13. Marine Mammals

Peter J.H. Reijnders
Kai F. Abt
Sophie M.J.M. Brasseur
Kees (C.J.) Camphuysen
Bettina Reineking
Meike Scheidat
Ursula Siebert
Michael Stede
Jakob Tougaard
Svend Tougaard

Harbour seals
(Photo: K.-E. Heers)

13.1 Introduction

Marine mammals regarded as indigenous species in the Wadden Sea are the harbour (or common) seal *Phoca vitulina*, grey seal *Halichoerus grypus*, and harbour porpoise *Phocoena phocoena*. Several other marine mammal species, both pinnipeds and cetaceans, occur in the Wadden Sea and adjacent North Sea, either as stragglers or regular visitors. Stranding records since the 1999 Quality Status Report, show that occasionally five other species of seals are encountered in the Wadden Sea area and adjacent North Sea. These are: the harp seal *Phoca groenlandica*, hooded seal *Cystophora cristata*, ringed seal *Phoca hispida*, bearded seal *Erignathus barbatus* and walrus *Odobenus rosmarus*, all of which have a more northerly distribution. Cetaceans documented on the Wadden Sea coast are the white-beaked dolphin *Lagenorhynchus albirostris*, white-sided dolphin *Lagenorhynchus acutus*. Remarkable are the occurrence (live and dead) of large cetaceans in the Wadden Sea region since the 1999 QSR, notable six minke whales *Balaenoptera acutorostrata*, one humpback whale *Megaptera novaeangliae*, two fin whales *Balaenoptera physalus* and thirteen sperm whales *Physeter macrocephalus*.

The intention of this chapter is to describe the status of the harbour and grey seal, and of the harbour porpoise, as an update of the 1999 QSR and in relation to the Targets set for these species in the Wadden Sea Plan as well as the Seal Management Plan (Seal Management Plan, 1992, 1996, 2002).

Target

Viable stocks and a natural reproduction capacity of common/harbour seal, grey seal and harbour porpoise in the tidal areas and the offshore zone.

According to the 1999 QSR, the population size of the harbour seal in 1988 was much higher than before the virus-epizootic of 1988 (de Jong *et al.*, 1999). At the Ministerial Conference in Esbjerg 2001, the positive development of the harbour seal population, which may be regarded as viable, was noted with satisfaction and an amended Seal Management Plan (SMP) for 2002-2006 was adopted (Seal Management Plan, 2002). The SMP will be revised on a regular basis.

The grey seal population in the Wadden Sea was relatively small and according to the 1999 QSR there was insufficient knowledge to judge whether the population was viable. Therefore, the new Seal Management Plan 2002-2006 also includes management actions for the grey seal, such as establishment of protected areas and improved monitoring.

Regarding the harbour porpoise, the 1999 QSR stated that there is too little knowledge about the population dynamics of the species to be able to evaluate the Target.

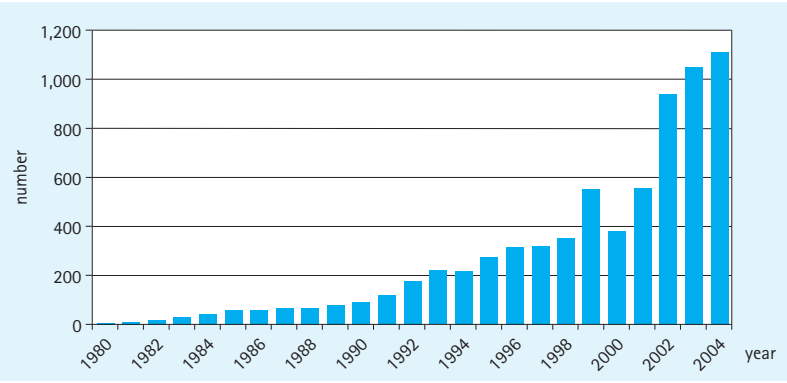

Figure 13.1: Moult counts (March/April) of grey seals in the Dutch Wadden Sea.

13.2 Grey seal

Grey seals had been extinct in the Wadden Sea area (south-eastern North Sea) for centuries. Some 25 years ago, grey seals started to re-establish in a few colonies off the German island of Amrum and in the western part of the Dutch Wadden Sea (Reijnders *et al.*, 1995; Abt *et al.*, 2002). Most probably, the animals originated from the eastern UK, mainly the Farne Islands where grey seals are abundant.

In the western Dutch Wadden Sea, the development of the grey seal has been abundant (Figure 13.1). After the colony was established in the early 1980s, surveys during moult (March/April) show an annual increase of 20% on average (Reijnders and Brasseur, 2003), amounting to over a thousand animals counted during the moult in 2004. This increase is approximately 1½ times the maximum figure reported for an autochthonously growing grey seal stock in Canada (Zwanenburg and Bowen, 1990; Bowen *et al.*, 2003), which could be explained by a continuous influx from the British Isles (Reijnders *et al.*, 1995; Reijnders, 1996).

In the Wadden Sea of Schleswig-Holstein, recent grey seal pup production (minimum estimates) was between 20 and 30 (Figure 13.2). Occasional surveys in the peak moulting season (early April) counted up to 108 grey seals in total. In general, numbers have been increasing by 4–5% per year on average. Numbers may largely be influenced by seasonal influx and should be interpreted in a wider geographic context, *i.e.* the North Sea (Abt *et al.*, 2002).

On the Düne isle (Helgoland, German Bight), 120 grey seals were observed in spring 2003 (R. Blädel, pers. comm.; Verein Jordsand, pers. comm.). There are signs of increasing colonies of grey seals elsewhere in German marine waters. In winter 2003, a maximum of 15 grey seals were seen on Borkum Riff and in summer 2003, 14 on Norderney. In the latter two areas, there does not seem to be any significant breeding.

13.3 Harbour seal

13.3.1 Distribution

At the end of the 1990s, the deployment of satellite transmitters on seals became possible, shedding new light on the seals' distribution. It appears that irrespective of the season, the animals travel hundreds of kilometers away from their haul-outs. Though still based on a restricted number of animals, it is clear that the seals from the Wadden Sea use the North Sea much more than realized before (Figure 13.3). One can hypothesize as to whether the seals' range may have changed, and if so, whether this is due to increased population size and/or to, for example, decreas-

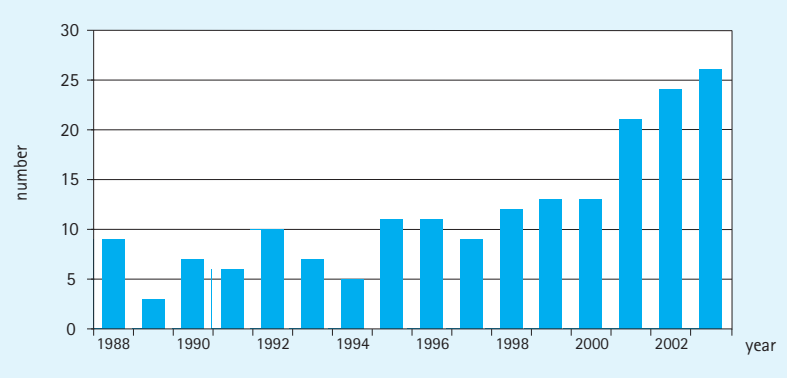

Figure 13.2: Minimum annual pup production of grey seals in the Wadden Sea of Schleswig-Holstein (Germany).

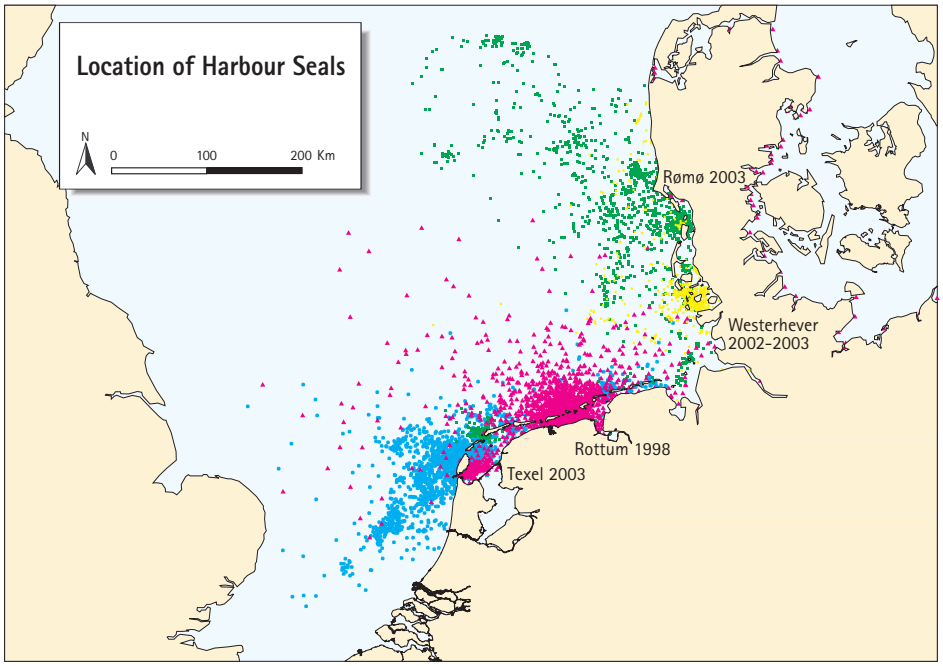

Figure 13.3: Locations of harbour seals revealed through satellite telemetry. Blue: seals tagged close to Texel in 2003; red: seals tagged at Rottum in 1998; green: seals tagged at Rømø in 2002; yellow: seals tagged close to Westerhever in 2002/2003.

ing fish abundance. Future research will show how different areas in the North Sea are utilized and how foraging opportunities may influence the spreading of the animals.

13.3.2 Developments and trends 1988 – present

After a disastrous Phocine Distemper Virus (PDV)-epizootic in 1988 (Kennedy, 1990), the harbour seal population recovered nearly fivefold, from some 4,400 animals counted in 1989 to 20,975 in 2002 (Figure 13.4).

The population growth, averaging 12.7% per year (Figure 13.5), was close to exponential during these 14 years (Reijnders *et al.*, 2003a). There were no clear signs of density dependence, such as retarded population growth. Apparently, the carrying capacity (*K*) of the area has not been reached yet. The population size in 2002, estimated to be at least around 30,000 animals, is well below *K*.

The ratio of pups to total number of seals counted remained fairly constant during 1990-2002, and averaged 0.216 (SD = 0.019). Before the epizootic (1974-1987) that ratio had been lower, *viz.* 0.163 (SD = 0.009).

It is likely that survival and fertility of seals in the Wadden Sea were at their highest possible level

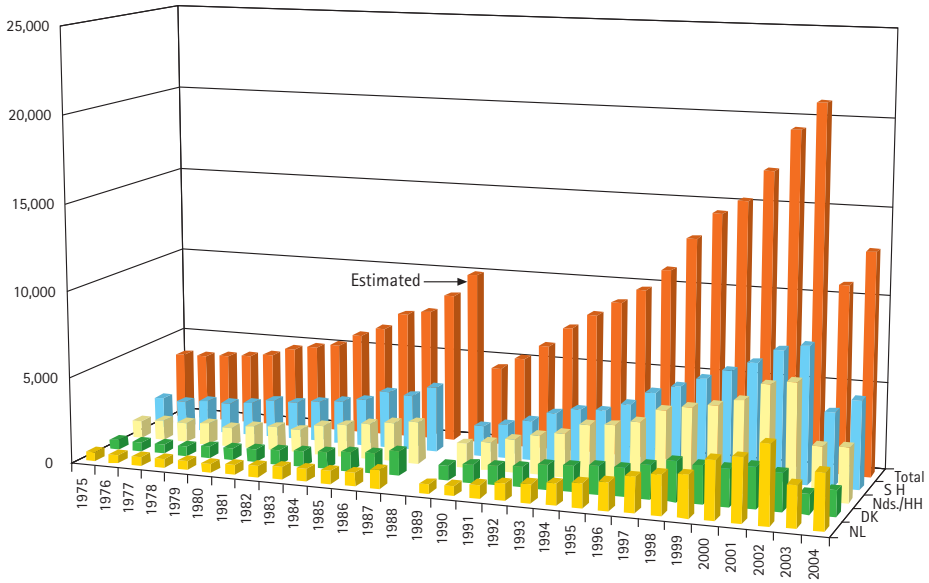

Figure 13.4: Number of harbour seals counted in the different Wadden Sea regions: The Netherlands (NL), Denmark (DK), Niedersachsen and Hamburg (Nds/HH), Schleswig Holstein (SH) and total.

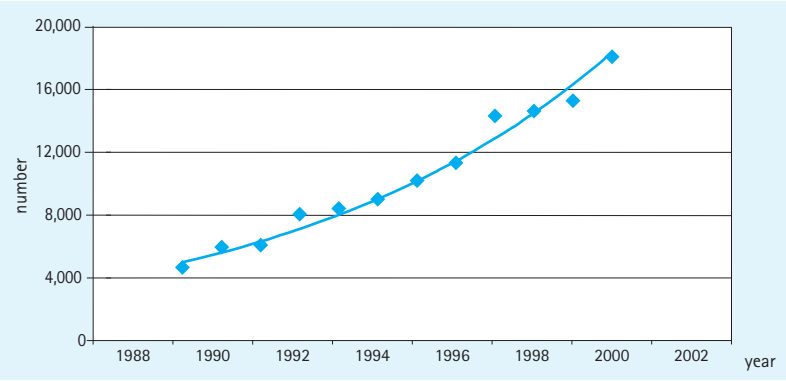

Figure 13.5: Calculated population trend of harbour seals in the Wadden Sea (line) for the period 1990–2001, based on annual aerial counts (symbols) during the moult (August).

in the 1990s (*cf.* Härkönen *et al.*, 2002). Therefore, it is safe to conclude that in terms of demographic parameters the population status of harbour seals in the Wadden Sea is satisfactory. Compared to an annual decline of 2.8% in 1960-1973, the population increased by 7% per year during 1974-1987, and after the 1988 epizootic the increase further grew to an average of 12.7% per year during 1989-2002 (Reijnders *et al.*, 1997; Abt, 2002).

In 2002, a second PDV-epizootic struck the population (Jensen *et al.*, 2002; Müller *et al.*, 2004). In 2003, only 47% of the expected number of seals (if no epizootic had occurred) was counted, *viz.* 10,800 animals. This number is comparable to the population count in 1996. Interestingly, the pup to total ratio that year (27%) was much higher than before (only 15% following the first epizootic). This offers good prospects for a quick recovery (Reijnders *et al.*, 2003b; section 13.3.3). Indeed, the surveys in 2004 showed that compared to 2003 the population has increased by 18% and the pup to total ratio was 29%, and a strong recovery seems to be on its way.

The 1988 epizootic somewhat changed the distribution of the harbour seal population throughout the Wadden Sea (Table 13.1). In 1987, Schleswig-Holstein was home to most of the animals (43%), and still is (almost 40 %). Of particular interest is the relative growth in The Netherlands, where by 2001, 20% of the population was counted compared to 12% in 1987. Denmark apparently has lost importance, as demonstrated by the lower than average population growth from 1989 onwards, which virtually stopped from 1999 because of the relocation of a large group, almost a quarter of all 'Danish' seals, from haul-out sites just north of the border into the Schleswig-Holstein area.

13.3.3 Impact and consequences of the PDV disease

Short term trends

About 50% of the harbour seal population in the Wadden Sea was killed by the 2002 phocine distemper virus outbreak (Reijnders *et al.*, 2003c). As a consequence, the population size was again pushed well below the carrying capacity of the area. In the coming years, the stocks can be expected to recover. Growing exponentially at 12.7% per year, the population would take 6 years to reach the size that had been expected for 2003 (22,600 counted animals in August). Population recovery, however, may be faster and take only 4–5 years. This is because demographic data from distemper victims suggests that mortality was disproportionately high in adult males, and lower in adult females. The surviving population therefore contains an elevated proportion of mature females (about 40% instead of 30%), representing a high reproduction potential. This is already reflected in the unusually high ratio of pups to total number of seals counted in 2003. The demographic structure of the population will gradually return to stable proportions. For a limited period, an elevated productivity may prevail, resulting in elevated rates of population increase (14–17% per year), eventually resulting in a shorter recovery time, provid-

Table 13.1: Distribution of the entire harbour seal population over the different Wadden Sea regions in different years, based on counts during the moult (August).

Year	NL	NDS	SH	DK	Total count
1987	12%	28%	43%	17%	8,296
1988		1st PDV-epizootic			
1989	13%	28%	38%	21%	4,000
2001	20%	30%	37%	13%	17,900
2002		2nd PDV-epizootic			
2003	22%	28%	39%	11%	10,817

ed that meanwhile no further PDV outbreak occurs.

Possible trends in the case of recurrent PDV outbreaks

What future may be expected for the seal population in view of distemper epizootics recurring at uncertain intervals? It is clear that the recovery and subsequent growth to carrying capacity levels would be severely disturbed. The shorter the interval between two epidemics, the lower the long-term population growth would be. Assuming that seals do not die from a second PDV infection while those not previously infected are subject to an average mortality of 50% (as observed in the 2002 epizootic), it would be expected that the long-term population trend will probably be positive at any interval length. The shortest possible interval is calculated to be two years, because only then there are enough susceptible animals around to start a new epizootic (Grenfell *et al.*, 1992). This scenario, however, should be taken with adequate caution, particularly because knowledge on phocine distemper characteristics such as persistency, virulence and transmission rates, is still scarce. Moreover, factors not taken into account, *e.g.* changes in environmental conditions in the seals' habitat, may lead to different mortalities than expected.

13.3.4 Health

Describing the health status of harbour seals in the Wadden Sea is complex because it is influenced by many different factors and can also be expressed in a wide variety of physiological parameters. A comparison of the outcome of autopsies carried out by members of the Trilateral Seal Expert Group on harbour seals in the periods 1979–1987 and 1999–June 2002 indicates that in pups perinatal disorders are the most significant threat. The occurrence of arthritis decreased during the second period (Siebert, 2003). The yearlings suffered mainly from lesions in the respiratory tract. In 1979-1987 these lesions were also present in older subadults, but not in 1999-2002. A second important observation during 1979-1987 was a high portion of fatal birth anomalies in adult females. Cases of fatal intestinal disorders in adult seals, such as intussusceptions and volvulus of the small intestine were observed in 2000-2002. The decline in occurrence of ecto-parasites, *e.g.* the seal louse *Echinophthyrius horridus*, and the incidence of circum-umbilical ulcers, declined from approximately 15% in the early 1980s down to 1.5% around 2000.

Long-term field and pathological investigations indicate that there is an improvement of the health condition in general. Further research is needed to investigate the cause of increased number of perinatal disorders in pups.

13.3.5 Environmental conditions of relevance to the status of the population

Anthropogenic impacts

Human activities potentially influencing the status of the harbour seal population include pollution, fisheries, shipping, tourist activities and more recently the building and operating of wind farms and gravel extraction. Hunting of seals was phased out in all Wadden Sea countries between 1962 and 1976.

Compared to the situation described in the 1999 QSR, the levels of the classical chemical compounds such as PCBs and DDT in seal tissue have continued to decrease (Härkönen *et al.*, submitted). Consequently, the impact of these pollutants on the seal population has significantly reduced compared to the period before the 1988 epizootic (Reijnders *et al.*, 1997).

With respect to the other human activities mentioned, not much new information has become available. Without ignoring the importance of the other factors, we consider it as a priority to address the aspect of adequate food availability in and outside the Wadden Sea. Besides the indirect method of relating seal distribution to fish distribution, technical solutions need to be developed to generate a more direct way of assessing the diet composition of the harbour seal.

Though population development is very well recorded in the area, distribution and habitat use away from the haul-out sites are still understood only at the level of individual seals rather than at a population level. In order to anticipate the effects of, for example, the development of large scale wind farms, information is needed on the relative importance for seals of the different ar-

Dead harbour seals, Denmark 2002 (Photo: S. Tougaard).

eas, including haul-out sites, feeding grounds and migration routes. With respect to disturbance, information on 'dose and effects' of disturbance and possible habituation is needed. Only then will it be possible to estimate the cumulative effects of different human activities in some areas and to determine when and how these activities would affect the carrying capacity of the area for the seal population. Phrased differently: we need to find a way to assess how many new human activities such as wind farms and/or gravel extraction seals can stand in addition to the traditional human use of their habitat in the form of recreation and shipping.

Taking

Taking of live seals and their subsequent release after rehabilitation creates the risk of introducing pathogens which can have negative effects on the wild population. Based on information on growth and condition (reproduction, health, survival) of the populations, it was decided in 1991, and reconfirmed in 1994, by the responsible authorities of the Wadden Sea countries, that taking, rehabilitation and subsequent release of seals is not necessary from a biological nor a management point of view. According to the Seal Management Plan 2002: 'the number of seals taken from and released to the Wadden Sea should be reduced to the lowest level possible' (Trilateral Seal Expert Group-plus, 2002). New data, from 2002 onwards, will demonstrate whether the trilaterally developed guidelines for handling of seals will successfully result in a significant reduction of the number of animals taken, rehabilitated and released per total numbers in the respective (sub)population.

According to the Seal Management Plan (SMP), for all dead animals found a trilaterally agreed minimum number of parameters should be measured, and the data forwarded to the responsible state agencies and stored in a database. Data to be collected should at least include: number, date and place found, length, age and sex. Together with post-mortem examinations, this data will assist in evaluating the health status of the population. It is essential that the effort of the search is recorded as well.

13.4 Harbour porpoise

13.4.1 Around the West Frisian islands – Dutch waters

The only recent North Sea-wide survey of harbour porpoises is the SCANS mid-summer survey of 1994 (Hammond *et al.*, 2002). The density of harbour porpoises off the coast of The Netherlands and Niedersachsen (area H) was 0.09 km^{-2}. Within the Wadden Sea itself and the adjacent North Sea area, dedicated surveys do not exist. Opportunis-

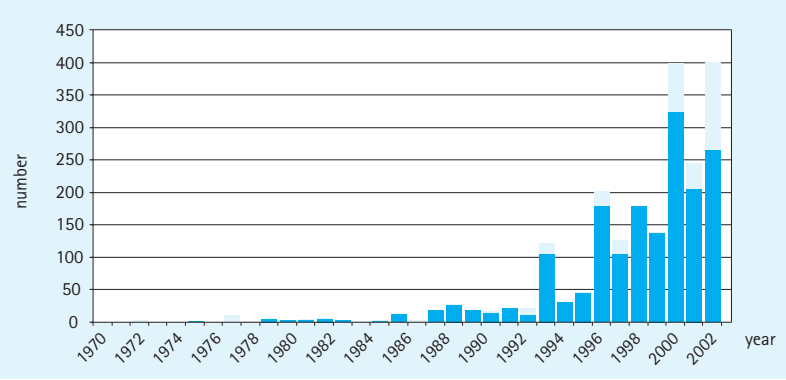

Figure 13.6: Increase in sightings of harbour porpoises in The Netherlands since 1972, including effort-corrected sightings from sea-watching sites (dark blue) and accidental reports (light blue).

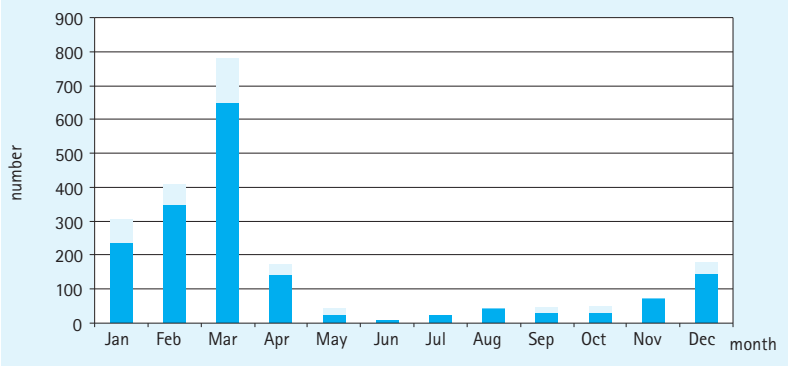

Figure 13.7: Seasonal pattern in sightings of harbour porpoises in The Netherlands, including effort corrected sightings from sea-watching sites (dark blue) and accidental reports (ligth blue).

tic observations show that here the number of sightings is consistently very low, and virtually restricted to areas with turbulent water and channels between the islands. Along the North Sea mainland coast in The Netherlands (*i.e.* south of Den Helder) several fixed sites exist, providing very frequent sightings and a clear-cut seasonal pattern (Figures 13.6 and 13.7).

Harbour porpoises were initially winter visitors in Dutch coastal waters, but have become year-round visitors more recently. Contrary to the period mid 1980s to1995, adult females with small offspring have been observed with increasing regularity in recent years (Camphuysen, 1994; Camphuysen, 2005). Documented strandings show increasing numbers washed ashore, and a similar trend of more frequent strandings of young individuals (Addink and Smeenk, 1999). It is postulated that the same trends and seasonal patterns occur at the West Frisian islands, which is corroborated by opportunistic sightings only. It is hypothesized that the increase in harbour porpoises in the Dutch waters since the mid 1990s until now, is linked to a distributional shift of harbour porpoises in the North Sea rather than population fluctuations. The re-distribution may be triggered by local reductions or regional changes in principal prey availability (Camphuysen, 2005).

13.4.2 In the German Bight

During the previously mentioned SCANS survey of 1994, the highest density of porpoises in all sub-regions in the North Sea was found in the waters of Schleswig-Holstein (area Y), and amounted to 0.812 km^{-2}. The extraordinarily high proportion of mother-calf groups in that area was remarkable. More recently, during May-August in 2002 and 2003, aerial surveys were conducted in the German EEZ of the North Sea (Figure 13.8) to assess harbour porpoise distribution, density and abundance.

In both 2002 and 2003 the highest density of porpoises was seen in area C and the lowest in area D (Table 13.2).

The high density area is larger than previously thought (Sonntag *et al.*, 1999) and not just restricted to the coastal waters (Scheidat *et al.*, 2003). The offshore regions A and B had similar densities, both within and between years. The density and the resulting abundance estimates were different between the years 2002 and 2003, but the overall patterns of mean abundance in the German EEZ of the North Sea are very similar between years.

The overall mean abundance of harbour porpoises in the German EEZ of the North Sea, in summer 2002 and 2003, amounted to around 36,500 animals (Table 13.3).

Because of the very high density of harbour porpoises off the coast of northern Schleswig-Holstein, an area which is also an important calving ground, a whale sanctuary off Sylt and Amrum was established in 1999. Within the whale sanctuary, it is not allowed to seriously harm whales, and - according to a revised coastal Fishery Order ('Küstenfischereiordnung') - to use bot-

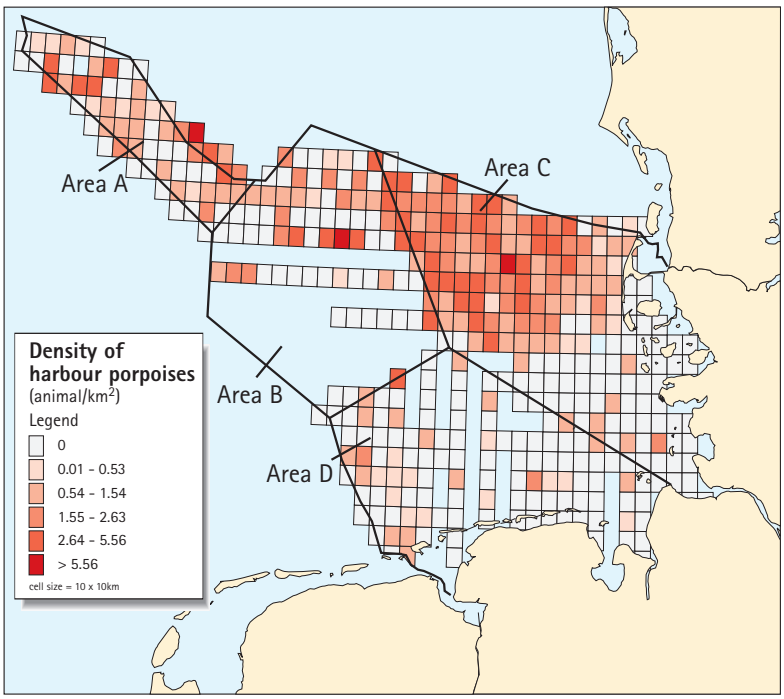

Figure 13.8: Map showing the distribution of harbour porpoises in the German EEZ of the North Sea. Area A = Entenschnabel; B = Offshore; C = Nordfriesland; D = Ostfriesland. For each cell (3' latitude by 6' longitude), density is shown in animals per km². Results are shown of flights conducted under good or moderate conditions during May – August in 2002 and 2003.

Table 13.2: Density and abundance of porpoises from May to August in 2002 and 2003 in four areas of the German EEZ of the North Sea. A = Entenschnabel, B = Offshore, C = Nordfriesland and D = Ostfriesland. The coefficient of variation (C.V.) was calculated for each area using the values for 2002 and 2003 as samples. The mean shown is the geometric mean based on log-transformed data.

Area	Size (km²)	2002 Effort (km²)	2002 No. of porp.	2002 Density (animals/km²)	2003 Effort (km²)	2003 No. of porp.	2003 Density (animals/km²)	Abundance per area 2002	Abundance per area 2003	Mean abundance 2002-2003	C.V.
A	3,903	3.9	4	1.03	110.3	90	0.82	4,003	3,184	**3,570**	0.18
B	11,650	56.4	33	0.59	58.1	42	0.72	6,821	8,427	**7,582**	0.17
C	13,668	231.3	353	1.53	379.4	703	1.85	20,857	25,329	**22,986**	0.15
D	11,824	179.7	41	0.23	97.9	18	0.18	2,698	2,174	**2,422**	0.17

tom set nets higher than 1.3 m and a mesh size >150 mm, to conduct industrial fishing or to use drift nets. The whale sanctuary is enshrined in German National Park Act and the Coastal Fisheries Order, which are only valid for German fishermen. Therefore, this national legislation should be implemented into EU Fishery Legislation. As a first step, the EU-notification of the revised Coastal Fishery Order was applied for.

Table 13.3: Calculation of overall harbour porpoise abundance in the German North Sea EEZ during the months May to August in 2002 and 2003. Mean presented is based on the log-transformed data and corresponds to the geometric mean. C.V. = coefficient of variation; C.I. = confidence interval.

2002	2003	Mean (geometric)	C.V.	C.I. Lower 95%	C.I. Upper 95%
34,381	39,115	**36,672**	0.10	**16,154**	**83,247**

13.4.3 In Danish waters

Little information is available about harbour porpoises inside the Danish Wadden Sea. A three-year national campaign in 2000-2002 among pleasure boat owners resulted in 13 sightings of porpoises in waters around Rømø, Mandø and Fanø, of which three were with a calf and one sighting comprised one-five animals (Kinze *et al.*, 2003). This number of sightings may seem low compared to German and Dutch waters, but is probably a reflection of the much lower level of boat traffic and hence also much lower observation activity.

Much more information about abundance is available in the waters west of the islands and especially around Horns Reef, extending 40 km westwards from the Skallingen Peninsula. This information (Figure 13.9) comes from ship-based surveys conducted in 1987-2003, originally aimed at counting seabirds. Since 1999, dedicated porpoise surveys have been conducted in the area, in connection to the offshore wind farm on Horns Reef. These surveys revealed the presence of 500-1,000 porpoises in the Horns Reef area, with substantial variation, however, from survey to survey. Average densities are comparable to those found in the SCANS survey, viz. 0.65 and 0.81 animals/km² for areas L (eastern part of Fisher) and Y (Danish and Schleswig-Holstein parts of the Wadden Sea) respectively.

The survey data from Horns Reef (Figure 13.9) does not show any trend in the abundance of porpoises at Horns Reef over the last 18 years.

13.5 Conclusions

13.5.1 Scientific assessment – Issues of concern

Harbour seal, grey seal and harbour porpoises are species included in Annex II of the EC Habitats Directive.

13.5.1.1 Harbour seal

After a successful recovery from a PDV-epizootic in 1988, the harbour seal population in the Wadden Sea was struck again by a seal virus (PDV) in 2002. In 2003, numbers were only 47% of those that would have been expected if no epizootic had occurred. Pup production in 2003 (number of pups per total number counted) was higher than before the epizootic. This can be explained by the skewed age and sex composition of the surviving population. The demographic structure will gradually return to a stable composition. It is essential to continue close monitoring of the population to assess the recovery from its depleted size.

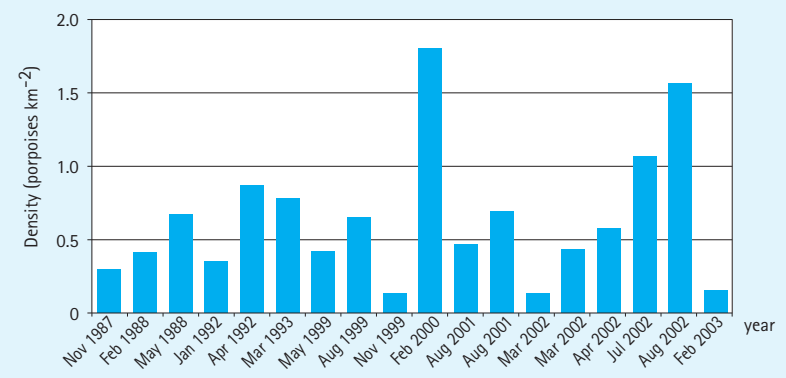

Figure 13.9: Harbour porpoise densities from ship-based visual surveys at Horns Reef, DK. Surveyed areas are not identical and survey conditions (sea state, eye height etc.) vary between surveys. Figures are not corrected for animals missed by the observers (g(0) correction). Data source: Tougaard *et al.*, (2000), Skov *et al.*, (2002) and Tougaard *et al.*, (2003).

Harbour seals (Photo: S. Tougaard).

Recently, satellite telemetry was used to investigate habitat use of harbour seals. This revealed that seals use the North Sea to a much larger extent, in terms of numbers as well as range, than thought before. It is therefore considered of importance to intensify studies focused on foraging ecology to identify critical habitats for this species in the North Sea.

The increasing human exploitation of marine waters gives rise to a new concern. In particular the booming wind farm industry in the North Sea, and to a lesser extent gravel extraction, poses potential threats to harbour seals through interference with foraging and migratory behavior. This issue needs to be addressed as a matter of priority.

13.5.1.2 Grey seal

The grey seal population in the Wadden Sea is growing. In the Dutch Wadden Sea, the development of the grey seal population since its establishment in the early 1980s has been abundant with an average annual increase of 20%. Some of the growth can be attributed to influx from colonies of the UK east coast. In the Wadden Sea of Schleswig-Holstein, the numbers have been increasing by on average 4-5% per year. Outside the reproductive colonies in the Dutch Wadden Sea and in the Wadden Sea of Schleswig-Holstein, there are signs of a more recent establishment of grey seal colonies in the Wadden Sea of Niedersachsen (Borkum Riff and Norderney) and the Isle of Helgoland (German Bight), until now without any significant breeding.

The conservation of grey seals in the Wadden Sea must involve effective protection of colony sites particularly during the breeding season (November-January) and moulting season (March-April). This is currently implemented in Schleswig-Holstein, but not in The Netherlands, where major colonies fall outside the Conservation Area, and strict protection of seals is only provided from 15 May till 1 September.

Grey seals (Photo: H.-U. Rösner, WWF).

Harbour porpoise (Photo: B. Lammel, WWF).

The other concern is our lack of knowledge about the basic biology of this species in the waters of the entire Wadden Sea. For this indigenous species, which is included in the Seal Management Plan, studies of changes in numbers as well as habitat use should be initiated in order to obtain data essential for designing appropriate management.

13.5.1.3 Harbour porpoise

Since the SCANS surveys in 1994, no further North Sea-wide comprehensive survey has been carried out. Opportunistic observations within the Dutch Wadden Sea show that the number of sightings is still very low. Along the Dutch mainland coast fixed observation sites exist which supply more regular counts. This data demonstrates that since the mid-1990s harbour porpoises are becoming year-round visitors, mother-calf groups have been observed with increasing regularity and the number of harbour porpoises sighted have increased considerably by 41% per annum.

Aerial surveys of harbour porpoises in the German Bight carried out in the summers of 2002 and 2003 revealed that the overall mean abundance of harbour porpoises in the German EEZ of the North Sea amounted to around 36,500 animals.

Information about harbour porpoises in the Danish Wadden Sea is scarce. Porpoises, including mothers and calves, are observed, but no density data is available. Much better data is available for the areas west of the Wadden Sea islands. Since 1987, boat surveys originally designed for bird monitoring also provided data on the occurrence of marine mammals. Since 2000, dedicated porpoise surveys have been conducted in connection with the offshore wind farm on Horns Reef. These surveys reveal the presence of 500-1,000 porpoises in the area, but show substantial variation from survey to survey, without any trend in the abundance over the last 18 years.

Fortunately, the recent development of wind farms in the North Sea created the opportunity to investigate the distribution, abundance and density of porpoises in North Sea areas adjacent to the Wadden Sea. Until then, lack of knowledge hampered the assessment of the status of the harbour porpoise in these waters. Continued monitoring of harbour porpoises is therefore considered a priority. Detailed suggestions to that effect are included in the section Recommendations for research and monitoring.

At the same time, however, these offshore developments pose a potential threat to the harbour porpoise population(s). Disturbance at feeding and nursing grounds, as well as effects on migratory behavior, may be expected, and should be, and already partly are, the subject of Environmental Impact Assessment (EIA) studies. These potential effects come on top of existing pressures such as by-catch of fisheries and pollution. By-catch in particular is considered the main threat to harbour porpoises in the North Sea and the Baltic (*e.g.* ASCOBANS, 2003). By-catch is occurring in coastal waters adjacent to the Wadden Sea and along the Dutch mainland coast, as demonstrated by Smeenk *et al.* (2004) and Siebert *et al.* (submitted). The magnitude of the by-catch in terms of numbers per stock/population size in the Wadden Sea and adjacent North Sea is unknown and therefore the sustainability of the porpoise by-catch in Dutch, German and Danish EEZ waters should be addressed, including possible mitigation measures.

13.5.2 Status and assessment of the target implementation

Target

Viable stocks and a natural reproduction capacity of common/harbour seal, grey seal and harbour porpoise in the tidal areas and the offshore zone.

Viability

Viability can be defined as the survival of a population in a state that maintains its vigor and its potential for evolutionary adaptation (Soulé, 1987). It is generally agreed that there is no single value that can be globally applied in all situations. Two components of viability analysis may serve to indicate the persistence of a given population, *i.e.* genetic criteria and risk of extinction.

From an inbreeding point of view, the minimum size of a mammal population with life history parameters such as the harbour seal is considered to be 500 individuals. It is evident that the size of the Wadden Sea harbour seal population is far beyond that threshold and can therefore be regarded as viable.

The situation with respect to the grey seal is more complex. The colonies in the Dutch Wadden Sea number at least 1,100 specimens, however, data on life history parameters such as reproductive performance as well as survival in the colonies, is lacking. It is assumed that immigration from the east coast of the UK (notably the Farne Islands and Scotland) still has a prominent influence on the developments of these colonies, but the extent of this is unknown. Therefore, no conclusions can be drawn about the self-supporting capacity of these grey seal colonies.

Besides the fact that there has never been a harbour porpoise population in the Wadden Sea and numbers observed are rather a reflection of the distribution of harbour porpoise population(s) or stocks in the adjacent North Sea, data to evaluate the target for this species is lacking.

The other criterion, risk of extinction, can only be addressed for harbour seals, as data for grey seals and harbour porpoises is lacking.

The re-occurrence of mass mortalities has prompted the question of how recurrent epizootic outbreaks may affect the harbour seal population. Harding *et al.* (2002, 2003) have shown that the extinction risk, *i.e.* the risk to decline to 10% of the initial population size, for the Kattegat-Skagerrak harbour seal population increases from 0.09 in the absence of epizootics to 0.56 in the presence of epizootics. This is on the assumption of an upper boundary level of 50,000 individuals. If no boundary level is assumed, the calculated risk is negligible in the absence of epizootics or 5% with epizootics occurring. Much of the outcome of the risk analysis is dependent on the assumed immunity, frequency of epizootics, meta-population structure, upper boundary levels and sampling variability. Future changes in these values are unknown and therefore it is not possible to exactly state what the risk for extinction is and subsequently whether viability of the population will be seriously impeded. However, it is considered safe to assume for the harbour seal population in the Wadden Sea, that with the PDV properties as operative in that area during the last epizootic, there is no significant risk of quasi-extinction.

Natural reproduction capacity

For the parameter 'natural reproduction capacity' no quantification can be given for either the harbour seal, grey seal or harbour porpoise, because of insufficient knowledge of this parameter. It is possible to provide a qualitative indication on the reproductive status of the harbour seal. Though no data is available on a straightforward measure such as fertility amongst the female section of the population, comparison of growth rate, calculated per capita birth rate and death rate in this population with similar data from harbour seal populations elsewhere may provide some insight in their 'natural reproduction capacity'. Based on the data obtained for the Wadden Sea harbour seal population and the population in the Kattegat-Skagerrak (Abt, 2002; Reijnders and Brasseur, 2003), it is concluded that the reproduction capacity of the Wadden Sea harbour seal population was at a satisfactorily level.

13.5.3 Recommendations

In the Seal Management Plan (SMP) 2002-2006, the required effort and objectives as well as management, research and monitoring actions for the running time-period are given. These relate to habitats, pollution, wardening, research and monitoring, taking and exceptions for taking and public information (Trilateral Seal Expert Group-plus, 2002). The SMP contains the main recommendations regarding seals and the listed actions in the SMP are still relevant and should be implemented.

In addition to the SMP, the following recommendations are emphasized especially because of the recent increase in numbers of the seals, and rapidly developing offshore wind farms.

13.5.3.1 Recommendations for management

Because of increasing numbers of grey seals in the Wadden Sea and at Düne Helgoland, it is recommended to ensure that grey seal colonies are protected. Reserves should be maintained, extended and established in such a way that disturbance is limited to a minimum.

For recommendations with respect to the harbour seal, see SMP 2002-2006.

For the protection of the harbour porpoise, the national regulations of the German Whale Sanctuary off Sylt and Amrum should be incorporated into EC legislation.

13.5.3.2 Recommendations for research and monitoring

Given the severe depletion of the Wadden Sea harbour seal population in 2002, it is emphasized that monitoring of this population should be continued at the same level of intensity as in the past decennium, to enable its recovery to be followed closely.

In view of the increasing awareness that harbour seals from the Wadden Sea use the North Sea as feeding grounds, and the growing pressure on fish resources in the North Sea, it is recommended that research into the feeding ecology (*e.g.* diet composition and foraging sites) of this species should be continued and intensified.

Recognising 1) the rapidly expanding human offshore activities such as construction and operation of wind farms and gravel extraction, and 2) the evident importance of the North Sea as feeding grounds for harbour seals, it is recommended that alongside ongoing studies about impact of those activities on harbour porpoises, priority should be given to include studies focusing on impacts of those activities on harbour seals, in particular foraging and migratory behavior.

In order to design adequate management measures and enable the evaluation of the targets for grey seals and harbour porpoises, it is recommended that monitoring grey seals and harbour porpoises should be continued or initiated in the framework of the TMAP.

Because of increasing numbers of grey seals in the Wadden Sea and at Düne Helgoland, it is considered necessary to start studies on grey seal basic population biology such as population/stock size, pup production, and distribution during and outside the breeding and moult season.

By-catch by fisheries of harbour porpoises does occur in the waters adjacent to the Wadden Sea. It is unclear what the impact is on the stocks concerned. As a start, it is recommended that the location and extent of the by-catch should be investigated.

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