvriendelijk vistuig, zijn vermoedelijk verantwoordelijk voor de meeste bijvangsten van bruinvissen in de zuidelijke Noordzee.

Er ontbreken nog veel gegevens over de ecologie van bruinvissen, over de omvang van bijvangst, en over de ruimtelijke en temporele spreiding van de verschillende visserijtypes. Om dergelijke gegevens te kunnen verzamelen, zou een internationaal gecoördineerd en gestandaardiseerd onderzoek moeten worden opgezet. De daarvoor benodigde fondsen zouden structureel, stabiel (over een lange periode) en vooral onafhankelijk van zowel de visserijindustrie als van andere belangengroepen ter beschikking moeten worden gesteld.

Initiatieven om de bruinvis te beschermen zijn tegenwoordig van teveel verschillende fora afkomstig. ASCOBANS lijkt ons de meest geschikte overlegstructuur voor de coördinatie van wetenschappelijke onderzoeksprogramma's betreffende bruinvissen in de Noordzee. Effectieve maatregelen om bijvangsten te voorkomen of op zijn minst te verminderen, kunnen daarentegen beter vanuit de Europese Commissie genomen worden, gezien hun competenties en verantwoordelijkheden met betrekking tot de visserij en het mariene milieu. Ook maatregelen ter beteugeling van de recreatieve staandwantvisserij vereisen een internationale aanpak.

Een veelbelovende methode om bijvangsten te verminderen is het gebruik van pingers (geluidsapparaatjes die aan netten bevestigd kunnen worden). Het gebruik van pingers is momenteel meestal niet verplicht bij de kieuw- en warnetvisserij in de zuidelijke Noordzee, en problemen die effectief gebruik van pingers in de weg staan zouden zo snel mogelijk aangepakt en opgelost moeten worden.

Hoewel staand want in de Belgische en Nederlandse commerciële visserij nog maar een bescheiden plaats inneemt, zijn er duidelijke veranderingen waarneembaar. Onder druk van de brandstofprijzen (tot eind 2008), maar ook gezien de milieubezwaren ten aanzien van boomkorvisserij, stappen steeds meer vissers over op passief, selectief vistuig. Wanneer deze verandering niet kritisch wordt gevolgd en begeleid, dan staan er in de toekomst nog grotere problemen met bijvangsten te wachten. Het is duidelijk dat een integrale oplossing van het probleem van bijvangsten van bruinvissen een grote uitdaging genoemd kan worden, gezien de combinatie van samenhangende factoren zoals wetgeving, milieu, klimaat, en sociale, economische, politieke en visserijtechnische aspecten.

Résumé

En mer du Nord, le cétacé le plus abondant est le marsouin, *Phocoena phocoena*. Pour des raisons qui ne sont pas complètement élucidées, cette espèce avait graduellement disparu de la partie sud de la mer du Nord dans les années 1950 pour y opérer un retour spectaculaire vers la fin du 20ème siècle. Une analyse des données d'observation provenant de Belgique et des Pays-Bas et les résultats de l'examen de plusieurs centaines d'animaux échoués sur la côte, nous renseignent sur des aspects écologiques de cette population, sur les tendances constatées et sur les menaces auxquelles elle est exposée.

La récente augmentation de cette espèce dans la partie sud de la mer du Nord est probablement liée à des causes alimentaires et provoquée par l'arrivée d'individus venant du nord. L'apport consiste principalement en juvéniles, les mâles étant significativement plus nombreux que les femelles. Toutefois, l'échouage de femelles gravides et la présence de nombreux nouveaux-nés indiquent que la reproduction n'est pas absente de la partie sud de la mer du Nord. La présence du marsouin suit clairement un schéma saisonnier. Les comptages atteignent un maximum dans les eaux côtières entre février et avril. A la fin du printemps on observe un déplacement vers le nord et la haute mer et une fois l'été venu les marsouins deviennent rares dans les eaux côtières. Une petite population résidentielle semble s'être établie dans la zone du Delta aux Pays-Bas. Des observations faites en 2007 et 2008 indiquent que ce schéma saisonnier pourrait être instable.

Avec le retour du marsouin dans la partie sud de la mer du Nord, un problème de prise accessoire est apparu. Près de la moitié des marsouins rejetés sur le littoral sont morts accidentellement dans des engins de pêche, un taux qui a de quoi inquiéter. On considère que les trémails et les filets maillants, des types d'engin de pêche par ailleurs relativement respectueux de l'environnement, ont été responsables de la plupart des prises accessoires enregistrées.

Outre un manque de données sur l'écologie du marsouin est apparu un besoin urgent de données supplémentaires sur le taux réel de prise accessoire et sur la distribution spatiale et temporelle des procédés de pêche concernés. Pour obtenir ces données il faudrait coordonner et standardiser des initiatives de recherche à l'échelon international. A la base, les fonds de recherche devraient être structurels, stables et indépendants de l'industrie de la pêche et des pêcheurs. Pour le moment, les initiatives de protection sont dispersées entre de nombreuses organisations. Pour coordonner les efforts scientifiques en mer du Nord, le forum le plus adéquat serait probablement ASCOBANS. Pour mettre au point des mesures correctives, le cadre le plus approprié devrait être la Commission Européenne, compte tenu de sa compétence tant en matière de pêche qu'en matière d'environnement. Il faut aussi que des mesures de prévention des prises accessoires soient prises à l'échelon international pour la pêche récréative.

Une des mesures de prévention des prises accessoires les plus prometteuses est l'usage de *pingers*. Il reste cependant de nombreux problèmes à résoudre pour leur utilisation et, à l'heure actuelle, leur usage n'est pas obligatoire dans la plupart des pêcheries à trémail et filet maillant dans la partie sud de la mer du Nord.

Bien qu'actuellement peu de pêcheurs belges et hollandais utilisent des trémails ou filets maillants, cette situation est en train de changer en raison du prix du carburant et des objections environnementales quant à l'usage du chalut à perche. Il est par conséquent probable qu'en l'absence de réelles mesures de protection le problème de la prise accessoire du marsouin dans les régions côtières de la mer du Nord aille en s'aggravant. En découdre avec les problèmes auxquels le marsouin fait actuellement face constitue évidemment un défi, vu la combinaison de facteurs environnementaux, climatiques, sociaux, économiques, politiques, juridiques et techniques dont il faut tenir compte.

1. Introduction

The occurrence of the harbour porpoise in the southern North Sea has been irregular during the 20th century. The fairly sudden reappearance of the species in coastal waters of the southern North Sea in the 1990s resulted in a renewed research effort. This effort was dedicated to the ecology, life history and causes of death (Addink *et al.,* 1995; Leopold & Camphuysen, 2006; Debacker *et al.,* 2002; Jauniaux *et al.,* 2002a), but attention was also paid to pollutant loads in the tissues of these top predators (Chu *et al.,* 2003; Das *et al.,* 2004; Evans *et al.,* 2007; Van de Vijver *et al.,* 2004; Weijs *et al.,* 2009a; b). Also since 1991 some stranded porpoises were successfully rehabilitated and research on anatomy, physiology, biomechanics, behaviour and acoustics was conducted in captive settings (Nachtigall *et al.,* 1995; Read *et al.,* 1997).

Together with the increase of the number of porpoises, an important threat for this vulnerable species became apparent. Many of the corpses washed ashore appeared to be animals that had suffocated in fishing gear, a problem which was already well known in other parts of the North Sea (Benke, 1994; Berggren, 1994; Kinze, 1994; Carlström & Berggren, 1997; Vinther, 1999; Vinther & Larsen, 2004).

This report intends to review the current situation regarding the status of, and threats to the harbour porpoise in the southern North Sea. The North Sea Conservation Plan for the harbour porpoise, as is being developed by ASCOBANS (Reijnders *et al.,* 2009; see also Eisfeld & Kock, 2006), includes similar information as provided in this report. The focus on the report before you lies with the historical abundance of the porpoise in Belgian and Dutch waters, on recent trends in numbers of strandings and sightings, and on the related specific conservation problems in these waters. However, the conclusions and recommendations could be of value for other parts of the species' range.

2. The harbour porpoise

Description

The harbour porpoise *(Phocoena phocoena)* is a toothed whale (Odontoceti). With a maximum length of only 1.8 m, it is one of the smallest cetaceans in existence (Rice, 1998). Porpoises are characterised by small spatulate (chisel) teeth, a relatively indistinct, triangular dorsal fin, and a blunt (rounded) head. The dorsal side of the harbour porpoise is brownish to dark grey, while the ventral parts are bright white. A gradual colour change is prominent on the sides of the animal. Flippers and tail are blackish to dark grey (Fig. 1 and 2).

Figure 1: The harbour porpoise is a small, inconspicuous cetacean which in most cases will avoid human presence.

Distribution

The harbour porpoise is found in the cool and temperate coastal waters of both the North-Atlantic and Pacific Oceans. Throughout its range, it is generally limited to the continental shelf. Within European and adjacent waters, the species is widespread and locally abundant in Icelandic and Norwegian waters, the North Sea, the Skagerrak, the Kattegat, around the British Isles, the eastern Channel and the Atlantic coast of France. Smaller densities occur within the Baltic Sea, and off Portugal and the Atlantic coast of Spain. Sparse records in the eastern part of the Mediterranean are mostly linked to the isolated Black Sea population (Birkun & Frantzis, 2006; Frantzis *et al.*, 2001; Fontaine *et al.*, 2007; Güçlüsoy, 2007; Rosel *et al.*, 2003), although some strandings suggest the presence of a small local stock (Fernández-Casado *et al.*, 2000; Frantzis *et al.*, 2003). An isolated population exists off West Africa (Boisseau *et al.*, 2007).

Two dedicated abundance surveys (SCANS I and SCANS II) concluded that porpoises numbered around a quarter of a million in the whole of the North Sea (Hammond *et al.*, 2002; SCANS II, 2008).

Reproduction

Porpoises are sexually mature at an age of 3 to 4 (males) and 4 to 5 years (females), and longevity is around 20 years. They reach sexual maturity at a body length of around 1.35 m in males and 1.40 m in females (Karakosta *et al.*, 1999; Lockyer, 1995a; b; Lockyer *et al.*, 2001; Van Deinse, 1925), although geographical differences exist. Body size and age at first reproduction could also vary in time, possibly as a consequence of changed feeding conditions, environmental factors or population sizes, as has been noticed in the Bay of Fundy, Canada (Read & Gaskin, 1990).

In the southern North Sea porpoises are mostly born between May and August, after a gestation period of 10 to 11 months. A peak in births occurs in June and July, as derived from strandings of neonates and stillborn animals (Addink *et al*., 1995). At birth porpoises measure 0.7 to 0.8 m (Van Deinse, 1925). The lactation period lasts around 8 months. Females give birth to one young every year or, more likely, every two years, which means this species only reproduces very slowly (Fisher & Harrison, 1970).

Social behaviour

Porpoises are inconspicuous animals. They will generally flee from motorised vessels, in contrast to several other cetacean species. They are rarely found in association with other cetaceans. Porpoises generally do not form large groups: usually they remain solitary or form groups of 2 to 4 animals. In rich feeding areas and during migration, larger, but fairly loose congregations of porpoises may be observed (Baptist & Witte, 1996; Jefferson *et al*., 1993).

Feeding behaviour

Porpoises do not seem to specialise on particular prey species, but can be considered opportunistic feeders. Their diet consists of many different species of fish, cephalopods, crustaceans and even polychaetes (Leopold & Camphuysen, 2006; Santos, 1998). It varies according to area (geographical patterns in prey distribution), season, and age of the porpoise. Immature porpoises in the southern North Sea were recently found to focus on small demersal fish (especially gobies Gobiidae), while larger porpoises mainly feed on gadoids, clupeids (sprat *Sprattus sprattus* and herring *Clupea harengus*) and sandeels (Ammodytidae), mostly smaller than 30 cm in length.

From recent diet studies in porpoises stranded in The Netherlands, a suggested historical link with the seasonal occurrence of clupeids in nearshore waters (Dudok van Heel, 1960; Rae, 1965; 1973; Ter Pelkwijk, 1937; Verwey, 1975a; b; Verwey *et al*., 1947) does not seem to be substantiated. However, as Santos & Pierce (2003) suggested, harbour porpoises in the northeast Atlantic may have switched to a diet based on sandeels, whiting (*Merlangius merlangus*) and other fish species following the decline in herring stocks.

Unlike white-beaked dolphins (*Lagenorhynchus albirostris*), North Sea porpoises can frequently be observed feeding close inshore, sometimes even in the shallow waters of the surf zone. The shallow southern part of the North Sea, and especially its coastal waters, can be very turbid. There is little doubt that porpoises can find their food in these murky waters by no other means than echolocation (Kastelein *et al*., 1999). They can even detect prey buried in the sediment (Kastelein *et al*., 1997). Fairly little is known about the hunting techniques of harbour porpoises in the southern North Sea. Verwey (1975a; b) made a description of the feeding behaviour of harbour porpoises in very shallow parts of the Dutch coastal waters and the western Wadden Sea: *"With dorsal fins constantly exposed, animals worked their way through the shallowest*

Figure 2: A stranded dead porpoise: for many people the only chance to see a porpoise nearby.

waters near the shore". In all situations, the number of porpoises present during a feeding bout in shallow inshore areas was fairly small, half a dozen animals at most, with not the slightest indication of a co-ordinated drive hunt.

Off the Dutch coast, some areas are clearly favoured, such as the outer Marsdiep area (western Wadden Sea), the edges of some deeper waters in the western Oosterschelde off Burghsluis, and waters around the piers of IJmuiden. An attractive local feeding opportunity is the most likely explanation for the frequent presence of porpoises in these areas. Recent sightings of apparently feeding animals also highlight the importance of nearshore river plume fronts and tidal eddies as feeding grounds (C.J. Camphuysen, unpublished data). Along most of the sandy coasts of Belgium and The Netherlands, however, the feeding behaviour is generally much harder to study and, hence, the possible significance of these waters cannot easily be determined.

In offshore waters of the southern North Sea, co-ordinated drive hunts for pelagic fish are frequently seen, often characterised by associated seabirds: northern gannets (*Morus bassanus*), black-legged kittiwakes (*Rissa tridactyla*) and several tern species (Sternidae; C.J. Camphuysen, personal observation). It has been impossible to identify the targeted prey under these conditions, but these drive hunts are typically conducted by small numbers of porpoises (2 to 4 animals, occasionally more) working in a concerted action and swimming at high speed while driving prey fish towards the surface. Potential prey candidates under these conditions are sandeels, clupeids, and perhaps even mackerel (*Scomber scombrus*) and horse mackerel (*Trachurus trachurus*): shoaling fish in the water column, rather than more dispersed demersal fish species. It should be noted that pelagic fishing behaviour by cetaceans is obviously considerably easier to spot than any activities on the sea floor.

The frequent local co-occurrence of high densities of harbour porpoises and divers (Gaviidae) in the southern North Sea (Camphuysen, 2004b; Camphuysen & Leopold, 1998; Leopold, 1996) and the remarkable similarities in the diet of these two types of predators (M.F. Leopold pers. comm.; Leopold, 2001) indicate similar demersal foraging habits in this area.

Natural enemies

Natural enemies of the harbour porpoise in the North Sea are large sharks, killer whales (*Orcinus orca*) and common bottlenose dolphins (*Tursiops truncatus*), but none of these species commonly occur in Belgian and Dutch waters. Several of the (very few) killer whales found stranded in The Netherlands were found to have the remains of harbour porpoises in their stomach (Camphuysen & Peet, 2006; Van Dieren, 1931; van Laar, 1963). From a detailed analysis of the sightings data presented by Verwey (1975a; b) in the Marsdiep area, it is obvious that porpoises were relatively rare in spring, when bottlenose dolphins entered the area for their annual hunt for *Zuiderzeeharing* (a herring race). From ship-based observations in the North Sea at large (including the southern North Sea), it is obvious that dolphins (mostly white-beaked dolphins) and harbour porpoises do not normally co-occur in substantial numbers in the same areas at the same time (ESAS, unpublished data).

3. Legal framework for the protection of the harbour porpoise

Harbour porpoises, as all cetaceans in the North Sea, are legally protected by Belgium and The Netherlands by means of international and national legislation. This means that intentional killing, intentional disturbance, and trading or collecting animals or parts of them is illegal.

3.1 International fora

Cetaceans are very (or even the most) popular marine animals, in particular because of their intelligence, their impressive size and their elegance. However, some species are very vulnerable, or even threatened with extinction. For these reasons cetaceans were among the first animals to have been legally protected. Since most cetaceans are wide-ranging, often displaying migration patterns, protection measures are to be co-ordinated on an international level.

There is a variety of international conventions, agreements and action plans dealing with the protection and conservation of cetaceans (Trouwborst & Dotinga, 2008). They provide a framework for their parties to adopt national implementing legislation. The following instruments will not be discussed in detail, but are mentioned for completeness: the United Nation's *Convention on the Law of the Sea* (UNCLOS)[1], the *Code of Conduct for Responsible Fisheries* of the Food and Agriculture Organisation of the United Nations (FAO)[2] and the *Convention on Biological Diversity* of the United Nations (CBD)[3].

UNCLOS represents the constitution of the oceans and sets out the global legal framework for human activities at sea. UNCLOS requests Parties, inter alia, to cooperate in the conservation of marine mammals in the EEZ and the high seas, and in the case of cetaceans to work through the appropriate international organizations for their conservation, management and study.

The FAO Code of Conduct for Responsible Fisheries provides a non-legally binding framework for the international and national efforts towards a sustainable use of living aquatic resources, in harmony with the environment. It sets an obligation to fish in a responsible way, in order to ensure the conservation of target species and species belonging to, or associated with the same ecosystem. States should minimise bycatch of non-target species, and undertake research into the selectivity of fishing gear and their environmental impact.

By signing the CBD, world leaders committed, among other things, to the conservation of biological diversity and the sustainable use of its components. For Belgium and The Netherlands, OSPAR (see below) and the European Directives can be considered as the most important instruments for implementing the marine aspects of the CBD.

The international conventions and agreements detailed hereunder have been signed and ratified, amongst other nations, by Belgium and The Netherlands. Specific fisheries measures taken at a national and an international level, with a direct or indirect effect on the harbour porpoise in the southern North Sea, are being dealt with in chapter 5.

The IWC

The *International Whaling Commission* (IWC)[4] was set up in 1946 by the International Convention for the Regulation of Whaling (ICRW) to work on conservation and management of whale stocks. Although the application of the ICRW to small cetaceans is still questioned by some Parties, they have been a focus of study and management advice within the Sub-Committee Small Cetaceans of the IWC Scientific Committee. Several IWC resolutions[5] have been adopted concerning directed and incidental catches of small cetacean species, and a reduction of bycatch levels of porpoises in the North-Atlantic has been recommended.

CMS and ASCOBANS

The *Convention on the Conservation of Migratory Species of wild animals*[6] (also known as CMS or the Bonn Convention) is a global convention concluded in 1979 under the United Nations Environment Programme (UNEP). It aims to conserve migratory species throughout their range. Appendix I to the Convention lists migratory species that are threatened with extinction. Species that need, or would benefit from international co-operation are listed in Appendix II. For these species (a.o. the harbour porpoise), CMS encourages states to conclude regional Agreements. CMS has repeatedly adopted resolutions dealing with the assessment of human impacts on cetaceans and the limitation of incidental catches[7]. Such resolutions however, do not specifically refer to harbour porpoises; they are very general, and only impose a moral obligation upon Parties.

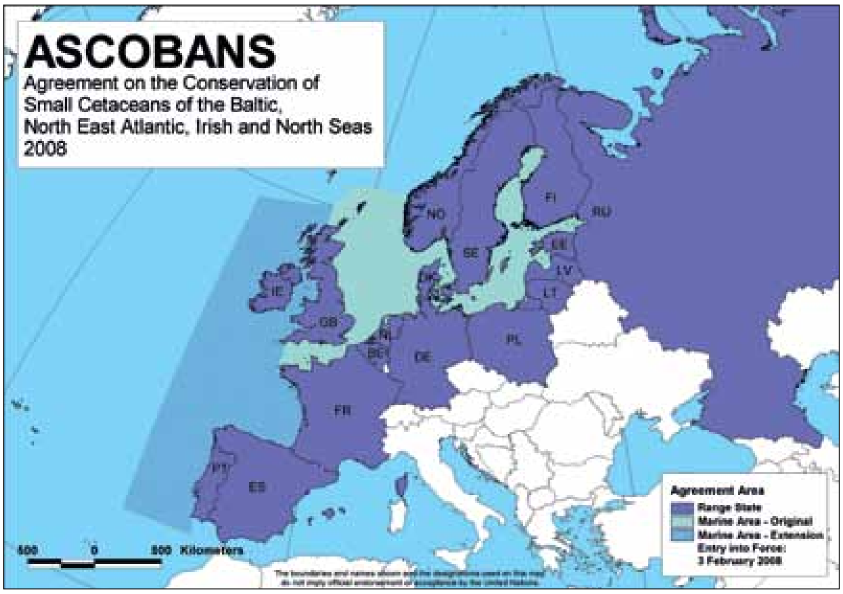

Figure 3: Map of the new ASCOBANS Area indicating the original and extended Agreement area and the range states. Current Parties are France, the United Kingdom, Belgium, The Netherlands, Germany, Denmark, Poland, Lithuania, Finland and Sweden.

Under CMS, the regional Agreement ASCOBANS was concluded. This Agreement, originally named the *Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas*[8], aims to conserve the small cetaceans (all toothed whales except for the sperm whale) in the Baltic and North Seas[9]. The current ASCOBANS area (Fig. 3) also covers waters under the jurisdiction of Ireland, Spain, Portugal, Norway, Estonia, Latvia and the Russian Federation, although these range states have chosen not to become a party.

The principle aim of ASCOBANS is to achieve an efficient protection of small cetaceans through international co-operation. This should be achieved through the implementation of a *Conservation and Management Plan* (annexed to the Agreement text) with the following priority actions:

1. Habitat conservation and management, including the reduction of pollution and bycatch, the regulation of activities with an indirect impact on small cetaceans, the prevention of disturbance and the establishment of protected areas;
2. Surveys and research, including research on stranded animals;
3. Effective national legal protection;
4. Information and education of the public on the species and issues.

ASCOBANS has been successful in bringing together administrators, scientists and delegates from the Parties, range states, and relevant inter-governmental and non-governmental organisations. One of its major achievements is the development of the generally adopted principle that annual bycatch levels of small cetaceans should be less than 1.7 % of the best population estimates, and that a take of porpoises of less than 1 % of the population size should be an intermediate precautionary objective[10]. An annual bycatch above 1.7 % of the population is unsustainable, and therefore unacceptable.

ASCOBANS has recently been criticised for its lack of progress. Indeed: it so far failed to yield legally binding protection measures. This is mainly due to a lack of (legal) competence, especially in the field of fisheries. On the other hand, many of the subjects dealt with by ASCOBANS have been taken up in other fora, and part of the achievements of ASCOBANS can be traced back in management actions taken at other levels, both internationally and nationally. Up to now, most of the efforts in ASCOBANS have been dedicated to the harbour porpoise, although it is also competent for the protection of the other small cetaceans in the Agreement area.

North Sea Conferences

The *International Conferences on the protection of the North Sea* (NSC)[11] are political events where ministers responsible for the protection of the marine environment assess which additional measures should be taken. Although the commitments made at the NSC are not legally binding, they have high political force and reflect the solutions nations around the North Sea are considering for

resolving environmental problems. In many cases, these commitments are endorsed afterwards in legally binding fora such as the OSPAR Convention or the European Community legislation. At the 5th NSC, held in March 2002 in Bergen, Norway, it was agreed that the porpoise bycatch level should be reduced. As an interim objective, the Ministers of North Sea riparian states, along the lines of ASCOBANS, agreed to reduce annual bycatches to below 1.7 % of the best population estimate. In 2006 they agreed that special attention should also be given to the development of fishing gear and fishing methods that will help to reduce by-catches of marine mammals to less than 1 % of the best available population estimates. They furthermore agreed that a Recovery Plan for the harbour porpoise in the North Sea should be developed (Anonymous, 2002). The development of a *Recovery Plan* was taken up by ASCOBANS, building on the experience with a recovery plan for the porpoise in the Baltic (the Jastarna Plan).

EU Habitats Directive

The *European Community Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora*[12] (commonly know as the Habitats Directive) was adopted in 1992. It contains a list of species of Community importance that have to be strictly protected (Annex IV). Next to this, a number of species have been listed for which sites need to be selected by Member States to contribute to conserving their habitats (Annex II). These Special Areas of Conservation (SACs) should constitute, together with the areas listed under the European Birds Directive (Special Protection Areas or SPAs), a network of sites which will act as the backbone of the European policy concerning habitat protection: the NATURA 2000 network. The harbour porpoise is included in Annex II and Annex IV of the Habitats Directive.

While through this Directive the harbour porpoise is protected in all EU Member States, it has been difficult to establish protected areas specifically for this species throughout Europe. Article 4 of the Habitats Directive states that *for aquatic species which range over wide areas,* [SAC's] *will be proposed only where there is a clearly identifiable area representing the physical and biological factors essential to their life and reproduction.* Given the lack of detailed data on the distribution and reproduction of the harbour porpoise, the migratory nature of the animal and its fairly irregular occurrence in certain areas, it has been difficult to assess the location of the most suitable sites. It is now more and more acknowledged that it might not even be relevant to identify SAC's for this wide-ranging species. This is not only the case for the harbour porpoise. Given the lack of information on the distribution of many marine species and habitats, the establishment of the NATURA 2000 network at sea is still far from complete.

While the European nature conservation legislation, together with international treaties, imposes a strict protection of the porpoise, the main threat for porpoises are certain fishing activities. Fishing activities are mainly managed by the European Commission in its Common Fisheries Policy. The Habitats Directive only touches fisheries and the bycatch problem marginally and in general terms (in Article 12(4), Article 15, and Annex VI). According to Article 12(4), Member States must introduce *a system to monitor the incidental capture and killing of Annex IV species,* and are required to *undertake further research or conservation measures to ensure that the incidental capture and killing does not have a significant impact on the species concerned.* Article 15 states that Member States should *prohibit the use of all indiscriminate means capable of causing local disappearance, or serious disturbance to, populations of species of Annex IVa* for which a derogation is applied [according to Article 16]. In Annex VI prohibited means of capture and killing are listed, among which *nets which are non-selective according to their principle or their conditions of use.*

While some fisheries provisions seem to have been taken in the Habitats Directive, it is clear that in practice they remained idle in most Member States. This is due to the fact that in most cases different national authorities are responsible for fisheries and for environmental protection, and too little communication exists between them. The relevant fisheries measures, both on a European and national (Dutch and Belgian) level, are being dealt with further on in this document.

For the member states of the European Community, the obligations under the 1979 *Convention on the Conservation of Wildlife and Natural Habitats in Europe*[13], also known as the Bern Convention, have been largely taken up into the European Habitats and Birds Directives.

Next to the Habitats Directive, also the European Marine Strategy Directive, adopted in 2008, is of relevance[14]. Maintaining biological diversity is one of the quality descriptors to achieve *Good Environmental Status.* This means that biological diversity is maintained, and that the quality and occurrence of habitats, and the distribution and abundance of species, are in line with prevailing physiographic, geographic and climatic conditions.

CITES

The 1973 *Convention on the International Trade in Endangered Species of wild fauna and flora,* also known as CITES or the Convention of Washington[15] aims to ensure that the trade in species does not threaten their survival in the wild. In several appendices, CITES sets varying regulations for the international trade in species: in live plants and animals, as well as in parts of them. The harbour porpoise is included in Appendix II, which lists species that are not necessarily threatened with extinction, but may become so unless trade is closely controlled. International trade in specimens of Appendix II species may be authorized by the granting of an export permit or a re-export certificate. No import permit is necessary for these species under CITES.

Within the European Union CITES has been implemented since 1 January 1984 through regulations known as the *Wildlife Trade Regulations*[16]. The provisions in the EU Wildlife Trade Regulations are stricter at some points than CITES. All cetaceans are listed in Annex A of Council Regulation 338/97, which effectively treats them as if they were CITES Appendix I species. Commercial trade of these species within the European Community is therefore not allowed.

OSPAR Convention

The 1992 *Convention for the protection of the marine environment in the north-east Atlantic* (OSPAR)[17] is managed by the OSPAR Commission, which consists of the representatives of the 15 OSPAR Parties[18] and the European Commission. In its Annex V and Appendix 3, OSPAR deals with the protection and conservation of the ecosystems and biological diversity of the maritime area.

In order to guide the setting of priorities for the implementation of Annex V, OSPAR has compiled an initial list of species and habitats to be protected because they are threatened and/or declining. The harbour porpoise is one of the species on the initial OSPAR list (OSPAR, 2004; 2006a). Given this listing, OSPAR is looking into the relevance to take measures in an OSPAR framework. Undoubtedly the OSPAR programmes and measures in the framework of the reduction of pollution are beneficial to the harbour porpoise, but they are generic, and not aimed specifically at marine mammals. OSPAR is not competent to adopt measures in the field of fisheries management, but it can draw the attention of the relevant authorities, including the European Commission, to issues where it considers that action is desirable.

To help fulfil its commitments in applying an ecosystem approach to the management of human activities that may affect the marine environment, OSPAR is developing *Ecological Quality Objectives* (EcoQO's) for the North Sea as a test case. These EcoQO's can be considered as objectives for a number of indicators, which are related to environmental problems. One of the objectives that OSPAR has put forward is that annual bycatch levels should be reduced to below 1.7 % of the best population estimate, along the lines of ASCOBANS and NSC recommendations (OSPAR, 2006b).

3.2 National legislation in Belgium and The Netherlands

The harbour porpoise is legally protected through national legislation in Belgium and The Netherlands.

In Belgium the harbour porpoise is a protected species according to a Royal Decree issued in 1980[19] and a Ministerial Decree issued in 1997[20] (Flemish regional legislation). In the marine environment, the species is legally protected through a framework law on the protection of the marine environment issued in 1999[21]. The general measures set out in this law were further implemented through a Royal Decree in 2001, which was signed both by the minister responsible for the environment of the Belgian part of the North Sea, as by the minister responsible for marine fisheries. It contains protection measures as well as measures to facilitate scientific research[22].

In The Netherlands the harbour porpoise is protected through the Law on the Flora and Fauna[23]. According to this legislation it is illegal to kill, wound, catch, and obtain protected species, to track them with the abovementioned intentions, or to disturb them on purpose.

4. The harbour porpoise in Belgian and Dutch waters

4.1 Before the 20th century

There is substantial, but fairly anecdotal information on the harbour porpoise in Belgium and The Netherlands before the 20th century. Archaeological excavations of pre-historic coastal settlements have revealed the use of harbour porpoises by early Neolithic (human) hunter-gatherer populations roaming the coasts of the southern North Sea in what is now called Belgium and The Netherlands (Louwe Kooijmans *et al.*, 2005). The animal is frequently mentioned in historical accounts that date back to the Middle Ages. For instance, it can be traced back in the accounts of the bailiffs of the county of Flanders, because of the claim that was laid on stranded animals by the count (De Groote, 1999). The animal is often mentioned in early natural history publications, but in many cases it was not discriminated from other small cetaceans.

Early descriptions of porpoises which include some life-history information, are those given by Adriaen Coenen (1585) and Mattheus Smallegange (1696). Historic records indicate that the porpoise was part of the diet of coastal inhabitants, and that it was actively hunted (Fig. 4). The first cooking book in Dutch even describes a recipe to prepare porpoise with pepper. The historic information on strandings, sightings and catches of harbour porpoises in Belgium and The Netherlands is extensively described by Camphuysen & Peet (2006).

Figure 4: Information on the occurrence of the porpoise in the (distant) past is largely anecdotal. This painting by Frans Snyders (Antwerp, 1579-1657) describes in a baroque way the fish market in Flanders in the 17th century. Next to some fish species that are rare now, we find a harbour porpoise at the lower right hand side of the painting (© KMSK Antwerp).

4.2 Research on the harbour porpoise in Belgium and The Netherlands during the 20th century

The harbour porpoise appears not to have been an attractive study subject in the southern North Sea during the first half of the 20th century, due in part to its high abundance, but also to its inconspicuous nature and small size. Studies and publications of rarer and more spectacular cetaceans that washed ashore were seemingly more rewarding. Also sightings were rarely reported, probably because the animal was so common. Therefore, information about the harbour porpoise in the early 20th century in The Netherlands and Belgium is scarce.

Research in The Netherlands

Observations of porpoises were rarely recorded in the past, except when they occurred in unusual areas, such as far upstream rivers or in cities. When the Zuiderzee was closed by the *Afsluitdijk* (a barrier dam connecting Friesland with mainland Noord-Holland) in 1931, and became the lake IJsselmeer, the fate of the enclosed harbour porpoises was reported in an anecdotal way only (Stoppelaar *et al.*, 1935). Given the expected radical changes of this sea area that was to change into a freshwater lake, most organisms were carefully monitored. However, our knowledge of the seemingly resident porpoises in the area prior to, and following the enclosure is very incomplete (Heinsius, 1914; Redeke, 1922; Weber, 1922).

One of the first to study the porpoise in the wild was Jan Verwey, former director of the *Royal Netherlands Institute for Sea Research* (NIOZ). He described the behaviour and seasonal trends of harbour porpoises in Dutch nearshore waters before and after World War II (Verwey 1975a; b). His descriptions of porpoises in the Marsdiep area are some of the very few first-hand accounts of porpoise behaviour and fluctuations in seasonal abundance in Dutch nearshore waters.

Antonius Boudewijn van Deinse (1885-1965), who was fully devoted throughout his life to the proper documentation of cetaceans stranded in The Netherlands, considered harbour porpoises too abundant to be of interest. Only 'abnormal' cases were reported and the annual number washed ashore was often indicated by the mathematical symbol " ∞ " (*infinite;* Van Deinse, 1925; 1931; 1946 and annual reports 1944-1966). Growth rates of porpoises and reproductive characteristics were investigated by van Utrecht (1978).

After the death of Van Deinse in 1965, a systematic recording of (reported) strandings of cetaceans in The Netherlands was taken up again only in 1970. From 1970 onwards, details on porpoises were included in the stranding reports (Husson & van Bree, 1972; 1976; van Bree & Husson, 1974; van Bree & Smeenk, 1978; 1982; Smeenk, 1986; 1989; 1992; 1995; 2003). After the retirement of Smeenk in 2005, the strandings data were digitised by C.J. Camphuysen and forwarded to *Naturalis,* Leiden (the Dutch national Natural History Museum). Today, strandings data are made available to the general public through a website[24], and the bones of rarer cetaceans, and a selection of stranded porpoises, are added to the extensive collections of this museum.

Dutch seawatchers, systematically recording the passage of migratory seabirds, waders and waterfowl since 1972, were the first to report some sightings of porpoises from the Dutch coast (Camphuysen, 1982; 1985; Camphuysen & Van Dijk, 1983). It was from these effort-corrected data that the return of the harbour porpoise in coastal waters of the southern North Sea started to be properly documented (Camphuysen, 1994; 2004a; Camphuysen & Leopold, 1993).

Research in Belgium

In the 19th century Pierre-Joseph Van Beneden (1809-1894), professor at the University of Leuven, had studied cetaceans, but mostly the larger whales and fossil cetaceans found in abundance in deposits around Antwerp. A systematic investigation of stranded animals did not exist during the 19th century and the first half of the 20th century. Data on small cetaceans in Belgium remain therefore largely anecdotal and scattered. It seems that only porpoises caught tens of kilometres upstream the river Scheldt found their way into journals and local papers – nobody seems to have expressed an interest in strandings of porpoises on beaches, or what must have been regular sightings at sea. At least in the 19th century the porpoise was considered common in the Scheldt up to Antwerp, and at the Belgian coast, where strandings frequently occurred (De Selys-Longchamps, 1842; Lameere, 1895).

Early Belgian strandings- and sightings data were summarised by Wim De Smet (°1932). He published two extensive reports on the historic occurrence of cetaceans along the *Flemish coasts,* which stretch from Calais, France, to the mouth of the river Scheldt, The Netherlands (De Smet, 1974; 1981). In the 1960s, Wim De Smet initiated, together with the University of Antwerp and later with the Fisheries Research Station, a more systematic research of stranded cetaceans (De Smet, 1979). The increased interest in cetaceans in those years followed an increasing environmental awareness caused by marine pollution and its consequences.

From the 1970s onwards, data on strandings and sightings in Belgium were collected by the veterinary surgeon John Van Gompel, in co-operation with the Royal Belgian

Institute of Natural Sciences (RBINS) and later with the University of Liège. From this period onwards, a clearer picture exists about the occurrence of porpoises in Belgium (Van Gompel, 1991; 1996).

In order to contribute to specific obligations of the Belgian government in the framework of a number of international commitments, a dedicated and government supported research network was established in 1992. This multidisciplinary network is co-ordinated by the Management Unit of the North Sea Mathematical Models (MUMM), a Department of the RBINS. MUMM maintains a database on marine mammal strandings and sightings, part of which can be consulted on its website[25]. Selected remains of stranded cetaceans are taken up in the extensive natural history collection of the RBINS, and some are on display in its museum.

4.3 The occurrence of the harbour porpoise in Belgium and The Netherlands in the 20th and early 21st century

Despite our data being very incomplete, it is possible to at least reconstruct shifts in abundance of porpoises through most of the 20th and early 21st centuries (see also Camphuysen & Peet, 2006; Reijnders, 1992; Smeenk 1987). From 1900 to the early 1950s, harbour porpoises were considered *"abundant and widespread"* in coastal waters throughout the southern North Sea (Van Deinse, 1925). There are no reasons to doubt that prior to that period the shallow waters of the southern North Sea, with its estuaries and river mouths, and even the Wadden Sea and the former Zuiderzee, had been prime habitats for porpoises for centuries (Camphuysen & Peet, 2006).

Occurrence in The Netherlands

According to Weber (1922) and Van Deinse (1925), porpoises were common not only along the Dutch coast, but also in the Zuiderzee. In the latter area, porpoises were observed to hunt anchovy *(Engraulis encrasicolus)* and garfish *(Belone belone)* during summer months (Heinsius, 1914), but since this is the only original published account of some sightings, we have no idea of how representative the report actually is for these porpoises. Shortly after the closing of the Zuiderzee, its entire surface froze during a severe winter, and all enclosed porpoises died (Stoppelaar *et al.*, 1935).

Some authors claimed that during the early 20th century harbour porpoises were most numerous in summer months, and go as far as claiming that harbour porpoises were *as strongly coupled with good (warm) summer weather as swallows may be expected as spring migrants* (IJsseling & Scheygrond, 1943). Neither the strandings data, nor the anecdotal sightings data currently available, seem to support that claim (Camphuysen & Peet, 2006; Verwey, 1975a; b).

More detailed information on the occurrence of the harbour porpoise in The Netherlands is available from around World War II, especially about porpoises in the western Wadden Sea. Before World War II, Jan Verwey and his colleagues of the zoological station at Den Helder saw porpoises almost daily, although numbers varied on a monthly basis (Verwey, 1975a; b). Small numbers were observed from February to May, and these increased in June and July. The highest numbers were seen from December to February. For reasons not quite well understood, the formerly abundant species gradually disappeared after World War II, somewhere during the 1950s and 1960s. At first, the decline was reported by some naturalists, but ignored - or denied - by established scientists such as Van Deinse (1952; 1956; 1957; 1958; 1960; 1961) and Vader (1956). An incidental report published by Dudok van Heel (1960) on 40 to 50 harbour porpoises in mid-January 1958 in the Texelstroom area (western Wadden Sea) seemed to confirm that harbour porpoises were still numerous. This was the last sighting of any significance, however, and virtually none were reported in the 1960s and 1970s in the waters around The Netherlands. In the 1970s, sightings of harbour porpoises were so rare that the animal might as well be considered locally extinct (Camphuysen, 1982). Between 1970 and 1985, Dutch seawatchers recorded only 20 porpoises during 40.000 hours of observations, illustrating well how rare this species was in coastal waters.

Occurrence in Belgium

From the publications by Wim De Smet (1974; 1981) it appears that the harbour porpoise was common during the first half of the 20th century in Belgian waters, but the evidence for this is very anecdotal. As was noticed in The Netherlands, it appeared that the numbers of harbour porpoises had declined in Belgian waters after World War II. Wim De Smet tried to organise a scientific investigation of stranded marine mammals from the 1960s onwards, but he succeeded in collecting only very few porpoises. Also during the period when John Van Gompel recorded strandings, and performed scientific investigations of stranded animals, their numbers remained very low (Van Gompel, 1991; 1996), with on average only 1 recorded stranding per year between 1970 and 1989. Although a number of strandings were probably not recorded, this indicates the scarcity of the porpoise in Belgian waters during those decades.

4.4 Increase in the number of porpoises in the southern North Sea at the end of the 20th century: evidence from stranding records

Not only sightings of porpoises were rare from the 1960s to the 1980s, also strandings were scarce and far apart. The total number of stranded animals recorded per year in The Netherlands and Belgium between 1970 and 2007 is shown in figure 5. In the 1970s between 6 and 29 porpoises were found stranded annually in The Netherlands, clearly contrasting with the *infinite* number reported by Van Deinse in the first half of the 20th century. The total number of recorded strandings in the 1970s and 1980s in Belgium was only 21. From the late 1980s (The Netherlands) and the mid-1990s (Belgium) the number of stranded porpoises steadily increased. As with the historic decline (Reijnders, 1992; Verwey, 1975a; b), also the increase in occurrence as evidenced through sightings, appeared to be concurrent with trends in strandings.

In The Netherlands on average 30 porpoises washed ashore per year in the 1980s. This increased to 45 per year in the 1990s, and 242 per year in the early 21st century (data from the national strandings database managed at Naturalis Leiden and at Royal NIOZ, Texel; Addink & Smeenk, 1999). Recorded stranding numbers in Belgium increased from on average 6 per year in the 1990s to 49 per year in the early 21st century (data from De Smet, 1974; 1981; Van Gompel, 1991; 1996; database MUMM). The number of stranded porpoises was considerably lower in 2007 than in 2006. Data collected in the first four months of 2008 show that it has declined even further. The coming years will show whether this recent decline will continue, or if it was a temporary phenomenon.

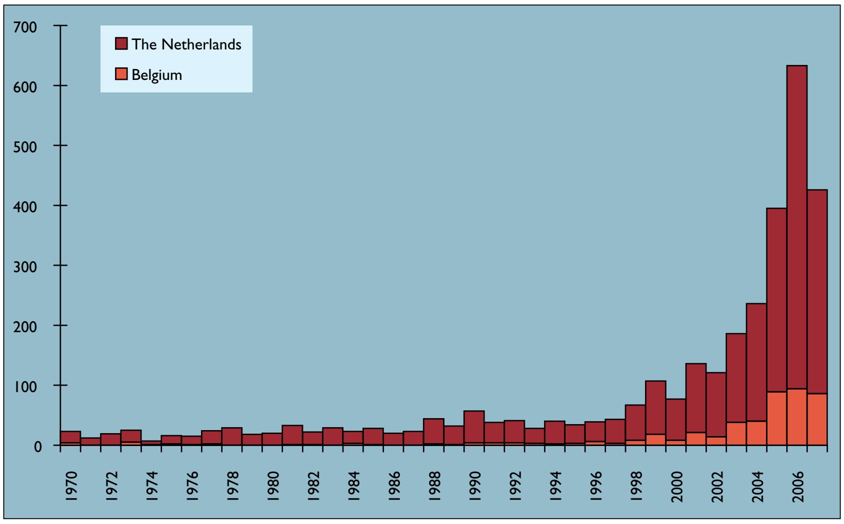

Figure 5: Annual number of recorded stranded harbour porpoises in Belgium and The Netherlands from 1970 to 2007 (data: NIOZ, Naturalis and RBINS/MUMM). In both countries a similar trend occurred: a virtual absence of strandings during the 1970s and 1980s, a steady increase between the 1990s and 2006, and a slight decline in 2007.

4.5 Increase of the numbers of porpoises in the southern North Sea at the end of the 20th century: evidence from sightings

Sources of information

The numbers and distribution of porpoises at sea originate from different sources. In the late 1970s, a standardised protocol to record seabirds at sea was developed (Tasker *et al.*, 1984). The standardisation of observation techniques *(line-transect survey methods)* permitted the construction of a joint, international database on seabirds: the *European Seabirds at Sea database* (ESAS database; Reid & Camphuysen, 1998). During the seabird surveys also marine mammal sightings were recorded, together with temporal and spatial patterns in observer effort. These marine mammal observations constituted the first, and to date the most comprehensive dataset on the abundance and spatial distribution of cetaceans in the North Sea.

Both in the summer of 1994 and 2005 an international survey was carried out, dedicated to the assessment of the porpoise population size within the North Sea and adjacent areas. These so-called *SCANS I* and *SCANS II*[26]

surveys included Belgian and Dutch waters. Apart from these two extensive international research campaigns, there have been a number of dedicated national aerial and ship-based marine mammal surveys over smaller areas, usually in the framework of projects, or in the implementation of the obligations under the Habitats Directive.

Another source of information for the occurrence of porpoises in nearshore waters is the sea-watching dataset of the *Nederlandse Zeevogelgroep* (NZG), containing besides numbers and species of birds migrating along the coastline, also sightings of marine mammals. These effort-corrected sightings data are available form 1972 onwards. In recent years, most seawatching results, also from the Belgian coast, are instantly made available on the internet[27], allowing immediate analyses and comparisons of patterns in abundance throughout the year and over the surveyed (coastal) area.

Useful information can also be obtained from the non-effort-related sightings reported by the public, or by people active at sea on board aircraft, helicopters, fishing vessels, ferries or gas rigs[28]. Although not effort related, these anecdotal data do give valuable information, and further encourage people to report their sightings, to learn how to discriminate the different species, and to understand conservation efforts. Obvious restrictions of the incidental sightings are the following:

1. Misidentifications are more likely to occur, although there are very few cetacean species in Belgian and Dutch waters that can be confused with harbour porpoises.
2. Sightings tend to be concentrated around marinas, coastal vantage points and frequently used shipping lanes for yachts.
3. One could expect that sightings predominantly occur during periods with a higher level of marine recreation (summer).
4. The number of sightings reported has increased due to an increasing attention of the public towards environmental matters, and the easy way in which sightings can be reported through the internet.

However, in all previous compilations of these data it was obvious that trends in incidental sightings of harbour porpoises closely followed both spatial and temporal trends in sightings from effort-corrected data and strandings information (e.g. Camphuysen, 2004a).

Yearly trends in the occurrence

The *Sea Watch Foundation,* the *Joint Nature Conservation Committee* (JNCC) and the Sea Mammal Research Unit (SMRU) systematically analysed effort related sightings data collected up to around 2000 in British and adjacent waters, including ESAS and SCANS I data. The distribution of porpoises in the North Sea which is presented (Reid *et al.*, 2003), is from before the species returned to the southern North Sea. Porpoises were common throughout the North Sea, except in its southernmost part, including Belgian and Dutch coastal waters.

The return of the harbour porpoise in Dutch coastal waters was first noticed during the monitoring of migrating birds from the coastline by seawatchers (Fig. 6). This increase in sightings in the 1990s and the early 21st century could only be described as *a spectacular come-back* (Camphuysen, 2004a). From the mid-1990s to the early 21st century, an annual increase of on average 41 % was found, which is clearly more than the potential natural population growth. At first, only fully-grown animals were seen, and the occurrence was virtually restricted to mid-winter. In later years, numbers not only sharply increased in winter

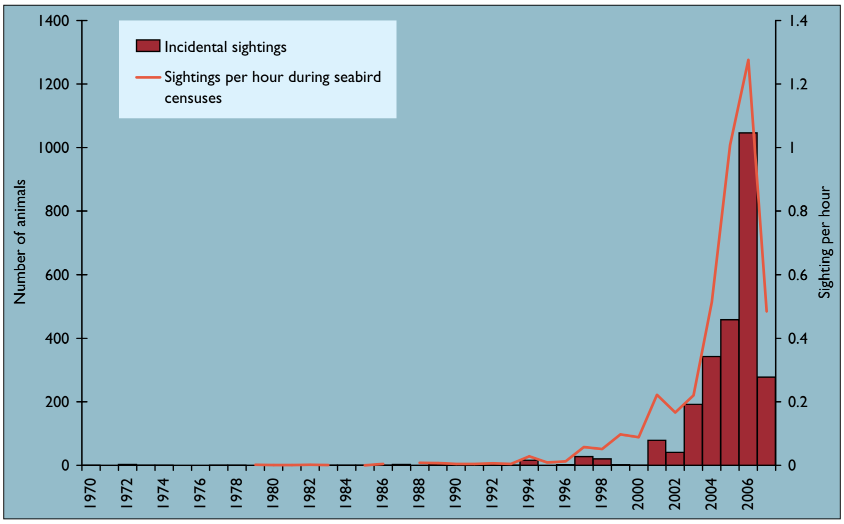

Figure 6: Annual sightings of harbour porpoises in Dutch coastal waters (coastal observations only), including effort corrected sightings from seawatchers (animals hour-1, orange line, right y-axis) and incidental sightings reported by others (number of animals reported, red, left y-axis). Note the spectacular decline in sightings in 2007.

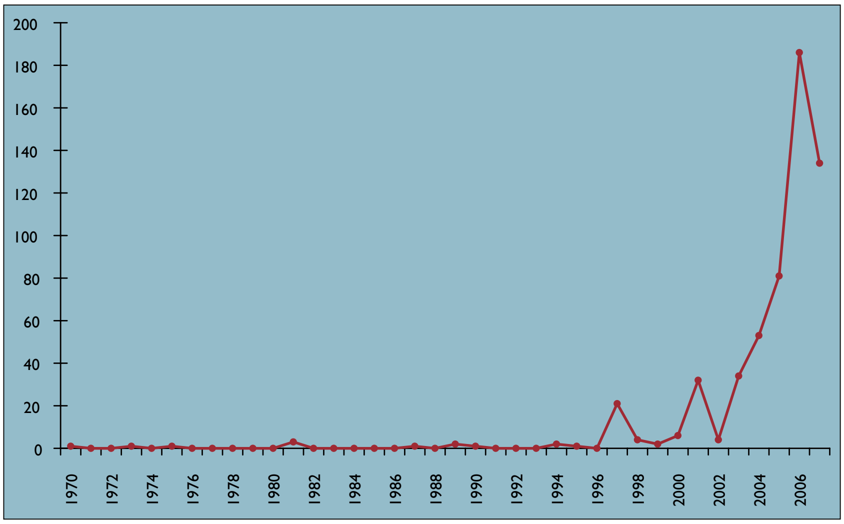

Figure 7: Annual number of porpoises reported by the public from 1970 to 2007 in Belgian waters (anecdotal sightings only) (data MUMM).

and spring, but more animals, including some mother-calf pairs, were seen also in summer and autumn.

An increase in sightings of harbour porpoises in the Dutch sector of the North Sea was reported from systematic aerial surveys between 1985 and 1997 by Witte *et al.* (1998); this was confirmed by a later analysis of aerial survey data from 1991 to 2003 by Osinga (2005). The increase in sightings reported from Zeeland occurred after 2000, 12 years after the observation of an increase in the northern part of Dutch waters (Camphuysen & Heijboer, 2008). In 2007, the number of sightings reported by the public, and the sightings from the seawatchers along the coastline, indicated a drastic decline in the abundance of harbour porpoises in nearshore waters (Fig. 6).

Based on anecdotal records, the number of sightings in Belgian waters started to increase a few years later than in The Netherlands, possibly indicating a continued extension of the range of the species towards the south during the beginning of the 21st century (Fig. 7). Data gathered by the *Research Institute for Nature and Forest* (INBO) during seabird surveys had also demonstrated the increase in Belgian waters (Courtens *et al.*, 2008). The trends in sightings in Belgian waters and in the most southerly waters of The Netherlands (Zeeland) are similar.

Seasonal pattern of occurrence

Next to the annual trend, the sightings data also indicate seasonal movements of the species. An analysis of the seasonal pattern in sightings reported to the NZG Marine Mammal database is interesting in the sense that prior to 2000, when nearshore abundance was still low, distinct peaks in the number of reported porpoises can be observed in April and December (Fig. 8). Neither one can be explained easily by peaks in likely sightings from the activities of fishermen, yachtsmen and research vessels at sea. The peak in coastal sightings is modest and restricted to March.

In recent years (2000-2007), following a drastic increase in sightings frequency, a distinct spring peak in reported sightings was obvious, followed by a dip in June and a slightly higher level from July onwards (Fig. 8). The seasonal pattern can be described as follows: low densities during summer, a gradual increase in autumn towards a peak in abundance in winter and early spring (in particular in February and March), followed by a sharp decline during spring. The pattern on the basis of anecdotal observations in Belgium between 2000 and 2007 was slightly different: the bulk of the porpoises seemed to arrive in Belgian waters slightly later in the year than in Dutch waters, and peaked from February to April; hardly any sightings were reported after May (Fig. 9). It should be mentioned that only a small shift in the distribution of porpoises can have large effects on the sighting rates, especially for the anecdotal observations which are concentrated near the coastline.

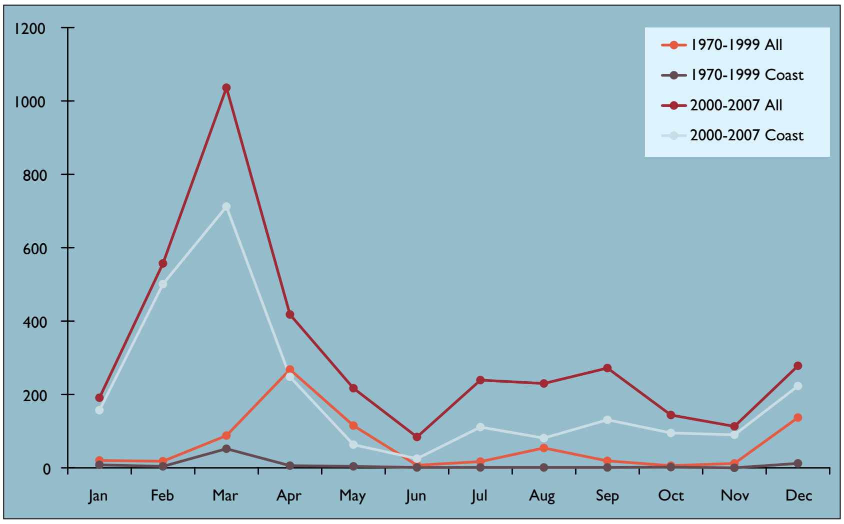

Figure 8: Anecdotal observations of harbour porpoises per month reported to the Marine Mammal database (The Netherlands), 1970-1999 and 2000-2007, discriminating between animals seen from coastal vantage points and all animals reported (including offshore sightings; data: NZG Marine Mammal Database, C.J. Camphuysen).

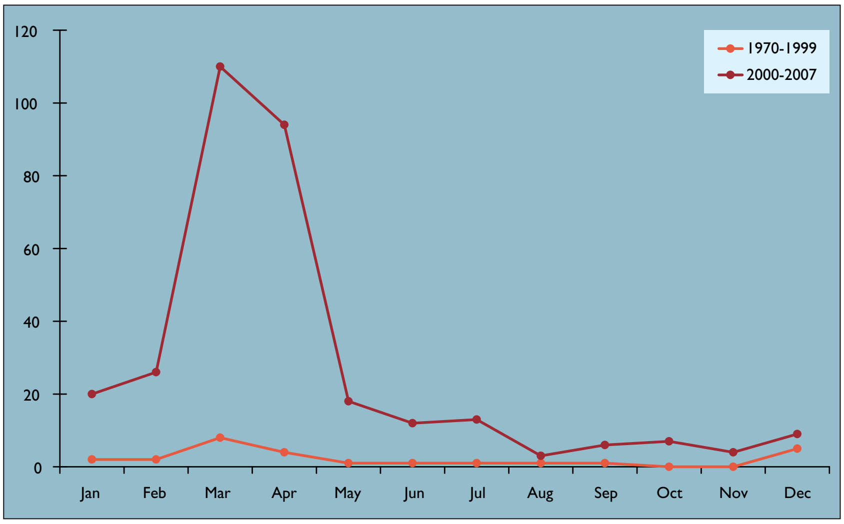

Figure 9: Anecdotal observations of porpoises per month in Belgium from 1970 to 1999, and from 2000 to 2007 (data reported to MUMM, unpublished). The observations made from the surveillance aircraft operated by MUMM, which are numerous but irregular due to an irregular effort, were excluded.

The seasonal pattern could be explained by a process whereby part of the porpoises occurring offshore in the central and southern North Sea migrate towards shallower nearshore Belgian and Dutch waters during autumn. They reach Dutch waters first, but mostly along the mainland coast rather than off the Wadden Sea islands. During winter, numbers of porpoises start to increase along the Belgian and northern French coast. Porpoises start leaving coastal waters in early spring, and most have left by late spring. The peak period of births (between May and August) coincides with a *minimal presence* of harbour porpoises in coastal waters, and the seasonal movements may be motivated by a return to breeding grounds for the summer. One important difference between the recent sightings and a reconstruction of porpoise abundance from historical information, even if sightings in the past were not *'typically in the summer'* and *'with warm weather'* (e.g. IJsseling & Scheygrond, 1943), is their near-complete absence in June and scarcity in July in nearshore waters in recent years.

An exception to this is the presence of the porpoise in Zeeland, the southernmost part of The Netherlands. The seasonal pattern of sightings in Zeeland, including (the enclosed) lake Grevelingen, indicates that porpoises currently occur in this area throughout the year (Camphuysen & Heijboer, 2008).

As is obvious with the strandings data, also sightings data recorded in 2007 suggest that the overall picture of the occurrence of the porpoise in the southern North Sea might be changing again (Camphuysen, 2008).

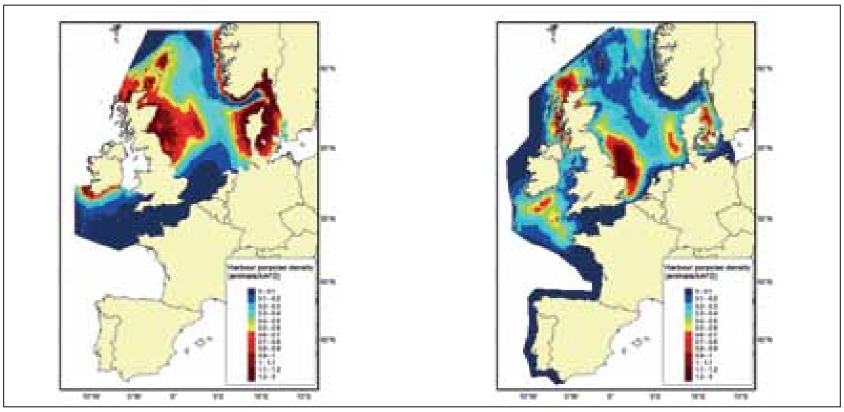

Figure 10: A comparison between the results of the two major cetacean abundance and distribution surveys (left: SCANS I, July 1994, right: SCANS II, July 2005) clearly indicates the shift in distribution of harbour porpoises in the North Sea. The colour bar indicates porpoise density (no of animals per km²; SCANS II, 2008).

Summer distribution trend observed over the North Sea

The comparison between the results obtained from SCANS I and SCANS II[29] (Hammond *et al.*, 1995; SCANS, 2008) clearly demonstrates the shift in distribution from northern waters towards the south between 1994 and 2005 (Fig. 10). Although the results of SCANS II indicated a relatively high density of porpoises in the southern North Sea, the data were gathered in July, outside the months with the highest density of porpoises in Belgian and Dutch waters. A clear seasonal pattern exists, and therefore SCANS results should be used to assess (as they generally are) abundance and summer distribution only (CEC, 2002). Actual densities in coastal waters of Belgium and The Netherlands during winter and spring were undoubtedly higher than the figures reported in SCANS II for July (SCANS II, 2008; Haelters & Jacques, 2006; Depestele *et al.*, 2007).

4.6 Possible reasons for the irregular occurrence of the harbour porpoise in the southern North Sea during the 20th century

The different aspects in the decline of the harbour porpoise in Belgian and Dutch coastal waters after World War II have not been documented in detail. In the absence of extensive scientific studies, the cause-effect relations put forward therefore can never exceed the level of postulation. The explanations proposed are summed up below; it is likely that the real reason behind the disappearance is a combination of several of them.

1. The construction of the *Afsluitdijk,* enclosing part of the Wadden Sea, was mentioned by some as the reason for the decline. Although this might have had important local effects on the prey of porpoises, this barrier was already completed in the 1930s; the first signs of a decline were observed more than a decade later.
2. As top predators, porpoises are very sensitive for pollutants such as heavy metals, PCBs and pesticides. During the decline of the porpoise population also the numbers of harbour seals in the Dutch Wadden Sea dropped dramatically: PCBs have been put forward as the reason for a decline in their reproductive capacity in that area (Reijnders, 1986). Likewise, high pesticide levels were associated with the mass die-off of seabirds in the Wadden Sea area in the 1960s (Koeman, 1971).
3. Directed catches might have occurred up to the first half of the 20th century, but the percentage of the population caught in coastal waters of the southern North Sea was probably very small.
4. Porpoises are vulnerable to incidental death in certain fishing gears; it is not clear to which extent incidental catches in gillnets or driftnets could have caused the decline in numbers in the southern North Sea.
5. It is unlikely that the increase in disturbing human activities such as shipping, offshore construction works, seismic research and recreation was a major cause for the near complete disappearance of the porpoise from the southern North Sea, given the current level of these forms of disturbance, and the current number of porpoises.
6. Overfishing has lead to a severe decline in the stocks of herring and sprat in the

North Sea from the 1960s onwards. These clupeids were a prey of choice for porpoises, which had to switch to other and less suitable prey species. Overfishing in the southern North Sea, and a better availability of suitable prey in the central and northern North Sea, might have caused a shift in the North Sea porpoise population in the middle of the 20th century.

7. Climate changes might have had a direct or indirect impact on the number of porpoises in the North Sea, on their distribution and on migration patterns.

Unambiguous explanations for the initial decline in the abundance of the harbour porpoise have never been given. It appears equally difficult to fully understand its come-back, which occurred over a similar period of time. There is evidence, however, that distributional shifts rather than population fluctuations underlie the recent trends observed.

The redistribution of harbour porpoises in the North Sea may have been triggered by local reductions or shifts in principal prey availability, in particular in the northern part of the North Sea (Camphuysen 2004a, SCANS II, 2008). This is probably caused by changes in environmental conditions. Similarly, feeding conditions for certain seabirds nesting in colonies in the northern North Sea have severely worsened during the last years, as seen in a generally very poor breeding success. While porpoises can undertake migrations towards better feeding grounds, it is not possible for seabirds to change the location of their breeding colonies on a short term basis – this is something that may take several generation times.

However, bad local feeding conditions can still cause serious problems for porpoises. Being amongst the smallest of marine mammals, they cannot cope for long periods without food. Studying animals in captivity, Kastelein *et al.* (1997) demonstrated that porpoises need to take in 4 to 9.5 % of their body weight in food on a daily basis to stay healthy. In the wild the level of food intake is likely to be even higher, given the colder water and the greater effort needed to obtain prey. Taking in sufficient food is also prey-related: some fish species (such as herring) are better suited as prey than others (such as gadoids) due to a higher calorific value. When food intake is irregular and insufficient, porpoises depend on their fat reserves. Given that the fat reserve also serves as thermo-insulation, an animal can die because of hypothermia before the total fat reserve is used.

4.7 An analysis of strandings data

Introduction

In many cases, peaks in the numbers of stranded animals reflect peaks in numbers at sea. However, a bias can exist due to an increased seasonal mortality due to bycatch, or a high mortality of very young animals. There is also a bias due to the location of death: the chance of a dead porpoise being washed ashore depends greatly on its distance from the coastline and on meteorological conditions during the period the carcass floats at sea.

Stranded porpoises potentially provide us with valuable information on their ecology, on the structure and health status of the part of the population found ashore, and on human impacts. Depending on their state of decomposition, stranded cetaceans are generally thoroughly investigated nowadays. Next to gathering the standard data such as length, weight and sex, additional research – depending on the state of the carcass - is performed in the fields of virology, bacteriology, toxicology, reproduction and feeding ecology. However, this type of research has only been conducted widely since the early 1990s. Furthermore, the representativeness of the investigated animals regarding the entire population can be disputed.

It is possible to record trends in strandings by using the basic data that were routinely recorded in the past. These basic data include stranding location and date, and length and sex of the stranded animals. For a few years after the death of Van Deinse in 1965, virtually no data on stranded animals were collected in The Netherlands. In Belgium a systematic recording of stranded animals only started during the 1970s. For these reasons, 1970 is chosen as the starting point of the analysis presented below. The older the data sets, the more incomplete they get. However, they still provide us with an indication of the changes in strandings that have occurred.

Monthly stranding rates between 1970 and 2007

The monthly stranding rates between 1970 and 2007 show very similar trends in Belgium and in The Netherlands (Fig. 11 and 12). They indicate an irregular occurrence of strandings throughout the year, with a considerably less distinct peak than the seasonal observations in nearshore waters (Fig. 8 and 9). During the 21st century, strandings peaked from March to May, and in August. The peak at the Belgian coast in May is for a large part a consequence of the stranding of decomposed animals, which probably had died already in April. The peak in strandings of porpoises during March and April is for an important part related to incidental catches during these months (see further). Strandings during the summer months, when only few observations are reported, concern in many cases newborn or very young animals, or very decomposed animals that may have drifted in from further offshore.

The apparent mismatch between sightings data and strandings data can also be caused by the fact that porpoises abandon just the coastal zone rather than the entire Southern Bight. The presence of porpoises at sea in summer, at least in Dutch waters, is confirmed from ship-based surveys (ESAS unpubl. data), aerial surveys (Witte *et al.*, 1998; Osinga, 2005), anecdotal information (Marine Mammal Database, C.J. Camphuysen) and the SCANS II survey (SMRU, 2008).

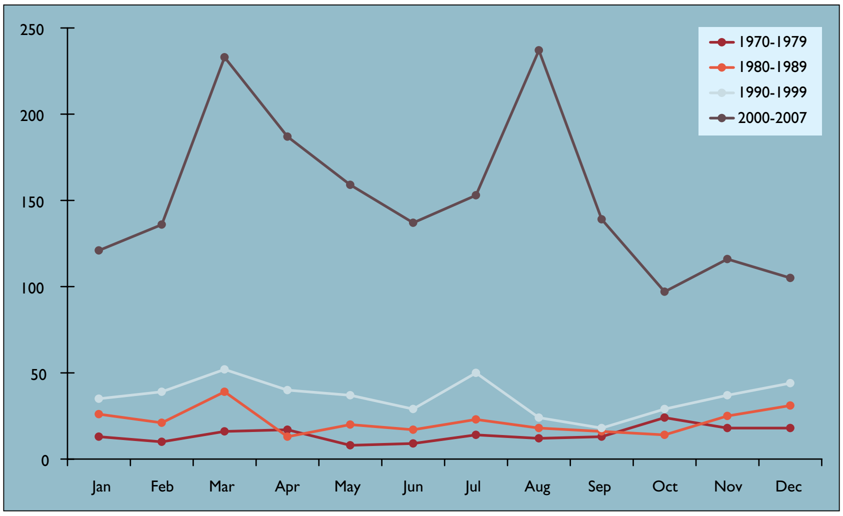

Figure 11: Numbers of porpoises washed ashore in The Netherlands per month over decades between 1970 and 2007.

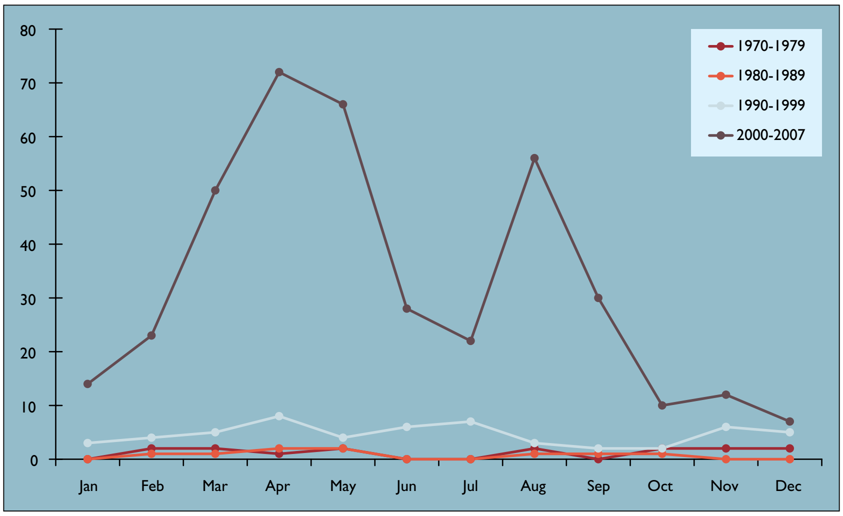

Figure 12: Numbers of porpoises washed ashore in Belgium per month over decades between 1970 and 2007.

Population structure of stranded animals

Since 1970, many of the carcasses of porpoises washed ashore in Belgium and The Netherlands were measured and sexed, even when they were not collected for further scientific research. Although length is not the best estimate for age, it can be used for rough age group assessment. Length at maturity is still disputed, but undoubtedly a lot of variation exists between individuals. As no information about sexual maturity was available for most of the animals in our databases, we have classified the animals for which length data were available into different age categories. Animals were classified as *neonate* when they were smaller than 0.90 m, and therefore in most cases probably only a few weeks old. We classified them as *juvenile* when at least 0.90 m long and smaller than 1.35 m or 1.40 m respectively in males and females. The remainder was considered as having reached adulthood. It was not possible to indicate whether animals could be considered as *calves,* which would concern the whole lactation period.

In total 2.328 porpoises (1.906 from The Netherlands, 422 from Belgium) that stranded between 1970 and 2007 were categorised into age categories. These data indicate that the age composition of stranded animals has changed. Between 1970 and 1999, 37 % of the animals was considered adult, while this was only the case for 20 % between 2000 and 2007 (Fig. 13). The difference in the percentage of neonates between the periods before and after 2000 was less pronounced: 7 respectively 8 % of the stranded animals was classified as neonate. The data indicate that the increase in stranded animals is predominantly due to an increase in strandings of juveniles (Fig. 14). The suggested increase in sightings of presumed mother-calve pairs during the last years is confirmed by the slight increase in the number of stranded neonates.

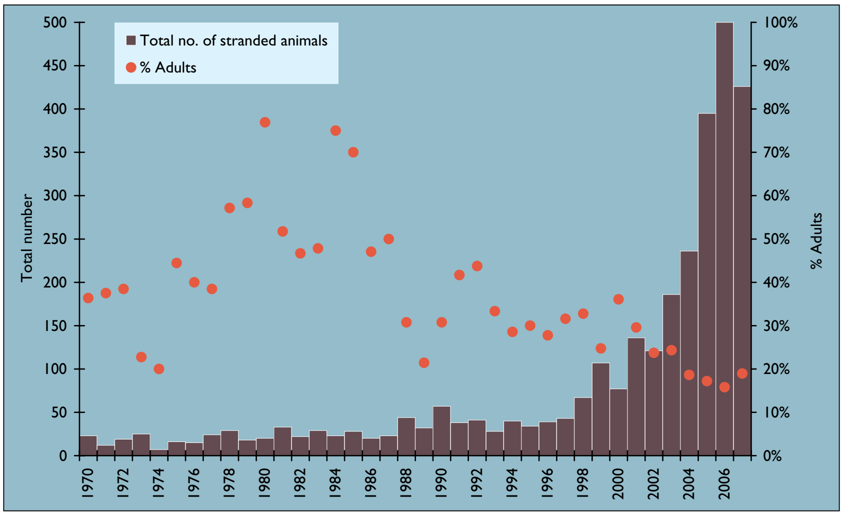

Figure 13: Annual percentage of adults in stranded porpoises combined from Belgium and The Netherlands (data: NIOZ, Naturalis and RBINS/MUMM).

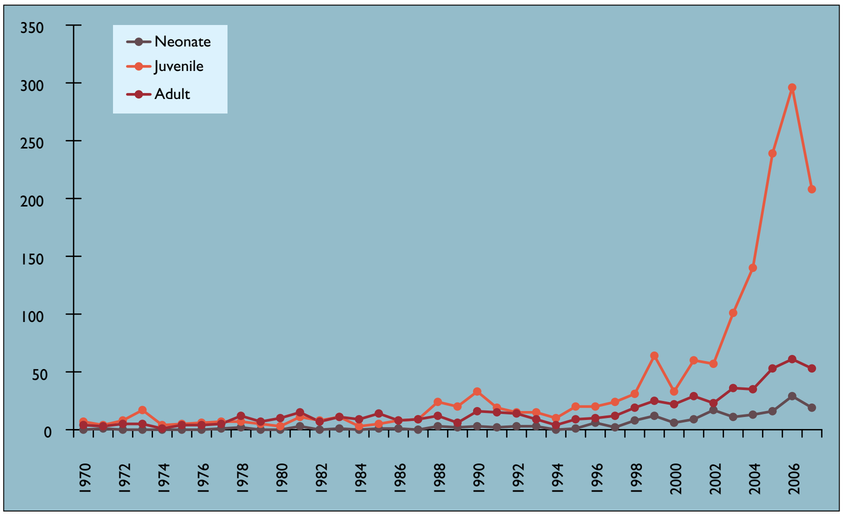

Figure 14: Annual age category distribution in stranded animals combined from Belgium and The Netherlands: neonates, juveniles and adults (data: NIOZ, Naturalis and RBINS/MUMM).

For 63 % of the porpoises recorded from Belgian and Dutch beaches between 1970 and 2007 (1.981 of 3.166), the sex was recorded. Considered over the whole period between 1970 and 2007, 54 % were males and 46 % were females. However, between 1970 and 1999 more females were recorded than males (44 % males), while between 2000 and 2007 more males were recorded (59 % males; Fig. 15). The apparent change in sex ratio coincides with the pronounced increase in strandings since 1999.

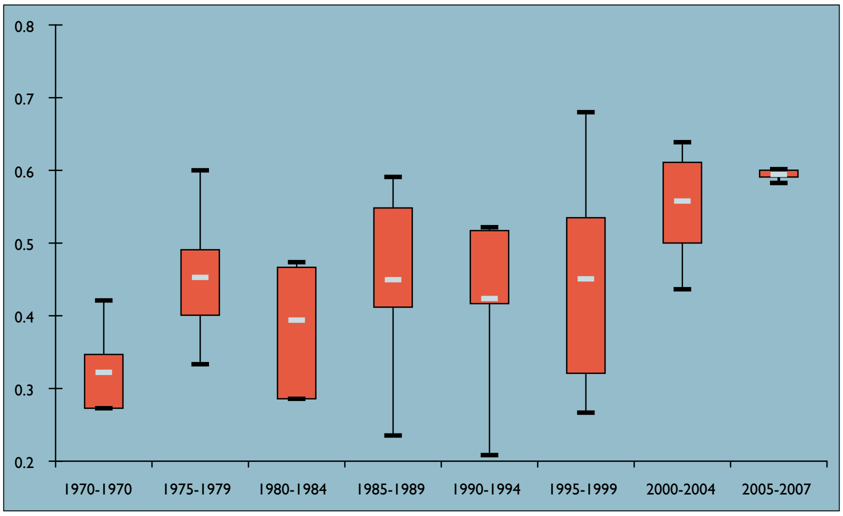

Figure 15: Sex ratio in stranded animals from 1970 to 2007 in Belgium and The Netherlands: percentage of males: average per time period (blue) and yearly variation (extreme values, 25 and 75 percentile; exclusion of sample sizes < 10) (data: NIOZ, Naturalis and RBINS/MUMM).

The data presented above indicate that the increase in numbers of stranded porpoises in Belgian and Dutch coastal waters is mainly caused by juveniles, with larger numbers of males than females. Given that many of the stranded animals were bycaught, this figure might be biased by differences in bycatch probability related to age and sex. However, studies that included samples of stranded Dutch porpoises collected in the 1990s, suggest that males may disperse more than females (Walton, 1997).

5. Bycatch of porpoises in Belgium and The Netherlands

5.1 Introduction

At the end of the 20th century, many of the stranded porpoises were a testimony of one of the major problems for this vulnerable species: bycatch in fishing gear. In some rare cases bycatch has been reported by fishermen, but the external and internal signs on stranded porpoises provide evidence for the fact that bycatch is not a rare event.

5.2 Fishing gears leading to bycatch

The most common commercial fishing practice in the southern North Sea is bottom trawling (beam- and ottertrawling) for demersal fish and shrimp. Next to bottom trawling, a more limited fishing effort exists with pelagic trawls and static gear. There is little evidence of porpoise bycatch in trawls in the southern North Sea, probably due to the avoidance behaviour of porpoises towards motorised vessels. While dead porpoises may end up in the nets of the trawlers, such events are not considered as bycatch.

The fishing gear known as the major cause of bycatch of porpoises in the southern North Sea is static gear, especially gill and tangle nets (Fig. 16). These long nets are anchored on the seafloor. In comparison to bottom trawls, and especially beamtrawls, their use is considered as relatively environmentally friendly: they cause little bottom disturbance, there is a low bycatch of unwanted organisms or undersized target fish species, and the fuel consumption per kg marketed fish is only a fraction of the fuel consumption in towed gears. One of the major environmental concerns in these fisheries is bycatch of marine mammals: it is considered as the main anthropogenic mortality factor for harbour porpoises worldwide (Jefferson & Curry, 1994; Lewison *et al.*, 2004).

Catches of marine mammals in the southern North Sea are nowadays always incidental. It is an important issue for conservation and animal welfare. Bycatch of these charismatic and popular animals is perceived as negative in the eyes of the public. Also most fishermen themselves regret that bycatches occur, but not in the least for economical reasons. In many cases bycaught animals cause gear damage, slow down regular fishing activities, and may cause a reduction in fish catches. Therefore, fishermen are or should be inclined to cooperate with scientists and administrators to discuss, develop and use bycatch mitigation measures. The development of such measures is challenging, given that they should not lead to a financial burden to the fishermen, nor significantly reduce catches or cause other negative environmental impacts.

5.3 Gill and tangle net fisheries in Belgium and The Netherlands

Belgium and The Netherlands are not considered as gillnetting nations. Of the (currently around) 105 Belgian commercial fishing vessels, only 3 to 4 deploy gillnets and tangle nets. In The Netherlands 60 to 70 small vessels regularly deploy static gear (2006), but this number is increasing (Anonymous, 2006a; de Graaff & Smit, 2007). The total net length per fishermen varies from a few kms to up to 20 kms.

The main target species in static gear fishery in the southern North Sea are sole *(Solea solea)* and other flatfish, which are fished in the coastal zone

Figure 16: Nearshore gillnet deployment off Wijk aan Zee, The Netherlands, 2007.

between March and November. Cod *(Gadus morhua)* is targeted during winter months, especially near shipwrecks. During summer months some effort is dedicated to bass *(Dicentrarchus labrax)*, a valuable species which is becoming more abundant, and for which no European catch quota are set. Gill and tangle net fisheries are fairly selective. For each target species or group of target species a specific gear type is being used.

In Belgium recreational fisheries with gillnets are limited by law to the intertidal zone – it is illegal to use them at sea. In The Netherlands, there is no information on the number of recreational vessels deploying gill and tangle nets, the length of the nets set and the areas most frequented.

The numbers of professional static gear vessels in Belgium and The Netherlands are low compared to those with home ports in the eastern Channel. Probably more than 150 professional static gear fishing vessels are active in the Channel and/or the southern North Sea (ICES Areas VIId and IVc) from the south-east coast of England, and the same number from the ports of northern France (Guitton *et al.*, 2003). Next to these, also Danish static gear fishing vessels are active in the southern North Sea, including Belgian and Dutch waters (Fig. 17).

It is expected however that in the near future more European fishermen will switch from towed gear to static gear. This is not only due to the increasing knowledge of, and awareness about the negative impacts of bottom trawling on species and habitats, but especially for economical reasons. Fuel prices affect trawlers in particular, and soaring fuel prices in recent years (up to the end of 2008) make a switch from trawlnets to static gears attractive. An important part of the funding under the European Fishery Fund 2007-2013[30] is being dedicated towards initiatives reducing fuel consumption, including fleet conversions.

The incidence and scale of porpoise bycatch have been studied in many parts of the north Atlantic, including the North Sea, the Channel and the Irish Sea (e.g. Northridge & Hammond, 1999; Northridge *et al.*, 2003; Siebert *et al.*, 2001; Tregenza & Berrow, 1997; Vinther, 1999; Vinther & Larsen, 2002; 2004). Many variables affect bycatch rate. There are clear indications that some types of net, such as cod nets, have relatively higher bycatch rates. However, also local conditions can have an influence,

Figure 17: Danish static gear fishing vessels are active in Belgian and Dutch waters (images: Dutch coastal waters, 2007).

as can other less studied variables such as porpoise foraging behaviour. The results of bycatch research thus sometimes seem contradictory. Variables that can have profound effects on the potential of nets to cause incidental bycatches of porpoises are the following:

1. Season of the year (given the porpoise is a migratory species);
2. Type of net (which depends mainly on the target species): height of the net and hanging ratio (the ratio between the height of the stretched net, and the effective height on the seafloor), and type and thickness of twine (having an effect on the visibility, the acoustic reflectiveness, the entangling ability and the escape possibilities);
3. Position of the net (e.g. wreck or not);
4. Use and type of pinger;
5. Water depth;
6. Water current;
7. Porpoise feeding behaviour (e.g. pelagic or demersal).

Next to the bycatch issue, also the catch rate of target species has been an important factor in bycatch studies. Fishermen might be reluctant to accept a net with a lower bycatch rate for porpoises, if it also has a lower catch rate for target fish species.

Some of the static gear types used in Belgium and The Netherlands are illustrated below (Fig. 18). During interviews, fishermen (all Belgian) indicated their experiences with bycatch of porpoises in each of these net types. The results of the interviews seem to confirm that bycatch rate highly depends on the type of net, the material it is made of, and the water depth in which it is deployed. The fishermen we interviewed consider marine mammal bycatch as a problem, and are very co-operative in finding solutions.

During discussions with Dutch static gear fishermen, and a more informal follow-up at a symposium in Noordwijk aan Zee organised in the frame of *The year of the Dolphin* in 2007, the problem of bycatches of harbour porpoises in set-nets was reluctantly recognised. Without exactly indicating when and where, it became obvious however that some deployments at certain times of the year and in certain areas posed greater risks for porpoises than others. The potential use of deterrents (such as pingers) was discussed and the overall opinion was that these should be deployed with care, using the experience and initiative of the fishermen themselves, who would known when and where to deploy them with the greatest effect. A free access to some deterrents-supply (provided by the government for example) was considered useful in this respect, so that the extra cost for fishermen would be minimal. These discussions made two points very clear: fishermen did confirm the suspicion that bycatches occurred in their nets (although the exact scale of the problem was not made clear) and, most importantly, that any solutions or other initiatives to help minimise the problem were welcomed by the fishermen.

It is important to realise that the reluctance of commercial fishermen to provide detailed information on bycatches is driven by the simple fact that they have little to gain in that process. Fishermen don't normally provide information about their exact fishing locations in the first place. They consider that information confidential because it can only be misused, for example by competitors (other fishermen). Broadcasting any information about potential damage they might inflict on natural resources during routine fishery operations is clearly not beneficial for them, given the restrictions and limitations that knowledge might lead to. Like in other commercial activities, any information or knowledge that might harm the immediate commercial interests of fishermen is treated as confidential by them.

Examples of static gear types used by Belgian and Dutch fishermen

Nylon sole net

Nylon trammel nets are very visible under water. They are mainly used to fish for sole. The mesh size is 90-110 mm, and the net height is around 1 m. The hanging ratio is around 0.6. Although they do not catch as much fish as monofilament sole nets (see below), they are popular because of their selectivity: these nets are very selective for sole, and they catch less undersized fish. These nets also take less garbage and invertebrates than the monofilament type (see further). On the other hand, they are less suitable for catching certain other valuable species such as turbot *(Scophthalmus maximus)* and plaice *(Pleuronectes platessa)*, and they are three times more expensive than the monofilament type sole net. However, because the fish are less entangled, they can be taken out of the net much faster, which makes the fishing operation more efficient. Fishermen claim they never took a porpoise in these nets.

Monofilament sole net

This type of trammel net is, when new, invisible in the water. It is stretched around 1 m high, but only stands around 50 cm high above the seabed when deployed because of the low lifting capacity of the float line (hanging ratio: 0.5). It catches, compared to nylon nets, more turbot, brill *(Scophthalmus rhombus)* and plaice, and the same amount of sole. On the other hand more undersized fish and non-commercial species are being entangled as well, and more garbage gets stuck. Fish are entangled more tightly, which may be problematic for instance in areas with high densities of dogfish *(Scyliorhinus canicula)*. As a consequence, these nets take longer to be emptied and reset. One of the fishermen interviewed indicates that he never caught a porpoise in these nets, set in depths of 20 to 30 m. However, another fisherman, setting his net in shallower water nearer to the coastline, did report bycatch (0 to 6 per year) in this type of net.

Monofilament cod/bass net

These types of gillnet are mainly used for catching bass or cod. They have, according to the main target species, a mesh size of 120 – 160 mm, and stand 3 to 5 m high on the seabed. In these nets a fairly high level of bycatch is possible. According to one fisherman bycatch rates in this type of net differed between areas in the North Sea: *'north of 54°N'* up to 4 porpoises were caught on one day, while in more southerly waters this was only 0 to 4 per year.

Figure 18: Different types of net used by a Belgian gillnet fisherman. Top right: nylon trammel (tangle) net (sole); bottom left: monofilament trammel (tangle) net (sole); bottom right: monofilament gillnet (cod).

5.4 National and international legislation concerning fisheries and the bycatch of cetaceans

There are synergies in the objectives of different international instruments dealing with the protection of small cetaceans. The responsibilities for conservation of porpoises and management of activities influencing porpoises are shared between Member States and the different Directorates of the European Commission (EC). Management of professional fisheries is mainly dealt with in the European Common Fisheries Policy (CFP), whereas recreational fisheries are for a large extent being dealt with at a local (national) level.

International legislation

Until recently, bycatch mitigation was virtually inexistent in a European context, due to a lack of effective measures, and a gap between the European environmental and fisheries regulatory frameworks. While the porpoise is a protected species under the European Habitats Directive, the biggest concern for the species is bycatch, occurring during activities administered through the CFP. In the past the CFP focused on the management of individual commercial fish stocks. This approach is gradually moving towards an integrated management of fishing activities based on the goals of the ecosystem approach, in which also attention is paid to the non-commercial elements of the marine environment.

In order to prevent bycatch of small cetaceans, the European Commission issued Regulation 812/2004[31], which acknowledges the threat bycatch poses to the species, and the insufficiency of measures. The need to ensure consistency between the European fishery and environmental legislation is stressed. Regulation 812/2004 is built on three pillars:

1. The mandatory use, and the assessment of the effects of pingers in specific static and mobile gear fisheries to prevent bycatch. Pingers are acoustic deterrent devices specifically aimed at keeping porpoises away from fishing gear; the Regulation gives a technical description of the pingers.
2. The development and implementation of independent observer schemes in specific fisheries to assess bycatch.
3. The banning of the use of driftnets in the Baltic Sea.

This Regulation is hardly of relevance for the current static gear fisheries in Belgian and Dutch waters, due to the specifications of gear types, periods of the year and areas where obligations exist. In other parts of the harbour porpoise distribution area, the implementation of the Regulation has faced important difficulties in its implementation, control and enforcement. Due to several reasons it has been very problematic to implement the mandatory use of pingers, and to assess the effects of pingers. It has equally been very difficult to assess bycatch, due to a lack of information on relevant fleets and on the level of bycatch. Even an overall analysis of the implementation of Regulation 812/2004 has not been straightforward so far, due to the variations in format, content and level of detail of the national reports that have been submitted (ICES, 2008a).

Closely linked to some of the provisions in Regulation 812/2004 are the data collection requirements under Council Regulation (EC) 199/2008[32]. This Regulation requires Member States to set up coordinated programmes for collection, management and use of biological, technical, environmental and socio-economic data, on professional and - where appropriate – also on recreational fisheries. Ecosystem data should be included to allow for an estimation of the impact of fisheries on the marine ecosystem. However, concerns have been raised about the feasibility and the costs involved with the collection of certain data.

National legislation in Belgium

Recreational use of gill and tangle nets was banned in the subtidal zone (Royal Decree of 21 December 2001) after the identification of a marine mammal bycatch problem. When it had become clear that incidental catches of porpoises continued to occur in the intertidal zone (Fig. 19), the responsible Flemish authorities issued a number of limitations for this fishery at the end of 2006. These included a limitation in the number, height and length of gillnets, and a ban on the recreational use of trammel nets (Fig. 20). However, some of these new fishery regulations were less strict than the legislation that was already in force in some coastal communities, and some inconsistencies between the Flemish and local community regulations persisted. The observations of bycatch in 2007 indicate that the measures taken have been at best partially successful. Trammel nets for recreational beach fisheries were continued to be promoted (and sold?) in a fishing gear shop in Ostend at least until the end of 2007.

Given obligations under the Habitats Directive and the fact that Belgian authorities issued licences for the recreational use of gear known to incidentally kill porpoises, the European Commission (EC) started an infringement procedure (case 2003/2081) against Belgium. The EC had the following two arguments for starting this legal procedure:

1. According to Article 12(1) of the Habitats Directive, Member States shall take the requisite measures to establish a system of strict protection for the animal species listed in Annex IV (a) in their natural range, prohibiting all forms of deliberate

capture or killing of specimens of these species in the wild. In licensing the use of recreational gillnets, Belgium had agreed to, or accepted the possibility of incidental mortality of this protected species. As such, this could be considered as deliberate killing. A similar argument had been used by the EC in a case against the Kingdom of Spain (case C-221/04), where the Court made it clear that deliberate capture or killing [as in article 12/1] *is the case when the person who undertook the activity in which a specimen of a protected species was killed, wanted this animal to be killed, or was at least aware of the fact that this mortality could occur, and accepted it.*

2. The bycatch was probably occurring in conflict with Article 12(4) of the Habitats Directive, which states that Member States shall establish a system to monitor the incidental capture and killing of the animal species listed in Annex IV (a). In the light of the information gathered, Member States shall take further research or conservation measures as required to ensure that incidental capture and killing does not have a significant negative impact on the species concerned.

Up to today (1 October 2008), the EC case against Belgium has not been concluded.

Figure 19: During a very short period in March – April 2006 more than 10 porpoises, washed ashore in Belgium. Probably most of these had died during recreational beach gillnet fisheries.

Figure 20: Cod caught in a tangle net, as used in recreational fisheries in the intertidal zone (Koksijde, Belgium).

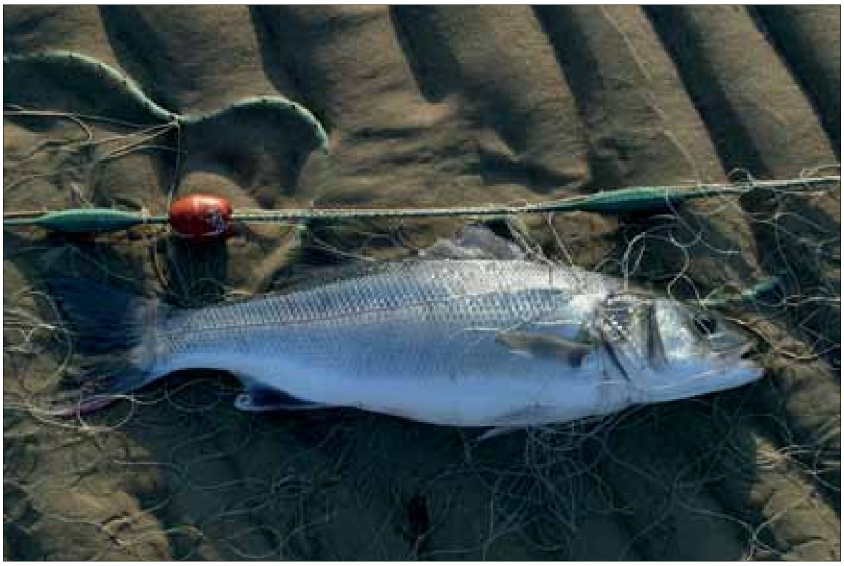

Figure 21: Bass in a recreational gillnet at low tide, De Hors, Texel.

National legislation in The Netherlands

There is no specific regulation in The Netherlands regarding marine mammal bycatch issues in recreational static gear fisheries (Fig. 21). Commercial fisheries are regulated with the 1963 Fisheries Act[33] and more specific regulations that entered into force in 1977[34]. Frequent bycatches of harbour porpoises in nearshore fisheries, as were demonstrated to occur during examinations and necropsies of stranded individuals, have thus far not led to specific measures. Since 2005, several projects commissioned by the Ministry of Agriculture, Nature and Food Quality (LNV) commenced. The objectives are to assess the number of porpoises in Dutch waters through aerial surveys, to observe and sample bycatches with observers onboard set net fishing vessels, and to assess the number of bycatches during systematic autopsies of stranded individuals.

5.5 The use of pingers

Pingers or acoustic alarms are electronic devices that emit sounds (sonic and ultrasound) alerting or scaring away marine mammals (Fig. 22). They are especially deployed to reduce bycatch of cetaceans in static gear fishing operations, and have been made compulsory for certain fishing activities in European waters by Regulation 812/2004. They have been in use in some fisheries around the world, amongst others in cod wreck net fisheries in Denmark since 2000, after the detection of a high porpoise bycatch rate in this type of fishery (Larsen *et al.*, 2002b).

While provisions for the use of pingers are included in Regulation 812/2004, fishermen have experienced great problems in their timely application. The problems are in many cases acknowledged by national administrations dealing with the implementation and control of the European fishery legislation. Therefore the mandatory use of pingers has been repeatedly postponed, and in many fleets there is little or no enforcement.

Although static gear fishermen acknowledge the necessity to reduce bycatches, they are reluctant to invest in a technology that has, in their eyes, not proven to be effective. In particular, they are concerned about the high cost of pingers, the technical difficulties in deploying them, and the doubt about their effect. Other problems are related to the effects of pingers on marine mammals and target species.

The effects of pingers

Although it has been demonstrated that pingers can be effective in reducing bycatch (Kraus *et al.*, 1997; Larsen, 1999), the mechanisms by which they have an effect on marine mammals are not very well understood. Given that the hearing sensitivity of marine mammals is species dependent, pingers may be effective for only one cetacean species, or may not be effective at all (Kastelein *et al.*, 2006). Also other acoustic specifications of the sounds emitted by pingers (such as source level, spectrum, duty cycle, signal duration and signal interval) can have an influence on their effectiveness (Kastelein *et al.*, 2007a; 2008a; b).

In some cases a dinner bell effect has been noted, where marine mammals associate the sound with the availability of easy food which is caught in the net (Amundin *et al.*, 2006; Kastelein *et al.*, 2007a; Pleskunas & Tregenza, 2006). When repeatedly exposed to the sound of pingers, marine mammals can display a certain level of habituation (Jørgensen *et al.*, 2006; Cox *et al.*, 2001). As a consequence, the effectiveness of the pingers could decrease over time.

Pingers increase underwater noise levels, and can thus influence the communication or foraging behaviour of marine fauna. The use of pingers in high densities can cause habitat exclusion for porpoises, with possible impacts on a population level. Another potential problem with pingers is that they can get detached from the net, and thus can deter porpoises until their battery runs down (CEC, 2002).

Pingers can also have an effect on the target fish species. Kastelein *et al.* (2007b) tested some pingers for their effect on a number of commercial and non commercial fish species. In certain cases the sounds of pingers triggered responses in fish in a pool, and as such they have the potential to influence the catch rate of fishing nets.

The design of pingers

There are a number of problems related to the deployment, durability and battery life of pingers (Anonymous, 2006b; Caslake, 2005; Caslake & Lart, 2006; Franse, 2005; Larsen, 2000; Le Berre, 2005). Pingers can interfere mechanically with the fishing activities, and have the potential to cause harm to people streaming and hauling the net. Some pingers are not sufficiently robust, and can easily get damaged

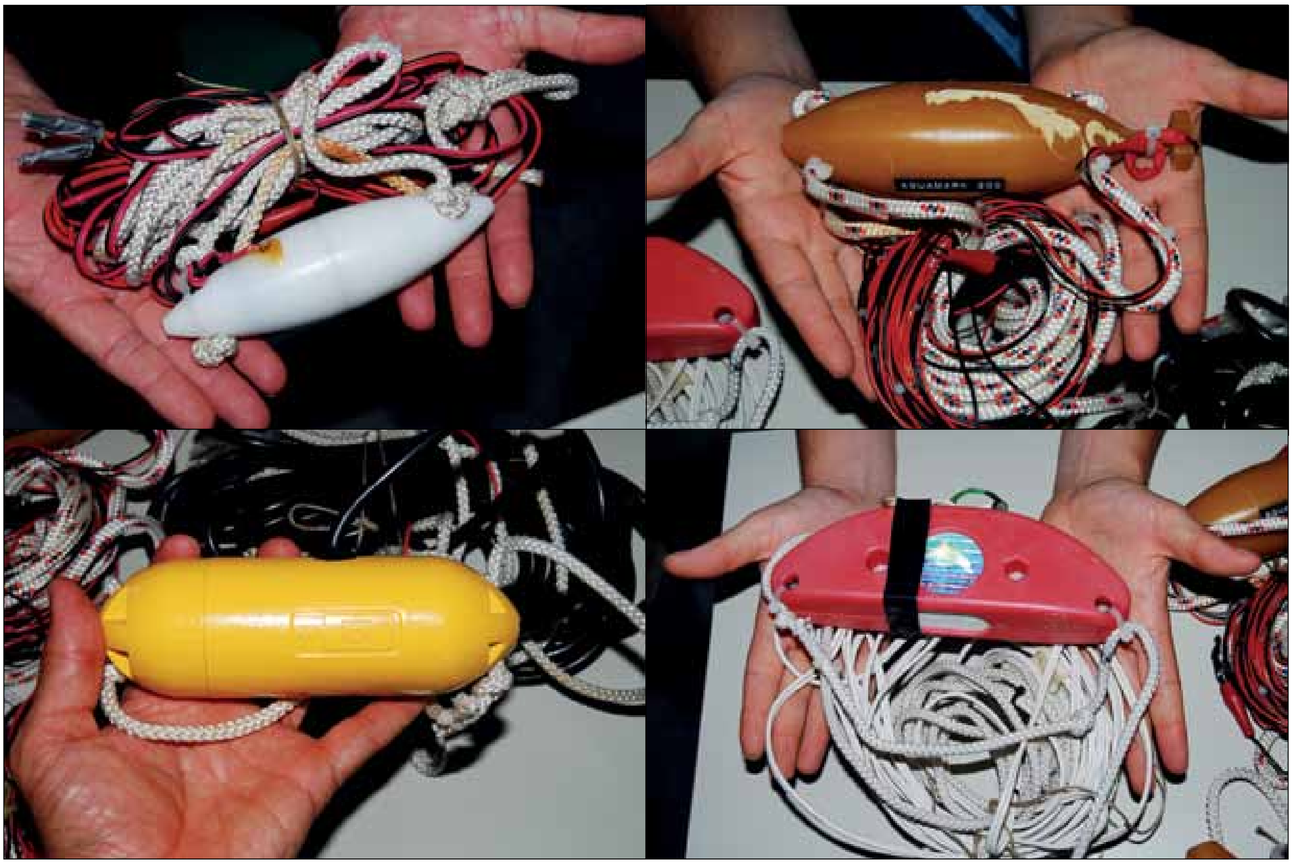

Figure 22: Some examples of commercially available pingers. These were modified (wires attached for remote activation) for scientific research purposes at SEAMARCO, The Netherlands.

during deployment. Other problems with some pingers are battery life and electrical malfunction. Pingers running out of battery life need to be replaced, and if discarded at sea can cause plastic and chemical pollution.

The cost of a pinger

The combination of the cost of a pinger and the number that needs to be used, makes the investment large. The number of pingers per length of net required under Regulation 812/2004 is fairly high (1 per 200 m of net). In recent studies this number is questioned; pingers could be deployed with a wider interspace yielding a similar effect (Anonymous, 2007a; Caslake & Lart, 2006), and in the Danish administrative law a distance between pingers of 455 m instead of 200 m has been taken up. In contrast, Palka *et al.* (2008) observed that bycatch rates of porpoises in nets with some but not all of the required number of pingers was higher than in nets without pingers (north-eastern United States waters). However, all pingers have different signal parameters, and it is dangerous to compare studies which used different pingers or pingers which are attached to different fishing gear.

Conclusions on the use of pingers

While some pingers clearly can reduce bycatch in some fisheries, some pingers fail their intended effects due to several reasons. They have been described as a *technology under development* (Anonymous, 2006b). Some porpoise bycatch mitigation measures clearly needed to be taken as a consequence of the obvious problems this popular species was facing, and the pressure from the public on politicians. Regulation 812/2004 was a step in that direction. Some perceive the sections in the Regulation related to pingers as premature, and believe that a risk has been taken that good ideas are discarded by fishermen. This might in future impede the application of pingers that would perform well. On the other hand, Regulation 812/2004 has given a boost to bycatch research and to research into modifications of the design and technical specifications of pingers, and to the development of alternatives (e.g. Amundin *et al.*, 2006; Pleskunas & Tregenza, 2006), and as such should be considered as a basis to build upon. This is important given the apparent absence of alternatives measures, and especially near future fishing fleet developments.

In any case, fishermen are reluctant to make an investment in pingers, and especially as long as only a limited usefulness of pingers has been demonstrated or technical difficulties in their deployment (practicality and safety) remain. Providing effective pingers for free in sufficiently large numbers at strategic locations (the main harbours), to be used exclusively when needed by fishermen operating static gear (using local expertise in other words), might be the most attractive solution for the fisheries and the most effective solution in the long run. This way the use of pingers and their performance can be controlled, regulated, evaluated and improved.

5.6 Assessing bycatch levels in Belgium and The Netherlands

The collection of animals

In the absence of directed studies with independent observer schemes, the investigation of stranded animals – as recommended by ASCOBANS – can give us an indirect idea of the level of bycatch in Belgian and Dutch waters.

The organisation of a systematic investigation of stranded porpoises has been somewhat different in Belgium and in The Netherlands. In Belgium most carcasses washed ashore have been collected and autopsied since the early 1990s. This has been possible thanks to the short coastline, the easy access to the nation's wide sandy beaches, and the central location of the institute organising the research of stranded marine mammals (RBINS/MUMM, Ostend).

In The Netherlands, estimates of bycatch mortality among stranded animals are more diffuse, given the longer coastline, the more difficult access to many locations, and the related technical difficulties in collecting carcasses. Nevertheless, many animals have been collected for scientific research purposes, amongst others by Naturalis, Leiden (Leopold & Camphuysen, 2006). Washed ashore animals collected north of Texel are being investigated by the seal sanctuary Pieterburen (Osinga *et al.*, 2007).

Dissection and dissection protocols

The dissection of collected animals was performed by experienced veterinary surgeons and/or biologists. The dissection protocols used in the investigation of stranded carcasses have evolved throughout the years, given experience and new insights (Jauniaux *et al.*, 2002b; Jauniaux & Jepson, 2006; Kuiken & García Hartmann, 1991). Gross port-mortem autopsy is normally combined with further histological examination (histopathology). The general methodology used today – depending on the state of the carcass - is the following:

1. Collection of the animal, description of the circumstances in which it was found (and in many cases preliminary description and photography of external features), labelling;
2. Immediate dissection or - alternatively - storage in deep freezer and defrosting before the dissection;
3. Description of the animal: measurements, weight, external features (photographs);

4. Dissection, sampling of tissues and organs (digestive tract, peripheral auditory system, gonads, teeth, etc.);
5. Evaluation and preliminary diagnosis of cause of death;
6. Additional laboratory investigations (for instance investigation of stomach contents, PCB's, heavy metals, etc.);
7. Final diagnosis and reporting.

Evidence of bycatch as the cause of death

In some cases an indication for bycatch as the cause of death is very straightforward, even for non-specialists. In other cases, it comes with a level of uncertainty. Bycatch can be identified as the cause of death through a combination of observations made while collecting the animals from the beach, gross pathology and results of histopathological investigations. The most important criteria that point towards bycatch are given below. Although some of these signs are not exclusively indicating bycatch, in combination they may provide sufficient evidence, and thereby virtually exclude other potential causes of death. It can be especially difficult to identify the cause of death in decayed carcasses. For some of the lesions, the images presented do not need further explanation. They sometimes indicate a violent and painful death struggle.

Criteria pointing towards bycatch as the cause of death:

1. Bycaught animal reported and/or returned to port by fisherman for scientific research purposes, or bycatch observation by independent observer;
2. External damage to fins, mouth, tail, etc. due to contact with fishing gear (Fig. 23 to 26);
3. Hyphaema (blood in the eye; Fig. 27);
4. Wounds inflicted during or after dislodging from the net (eg. opened abdominal cavity, amputation of tail stock, fractures, gaff marks,…; Fig. 28);
5. Good nutritional condition (Fig. 29);
6. Full stomach, fresh prey;
7. Subcutaneous bruises (Fig. 29);
8. Lung oedema;
9. Lung emphysema;
10. Persistent froth in airways;
11. Epicardial and pleural petichiae (small red spots caused by minor haemorrhages, usually as a consequence of physical trauma);
12. Exclusion of other causes of death (eg. pneumonia, stillborn, death during labour, severe emaciation, high parasite load, etc.; Fig. 30).

Figure 23: Evidence of bycatch in stranded porpoises: net marks on snout (upper and lower jaws).

Figure 24 (above): Evidence of bycatch in stranded porpoises: wounds on snout and eyes, twine marks.
Figure 25 (below): Evidence of bycatch in stranded porpoises: twine wounds on pectoral fins, tailstock and fluke.

Figure 26 (above): Evidence of bycatch in stranded animals: pectoral fin clippings.
Figure 27 (below): Evidence of bycatch in stranded animals: hyphaema (blood in the eyes) – notice also the net marks.

Figure 28 (above): Evidence of bycatch in stranded porpoises: cut-off tail, opened abdominal cavity.
Figure 29 (below): Evidence of bycatch observed during the autopsy include a thick blubber layer, which is atypical for porpoises having died of natural causes (left), and subcutaneous haemorrhages caused by physical trauma (right).

Figure 30: Death due to bycatch can be excluded when no signs of bycatch are present, and/or when signs of another cause of death are present; very emaciated or newborn animals (top left, bottom), external ulcers (top right, bottom), heavy infestation with internal or external parasites (middle left: worms protruding from the mouth; middle right: infestation of wounds by whale lice *Isocyamus delphinii*).

Bycaught porpoises washed ashore in Belgium and The Netherlands can originate from both professional as recreational fisheries, taking place inside or outside Belgian and Dutch waters. In most cases it is very difficult to identify the fishery that caused the bycatch. It has been possible in a number of cases to obtain evidence of bycatch in recreational fishing gear (gill nets and trammel nets set from the beach) in Belgium (Haelters *et al.*, 2004; Haelters & Kerckhof, 2006; Haelters *et al.*, 2007). This kind of fishery is more popular in Belgium than in The Netherlands, due to a more important tidal difference towards the southern North Sea. Porpoises bycaught during recreational beach fisheries have a good chance of washing ashore. Indications or evidence for bycatch in this fishery are the following:

1. Direct reporting of bycatch by fisherman or observation by third person (Fig. 31);
2. Very fresh condition (no trace of decomposition);
3. Froth protruding from the blowhole (Fig. 32);
5. Rigor mortis, indicating a recent death;
6. Position on the beach (low water mark, vicinity of recreational fishing gear);
7. Distance between the stranding location and the nearest location of professional fishing gear (exclusion method).

Figure 31: Direct evidence of bycatch is only rarely available. In this case a tourist observed the bycatch of a porpoise in recreational gillnet fisheries in Belgium (very shallow water); the porpoise was released alive but injured.

Figure 32: Froth protruding from the blowhole indicates bycatch that occurred very recently; notice also the net marks on the head (recreational beach fisheries, Belgium).

The number of recreational beach fishermen in Belgium (in Rappé, 2007) is much higher than the annual number of porpoises killed in this fishery; therefore the claim of many of them indicating they have never caught a porpoise, is justified. At the coastal community of Koksijde for instance, with a coastline of only 8 kms, 117 licences for recreational set net fisheries were issued in 2006. Not all static gear deployed on the beach are gill or tangle nets; many fishermen use – depending on the season - fykes or flat nets (*carrelet;* Fig. 33). These nets are probably not or less dangerous to porpoises, but are less efficient in catching sole, which migrates into shallow waters in spring (March – May).

For some decomposed animals washed ashore in Belgium it was clear they had been bycaught (a combination of a full stomach, cut open abdominal cavity, cut-off fins, good nutritional condition, …). These animals were classified as bycatch of unknown origin, although most probably this concerns animals which were bycaught at sea by professional fishermen, in or outside Belgian waters. In one case of a stranding of a large number of decomposed animals, most of them clearly bycaught, a mathematical model of sea currents demonstrated that they were bycaught in the southern North Sea – eastern Channel (Haelters *et al.*,

Figure 33: Apart from gillnets and certain types of tangle net, recreational beach fishermen use gear which poses less of a danger to porpoises. This is a flat net or carrelet, a type of net which only opens at its landward side, and catches flatfish on their return to sea with retreating water.

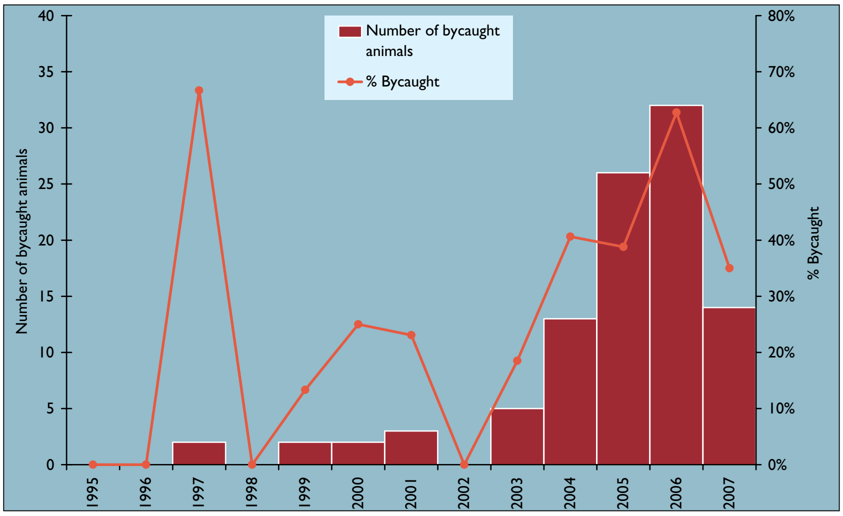

Figure 34: Number and percentage of stranded porpoises that were diagnosed as having been bycaught in Belgium between 1995 and 2007. The percentage was based on all collected animals for which a cause of death could be determined.

2006). In the eastern Channel static gear is being deployed in high densities, but a bycatch problem in these fisheries had never been acknowledged.

5.7 Level of bycatch among stranded porpoises in Belgium and The Netherlands

Data on bycatch of porpoises in Belgian waters, and of porpoises washed ashore in Belgium, are presented in figure 34. This figure indicates the number and percentage of stranded animals that definitely, or most probably had died in fishing nets. The percentage of bycatch is calculated on the total number of animals to which a cause of death (natural, bycatch or other) could be attributed. The few live stranded animals that died during or after transport to a rehabilitation centre were included under natural mortality. Since the clear increase in stranded animals from 1999 onwards, bycatch has been identified as the cause of death in 97 cases. However, this is likely to be an underestimate, given that the expertise in the investigation of stranded animals, and especially recognising evidence for bycatch, has increased during the last decade. Since 2003, the annual bycatch rate of porpoises ranged from 19 to 63 %.

Between 1990 and 2000, 130 porpoises stranded in The Netherlands were intensively investigated under the responsibility of the National Museum of Natural History (Naturalis) in Leiden. By combining gross pathology and histopathological techniques, the cause of death of 58 % of the animals was identified as bycatch (Smeenk *et al.*, 2004).

Necropsy sessions were carried out on animals stranded in The Netherlands in 2006 (Leopold & Camphuysen 2006) and 2007 (IMARES/NIOZ unpubl. data). The autopsies were carried out according to the 'Kuiken protocols', in which similar techniques are used (Kuiken & García Hartmann 1992; 1993; Kuiken 1994). In 2006, 64 harbour porpoises were necropsied. In 26 cases, the animals were too putrefied to identify lesions. In the remaining porpoises, two causes of death were dominant: bycatch in fishing gear (64 %) and infectious disease (30 %). Bycatch was mostly observed in animals stranded in March and April, whereas infectious diseases, mainly acute pneumonia, occurred throughout the year. Only 43 % of the bycaught animals were healthy, the others showed evidence of slight to severe emaciation, acute pneumonia or mild to severe parasitosis. The study confirmed that the diagnosis of bycatch in many cases cannot be based solely on external observations, and that not all bycaught porpoises are healthy individuals. Preliminary results of the autopsies performed on animals stranded in 2007 suggest that slightly less than half of the porpoises were either definite or probable/possible bycatch (IMARES/NIOZ unpublished data; Camphuysen *et al.*, 2008).

The results of the analysis in Belgium and The Netherlands are very similar, with the most recent annual bycatch percentages ranging between 35 and 65 %. The number of bycaught animals has increased, together with the increased number of porpoises in the southern North Sea. Bycatch was not evenly distributed throughout the year. It predominantly occurred during spring (March – April), when it was identified as the most important cause of mortality in stranded animals in The Netherlands (Leopold & Camphuysen 2006; IMARES/NIOZ unpubl. data) and Belgium (Haelters & Kerckhof, 2006; Fig. 35). This is related to a combination of a high density of porpoises during this period, and a high level of fishing with static gear.

Stranded bycaught animals only represent part of the total number of porpoises incidentally killed, and hardly any bycatches are reported. Moreover, signs exist that suggest efforts by fishermen to actively conceal bycatch. Sometimes body cavities of bycaught porpoises were opened to make the carcass sink out of sight. Along the Dutch coast, mutilated carcasses of porpoises were found on several locations, each with their own characteristic way of cutting, typical for the site or maybe for a person inflicting the damage (Fig. 36). The publication of a photograph in *Visserijnieuws* (a magazine for fishermen) was immediately followed by a decline in reported cases of mutilation. The practice returned within a year, however, at several locations.

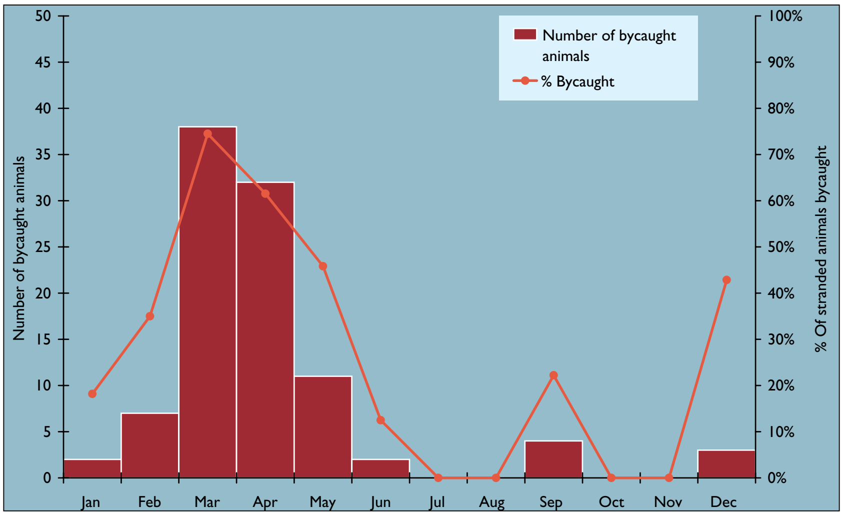

Figure 35: Total number of stranded animals in Belgium that was diagnosed as having been bycaught per month between 1995 and 2007. The percentage was calculated on the collected animals for which a cause of death could be identified.

Figure 36: Evidence of bycatch in stranded porpoises in The Netherlands: some of the severely mutilated carcasses with abdominal cavities cut open: 25 May 2006 (top); 30 March 2007 (bottom).

6. Other threats

Next to the bycatch issue, porpoises in the southern North Sea are facing other threats, caused by different human activities. Given that these activities impact the entire marine ecosystem and not just porpoises, they are not discussed in detail. For most of the threats summed up below, more generic mitigation measures are being taken, or are being investigated.

Overfishing

Overfishing can lead to a shift in species composition (Daan *et al.*, 2005), and thus to a decline in a preferred prey species for porpoises. In those cases porpoises may be forced to switch to less suitable prey species. This can have an impact on their productivity and longevity. A switching in prey by porpoises has been witnessed in the past after the collapse of the herring stock in the southern North Sea (Santos, 1998; Santos *et al.*, 2004). Although changes in fish community composition have clearly been linked with overfishing, it is in many cases difficult to discriminate between climate change effects and effects of fishing activities.

Climate change

Climate change can act in many different ways on cetacean populations. One of the most important effects of climate change on cetaceans in general is its potential effect on prey distribution and abundance (Simmonds & Isaac, 2007). As such, climate change can affect distribution, abundance, migration patterns, susceptibility to disease, and ultimately reproductive success in cetaceans (Learmonth *et al.*, 2006; McLeod *et al.*, 2005). So, even while in the North Sea porpoises themselves would not be negatively affected by warmer water, their prey would or could be influenced. Malnutrition in porpoises along the east coast of Scotland was recently linked with a reduction in sandeel stocks, possibly a consequence of climate change (McLeod *et al.*, 2007). A genetic study suggested that habitat-related fragmentation of the porpoise range was likely to intensify with predicted surface ocean surface warming (Fontaine *et al.*, 2007).

Underwater noise

Underwater noise is being considered as an important source of pollution, impacting on different components of the marine ecosystem (Simmonds *et al.*, 2003). Underwater noise can have direct effects on individual organisms, but also indirect effects through an impact on their prey and habitat. Data on underwater noise and its effects on biota are very incomplete and often contradicting. In general, chronic and acute effects are distinguished. Acute effects, with injury or death of marine organisms, can be caused by short but intense noise sources. A long exposure to less intense sound sources can have an influence on the quality of habitats, and can mask ecologically important sounds.

Sources of underwater noise are diverse: construction activities, seismic surveys, shipping, dredging, military activities, etc. As the intensity of shipping, both of merchant ships and of recreational motorised craft, has increased during the last decades, an impact on porpoises is likely. It is however very difficult to qualify and quantify such an impact.

More acute effects can occur due to noise with high energy levels. High noise levels are caused by different human activities such as seismic surveys, offshore construction, the use of military sonar, and the use of explosives. The construction of thousands of offshore windmills is being planned throughout the North Sea. Although some preventive or mitigating measures are being considered, eliminating effects on porpoises will be impossible. Especially during pile driving activities, very high noise levels can occur (Nedwell & Howell, 2004; Parvin & Nedwell, 2006a; b; Thomson *et al.*, 2006). This noise level can disturb porpoises up to tens of kilometres from its source. It is also possible that effects will occur during the operational and demolition phases of windfarms (Dolman *et al.*, 2007). For assessing the impact of the construction and operation of offshore windfarms on cetaceans, airborne, ship-based and acoustic means such as hydrophones and T-PoDs[35] are being deployed.

Nowacek *et al.* (2007) have expressed concern about the lack of investigation into the potential effects on cetaceans of prevalent noise sources such as those from sonar, depth finders and acoustics gear in fisheries. However, exposure–effect experiments with cetaceans are challenging.

Pollution

The harbour porpoise is a coastal toothed whale species, occurring in the vicinity of pollution sources. As top predators relying on a fat reserve and having long life spans, toothed whales are known to accumulate contaminants. Toxic effects can occur when the animals draw on these fat reserves, for instance during reproduction, migration and seasonal food shortage (Reijnders *et al.*, 1999). Other forms of pollution possibly impacting on porpoises are marine litter and eutrophication. While litter can have direct effects on marine mammals due to entanglement or ingestion, eutrophication can cause algal blooms, which in turn have effects on the food chain.

7. Recommendations

Disentangling the problems the harbour porpoise is facing in the southern North Sea is not straightforward. The combination of environmental, social, economical, political, legal and technical factors involved, makes it a challenging task. From our experience we have tried to present some recommendations, especially regarding the bycatch problem and harbour porpoise ecological data needs. These are in some cases detailed and practical, in other cases fairly general, and concern both research needs as well as practical measures. It is clear however that also research in other fields, such as on the effects of underwater noise on porpoises and on the impact of *new* pollutants, should be intensified.

■ The requirement of data on the ecology of porpoises

There is a general lack of data on different aspects of the ecology of the harbour porpoise. Knowledge about abundance, distribution and migration patterns, and the driving forces behind these, are either not well understood or lacking. In order to be able to assess the sustainability of bycatch, a continued effort towards collecting such data is essential. Also data on the feeding ecology of porpoises throughout the year are scarce. Building on a good working relationship with fishermen is necessary in order to obtain more reliable bycatch estimates. Additionally, receiving bycaught animals directly from fishermen would be useful for acquiring more information about porpoise ecology and for understanding bycatch circumstances.

A lot of research is undertaken on a country by country basis, which is not useful in the North Sea, bordered by many nations. Therefore research initiatives should be internationally co-ordinated and methods should be standardised. Standardised protocols and international databases on strandings, sightings and results of scientific research are necessary.

Although the harbour porpoise is placed high on the agenda of many international nature conservation fora, even funds for basic research efforts, such as funds for maintaining a stranding response coordination, are either lacking, or at best not structural, and therefore unstable. At least the collection and basic research (gross necropsy coupled with histopathology) of stranded and bycaught animals should be funded by governments on a structural basis.

■ The coordination of national and international protection initiatives

The harbour porpoise is legally protected in different international agreements. However, efforts are not coordinated, which leads to a dispersion of efforts, a duplication of work and a waste of resources. Moreover, in many cases the *measures* are merely recommendatory and, although they have some political force, they do not pose any legal obligations on State Parties. Parties often do not take the necessary steps to implement their commitments. This is largely due to the fact that long-time environmental and conservation objectives frequently conflict with short-time economic and social interests, often a priority for politicians.

Most international instruments have no effective enforcement and control mechanisms in place. An exception is the legislation prepared at the European Community level. Difficulties in developing such legislation, however, are the number of Member States which have to agree to measures, and the delay between the identification of problems and the appropriate actions to solve them. Often, contradictions between fisheries interests and environmental requirements at best lead to a status quo, or to a prevalence of fisheries interests on economic grounds.

The opinion of the authors of this report is that the most appropriate international framework for the coordination of scientific efforts with regard to the protection of small cetaceans in the North Sea would be ASCOBANS. For further developing measures, the most appropriate framework would be the European Community, given its competence in both fisheries and environmental matters, and its strong enforcement mechanisms. Nothing can be achieved, however, without the commitment and determination of national authorities and of fishermen.

■ Fisheries data requirements

Assessing the anthropogenic impact on the harbour porpoise is an obligation according to the European Habitats Directive. This Directive does not give a direction towards the methods for, for instance, assessing bycatch. It is likely that bycaught stranded animals only represent a small fraction of the total number of bycaught animals. Only an extensive and independent observer scheme in relevant fisheries can allow for an estimation of the level of bycatch. Such observer schemes were initiated in the North Sea for certain fisheries in which problems were suspected, or as part of research projects (e.g. Danish and British fisheries), but none were carried out in Belgian or Dutch fisheries. For some fisheries and in some areas in European waters, an observer programme has became mandatory according to European Regulation 812/2004. The provisions concerning observer programmes in this Regulation however, are not installed for the southern North Sea, including Belgian and Dutch waters. It is advised that such observer schemes are initiated, given the increased number of porpoises in this area.

For most areas in the North Sea, a lack of information exists on fishing effort, gear types, fleet sizes, and temporal and geographical distribution of fleets. As a consequence, it is very difficult to obtain an overall view of the impact of fisheries on target and non-target species, including species protected in an international framework. Although there are some obligations of reporting fisheries effort data under Regulation 812/2004, the reports submitted so far have proven to be very variable in format, and an analysis and overall assessment has not been possible. A new reporting format, recently developed by ICES (2008a), should resolve some of these problems. This reporting format includes a description of fleets, gear types, bycatch levels, independent observer schemes and bycatch mitigation measures.

Fisheries measures

Although many potential bycatch mitigation measures have been identified (Kaschner, 2003; STECF, 2002), virtually none have been taken in the southern North Sea. However, before taking new bycatch mitigation measures technical issues, legal aspects, and environmental and socio-economic factors should be addressed carefully (ICES, 2008b). New bycatch mitigation measures should be accompanied by monitoring, control and enforcement provisions. Assessments should be made of the possibilities and environmental consequences of a redistribution of fishing effort into other areas and other fishery types. Also seasonal and interannual variations in the distribution of porpoises should be taken into account. Any legislation should be adjustable in order to cope with such variations. With the current knowledge of the distribution and bycatch of porpoises for instance, extending some of the obligations in Regulation 812/2004 to Belgian and Dutch waters would be highly relevant.

It is important to undertake a wider consultation of fishermen in order to identify problem nets and problem seasons on a finer scale. As such, alternative nets, time area closures or temporary gear and effort restrictions could be envisaged.

Also a low number of bycatches per fisherman might be problematic: fishermen on an individual basis do not consider it a problem that one or a few porpoises are caught in their nets annually and might as such not consider it useful to adopt (expensive) measures. However, the level of bycatch of all fishermen combined, may be unsustainable and therefore unacceptable.

For the moment the only available effective means to prevent bycatch of porpoises, is the use of pingers. Hardly any use of pingers is compulsory in the southern North Sea, including Belgian and Dutch waters. Although pingers are required on certain nets in the eastern Channel, the regulations are not put into practice. The main reasons are technical problems during the deployment of pingers, the apparently perceived inefficiency of pingers and the difficulties in obtaining them. Some of the characteristics of the ideal pinger are:

1. It is safe and easy to be handled on board;
2. It is durable and cheap;
3. It is species specific, and has no effect on target (fish) species;
4. It is porpoise interactive (only emits sound with porpoises in the vicinity), in order to reduce the battery use and noise pollution.

The description of pingers in the current legislation, and the characteristics of the pingers commercially available on the market only answer to part of these characteristics. It is necessary for instance, that the development of a porpoise specific pinger is continued. Also, the development of interactive pingers, which only produce signals when they receive sonar signals of the cetacean species they should deter, should be continued and supported. To reduce risks of habituation and excessive noise pollution, pinger use could be restricted to the areas, gear types and seasons in which bycatches are known to occur most frequently.

Given that the fishing fleets of Belgium and The Netherlands consist mainly

of trawlers, the focus for investments for the coming years will be in the field of adapting these vessels, for instance in order to reduce fuel consumption. Studies on pingers will likely not be a priority, and the static gear fishermen might not get the necessary government support for taking bycatch prevention measures. Therefore internationally coordinated research efforts on technical issues are necessary, in addition to more limited national efforts.

Apart from the impact on the population, bycatch should be avoided for animal welfare matters: the wounds inflicted to the animals in their efforts to escape to the surface indicate a long and painful death struggle.

■ Measures for recreational fisheries

Data on the extent, gear types used, and catches in recreational or semi-professional fisheries are scarce and fragmentary. This is caused by a lack of legislation, reporting requirements, control and enforcement. Given the wide-ranging nature of cetaceans, technical measures for recreational activities with an impact on internationally protected species should be coordinated in an international framework, instead of being dealt with on a national or even local basis. As the volume of the catch of target species in recreational fisheries is only of secondary importance after the activity itself, negative impacts on cetaceans should be easier to mitigate. Measures should in first instance aim at an adaptation or limitation of certain gear types, and at seasonal measures.

■ The consequences of fleet conversions

Belgian and Dutch fishing fleets consist predominantly of beamtrawlers. Given dwindling fish stocks and increasing fuel prices, most profits in beamtrawl fisheries literally end up in smoke: the average fuel consumption in the Belgian fishing fleet was recently calculated at 3 liters per kg marketed fish (Anonymous, 2007b). As a consequence, alternative fishing techniques needing less fuel are being investigated. Also bottom towed gear receives more and more criticism for its impact on benthic habitats and for its generally low selectivity. Next to technical adaptations to gear and engines, a (partial) conversion of the fleet is being envisaged. One of the alternatives for beamtrawling is gill- and tangle netting. Given the foreseen and already observed increase in the number of fishing vessels deploying gill and tangle nets, it is likely that without effective preventive measures, the porpoise bycatch problem in certain areas in the North Sea will only increase.

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Notes to the text

1 United Nations Convention on the Law of the Sea, 10 December 1982; it entered into force in 1994.

2 The Code was unanimously adopted on 31 October 1995 by the FAO Conference.

3 Johannesburg, 26 August to 4 September 2002: World Summit on Sustainable Development.

4 International convention for the regulation of whaling, Washington, 2 December 1946.

5 Over 15 resolutions on small cetaceans have been adopted since 1990.

6 Bonn, 23 June 1979; entry into force in 1992.

7 E.g. Resolution 6.2. adopted at the 6th CoP, Cape Town, 1999, and Resolution 8.22 adopted at the 8th CoP, Nairobi, 2005.

8 New York, 17 March 1992; entry into force on 29 March 1994.

9 In February 2008 the Agreement's name was changed into the *Agreement on the Conservation of Small Cetaceans in the Baltic, Northeast Atlantic, Irish and North Seas* due to an area extension which at that time had been ratified by France, Denmark, The Netherlands, Germany and Finland.

10 Third Meeting of the Parties, Resolution 3 on the incidental take of small cetaceans, Bristol, UK, 2000.

11 The international Conferences on the protection of the North Sea took place in 1984 (Bremen), 1987 (London), 1990 (The Hague), 1995 (Esbjerg), 2002 (Bergen) and 2006 (Göteborg).

12 Directive 92/43/EC of the Council of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora.

13 Bern, 19 September 1979.

14 Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008.

15 Washington DC., USA, 3 March 1973; it entered into force on 1 July 1975.

16 Currently CITES is covered by Council Regulations (EC) 338/97, 1332/2005, 865/2006 and 605/2006, and Recommendation 2007/425/EC.

17 OSPAR was opened for ratification on 22 September 1992, and came into force on 25 March 1998.

18 Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

19 Royal Decree of 22 September 1980 *houdende maatregelen, van toepassing op het Vlaamse Gewest, ter bescherming van bepaalde in het wild levende inheemse diersoorten, die niet onder de toepassing vallen van de wetten en besluiten op de jacht, de riviervisserij en de vogelbescherming.* This Royal Decree is valid for the zone above the MLLWS mark.

20 Decree of the Flemish government of 21 October 1997 *betreffende het natuurbehoud en het natuurlijke milieu;* Belgian Official Journal of 10 January 1998.

21 Law on the protection of the marine environment of 20 January 1999; Belgian Official Journal of 12 March 1999.

22 Royal Decree of 21 December 2001 *betreffende de soortbescherming in de zeegebieden onder de rechtsbevoegdheid van België;* Belgian Official Journal of 14 February 2002.

23 Law of 25 May 1998 *houdende regels ter bescherming van in het wild levende planten- en diersoorten (Flora- en faunawet).*

24 http://www.walvisstrandingen.nl

25 http://www.mumm.ac.be

26 The international SCANS projects were coordinated by the Sea Mammal Research Unit, University of St.-Andrews, Schotland; they were aimed at estimating the summer abundance of porpoises in the North Sea and adjacent waters of the Atlantic Ocean. SCANS I: Small Cetacean Abundance in the North Sea; SCANS II: Small Cetaceans in the European Atlantic and The North Sea.

27 http://www.trektellen.nl;
http://www.waarnemingen.be

28 Such sightings are generally reported to Kees Camphuysen http://home.planet.nl/~camphuys/Cetacea.html in The Netherlands, and to the RBINS (MUMM: http://www.mumm.ac.be) in Belgium. Recently an environmental NGO in Belgium (Natuurpunt) took the initiative to develop an interactive forum (http://www.zeezoogdieren.org) concerning marine mammals in Belgium and The Netherlands; other Belgian data are collected through http://www.waarnemingen.be. The data gathered through these frameworks are also stored in the respective national databases.

29 http://www.smru.st-and.ac.uk

30 Regulation (EC) 1198/2006 of the Council of 27 July 2006 on the European Fisheries Fund and Commission Regulation (EC) 498/2007 of 26 March 2007 laying down detailed rules for the implementation of Council Regulation (EC) 1198/2006.

31 EC Council regulation No 812/2004 of 26 April 2004, laying down measures concerning incidental catches of cetaceans in fisheries and amending Regulation (EC) No 88/98.

32 Council Regulation of 25 February 2008 concerning the establishment of a Community framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the Common Fisheries Policy.

33 Law of 30 May 1963 *houdende nieuwe regelen omtrent de visserij.*

34 Rules for sea- and coastal fisheries, *Besluit van 25 november 1977 houdende bepalingen omtrent de uitoefening van de zee- en kustvisserij).*

35 A PoD or porpoise detector is an autonomous monitoring device for ultrasound. It monitors underwater sounds, and records length and repetition of clicks at certain frequencies. Afterwards the registered data are analysed; to the clicks a probability that they originate from porpoises or other cetaceans is attributed. In 2008 t-PoDs are being replaced by C-PoDs (Chelonia Ltd).

COLOPHON

The harbour porpoise in the southern North Sea: Abundance, threats and research- & management proposals

A report by Jan Haelters[1] & Kees C.J. Camphuysen[2]

[1] Royal Belgian Institute of Natural Sciences (RBINS), department Management Unit of the North Sea Mathematical Models (MUMM), j.haelters@mumm.ac.be

[2] Royal Netherlands Institute for Sea Research (NIOZ)

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