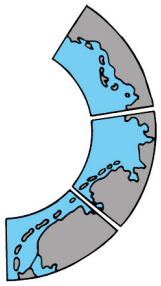
IMPLEMENTATION OF THE AGREEMENT ON THE CONSERVATION OF SEALS IN THE WADDEN SEA



Progress Report by the Common Wadden Sea Secretariat

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1. The Agreement on the Conservation of Seals in the Wadden Sea, which was the first regional agreement under the Bonn Convention, was concluded between Denmark, Germany and the Netherlands on 16 October 1990 in Bonn, Germany, and entered into force one year later. The Secretariat for the Agreement and the coordinating institution for the Seal Management Plan is the Common Wadden Sea Secretariat in Wilhelmshaven, Germany.

2. The aim of the Seal Agreement is to promote close cooperation amongst the Parties in order to achieve and maintain a favourable conservation status for the Harbour seal population, which was a particular critical issue in 1988 and 2002, the population was reduced by about 60% in 1988 and 47% in 2002 as a result of two disastrous Phocine Distemper virus (PDV)-epizootic.

3. “The Conservation and Management Plan for the Seal Population, 2007-2010”, the Seal Management Plan (SMP) builds on the obligations of the Seal Agreement and contains objectives and action points on habitat protection, research and monitoring, pollution and wardening, taking and public information, which are continuously implemented.

4. The plan covers the Wadden Sea stock of the Harbour seal (*Phoca vitulina vitulina*) and is also extended to cover the breeding stocks of the Grey seal (*Helichoerus grypus*) in the Wadden Sea, the latter one not covered by the Wadden Sea Seal Agreement. The overall aim is restore and maintain viable stocks and a natural reproduction capacity, including juvenile surviving of the Harbour and Grey seal.

5. Since the last epizootic in 2002, the population of the Harbour seals has recovered significantly. According to coordinated aerial flights in the entire Wadden Sea, a total of about 21,571 seals were counted in 2009, of which about 5,448 were pups, which equates to 25.3% of the total number of seals counted during the moult and is only slightly lower than the previous years. Besides an inter-annual fluctuation in count results due to environmental conditions, the observed lower increase could also be due to a population approaching the carrying capacity of their habitat. Given the still relative high pup percentage, the Trilateral Seal Expert Group (TSEG) considered that the latter is not yet the case.

6. Also for the Grey seals, the increasing trend in the population development has continued. After this originally native species of the Wadden Sea region almost completely disappeared, over the last three decades they have been recolonising again. In April 2009, 2,765 Grey seals were counted during the coordinated surveys in Germany and the Netherlands. The distribution of Grey seals has gradually extended continuously from a few local sites to an almost area-wide distribution throughout the Wadden Sea with some strongholds in the Netherlands and Germany, suggesting that the Grey seals could further spread in the Wadden Sea region.

7. The successful protection of Harbour and Grey seals over the last decades is a protection measure which also found its recognition in the acceptance of the Dutch and German Wadden Sea as World Heritage Site in June 2009 by the UNESCO.

8. The issue on the taking and releasing of seals is currently under discussion inside the TSEG. “Taking” is defined here as the removal of living seals from the natural environment to check the health condition of the animal, and then decide to (1) release the animal in its environment, (2) to euthanize it or (3) to try to rehabilitate the animal and subsequently release it into the wild. Most often “taking” relates to seal pups found without mother, or to weak or sick seals. Currently the issue on the taking of seals receives a new quality after the seals populations have recovered so fast after the last epidemic. Especially now, that the population is on the highest level ever reported. The TSEG forwarded their concern to the Trilateral Working Group (TWG) for further consideration in November 2009.

Common Wadden Sea Secretariat, Virchowstr. 1, D-26382 Wilhelmshaven, Germany
Tel. +49 4421 9108 0, E-Mail info@waddensea-secretariat.org, http://www.waddensea-secretariat.org/

9. It is clearly stated in the Seal Management Plan (1991-1995), pursuant to the Seal Agreement (concluded in 1991), that taking of seals is prohibited. This was later on further defined and explicitly declared in the so-called Leeuwarden Declaration (LD § 60, Appendix 3) by the responsible Trilateral Management Authorities at their 7th Trilateral Ministerial Conference (CWSS, 1994). They agreed "to reduce the taking of seals to the lowest level possible". A good health status of the seal population can only be achieved if natural selection processes can occur. From a biological and wildlife management point of view, human activities should not interfere with these basic processes. Even if animal welfare aspects are taken into account, human handling of seals should be restricted to a low level.

10. The SMP is an essential instrument that seeks a balance between conservation and management of the area, and contributes to achieving viable stocks. The Parties continuously amend the plan in order to meet the challenge of protecting this flagship species of the Wadden Sea. The SMP 2007-2010 currently in place will be evaluated to compile the future one from 2011 onwards.

Further information on marine mammals in the Wadden Sea including Harbour seals and Grey seals are given on the CWSS website (http://www.waddensea-secretariat.org/management/SMP/seals.html) and in the final draft version of the Thematic Report No. 20: Marine Mammals, Quality Status Report 2009, in **Annex I**:

Reijnders, P.J.H., Brasseur, M.J.M., Borchardt, T., Camphuysen, K.(C.J.), Czech, R., Gilles, A., Jensen, L.F., Leopold, M., Lucke, K., Ramdohr, S., Scheidat, M., Siebert, U., & J. Teilmann, 2009. Thematic Report No. 20: Marine Mammals. Quality Status Report 2009. Wadden Sea Ecosystem No. 25, Trilateral Monitoring and Assessment Group, Common Wadden Sea Secretariat, Wilhelmshaven, Germany.

Annex 1

QSR Update 2009

Thematic Report No. 20: Marine Mammals

Version No.: 3 **Date: 04 Mai 2009**

Author(s):
Peter J.H. Reijnders, Sophie M.J.M. Brasseur, Thomas Borchardt, Kees Camphuysen, Richard Czech, Anita Gilles, Lasse Fast Jensen, Mardik Leopold, Klaus Lucke, Sven Ramdohr, Meike Scheidat, Ursula Siebert and Jonas Teilmann

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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 as regular visitors. 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 along the Wadden Sea coast are the white-beaked dolphin *Lagenorhynchus albirostris*, white-sided dolphin *Lagenorhynchus acutus*. Remarkable is the occurrence (live and dead) of large cetaceans in the Wadden Sea region since the QSR, 2004, notably minke whales *Balaenoptera acutorostrata* and humpback whales *Megaptera novaeangliae*.

The intention of this chapter is to provide an update of the QSR, 2004. Therefore only deviations from trends elaborated in the QSR, 2004 and new information is provided. Issues of concern are given in the context of the Targets set for the harbour and grey seal, and the harbour porpoise in the Wadden Sea Plan as well as in the Seal Management Plans (SMP, 1992,, 1996,, 2002, and, 2007). These Targets are:

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

The present management of the species mentioned in the Targets is laid down in the Seal Management Plan, 2007-2010 (SMP).
(www.waddensea-secretariat.org/management/SMP/seals.html#smp)

Findings of the QSR 2004

The results from the assessment of the Target in the QSR, 2004 can be summarized as follows:

- Viability
  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 size of the Wadden Sea harbour seal population is far beyond the threshold for inbreeding (5,000 to avoid inbreeding on long term) and can therefore be regarded as viable.
  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.

The situation with respect to the grey seal is more complex. Data on life history parameters such as reproductive performance as well as survival in the colonies is lacking. Therefore, no conclusions can be drawn about the self-supporting capacity of these grey seal colonies. There has never been a harbour porpoise population in the Wadden Sea and umbers 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.

- 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. Based on the data obtained for the Wadden Sea harbour seal population and the population in the Kattegat-Skagerrak, it is concluded that the reproduction capacity of the Wadden Sea harbour seal population was at a satisfactorily level.

Status

Grey seals

Following a long term decline since the Neolithic, grey seals became extinct in the Wadden Sea and the Dutch North Sea coast by about 1500 AD (Reijnders *et al.,* 1995). Up until the mid-19th century, only occasional animals were reported on the Dutch, German and Danish North Sea coasts (Mohr, 1952, van Haaften, 1974). No regular pupping occurred until the end of the, 1970s when a breeding colony was established near Amrum in the German Wadden Sea. Somewhat later, additional breeding sites were discovered near Terschelling/Vlieland in the Dutch Wadden Sea (1980) and at Helgoland (Reijnders and Brasseur, 2003, Härkönen *et al.,* 2007). Tracking of movements indicate these seal groups to be linked to larger populations in the UK. However, genetic studies are needed to ascertain population structure and determine the relationships between the populations along mainland Europe as well as the UK. Interestingly the timing of pupping (December/January) and moult (March/April) differs substantially from that of the UK. Maximum numbers of grey seals counted during the moult in, 2008 in the Wadden Sea are 1746 in the Dutch Wadden Sea, 174 in the Niedersachsen part of the Wadden Sea, 98 in the Schleswig-Holstein Wadden Sea, and 206 at Helgoland. Specific monitoring of grey seals is not practiced in Denmark but they are regularly seen in low numbers during harbour seal counts. The development in maximum numbers of grey seals counted in the last decades in the Wadden Sea is given in Figure 1.
Relative strongholds for breeding in the Wadden Sea are the western Dutch Wadden Sea, Amrum in the German Wadden Sea, and Helgoland (German Bight). During counts in, 2008/2009 at least 200 pups were recorded in the Dutch Wadden Sea, 12 pups off Amrum, and 52 pups at Helgoland. It is noted though, that increasingly more grey seals are observed in other areas. This is particularly observable in the eastern Dutch Wadden Sea and the western part of the German Wadden Sea. In the Netherlands the monitoring is therefore being extended to the probable new areas from 2009 onwards.

Harbour seals
Counts of harbour seals during the moult (August) are used to compare population developments over the years. In 2002, a second PDV-epizootic struck the population, and in the following year 2003, only 47% of the expected number of seals (if no epizootic had occurred) was counted: 10,800 animals. This number is comparable to the population size in 1996. Interestingly, the average pup to total ratio in the period 2003-2007, being 26.9% (SD = 4.384), is much higher compared to only 21.6% following the former epizootic. The surveys for 2003 - 2007 showed that the numbers counted each year increased on average with 11.9% per year, demonstrating a prosperous recovery. Indeed in 2008, the population is estimated to amount to 20,254 animals and thereby passed its pre 2002-epizootic level of 19,383 animals (Brasseur *et al.,* 2008). The pup percentage, presently still high, may indicate that the age-structure of the population has not yet returned to stable proportions and could be still dominated by adult females. The recruit of young born after the epizootic will gradually lessen that influence. The development in numbers of harbour seals counted in the Wadden Sea is given in Figure 2.

Harbour porpoise
For the period 2005-2009 five sources are available on harbour porpoise abundance in the Wadden Sea region and adjacent North Sea: the SCANS II North Sea wide cetacean survey in 2005 (SCANS II 2006, SMRU 2008), data from the German MINOS and MINOS^{+} project (Wollny-Goerke and Eskildsen, 2008; Gilles *et al,* 2008) and the BEMLV project (Scheidat *et al.,* 2006),data from aerial

surveys carried out by NERI (Teilmann *et al.,* 2008), and the sea watching data set of the Nederlandse Zeevogelgroep (see Haelters and Camphuysen, 2008).
The SCANS II data showed no difference in the total (North Sea) abundance of porpoises compared to the SCANS I (1994) data. However, the average density in survey blocks north of 56^0N was about half of its density in 1994, whereas for the survey blocks south of 56^0N the density was twice the one estimated in 1994 (SCANS II, 2006).
Data from Scheidat *et al.* (2006) and Gilles *et al.* (2008) reveal the highest densities in the German North Sea EEZ, in May 2005, when abundance was estimated at 64,506 animals (95% C.I. = 36,776-127,036) and in summer 2006, with an estimate of 51,551 animals (95%CI = 27,879-98,910). Lowest estimates were obtained in autumn 2005 (e.g. 11,573 animals in October/November).
The Gilles *et al.* (2008) data further showed that the spatial distribution is not homogeneous, but animals have clear preferences for discrete areas. Hotspots were detected at Borkum Reef Ground and Sylt Outer Reef. Similarly the Danish monitoring data showed that the highest densities were found in the southern part of the Danish North Sea along the German border (Figure 3). Also here hotspots were identified, with one close to the Danish Wadden Sea (Teilmann *et al.,* 2008). The Danish data also showed a strong seasonality in sightings, with maxima in the summer period (Figure 4).
The Dutch sea watching data set evidently demonstrates that the increase in harbour porpoise sightings in Dutch coastal waters mentioned in Reijnders *et al.,* (2005) continued. A maximum sighting rate (sightings per hour) was obtained in 2006, thereafter it decreased spectacularly in 2007 (Figure 5) and continued in 2008 (C. Camphuysen, pers. comm.). There is a distinct spring peak in the sightings, with a slight decrease in June followed by a higher level from July onwards (Haelters and Camphuysen, 2008).

Factors influencing status

Infectious diseases

The health status of seals in the countries bordering the Wadden Sea was monitored through examination of live and dead individuals. Post mortem examination, including histology, immuno-histochemistry, microbiology, serology and parasitology were performed since the first epizootic in 1988. The majority of pathological findings concentrate around the respiratory and alimentary tracts. The prevalence of these findings is compared here for three periods: pre-1988, between the epizootics in 1988 and 2002, and 2002-2005.
With respect to the prevalence of parasites in harbour seals, both lungworm infestation and intestinal parasitation were higher between the two epizootics and after 2002, compared to the period before 1988. In contrary, lower acantochephalan (intestine parasites) and heartworm prevalence was found (Lehnert *et al.,* 2007; Siebert *et al.,* 2007). The prevalence of bronchopneumonia, gastritis and enteritis increased after the, 2002 epidemic, compared to the period 1988-2002, which may have been influenced by the 2002 Phocine Distemper Virus epizootic (Lehnert *et al.,* 2007; Siebert *et al.,* 2007). Bronchopneumonia due to parasitic and/or bacterial infections was the most common cause of death during 1988-2002 and onwards. The frequency of septicaemia as the cause of death or severest health impact increased significantly in harbour seals after the second seal die-off (Siebert *et al.,* 2007). Bacteria most frequently causing bronchopneumonia, gastroenteritis, polyarthritis, dermatitis, hepatitis, pyelonephritis, myocarditis and septicaemia in harbour seals and harbour porpoises were isolated and comprised α/β-haemolytic streptococci *Escherichia coli*, *Clostridium perfringens*, *Erysipelothrix rhusiopathiae*, *Staphylococcus aureus* and *Brucella maris* (Siebert *et al.,* 2007; Prenger-Berninghoff *et al.,* 2008; Siebert *et al.,* 2009).
A comparison of bacteriological findings in harbour porpoises from different regions of the North Atlantic revealed that organs from animals originating from Greenlandic and Icelandic waters showed clearly less bacterial growth and fewer associated pathological lesions when compared to animals from the German North and Baltic Sea and Norwegian waters (Siebert *et al.,* 2009).

No case of morbillivirus was reported after 2002. But a recent outbreak of disease leading to increased mortality of harbour seals in Europe began in 2007, starting again as in 1988 and 2002, on the small Danish island of Anholt and spreading subsequently to other major seal colonies in the Kattegat and Skagerrak over the next months (Härkönen *et al.,* 2008). Clinical signs of diseased seals and gross pathological findings were similar to those observed in 1988 and 2002. Clinical observations included a dorsally misshaped silhouette with intermittent hump formation in the shoulder region, and restricted movement. In the final stage, animals showed respiratory distress and hemoptysis (Härkönen *et al.,* 2008). Preliminary histopathological findings of four seals displayed multifocal acute catarrhal

bronchitis, chronic interstitial pneumonia, severe atelectasis, moderate follicular hyperplasia and acute lymphocytolysis. It was suggested that an unknown virus was most likely the pathogen causing the epidemic. As harbour porpoises showed similar pathological findings, a cross-species infection could not be ruled out (Härkönen *et al.,* 2008).
In conclusion, changes in the prevalence of parasitic and bacterial infections have occurred. But the general health status of harbour seals in the Wadden Sea appears to have improved compared with earlier decades. In particular the health of pups (0-6 months old) has improved after 2002 (Siebert *et al.,* 2007). However, the increasing prevalence of lung and intestinal parasites warrant the continued monitoring of the health status of seals.

Disturbance
Wind farms
Offshore wind farms may affect marine mammals in different ways: through noise related to construction and operation, and through the physical presence of wind turbines, the shipping of material and people during construction and maintenance. Much of the research into possible effects of offshore wind farms on marine mammals in the south-eastern North Sea has until now been focused on seasonal distribution patterns of seals and porpoises to identify preferred areas and investigate possible spatial overlap with planned offshore wind farms (Brasseur *et al.,* 2004; Wollny-Goerke and Eskildsen, 2008; Teilmann *et al.,* 2008). The only extensive studies on the construction and operation of offshore wind farms hitherto are studies in Danish waters: the Horns Rev area in the Danish North Sea, and Nysted in the Danish Baltic Sea (Teilmann *et al.,* 2006; Carstensen *et al.,* 2006). The results of many of the Dutch studies are expected in 2009 and 2010.
In the context of this chapter we will restrict our assessment to the findings in the Horns Rev study, as it is an area approximately 20 km northwest of the Danish Wadden Sea (Tougaard *et al.,* 2006 a, b). Porpoises' habitat use before, during and after construction of the wind farm, was studied by ship-based surveys and by passive acoustic monitoring. Both techniques were applied in the Horns Rev Offshore Wind Farm and in reference areas. The conclusions were that there was a negative effect of the construction as a whole, but that strong reactions up to 15 km away were observed during pile driving operations. No significant effects were found during operation. Compared to the wind farm in the Baltic Sea the effect on the porpoises were much weaker in the North Sea. Whether this difference is related to area characteristics or to differences in behaviour of the two populations, is unknown and caution should be given when extrapolating results between wind farms at different locations.
Harbour seals were provided with satellite transmitters before and after the construction of the wind farm in the Wadden Sea 20 km from Horns Rev, to study their habitat use in and around the wind farm area. For seals, no statistically significant differences were seen between the habitat use of seals in the wind farm area and seals in the reference area. However, this should not be interpreted as if there has been no influence. The authors conclude that with the accuracy of the seal locations obtained via satellite, no detailed analysis of behavior is possible. It is recommended to continue such studies as more detailed data on seal and porpoise habitat use are becoming available, and simultaneously techniques are developed to model the acoustic underwater world and the possible changes from wind farm induced noise. These new methods enable both more accurate tracking of seal movements and other behavior, assess the possible impact of noise from wind farms, and moreover provide better opportunities to study and apply mitigation measures.

Recreation
Recreational activities in the Wadden Sea and adjacent waters can negatively affect marine mammals using that area. Particularly seals will be affected as they are bound to the coastal waters and sandbanks for whelping, partly feeding, moulting and resting. In case of serious disturbances certain areas may become unsuitable for seals and in the southern Netherlands this even led to impairment of recovery of a depleted population (Brasseur and Reijnders, 2001). The detrimental impact of disturbance on seals was recognized by the responsible management authorities and protected areas were established in all Wadden Sea areas in the mid-1980s. This concern is explicitly addressed in the Seal Agreement - concluded between Denmark, Germany and The Netherlands in 1991 (under the Bonn Convention) - and obliges the Parties to create a network of protected areas to "ensure the preservation of all areas essential to the maintenance of the vital biological functions of seals". Momentarily, almost all of the haul-out sites are protected from disturbance during the summer. That is beneficial for harbour seals, but does not cover the demands of grey seal which have their pups, breed and moult in winter/early spring. It is envisaged that this caveat may be adequately addressed when the proposed Natura 2000 Network is designated. One concern though is the increasing

unregulated “seal watching” industry. This is not yet adequately addressed at a trilateral level, and is indicated a priority action in the running Seal Management Plan. The way of tackling this problem as approached in Schleswig-Holstein, may be a good example for application in the whole Wadden Sea. A combination of protection zones, restrictive shipping regulations and voluntary agreements with ship-owners conducting seal watching tours, seem to be a promising tool to make seal watching tours an ecologically acceptable activity.

Noise

Marine mammals evolved in the presence of this diverse natural sound environment and their hearing sensitivity is well adapted to perceiving signals that are biologically significant to them. Pinnipeds and cetaceans produce and receive sound over a great range of frequencies for use in communication, predator avoidance and to interact with their environment. Some toothed whale (odontocete) species have the capability to use echolocation for foraging and orientation in their underwater environment (Tyack and Clark, 2000). For these species sound became the most important sensory modality, and they rely on hearing for survival.

The three marine mammal species resident in the Wadden Sea area all share, as far as information is available, the sophisticated and very acute sense of hearing in marine mammals.

Sound in general can have diverse negative effects on marine mammals. It can cause acute or chronic stress (Fair and Becker, 2000), it may impede the perception of other biologically meaningful sounds (“masking”) (Richardson *et al.,* 1995; NRC, 2003; Janik, 2005; Madsen *et al.,* 2006), it can trigger behavioral reactions (NRC, 2005; Southall *et al.,* 2007; Nowacek *et al.,* 2007), and even lead to direct physiological or physical impairment and injury (Ketten *et al.,* 1993; Finneran *et al.,* 2002; Kastak *et al.,* 2008). Most of these processes are still poorly understood in marine mammals.

Based on the available information of the sound emissions from pile driving and other intense sound sources, on the one hand, and known effects of intense sound on terrestrial as well as some marine mammals on the other hand, it can be hypothesized that both seal species as well as harbour porpoises will be able to perceive these anthropogenic sound emissions and are likely to be impacted by them to varying degrees.

So far, the only available data on behavioural reactions in harbour porpoises to impulsive sound have come from visual and acoustic (T-POD) observations during the construction of wind turbines at Horns Rev, Denmark, where a significant effect on the presence and swimming behaviour was observed at a distance of up to 15 km from the sound source (Tougaard *et al.,* 2003). In the BROMMAD study (Gordon *et al.,* 2000), by contrast, no obvious behavioural reactions were observed in free-ranging harbour porpoises in response to airgun exposures.

Recent studies have shed some light on other sound-induced effects, namely masking and the acoustic tolerance of harbour porpoises to impulsive sound. In a dedicated study it was shown that e.g. the operational sound emitted by a 2 MW wind turbine would only mask the acoustic perception of harbour porpoises at close ranges (Lucke *et al.,* 2007). Intense impulsive sounds were tested for their potential auditory effect in a harbour porpoise in another auditory study (Lucke *et al.,* 2008). The animal’s auditory tolerance was determined by systematically increasing the received levels of an intense sound stimulus (an airgun impulse) and repeatedly testing the animal’s auditory sensitivity. At a sound pressure level of above, 200 dB re 1µPa and a sound energy of 164 dB re 1µPa2·s the animal’s hearing threshold shifted temporarily, thus providing the first scientific basis for a noise exposure criterion for this species. Future studies on the effects of sound on the distribution and abundance of the different marine mammal species might shed light on the effect of this type of pollution at the population level of the stocks/populations involved.

Taking

“Taking” is defined here as the removal of living seals from the natural environment to check the health condition of the animal, and then decide to (1) release the animal in its environment, (2) to euthanize it or (3) to try to rehabilitate the animal and subsequently release it into the wild. Most often “taking” relates to seal pups found without mother, or to weak or sick seals.

It is clearly stated in the Seal Management Plan (1991-1995), pursuant to the Seal Agreement (concluded in 1991), that taking of seals is prohibited. This was later on further defined and explicitly declared in the so-called Leeuwarden Declaration (LD § 60) by the responsible Trilateral Management Authorities at their 7th Trilateral Ministerial Conference (CWSS, 1994). They agreed “to reduce the taking of seals to the lowest level possible”. These decisions were made because 1) taking was not necessary any more to maintain the harbour seal population, because by then the population was in a good state and large enough to be considered as not vulnerable anymore, 2) taking can have negative

effects on the wild population, namely interfering with natural selection and population regulation, and 3) released animals can carry exotic pathogens to the wild population and diseases suppressed by medical treatment in the seal station, can break out after releasing the animal and harm the wild population.
Abt (unpublished manuscript, 2006) has analyzed the data about seal taking from Denmark (DK), Schleswig-Holstein (SH), Niedersachsen (Nds) and the Netherlands (NL) in the years 2000 - 2005. The vast majority of seals taken are pups. To calculate the level of taking, the number of taken animals was related to the number of newborn seals in each year. The year 2002 was excluded, because this year was atypical due to the second Phocine Distemper Virus outbreak.

Table 1: Estimated percentage of born harbour and grey seals that were taken alive from the Wadden Sea in 2000 – 2005, excluding 2002

country / species	NL harbour	Nds harbour	SH harbour	DK harbour	total harbour	NL grey
%	16.2	5.9	5.8	5.1	7.7	44.9

Among the seal pups taken only a certain percentage is accepted by authorised seal stations to try for rehabilitation. Those percentages are given in Table 2.

Table 2: Percentages and numbers of seals rehabilitated at seal stations in the period 2000 – 2005 excluding 2002, and number of released seals.

country / species	NL harbour	Nds harbour	SH harbour	DK harbour	NL grey	Other areas grey
% rehabilitation	99.9	82.3	30.3*	0	99.7	62.1
n	792	429	702	110	592	58
% released	92.0	86.7	88.3	0	97.1	100.0
n	791	353	213	0	590	36

* 2003 – 2007: 40 – 46 % (Borchardt, unpublished)

From the percentages of seals taken, accepted for rehabilitation, and released, it is possible to calculate the percentage of animals in the wild which have been in human care.

Table 3: Percentage of harbour and grey seals in the Wadden Sea that have been in human care between 2000 – 2005, excluding 2002

country / species	NL harbour	Nds harbour	SH harbour	DK harbour	total harbour	NL grey
%	14.9	4.2	1.5*	0	4.6	43.5

* 2.7 % in 2003 – 2007 (Borchardt, unpublished)

Table 3 shows that in Denmark no seals are rehabilitated and released, and seals are taken and released on a relative low level in Schleswig-Holstein and Niedersachsen. In the Netherlands the level of taking is relatively high for harbour seals, and strikingly high for grey seals: nearly every second grey seal has spent some time in a seal station.

Despite the declarations of the trilateral official authorities and the repeated statements in the successive Seal Management Plans aiming at bringing down taking to a low level, it is evident that this management goal is not achieved equally in the different Wadden Sea regions. It is sufficiently fulfilled in Denmark and Germany, but not in the Netherlands. The high proportion of seals passing through the Dutch seal stations might have negative impacts especially on the health status of grey seals. Basically there are two extremes in seal management: while the focus in Denmark is on the wild population, in the Netherlands it is in practice focused on the individual seal. The latter is contradictory to the general trilateral objective and formulated as Target: to guarantee the natural functioning of the ecosystem.
A good health status of the population can only be achieved if natural selection processes can occur. From a biological and wildlife management point of view, human activities should not interfere with

these basic processes. Even if animal welfare aspects are taken into account, human handling of seals should be restricted to a low level.

Bycatch
Bycatch or accidental drowning of porpoises is considered the most serious threat to harbour porpoises in the North Sea (Vinther and Larsen, 2004; EC, 2004; ASCOBANS, 2000; Reijnders *et al.,* 2009). The European Commission recognized the need to address this by issuing Council Regulation 812/2004, aiming at e.g. preventing bycatch through the mandatory use of pingers in certain fisheries, and to assess the extent of bycatch through observer schemes. However, fishing boats less than 12 m (15 m for observer schemes) are exempt from these obligations and in particular recreational set net fisheries with trammel/tangle/gill nets presumably continue to catch porpoises (Haelters and Camphuysen, 2009). In the context of this QSR Wadden Sea it is relevant to know that bycatch occurs in coastal waters close to the Wadden Sea (e.g. Siebert *et al.,* 2006, Haelters and Camphuysen, 2009). From early November 2008 till mid-March 2009, a total of 167 dead harbour porpoises were found on the Dutch coast and at least 60 of them were mutilated (Camphuysen and Oosterbaan, 2009). The majority of mutilated porpoises were found around the Islands Texel and Vlieland. These mutilated animals are probably bycaught given all characteristics that point into that direction (Camphuysen and Oosterbaan, 2009).
Regrettably data are lacking on the actual level of bycatch as well as the sort of fisheries activities involved. This latter includes the types of fishery, the intensity thereof, the spatial distribution and seasonality. We concur with the generally accepted view that this problem needs to be addressed with high priority, e.g in an approach as *i.a.* described in Camphuysen *et al.* (2008), Haelters and Camphuysen (2009), and Reijnders *et al.* (2009).
Though of a probably much lower scale, drowning of seals in e.g. fyke nets is a known phenomenon, also in the Wadden Sea. The extent thereof is unclear. In The Netherlands fyke net fishermen are obliged to put a guard net in front of the fyke, to prevent seals entering the nets (Reijnders *et al.,* 2005). This may be an approach to be followed up in other areas in the Wadden Sea.

Conclusions
Scientific assessment – Issues of concern
Grey seals
The number of grey seals observed in the Wadden Sea area has continued to increase since the last QSR (2004). The earlier concern about the lack of effective protection of their breeding and moulting grounds (especially in The Netherlands) has been largely addressed. The waters north of the Dutch Frisian Islands, encompassing grey seal breeding, moulting and resting sandbanks, have been designated as part of the Natura 2000 network and implementation into national law follows. A remaining concern is the lack of knowledge about some basic aspects of the biology of the grey seal in the Wadden Sea and adjacent North Sea. Knowledge on actual numbers using the area is imperfect, and the same holds for numbers of pups born, population structure within the Wadden Sea and genetic relationship with other populations elsewhere in the North Sea. This lack of knowledge prevents to design tailored management of this species.

Harbour seals
The harbour seal population has recovered prosperously from the last virus epizootic in 2002. Given the observed continued population growth, the question arises whether and at what point in time, the population may reach the carrying capacity of the area. This is an important issue, because while approaching carrying capacity, biological regulating processes will occur. These include lowered reproduction and survival resulting in decreased or stagnating growth rate, and increasing prevalence of parasites and diseases. This should not be interpreted as a population being in distress but a rather natural regulation process.

Harbour porpoises
A major issue of concern for this species is the growing offshore wind farm industry. Many plans are presented to build wind farms in e.g. coastal waters, including some close to the Wadden Sea Conservation area. This is a potential threat to harbour porpoises in these areas and in order to address this properly, detailed knowledge on distribution, abundance and specific habitat use is necessary. These data are largely missing for the coastal waters north of the western/middle part of the Wadden Sea and it is questionable whether the good time series of monitoring in the waters west of the northern and eastern Wadden Sea will be prolonged. These kinds of data are also essential to

assess bycatch, the other issue of concern. Next to numbers of animals bycaught, the population structure and the size of the stocks/populations from which these animals are removed needs to be known to investigate whether this removal is sustainable or not.
Another specific issue of concern is the recent bycatch of porpoises along the western Dutch Wadden Sea. Despite the lack of information on the actual level of bycatch in terms of sustainability, the frequency of strandings and mutilations are exceptional and unprecedented for this area. It therefore needs to be addressed with high priority.

General issues of concern
Impact of disturbance, whether exerted through recreational activities (including "seal watching") or noise (e.g. wind farms, shipping, seismic explorations, and military sonar) on marine mammals is hitherto less well studied. Given the increasing use of the Wadden Sea and adjacent North Sea for both professional and recreational use, we consider it relevant to include these aspects in future studies (see section on recommendations for research). Especially insight the cumulative effects of the mentioned various factors lacks in this respect.
Taking of seals, especially in The Netherlands, is a continued serious concern. The level of taking, especially grey seals in The Netherlands is so high that one may question whether the population can still be regarded a natural wild population. This is not only a matter of concern from a wildlife biological point of view, but also raises the question whether such a level of human handling of wild animals is acceptable from an animal welfare perspective, let alone its undermining effect of a joint trilaterally agreed policy.

Assessment of the Target implementation

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; Mills, 2008; Sinclair *et al.,* 2006). 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 short term minimum size of a mammal population with life history parameters such as the harbour seal is considered to be 500 individuals. However, if a population should also be able to survive catastrophes – in other words retain evolutionary potential on the long term - the minimum size is estimated to be at least 5000 animals. The harbour seal population has only increased since the QSR 2004 and therefore the conclusions in that QSR 2004 are even more valid, namely that the size of the Wadden Sea harbour seal population is far beyond those thresholds and can therefore be regarded as viable.

The situation with respect to the grey seal is still as complex as it was in 2004. Colonies have generally increased considerably, but data on life history parameters such as reproductive performance as well as survival in the colonies, is still lacking. Immigration from elsewhere is assumed to still have a prominent influence on the development of these colonies, but the extent of this is unknown. Therefore, no conclusions can be drawn about the self-supporting capacity, in essence viability, of these grey seal colonies. The other criterion, risk of extinction, can only be addressed for harbour seals, as data for grey seals is lacking.

For the harbour porpoise population in the Wadden Sea, actual numbers observed are probably a reflection of the distribution of harbour porpoise population(s) or stocks in the adjacent North Sea, than a resident Wadden Sea population. Data to evaluate the target for this species is lacking.

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 detailed 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, expressed as 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 (Reijnders *et al.,* 1997; Abt, 2002; Reijnders and Brasseur,, 2003; Brasseur *et al.,* 2008)

and the population in the Kattegat-Skagerrak (Härkönen *et al.,* 2002), it is concluded that the reproduction capacity of the Wadden Sea harbour seal population is at a satisfactorily level.

Summary of the target evaluation:

The population of harbour seals in the Wadden Sea can be considered viable with a satisfactory reproduction capacity.

The target regarding grey seal and harbour porpoise cannot be evaluated due to insufficient population data.

Recommendations for management

On request of the responsible seal management authorities the Trilateral Seal Expert Group designed an effective aerial survey scheme for harbour seals in the Wadden Sea, to tune the Trilateral Seal Agreement and EU Habitats Directive requirements (Meesters *et al.,* 2009). It is recommended that the proposed annual monitoring scheme will be closely followed trilaterally and in particular the proposed minimum survey frequency be respected.

The taking of seals in some parts in the Wadden Sea is excessive and it is recommended to bring that in line with the other practices in Niedersachsen, Schleswig-Holstein and Denmark, according to the trilaterally agreed policy. For detailed management recommendations see the SMP 2007-2010.

Recommendations for research and monitoring

Imperfect knowledge of grey seal biology in general and in particular knowledge on relationships between colonies in the Wadden Sea area as well as other colonies elsewhere in the North Sea, should be improved through dedicated research, including population biology and genetics.

It is recommended to continue and otherwise initiate monitoring of harbour and grey seal, as well as harbour porpoise populations, to closely follow population developments, both their dynamics and health condition in order to address the concerns expressed earlier in this chapter.

In addition, priority should also be given to promote studies on habitat use of harbour seals including feeding ecology, impact of wind farms on harbour and grey seals and harbour porpoises, and bycatch of porpoises. For details see e.g. the SMP 2007-2010.

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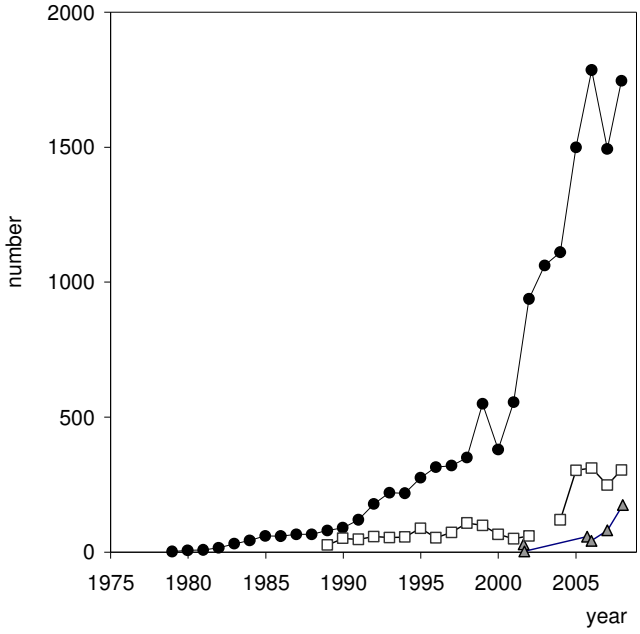

Figure 1: Counts of grey seals in the Wadden Sea during the moult (March/April). ● data for the Netherlands (source: IMARES); □ data for Schleswig-Holstein and Helgoland (source: National Park Schleswig-Holsteinisches Wattenmeer; ▲: data for Niedersachsen (source: Nationalpark Niedersächsisches Wattenmeer).

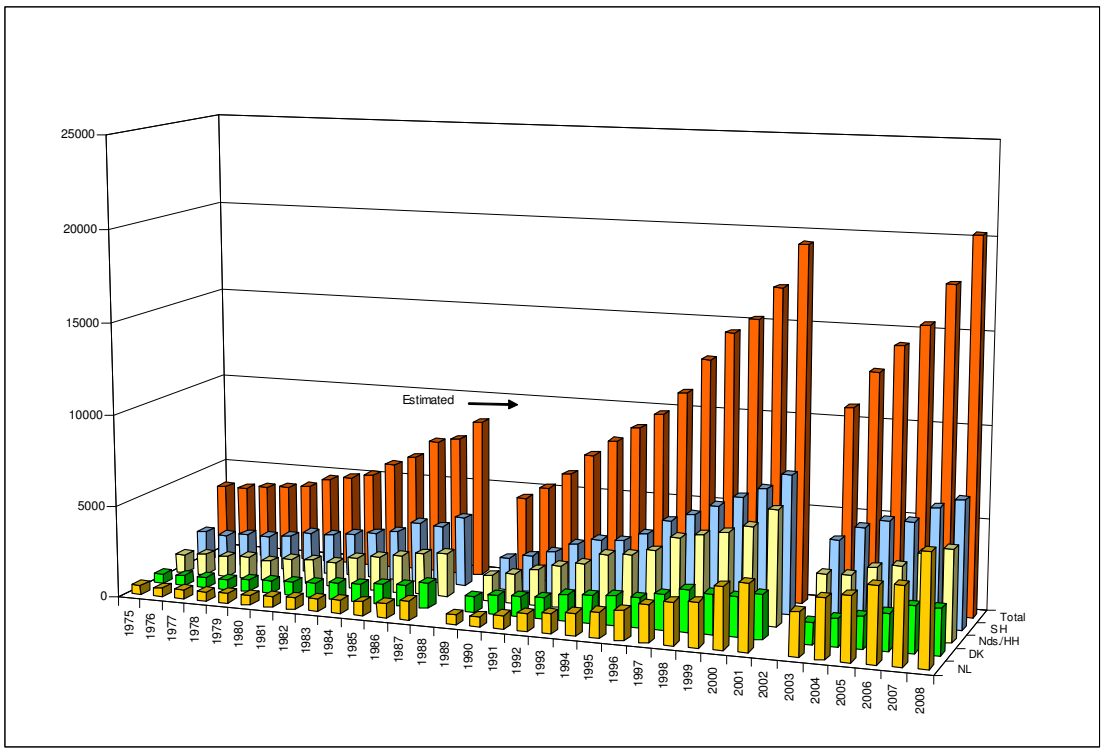

Figure 2: Number of counted harbour seals in the Wadden Sea since, 1975; NL= the Netherlands, DK= Denmark, NdS/HH= Niedersachsen and Hamburg, SH= Schleswig-Holstein, Total= entire Wadden Sea

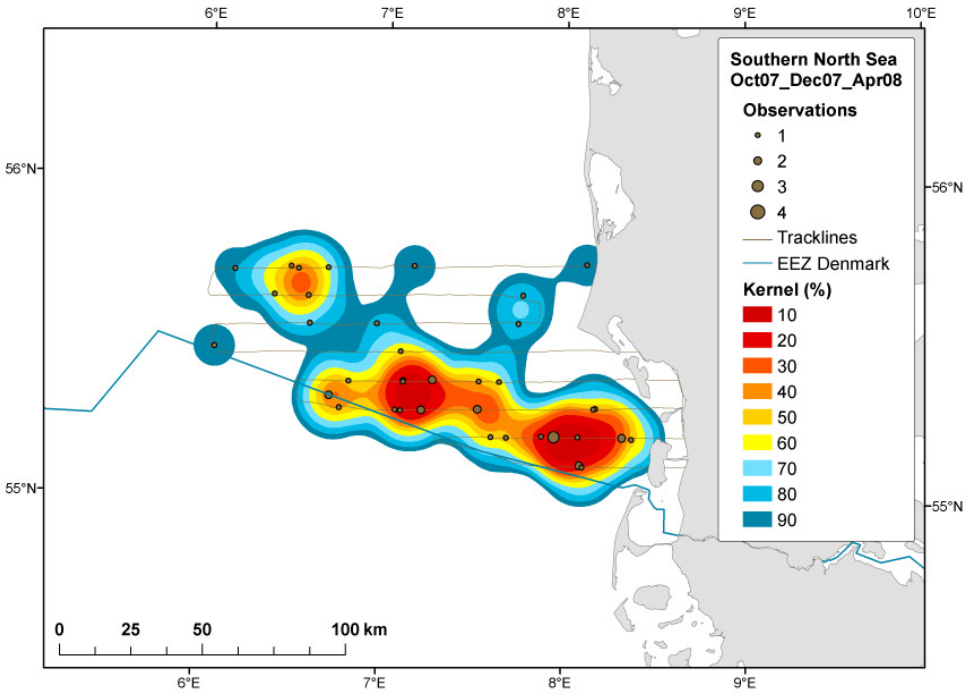

Figure 3: Combined data from three aerial surveys in October, December, 2007 and April 2008 with observations and kernel density contours. The color scale from blue over yellow to red shows increasing concentration of harbour porpoises.

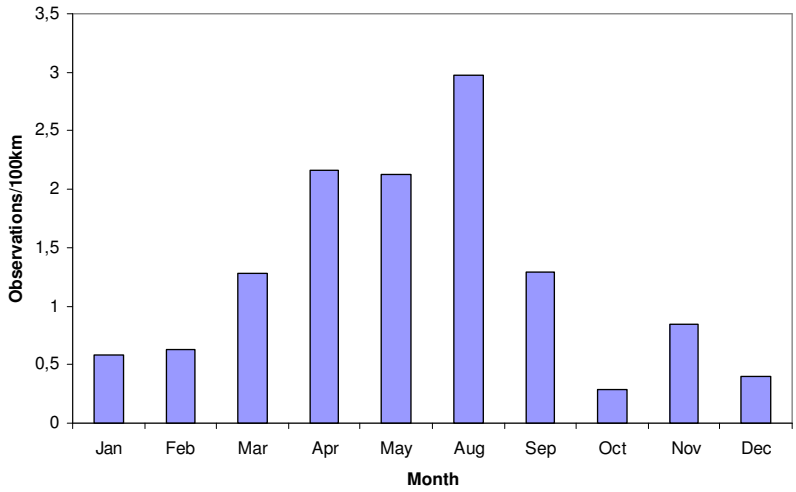

Figure 4: Monthly sighting rate from aerial surveys in the Danish Southern North Sea. Note that June-July is missing from the plot since no surveys were conducted in these months (after Teilmann *et al.,* 2008).

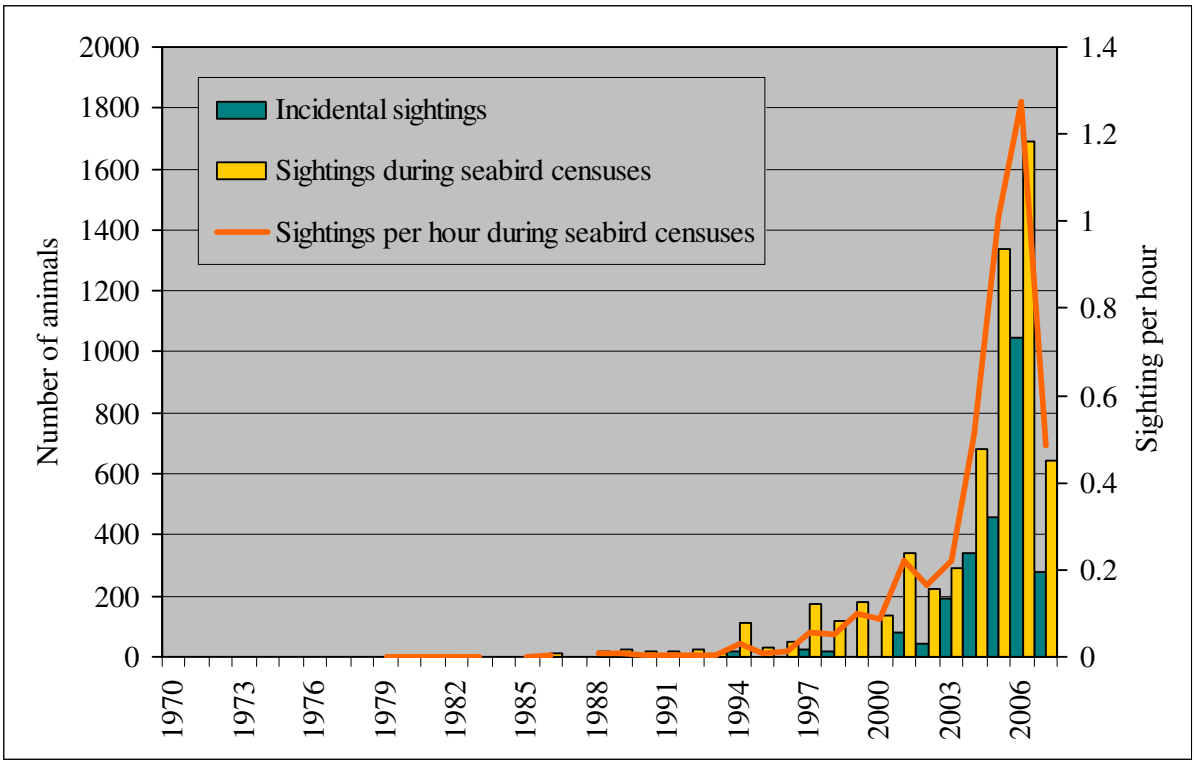

Figure 5: Sightings of harbour porpoises in Dutch coastal waters (coastal observations only), including systematic sightings from seawatchers (number of animals reported, yellow, left y-axis), effort corrected sightings from seawatchers (animals hour^{-1}, orange line, right y-axis) and incidental sightings reported by others (number of animals reported, green).