11. Offshore Area

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The red-throated diver *(Gavia stellata)* is the most common diver in the Offshore Area (Photo: K. Günther).

11.1 Introduction

The Offshore Area of the Trilateral Cooperation Area (Wadden Sea Area) is defined as the nearshore zone between the barrier islands and the line 3 sea miles from the baseline, respectively up to 12 sm in case the conservation areas exceeds the 3-sea-mile line (see also Figure 11.1) The area covers about 4,000 km^2, and is dominated by water depths of more than 10 m. A close connection between the intertidal areas inside the Wadden Sea and the Offshore Area justifies its inclusion in the Cooperation Area. This connection is clear with respect to water, geomorphology and biology. The tide causes a daily exchange of water between the Wadden Sea and the North Sea, the extent of which is modified by wind conditions. The Offshore Area forms one coherent geomorphological system with the Tidal Area, which can be demonstrated by sand transport. Several fish species spawn in the Wadden Sea; as young fish they move to the Offshore Area to grow up. Birds and sea mammals demonstrate both a daily and a seasonal shift in their use of the Tidal Area and the Offshore Area. These few examples illustrate the close connection between the two parts of cooperation area. The following Targets apply:

Targets

- An increased natural morphology, including the outer deltas between the islands.
- A favorable food availability for birds.
- Viable stocks and a natural reproduction capacity of the common seal, grey seal and harbour porpoise.

11.2 Water and geomorphology

Tides are the driving force for a daily exchange of water between the Wadden Sea and the North Sea. The offshore zone up to a depth of about 20 m forms a coherent geomorphological unit with the Tidal Area. Through the tidal inlets in between the barrier islands, sand and silt are transported back and forth between the Tidal and Offshore Areas ('sand sharing system'). The consequence of this dynamic equilibrium is that disturbances will be compensated until a new equilibrium is reached. Sea level rise and bottom subsidence cause a deepening of the tidal basin resulting in an increased net sand import from the offshore zone. Ultimately this sand originates from the seaward shores of the islands. Together with a net sedimentation along the mainland shore, this results in a landward movement of the islands (de Jong *et al.*, 1999).

Extraction of sand and gravel is generally carried out in the North Sea outside the 20 m depth contour. This material is used for construction works on the mainland and for replenishment (or nourishment) of eroding coasts, for example, along the Wadden Sea. For aesthetic reasons, shore replenishment with sand was favored to the use of concrete and stones, as is the case in many areas such as on Sylt (Reise and Lackschewitz, 2003). The yearly extraction of sand and gravel in the southern North Sea amounts to 45 million m^3 (Lozán *et al.*, 2002). Recovery of the areas where sand was extracted depends on local sediment dynamics, and is fast in areas with strong dynamics. The sand and gravel extraction results in a reduction of benthos biomass and change in species com-

position, at least temporarily. A complete recolonization of benthos after extraction takes between one month and ten years and sometimes even longer. In most cases, however, it takes a few years. The recolonization depends very much on the nature of the sediment and on water currents. The first species to invade are opportunistic taxa, and after a couple of years species from the original community begin to settle again and develop (Lozán *et al.*, 2002).

In 1995, an 800 m long stone cross-shore groyne was built near the northern tip of the island of Texel (NL), with the aim of long-term reduction of the cost of sand nourishments necessary to counteract local coastal erosion. This resulted in deposition of sediment on both sides of this groyne, forming a new beach plain. Also changes occurred in the geomorphology of the ebb tidal delta of the inlet Eijerlandse Gat, where a rearrangement of tidal channels was observed (de Kok, 2005).

11.3 Biology

The biology of the Wadden Sea and the North Sea is intimately linked. Phytoplankton is transported from the offshore zone to the Wadden Sea proper and, after dying off, is remineralized. The import of organic matter from the offshore zone is one of the main causes of the food richness of the Wadden Sea. Both cockles and blue mussels may restock the Wadden Sea from populations in deep water refuges in the North Sea after severe winters have decimated the population of the exposed tidal flats. Motile animals like fish, shrimps and crabs largely leave the Wadden Sea in autumn to survive the winter in the relatively warm waters of the North Sea, after which they return to the Wadden Sea. Without the high productivity in the Wadden Sea, the stock of these species would be greatly reduced (de Jong *et al.*, 1999).

11.3.1 Zoobenthos

In the coastal waters of the North Sea, the most important zoobenthos groups are molluscs, polychaetes, crustaceans and echinoderms. Polychaetes are the most abundant. Molluscs are second in abundance but have the highest biomass.

11.3.1 Zoobenthos communities

The ICES Study Group on the North Sea Benthos Project 2000 has analyzed zoobenthos samples from the North Sea taken in 2000/2001. Samples were grouped according to their similarity in species composition using PC-ORD and TWINSPAN cluster analyses. This resulted in the identification of nine clusters in the North Sea, largely related to water depths (increasing from south to north) and to differences in substratum types (coarse vs. fine) (SGNSBP, 2004).

At least two of these clusters were found along the Belgian-Dutch-German coast comprising the Offshore Area of the Wadden Sea Cooperation Area. The benthic fauna in these clusters had a relatively low species diversity, with, however, enhanced values in complex biotopes, *i.e.* with mixed substrate from fine to coarse sands, gravel and stones, such as near Borkum Riff and in the outer Amrum Grounds.

11.3.1.2 *Spisula*

Two species of the clam *Spisula* occur in the Offshore Area, viz. *Spisula subtruncata* and *S. solida*.

Surveys in The Netherlands since 1995, have shown that *Spisula subtruncata* is distributed all along the North Sea coast off the Frisian Islands south to the Delta area (Craeymeersch *et al.,* 2001). *Spisula* is being monitored in the spring, including 800-1000 stations. The biomass calculated for the North Sea coast off the Wadden Sea varies from 25,000 tons fresh weight in 1996 to about 210,000 tons in 2000. Yearly variations of the same magnitude were also recorded in other areas off the Dutch North Sea coast. However, the variation did not occur synchronously. The yearly commercial landings of *Spisula subtruncata* in The Netherlands in the period 1996-2001, were between 16,000-37,000 tons. Information on the occurrence of *Spisula subtruncata* in Germany and Denmark is scarce. In Danish waters off the Wadden Sea, the species was reported for some years, but has disappeared during recent years (P. Sand Kristensen, pers. com.)

The clam *Spisula solida* was investigated in 2000-2001 off the Schleswig-Holstein Wadden Sea (Rumohr, 2002). It occurred at Amrum bank at about 10 m depth off the islands of Sylt and Amrum, off the peninsula of Eiderstedt and at Vogelsand outside the Elbe estuary. Densities up to 30 individuals per m^2 were found at Amrum Bank, whereas at Vogelsand and in the area off Eiderstedt only 1-10 individuals per m^2 were reported. Due to its low densities, this species is not fished.

11.3.2 Birds

11.3.2.1 Coastal and marine species

Birds using the North Sea off the Wadden Sea have not been subject to regular monitoring. However, knowledge of the birdlife was derived through different initiatives and in national campaigns in the 1980s and 1990s and has grown enormously in recent years, especially in order to fulfill the obli-

Species	1% level of flyway	Period	Estimated number	Number in % of total population
Red/Black-throated diver	10,000	Dec-Mar	36,000 *	4
Eider	10,300	Oct-Feb	63,000 *	6
Common scoter	16,000	Dec-Feb	303,000 *	19
Velvet scoter	10,000	Dec-Feb	7,000	<1
Little gull	840	Mar-May	2,500 *	3
Common gull	17,000	Dec-Feb	67,000 *	4
Lesser black-backed gull	1,900	May-June	50,000 *	26
Herring gull	13,000	Nov-Feb	48,000 *	4
Sandwich tern	1,700	Apr-May	13,000 *	8
Common tern	1,900	Apr-May	4,000 *	2

Table 11.1: Estimated numbers of the most numerous seabird species occurring in the North Sea between the Wadden Sea islands and 20 m water depth in specific months of the year (Skov *et al.*, 1995; Garthe, 2003). * Number of international importance. 1% level according to Delany and Scott (2002).

gations of the EC Birds Directive. For example, Germany has recently concluded a project on numbers and distribution of seabirds and coastal birds within its 12-mile-zone (Krüger *et al.,* 2003; Garthe, 2003).

This chapter focuses on coastal and marine bird species occurring in the area from the islands out to 20 m depth. The term 'coastal' applies to species only using the area off the islands to a depth of 10 m. 'Marine' species occur at larger depths. In the area off the Wadden Sea, eight species occur in numbers, which are of international importance (Table 11.1). Recently, new information on seabird distribution has been obtained due to interest in establishing wind farms in the coastal waters of the North Sea (see chapter 2.9)

Among the 'marine' species, guillemot (*Uria aalge*) and razorbill (*Alca torda*) occur all over the North Sea outside the breeding season, feeding on small fish such as sandeels, herring and sprat. Along the West Frisian Islands they also use the coastal zone, with up to 2,000-3,000 individuals recorded. In waters shallower than 30 m they feed on small fish such as cod, herring and sprat. During the breeding season, 6,400 birds were recorded around the colony at Helgoland (Garthe, 2003). The gannet (*Morus bassanus*), is also found in the marine part of the North Sea, diving for shoaling fish. The fulmar (*Fulmarus glacialis*) is dispersed over most of the North Sea outside the breeding season, where they feed on planktonic crustaceans occurring in the upper water layer. A fraction of these birds also use the coastal zone near the Frisian Islands. The red-throated diver (*Gavia stellata*) is the most common (95%) of the divers (see photo), but the black-throated diver is also widespread (*G. arctica*) (Camphuysen and Leopold, 1994; Garthe, 2003). The divers spend the winter in the southern North Sea off the Wadden Sea in numbers up to 36,000 individuals. The majority of the divers were recorded between 4-26 m depth (Pedersen *et al.*, 2003). Aerial surveys during spring in the Danish and German sectors of the North Sea showed that most divers occurred in the eastern parts off the Wadden Sea. 7% of the divers occurred inside, and 93% outside the Wadden Sea Cooperation Area (MINOS, NERI, Elsam Engineering A/S). In the German sector of the North Sea, up to 13,700 divers (both species) have been counted all together. The largest concentration of the divers was recorded off Sylt, outside the Wadden Sea Cooperation Area.

Of the 'coastal' species, both the lesser black-backed gull (*Larus fuscus*) and herring gull (*Larus argentatus*) breed in the Wadden Sea, and during this time of the year the largest numbers of the two species are present. The lesser black-backed gull occurs in numbers over 50,000 individuals, which is more than 25% of the total population size. Outside the breeding season, most of these birds leave the North Sea to winter along the west coast of Africa. This is opposite to the herring gull, which spreads over the North Sea outside the breeding season. During spring and the breeding season, the lesser black-backed gull is widespread and numerous far out at sea, while the herring gull has a more coastal occurrence. The lesser black-backed gull feeds at sea on fish and crustaceans, while the herring gull forages in the intertidal zone mostly on bivalves and crustaceans (Kubetzki and Garthe, 2003). The common tern utilizes the coastal parts of the Offshore Area for catching small fish. The numbers are fairly stable at 3,000 individuals.

Common scoter (*Melanitta nigra)*, velvet scoter (*Melanitta fusca*) and eider (*Somateria mollissima*) use the food resources of the communities of cockles (*Cerastoderma edulis*) and clams (*Spisula subtruncata*) off the Wadden Sea. In October, the common scoter gathers off the Danish Islands, and their numbers increase during autumn to more than 300,000 individuals and their distribution expands to the whole coastal zone of the Wadden Sea (Camphuysen and Leopold, 1994; Laursen *et al.,* 1997). The largest concentrations occur off the Frisian and Danish islands, where up to 200,000

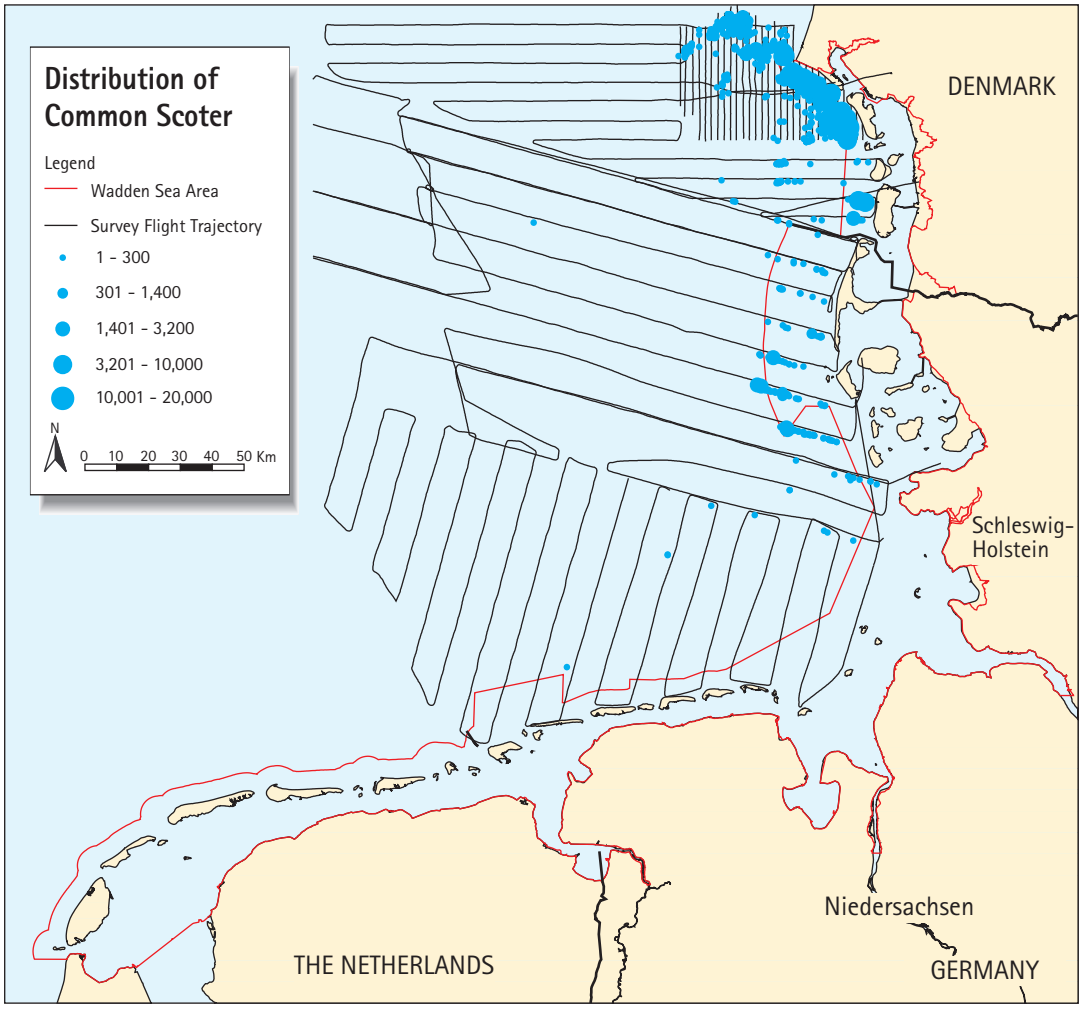

Figure 11.1: Geographical distribution of common scoter (*Melanitta nigra*) in the SE North Sea off the Wadden Sea. The birds were monitored by aircraft in March 2002, and the flight routes are shown. Red line: Wadden Sea Area (Trilateral Cooperation Area). Data source: MINOS (Germany), National Environmental Research Institute and Elsam Engineering A/S (Denmark).

individuals can assemble (Laursen and Frikke, 1987; Garthe, 2003). Most of these birds leave for northern breeding grounds, but about 30,000 non-breeding individuals spend the summer in the Wadden Sea area. In late summer, during moulting, large concentrations of common scoters are found in the offshore zone of the three countries (see Figure 12.2.4 in chapter 12.2). Ongoing studies initiated in connection with planned and established wind farms have shown that large concentrations of common scoters occur off the Danish and the Schleswig-Holstein Wadden Sea (Figure 11.1). The majority of the scoters occurred at water depths between 2-10 m (Petersen *et al.*, 2003). Aerial surveys during March showed that 61% of the common scoters occurred inside the Wadden Sea Cooperation Area and 39% outside (MINOS, NERI, Elsam Engineering A/S). This indicates the close connection between the Offshore Area of the Wadden Sea and the adjacent North Sea. The eider breeds in large colonies in the Wadden Sea, but during autumn also birds from the Baltic arrive, and up to 280,000 eiders winter in the offshore zone (see chapter 12.2).

Cormorants (*Phalacrocorax carbo*) forage on the fish stock in the coastal zone during their breeding season, when they occur in flocks of several hundred individuals. These birds mostly originate from breeding colonies nearby in the Wadden Sea area. Sandwich tern (*Sterna sandvicensis*) and common tern (*Sterna hirundo*) also breed in the Wadden Sea, with the highest numbers in the months before, during and after the breeding season. The sandwich terns especially abound off the large colonies in Schleswig-Holstein and off the islands in the Elbe-Weser-Jade estuary. This species mainly feeds on sandeel (see, for example, Garthe and Kubetzki, 1998) and part of its foraging grounds are situated far offshore (up to 15-25 km from the breeding colonies). The common gull (*Larus canus*) has a similar distribution, but has its greatest abundance outside the breeding season. The little gull (*Larus minutus*) feeds on pelagic crustaceans and small fish in the upper

water layer. It arrives in August, and numbers increase to more than 2,000 individuals in December.

11.3.2.2 Connection between the Offshore Area and the Tidal Area

Winter surveys during more than ten years, of eiders in both the Dutch and the Danish parts of the Wadden Sea and the adjacent North Sea have shown that the distribution of birds shifts between the Tidal Area and the Offshore Area. During 1993-2003, in the Dutch Wadden Sea between 1 and 58% of the eiders occurred in the Offshore Area (Berrevoets and Arts, 2003). The figures were high during the late 1990s and peaked in 2000 and 2001 at 48 and 58%, respectively. In the Danish Wadden Sea, the proportion of eiders in the offshore zone varied between 2 and 77% during 1981-2001, with the highest values during 1984-1987. After 1992, the proportion of eiders in the Offshore Area fell to 12%. These figures demonstrate a close connection between the two parts of the Wadden Sea Area. The reason for the observed shift between the two parts of the Wadden Sea is not known. The striking coincidence of intensive mussel fishery and hunting activity is, however, noteworthy, and might explain the changes in distributions. Following a period of intensive mussel fishery, high eider mortality was reported from the Dutch Wadden Sea in the winter 1999/2000 (Camphuysen, 2001). In the Danish Wadden Sea, probably two reasons contributed to the change in eider distribution. The proportion of eiders in the Danish Offshore Area peaked with 54% during 1984-1987. During that period intensive blue mussel fishery also took place in the Danish Wadden Sea, and eiders shifted to the Offshore Area to feed on cockles as an alternative food source (Laursen *et al.*, 2005). In 1992, the majority of the Danish Wadden Sea was closed for hunting, which included shooting of eiders between the islands and the mainland coast. After 1992, the proportion of eiders in the Offshore Area decreased to 12%, while in the years before 1992 it was 42% (NERI data). These facts indicate that there could be more than one reason for the shifting of eiders between the Wadden Sea and the Offshore Area. The latter area can play a role both as alternative feeding area and as refuge for the eiders. For other species, however, such as the cormorant and sandwich tern, the Offshore Area is just a part of their natural feeding area.

11.3.3 Marine Mammals

These species are treated extensively in chapter 13, both for the Offshore Area and the Tidal Area of the Wadden Sea.

11.4 Management

In October 2002, the Wadden Sea was designated as a Particularly Sensitive Sea Area (PSSA). The PSSA covers a part of the Offshore Area. The PSSA classification is given to sea areas that need special protection through actions due to their significance for recognized ecological, socio-economic or scientific reasons, and which may be vulnerable to impacts from international shipping activities (Reineking, 2002). The PSSA Wadden Sea is included on the relevant sea charts and this is expected to increase shipping safety and to reduce environmental impacts. In addition, it will contribute to a more close collaboration between the different shipping authorities, which may reduce or prevent the risk of future disasters (see chapter 4.4).

Notwithstanding this progress in protection, there still are other activities in the offshore zone of the Wadden Sea, which can pose a threat to sea birds. Fishing of stocks of the clam *Spisula subtruncata* can affect the numbers of common scoter (Leopold, 1993). Studies, however, of the actual effects on common scoters have not been conducted.

Another problem for the birds could be sand extraction in the German Bight. The sandwich terns breeding on the Wadden Sea islands in large colonies feed above sand banks in the North Sea especially during the breeding period. Their preferred prey, sandeels, live on these sand banks (Garthe and Kubetzki, 1998). The effects of sand extraction on sandwich terns are not known.

The increasing interest in building wind farms brings another risk to both seabirds and sea mammals in the North Sea (Exo *et al.*, 2003). These wind farms are not allowed in the Conservation Area, but some have already been established and others are planned closed to the Conservation Area, and therefore can influence parts of the same populations that use both the Offshore Area and Tidal Area.

Exo *et al.* (2003) list five possible impacts of offshore wind farms on sea birds:

- risk of collision,
- short-term habitat loss during construction,
- long-term habitat loss due to disturbance by turbines,
- formation of barriers on migration routes, and
- disruption of ecological units, such as roosting and feeding areas.

It is recommended that the actual impact of the wind farms is assessed through detailed studies on pilot offshore wind farms. It is vital that all

potential construction sites are considered as part of an integrated assessment framework, so that cumulative effects can be carefully taken into account (Exo *et al.,* 2003).

For the selection of localities for new offshore wind farms, a planning tool is needed. For this purpose, Garthe and Hüppop (2004) suggested a 'wind farm sensitivity index' for seabirds. This index scales the risk for a large number of seabird species in relation to wind farms. It was concluded that divers, velvet scoter, sandwich tern and great cormorant are most at risk, while species such as the black-legged kittiwake, black-headed gull and northern fulmar experience the lowest risk from operational wind farms.

The data presented above shows that the Wadden Sea Area comprises only part of the geographical occurrence of the common scoter and the diver, which are the species with the highest risk in relation to wind farms. A large proportion of the common scoter occurs inside and a large proportion of the divers outside the Wadden Sea Area. These species are both listed in Annex I of the EC Birds Directive, meaning that protection of these birds is obligatory. The already designated Special Protection Areas (SPAs) and the candidate Special Areas of Conservation (cSACs) in the offshore zone according to the EC Birds and Habitats Directive will support the protection of divers in the North Sea.

11.5 Target evaluation

11.5.1 Increased natural geomorphology

The sediments of the seabed of the Offshore Area and of the channels and flats in the Tidal Area of the Wadden Sea form a coherent 'sand sharing' system. As a consequence of sea level rise, sand will be transported from the coast off the islands into the Wadden Sea. Whereas coastal defense activities on the Wadden Sea islands have continued where necessary, no major changes in geomorphology or its dynamics can be reported since the 1999 QSR. One exception is the construction in 1995 of a long cross-shore dam at the northern tip of the island of Texel, which caused sand accretion on both sides of the dam, extending the beach in a seaward direction, as well as geomorphological changes in the ebb tidal delta of the Eijerlandse Gat inlet.

11.5.1.1 Conclusions

Apart from coastal defense activities on the Wadden Sea islands (*e.g.* sand nourishment, cross-shore dam at Texel) no evidence has become available regarding any negative development in natural dynamics of the geomorphology of the Offshore Area

11.5.1.2 Recommendation

A monitoring scheme should be introduced for parameters in the Offshore Area to track major changes in geomorphology.

11.5.2 Favourable food conditions for birds

Repeated inventories have demonstrated the occurrence of important stocks of the bivalve *Spisula subtruncata* along the Dutch coast, and of *S. solida* along the coast of Schleswig-Holstein. These bivalves are a major food source for diving ducks such as the common scoter and eider. Especially for the eider, these *Spisula* stocks are important for the survival when other bivalve stocks in the Wadden Sea are depleted, either by severe winter conditions or by extensive shellfish fishery. In The Netherlands, there is fishery on *Spisula*, the effects of which on the common scoter and eider have not been investigated.

From the ICES North Sea Benthos Project 2000 it appears that the macrozoobenthos community in the Offshore Area is part of coastal communities along the Belgian-Dutch-German coast, characterized by low species numbers, but locality enhanced where complex substrate (sand, gravel, stones) is present, such as near Borkum Riff and in the outer Amrum grounds.

11.5.2.1 Conclusions

Bivalve stocks in the Offshore Area are important as a food resource for the common scoter, eider and other diving ducks. For the eider, *Spisula* stocks in the Offshore Area are an essential lifeline during adverse conditions in the Wadden Sea.

11.5.2.2 Recommendations

A proper management of *Spisula* fishery needs to be developed to ensure compliance with the target 'favorable food availability for birds', especially for the common scoter, eider and velvet scoter.

11.5.3 Viable stocks of common seal, grey seal and harbour porpoise

For the evaluation of the target regarding sea mammals, the reader is referred to chapter 13.

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